UNITED STATES INTERNATIONAL TRADE COMMISSION
WASHINGTON, D.C.

Before the Honorable Thomas B. Pender
Administrative Law Judge

In the Matter of **CERTAIN MOBILE ELECTRONIC DEVICES AND RADIO FREQUENCY AND PROCESSING COMPONENTS THEREOF**	**Investigation No. 337-TA-1065**

QUALCOMM'S IDENTIFICATION OF EXPERT WITNESSES

Pursuant to the Procedural Schedule (Order No. 7), Complainant Qualcomm Incorporated ("Qualcomm") respectfully identifies the following expert witnesses who may offer opinions and/or testimony in this Investigation. This identification of expert witnesses is based on Qualcomm's current understanding of the evidence and issues to be decided at the hearing. Qualcomm reserves the right to amend or supplement these disclosures as appropriate, including in response to new information or allegations.

1. R. Jacob Baker, Ph.D.

Dr. Baker is a Professor of Electrical and Computer Engineering at the University of Nevada, Las Vegas ("UNLV"). He received his Ph.D. in electrical engineering from the University of Nevada, Reno in 1993. From 1993 to 2000, he served on the faculty in the department of Electrical Engineering at the University of Idaho ("UI") as both assistant and associate professor. In 2000, he joined a new electrical and computer engineering program at Boise State University ("BSU"), where he taught until 2012 and served as Department Chair from 2004 to 2007. In 2012, Dr. Baker re-joined the University of Nevada as a Professor of Electrical and Computer Engineering. During his tenure at the UI, BSU, and UNLV, Dr. Baker

has been the chief professor to more than 75 graduate students. Over the last 32 years, Dr. Baker has developed an expertise in integrated circuit design and fabrication, low-power interconnect and packaging techniques, design of wired/wireless communication and interface circuits, and power electronics. He is a named inventor on over 200 granted and pending U.S. patents, and has authored numerous papers and publications in the integrated circuits space. A copy of Dr. Baker's *curriculum vitae* is attached as Exhibit 1.

Dr. Baker may offer opinions and/or testimony in this Investigation relating to the technical background and state of the art relevant to the asserted claims of the asserted patents; the interpretation and scope of the asserted claims of the asserted patents; the validity and enforceability of the asserted claims of the asserted patents; the design, development, and operation of Qualcomm's domestic industry products and Respondent's accused products; infringement of the asserted claims by Respondent; and whether Qualcomm's domestic industry products practice the asserted patents. Dr. Baker may further offer opinions and/or testimony in rebuttal to Respondent's expert testimony and/or other issues asserted by Respondent.

2. Arthur W. Kelley, Ph.D.

Dr. Kelley is an electrical and computer engineering consultant with a Ph.D. in electrical engineering and more than 30 years of expertise consulting on semiconductor technologies, including power management integrated circuits. He is a former tenured associate professor at North Carolina State University, where he taught both undergraduate and graduate classes in power electronics. He is an expert and has authored more than 30 publications in the power electronics space. He is also a listed inventor on numerous patents covering power management integrated circuits. Dr. Kelley has been the editor-in-chief of both the IEEE Power Electronics

Society newsletter and IEEE Transactions on Power Electronics journal. A copy of Dr. Kelley's *curriculum vitae* is attached as Exhibit 2.

Dr. Kelley may offer opinions and/or testimony in this Investigation relating to the technical background and state of the art relevant to the asserted claims of the asserted patents; the interpretation and scope of the asserted claims of the asserted patents; the validity and enforceability of the asserted claims of the asserted patents; the design, development, and operation of Qualcomm's domestic industry products and Respondent's accused products; infringement of the asserted claims by Respondent; and whether Qualcomm's domestic industry products practice the asserted patents. Dr. Kelley may further offer opinions and/or testimony in rebuttal to Respondent's expert testimony and/or other issues asserted by Respondent.

3. Donald Y.C. Lie, Ph.D.

Dr. Lie is the Keh-Shew Lu Regents Chair Professor in Electrical and Computer Engineering at Texas Tech University. He is an expert and has over three decades of experience in the electrical and computer engineering space, including in the field of low-power RF integrated circuits. His work has advanced new concepts in that field and has been published in hundreds of technical papers. Dr. Lie is also a named inventor on seven U.S. patents, including several of low-power and high-efficiency switching RF power amplifiers. A copy of Dr. Lie's *curriculum vitae* is attached as Exhibit 3.

Dr. Lie may offer opinions and/or testimony in this Investigation relating to the technical background and state of the art relevant to the asserted claims of the asserted patents; the interpretation and scope of the asserted claims of the asserted patents; the validity and enforceability of the asserted claims of the asserted patents; the design, development, and operation of Qualcomm's domestic industry products and Respondent's accused products;

infringement of the asserted claims by Respondent; and whether Qualcomm's domestic industry products practice the asserted patents. Dr. Lie may further offer opinions and/or testimony in rebuttal to Respondent's expert testimony and/or other issues asserted by Respondent.

4. Paul S. Min, Ph.D.

Dr. Min is a Senior Professor in the Department of Electrical Systems Engineering at Washington University in St. Louis. He is an internationally recognized expert and has more than 30 years of experience as a researcher, educator, and entrepreneur in the high speed communications, electronics, and computing fields. His expertise includes, but is not limited to, communications, computing, semiconductors, electronic systems, switching, and wireless technologies. A copy of Dr. Min's *curriculum vitae* is attached as Exhibit 4.

Dr. Min may offer opinions and/or testimony in this Investigation relating to the technical background and state of the art relevant to the asserted claims of the asserted patents; the interpretation and scope of the asserted claims of the asserted patents; the validity and enforceability of the asserted claims of the asserted patents; the design, development, and operation of Qualcomm's domestic industry products and Respondent's accused products; infringement of the asserted claims by Respondent; and whether Qualcomm's domestic industry products practice the asserted patents. Dr. Min may further offer opinions and/or testimony in rebuttal to Respondent's expert testimony and/or other issues asserted by Respondent.

5. Murali Annavaram, Ph.D.

Dr. Annavaram has been a faculty member in the Ming-Hsieh Department of Electrical Engineering at the University of Southern California since 2007. He currently holds the Robert G. and Mary G. Lane Early Career Chair. He is an expert in computer and electrical engineering, including in the mobile energy efficiency space. He has developed architecture and

microarchitecture techniques for improving power, performance, and reliability of out of order processors, graphics processing units, (GPUs), server systems, and mobile devices. A copy of Dr. Annavaram's *curriculum vitae* is attached as Exhibit 5.

Dr. Annavaram may offer opinions and/or testimony in this Investigation relating to the technical background and state of the art relevant to the asserted claims of the asserted patents; the interpretation and scope of the asserted claims of the asserted patents; the validity and enforceability of the asserted claims of the asserted patents; the design, development, and operation of Qualcomm's domestic industry products and Respondent's accused products; infringement of the asserted claims by Respondent; and whether Qualcomm's domestic industry products practice the asserted patents. Dr. Annavaram may further offer opinions and/or testimony in rebuttal to Respondent's expert testimony and/or other issues asserted by Respondent.

6. John Villasenor, Ph.D.

Dr. Villasenor is a Professor of Electrical Engineering at the University of California, Los Angeles. He is also a nonresident senior fellow at the Brookings Institution and a Visiting Fellow at the Hoover Institution at Stanford University. He has led a Department of Homeland Security-funded research project at Stanford directed to improving cybersecurity for U.S. critical infrastructure. Dr. Villasenor is an expert in and has decades of experience in the digital communications and electronics space, with research on areas including power-efficient hardware implementation of communications algorithms, methods to make improved use of wireless spectrum, and approaches to increase the reliability of data transmitted over channels that are both noisy and rapidly changing. A copy of Dr. Villasenor's *curriculum vitae* is attached as Exhibit 6.

Dr. Villasenor may offer opinions and/or testimony in this Investigation relating to the technical background and state of the art relevant to the asserted claims of the asserted patents; the interpretation and scope of the asserted claims of the asserted patents; the validity and enforceability of the asserted claims of the asserted patents; the design, development, and operation of Qualcomm's domestic industry products and Respondent's accused products; infringement of the asserted claims by Respondent; and whether Qualcomm's domestic industry products practice the asserted patents. Dr. Villasenor may further offer opinions and/or testimony in rebuttal to Respondent's expert testimony and/or other issues asserted by Respondent.

7. Trevor Mudge, Ph.D.

Dr. Mudge is a Professor of Electrical Engineering & Computer Science at the University of Michigan. Since receiving his Ph.D. degree in computer science from the University of Illinois, Urbana in 1977, Dr. Mudge has authored numerous papers and chaired dozens of theses on key technology fields such as computer architecture, programming languages, compilation, VLSI design, and computer vision. He is an expert in those fields. In 2014, he was the recipient of ACM/IEEE CS Eckert-Mauchly Award for pioneering contributions to low-power computer architecture and its interaction with technology. A copy of Dr. Mudge's *curriculum vitae* is attached as Exhibit 7.

Dr. Mudge may offer opinions and/or testimony in this Investigation relating to the technical background and state of the art relevant to the asserted claims of the asserted patents; the interpretation and scope of the asserted claims of the asserted patents; the validity and enforceability of the asserted claims of the asserted patents; the design, development, and operation of Qualcomm's domestic industry products and Respondent's accused products;

infringement of the asserted claims by Respondent; and whether Qualcomm's domestic industry products practice the asserted patents. Dr. Mudge may further offer opinions and/or testimony in rebuttal to Respondent's expert testimony and/or other issues asserted by Respondent.

8. Michael C. Brogioli, Ph.D.

Dr. Brogioli is an Adjunct Professor of Electrical and Computer Engineering at Rice University, where he received his Ph.D. in electrical and computer engineering in 2007. He is an expert and instructs graduate level seminars on embedded computer architectures, and their relation to compiled languages and embedded software systems. He is also the author of the RISD compiler infrastructure for multi-clustered, scalable, VLIW based DSP architectures. A copy of Dr. Brogioli's *curriculum vitae* is attached as Exhibit 8.

Dr. Brogioli may offer opinions and/or testimony in this Investigation relating to the technical background and state of the art relevant to the asserted claims of the asserted patents; the interpretation and scope of the asserted claims of the asserted patents; the validity and enforceability of the asserted claims of the asserted patents; the design, development, and operation of Qualcomm's domestic industry products and Respondent's accused products; infringement of the asserted claims by Respondent; and whether Qualcomm's domestic industry products practice the asserted patents. Dr. Brogioli may further offer opinions and/or testimony in rebuttal to Respondent's expert testimony and/or other issues asserted by Respondent.

9. Tim A. Williams, Ph.D.

Dr. Williams has nearly 40 years of professional experience in wireless communications and telecom technologies. He is an expert in those fields and an entrepreneur who has participated in the organization and operation of start up companies that brought wireless LAN, software VoIP PBX, and 2-way paging technology to the marketplace. Dr. Williams holds

numerous patents in wireless and signal processing technology. A copy of Dr. Williams' *curriculum vitae* is attached as Exhibit 9.

Dr. Williams may offer opinions and/or testimony in this Investigation relating to the technical background and state of the art relevant to the asserted claims of the asserted patents; the interpretation and scope of the asserted claims of the asserted patents; the validity and enforceability of the asserted claims of the asserted patents; the design, development, and operation of Qualcomm's domestic industry products and Respondent's accused products; infringement of the asserted claims by Respondent; and whether Qualcomm's domestic industry products practice the asserted patents. Dr. Williams may further offer opinions and/or testimony in rebuttal to Respondent's expert testimony and/or other issues asserted by Respondent.

10. Carla S. Mulhern

Ms. Mulhern is an expert economist who specializes in the application of economic principles to issues arising in complex business litigation. She has served as an expert witness on damages issues in commercial litigation matters, including intellectual property and breach of contract cases, and provided testimony in various district and state courts. Ms. Mulhern's intellectual property damages experience includes cases involving allegations of patent, copyright, and trademark infringement, as well as misappropriation of trade secrets; she has also provided expert testimony on these issues in Section 337 cases at the ITC. Before the ITC, she has testified on a variety of economic issues, such as domestic industry, remedy, bonding, commercial success, and public interest. A copy of Ms. Mulhern's *curriculum vitae* is attached as Exhibit 10.

Ms. Mulhern may offer opinions and/or testimony in this Investigation relating to the economics of Qualcomm's domestic industry, the appropriate remedy and/or bond rate should

the Commission find a violation of Section 337, and the effect on the public interest should the Commission issue remedial orders against Respondent and the accused products in this Investigation, including any effect such remedial orders would have upon the public health and welfare, competitive conditions in the United States economy, the production of like or directly competitive articles in the United States, and consumers in the United States. Ms. Mulhern may further offer opinions and/or testimony in rebuttal to Respondent's expert testimony and/or other issues asserted by Respondent.

11. William Kerr, Ph.D.

Dr. Kerr is an expert in the economics of intellectual property and competitiveness. He has produced several books and articles on these subjects, including a leading treatise on the economics of intellectual property damages, now in its 11th edition. In more than 30 years as a professional economist, Dr. Kerr has taught economics and statistics and advised government and private clients on issues ranging from tax policy to economic development and on mergers and acquisition matters, as well as the development of international trade and licensing programs. He has testified as an expert in litigation related to intellectual property, antitrust issues, commercial disputes, international trade, and employment and discrimination matters. A copy of Dr. Kerr's *curriculum vitae* is attached as Exhibit 11.

Dr. Kerr may offer opinions and/or testimony in this Investigation relating to the economics of Qualcomm's domestic industry, the appropriate remedy and/or bond rate should the Commission find a violation of Section 337, and the effect on the public interest should the Commission issue remedial orders against Respondent and the accused products in this Investigation, including any effect such remedial orders would have upon the public health and welfare, competitive conditions in the United States economy, the production of like or directly

competitive articles in the United States, and consumers in the United States. Dr. Kerr may further offer opinions and/or testimony in rebuttal to Respondent's expert testimony and/or other issues asserted by Respondent.

12. J. Gregory Sidak

Mr. Sidak is the founder and chairman of Criterion Economics, L.L.C. He is an expert in antitrust, regulation, and intellectual property, as well as on damages and valuation in complex litigation and international arbitration generally. He has served as a court-appointed neutral economic expert on damages and liability. Mr. Sidak is also a founding co-editor of the Journal of Competition Law & Economics, the preeminent international journal on antitrust law and economics, which has been published quarterly by the Oxford University Press since 2005. A copy of Mr. Sidak's *curriculum vitae* is attached as Exhibit 12.

Mr. Sidak may offer opinions and/or testimony in this Investigation relating to the economics of Qualcomm's domestic industry, the appropriate remedy and/or bond rate should the Commission find a violation of Section 337, and the effect on the public interest should the Commission issue remedial orders against Respondent and the accused products in this Investigation, including any effect such remedial orders would have upon the public health and welfare, competitive conditions in the United States economy, the production of like or directly competitive articles in the United States, and consumers in the United States. Mr. Sidak may further offer opinions and/or testimony in rebuttal to Respondent's expert testimony and/or other issues asserted by Respondent.

13. Earl W. McCune Jr., Ph.D.

Dr. McCune is an electrical and computer engineering consultant with a Ph.D. in electrical engineering and more than 40 years of experience in RF design and analog and digital

signal processing. He is also a listed inventor on more than 50 patents broadly covering power amplifiers, power conversion, and power supply modulation. He has also authored numerous books and publications in the power electronic space, including on dynamic power supply transmitters and envelope tracking. Dr. McCune was an appointed IEEE MTT Distinguished Microwave Lecturer for 2013 through 2015. A copy of Mr. McCune's *curriculum vitae* is attached as Exhibit 13.

Dr. McCune may offer opinions and/or testimony in this Investigation relating to the technical background and state of the art relevant to the asserted claims of the asserted patents; the interpretation and scope of the asserted claims of the asserted patents; the validity and enforceability of the asserted claims of the asserted patents; the design, development, and operation of Qualcomm's domestic industry products; and whether Qualcomm's domestic industry products practice the asserted patents. Dr. McCune may further offer opinions and/or testimony in rebuttal to Respondent's expert testimony and/or other issues asserted by Respondent concerning the topics identified above.

Dated: October 20, 2017

Respectfully submitted,

/s/ S. Alex Lasher

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EXHIBIT 1

R. JACOB BAKER, PH.D., P.E.

Professor of Electrical and Computer Engineering
Department of Electrical and Computer Engineering

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EDUCATION

Ph.D. in Electrical Engineering; December 1993; University of Nevada, Reno, GPA 4.0/4.0. Dissertation Title: *Applying power MOSFETs to the design of electronic and electro-optic instrumentation.*

M.S. and B.S. in Electrical Engineering: May 1986 and 1988; University of Nevada, Las Vegas. Thesis Title: *Three-dimensional simulation of a MOSFET including the effects of gate oxide charge*.

ACADEMIC EXPERIENCE

January 1991 - Present: Professor of Electrical and Computer Engineering at the **University of Nevada, Las Vegas** from August 2012 to present. From January 2000 to July 2012 held various positions at **Boise State University** including: Professor (2003 – 2012), Department Chair (2004 - 2007), and tenured Associate Professor (2000 - 2003). From August 1993 to January 2000 was a tenured/tenure track faculty member at the **University of Idaho**: Assistant Professor (1993 - 1998) and then tenured Associate Professor (1998 - 2000). Lastly, from January 1991 to May 1993 held adjunct faculty positions in the departments of Electrical Engineering at the University of Nevada, Las Vegas and Reno. Additional details:

- Research is focused on analog and mixed-signal integrated circuit fabrication and design. Worked with multi-disciplinary teams (civil engineering, biology, materials science, etc.) on projects that have been funded by EPA, DARPA, NASA, Army, DMEA, and the AFRL.
- Current and past research and development interests are:
  - Capacitive sensing techniques using delta-sigma modulation and interfacing to sensors
  - Circuit design and fabrication for the control, use, and storage of renewable energy using thermoelectric generators
  - Design of electrical/biological circuits and systems using electrowetting on dielectric for automating and controlling biological experiments
  - Design of readout integrated circuits (ROICs) for use with focal plane arrays (FPAs)
  - Heterogeneous integration of III-V photonic devices (e.g. FPAs and VCSELs) with CMOS
  - Methods (e.g., 3D packaging and capacitive interconnects) to reduce power consumption in semiconductor memories, memory modules, and digital systems
  - Analog and mixed-signal circuit fabrication and design for communication systems, synchronization, energy storage, data conversion, and interfaces

- The design of writing and sensing circuitry for emerging nonvolatile memory technologies, focal planes, and displays (arrays) in nascent nanotechnologies (e.g. magnetic, chalcogenide)
- Reconfigurable electronics design and fabrication using nascent memory technologies such as the memristor
- Finding an electronic, that is, no mechanical component, replacement for the hard disk drive using nascent fabrication technologies
- Power electronics circuit design for consumers and consumer electronics including power management and adaptive control to reduce power consumption
- Design of bandpass delta-sigma modulators for IQ demodulation in wireless communication systems
- University prototyping, fabricating, and packaging of integrated circuits

- Led, as chair, the department in graduate curriculum (MS and PhD), program development, and ABET accreditation visits.
- Worked with established and start-up companies to provide technical expertise and identify employment opportunities for students.
- Held various leadership and service positions including: ECE chair, graduate coordinator, college curriculum committee (chair), promotion and tenure committee, scholarly activities committee, faculty search committee, university level search committees, etc. Collaborate with College of Engineering faculty on joint research projects.
- Taught courses in circuits, analog IC design, digital VLSI design and fabrication, and mixed-signal integrated circuit design to both on- and, via the Internet, off-campus students. Research emphasis in integrated circuit design using nascent technologies.

INDUSTRIAL EXPERIENCE

2013 - present: Working with Freedom Photonics and Attollo Engineering in the Santa Barbara area on the integration, fabrication and design, of optoelectronics with CMOS integrated circuits. Work includes the design of compact optical transceivers for range finding applications, high-efficiency integrated silicon avalanche photodetectors for quantum key receivers, Geiger mode SiGe receivers for long-range communications, and the fabrication of near-infrared focal plane arrays. Packaging and testing of numerous chips fabricated in both CMOS and SiGe technologies.

2013 - present: Working with National Security Technologies, LLC,) on the Design and Fabrication of Integrated electrical/photonic application specific integrated circuit (ASIC) design for use in the implementation of diagnostic instrumentation.

2013 - 2015: Consultant for OmniVision. Working on integrating CMOS image sensors (CIS) with memory for very high-speed consumer imager products. Design specialty DRAM, high-speed interfaces between CIS and DRAM, packaging techniques to pair the CIS with DRAM.

2010 - 2013: Worked with Arete' Associates on the design of high-speed compressive transimpedance amplifiers for LADAR projects and the design of ROIC unit cells. Work funded by the U. S. Air Force.

2013: Cirque, Inc. Consulting on the design of analog-to-digital interfaces for capacitive touch displays and pads.

2012: Consultant at Lockheed-Martin Santa Barbara Focal Plane Array. CMOS circuit design and fabrication for the development and manufacture of infrared components and imaging systems with an emphasis on highest sensitivity Indium Antimonide (InSb) focal plane arrays (FPAs) in linear through large staring formats. Product groups include FPAs, integrated dewar assemblies (IDCAs), camera heads, high-speed interfaces between image processors and imaging systems, and infrared imaging systems.

2010 - 2012: Working with Aerius Photonics (and then FLIR Inc. when Aerius was purchase by FLIR) on the design of Focal Plane Arrays funded (SBIRs and STTRs) by the U.S. Air Force, Navy, and Army. Experience with readout integrated circuits (ROICs) and the design/layout of photodetectors in standard CMOS.

2009 - 2010: Sun Microsystems, Inc. (now Oracle) VLSI research group. Provided consulting on memory circuit design/fabrication and proximity connection (PxC) interfaces to DRAMs and SRAMs for lower power, 3D packaging, for memory modules.

2009 - 2010: Contour Semiconductor, Inc. Design of NMOS voltage and current references as well as the design of a charge pump for an NMOS memory chip.

1994 - 2008: Affiliate faculty (Senior Designer), Micron Technology. Designed CMOS circuits for DRAMs including DLLs, PLLs for embedded graphics chips, voltage references and regulators, data converters, field-emitting display drivers, sensing for MRAM (using delta-sigma data conversion topologies), SRAMs, CMOS active pixel imagers and sensors, power supply design (linear and switching), input buffers, etc. Worked on a joint research project between Micron and HP labs in magnetic memory fabrication and design using the MTJ memory cell. Worked on numerous projects (too many to list) resulting in numerous US patents (see following list). Considerable experience working with product engineering to ensure high-yield from the production line from fabrication to test. Co-authored a book on DRAM circuit design through the support of Micron. Gained knowledge in the entire memory design process from fabrication to packaging. Developed, designed, and tested circuit design techniques for multi-level cell (MLC) Flash memory using signal processing.

January 2008: Consultant for Nascentric located in Austin, TX. Provide directions on circuit operation (DRAM, memory, and mixed-signal) for fast SPICE circuit simulations.

May 1997 - May 1999: Consultant for Tower Semiconductor, Haifa, Israel. Designed CMOS integrated circuit cells for various modem chips, interfaces, and serial buses including USB circuits, charging circuits based upon power up/down circuits using an MOS or bandgap reference, pre-amplifiers, comparators, etc.

Summer 1998: Consultant for Amkor Wafer Fabrication Services, Micron Technology, and Rendition, Inc., Design PLLs and DLLs for custom ASICs and a graphics controller chip.

Summers 1994 - 1995: Micron Display Inc. Designing phase locked loop for generating a pixel clock for field emitting displays and a NTSC to RGB circuit on chip in NMOS. These displays are miniature color displays for camcorder and wrist watch size color television. Worked on the fabrication and design of video peripheral circuits for these displays.

September - October 1993: Lawrence Berkeley Laboratory. Designed and constructed a 40 A, 2 kV power MOSFET pulse generator with a 3 ns rise-time and 8 ns fall-time for driving Helmholtz coils.

Summer 1993: Lawrence Livermore National Laboratory, Nova Laser Program. Researched picosecond instrumentation, including time-domain design for impulse radar and imaging.

December 1985 - June 1993: (from July 1992 to June 1993 employed as a consultant while finishing up my Ph.D.), E.G.&G. Energy Measurements Inc., Nevada, Senior Electronics Design Engineer. Responsible for the design and manufacturing of instrumentation used in support of Lawrence Livermore National Laboratory's Nuclear Test Program. Responsible for designing and fabricating over 30 electronic and electro-optic instruments including: CCD camera design, fiber optic transmitters employing high speed laser drive electronics, receivers employing envelop tracking for DC voltage restoration and regeneration of received information, receiver low noise amplifier design, frame synchronizers for re-assembling transmitted images, high-speed SRAM memory system design with battery back-up, calibration equipment design such as a tunnel diode pulse generator for testing compensation of oscilloscopes and DAC design for calibrating CCD readout

electronics, power supply and battery charger designs, sweep circuits for streak cameras, Pockel's cell drive electronics, vertical amplifier design using HBTs for analog oscilloscopes used at the Nevada Test Site, and 10 kV ramp designs using a planar triode to name some of the designs.

This position provided considerable fundamental grounding in EE with a broad exposure to PC board design to the design of cable equalizers. Summarizing, I gained experience in circuit design technologies including: bipolar, vacuum tubes (planar triodes for high voltages), hybrid integrated circuit fabrication and design, GaAs (high speed logic and HBTs), krytrons, power MOSFETs, microwave techniques, fiber optic transmitters/receivers, etc.

Summer 1985: Reynolds Electrical Engineering Company, Las Vegas, Nevada. Gained hands on experience in primary and secondary power system design, installation and trouble-shooting electric motors on mining equipment.

MEMBERSHIPS IN PROFESSIONAL AND SCHOLARLY ORGANIZATIONS

IEEE (student, 1983; member, 1988; senior member, 1997; Fellow, 2013)
Member of the honor societies Eta Kappa Nu and Tau Beta Pi
Licensed Professional Engineer

HONORS AND AWARDS

- Consolidated Students of the University of Nevada, Las Vegas (CSUN) Faculty Award, 2017
- Tau Beta Pi UNLV Outstanding Professor of the Year in 2013 - 2016
- UNLV ECE Department Distinguished Professor of the Year in 2015
- IEEE Fellow for contributions to the design of memory circuits - 2013
- Distinguished Lecturer for the IEEE Solid-State Circuits Society, 2012 - 2015
- IEEE Circuits and Systems (CAS) Education Award - 2011
- Twice elected to the Administrative Committee of the Solid-State Circuits Society, 2011 - 2016
- Frederick Emmons Terman Award from the American Society of Engineering Education - 2007
- President's Research and Scholarship Award, Boise State University - 2005
- Honored Faculty Member - Boise State University Top Ten Scholar/Alumni Association 2003
- Outstanding Department of Electrical Engineering faculty, Boise State 2001
- Recipient of the IEEE Power Electronics Society's Best Paper Award in 2000
- University of Idaho, Department of Electrical Engineering outstanding researcher award, 1998-99
- University of Idaho, College of Engineering Outstanding Young Faculty award, 1996-97

SERVICE

Reviewer for IEEE transactions on solid-state circuits, circuits and devices magazine, education, instrumentation, nanotechnology, VLSI, etc. Reviewer for several American Institute of Physics journals as well (Review of Scientific Instruments, Applied Physics letters, etc.) Board member of the IEEE press (reviewed dozens of books and book proposals). Reviewer for the National Institutes of Health. Technology editor and then Editor-in-Chief for the Solid-State Circuits Magazine.

Led the Department on ABET visits, curriculum and policy development, and new program development including the PhD in electrical and computer engineering. Provided significant University and College service in infrastructure development, Dean searches, VP searches, and growth of academic programs. Provided university/industry interactions including starting the ECE department's advisory board. Held positions as the ECE department Masters graduate coordinator and coordinator for the Sophomore Outcomes Assessment Test (SOAT).

Also currently serves, or has served, on the IEEE Press Editorial Board (1999-2004), as a member of the first Academic Committee of the State Key Laboratory of Analog and Mixed-Signal VLSI at the University of Macau, as editor for the Wiley-IEEE Press Book Series on Microelectronic

Systems (2010-present), on the IEEE Solid-State Circuits Society (SSCS) Administrative Committee (2011-2016), as an Advisory Professor to the School of Electronic and Information Engineering at Beijing Jiaotong University, as a Distinguished Lecturer for the SSCS (2012-2015), as the Technical Program Chair for the IEEE 58th 2015 International Midwest Symposium on Circuits and Systems, MWSCAS 2015, as advisor for the student branch of the IEEE at UNLV (2013-present), and as the Technology Editor (2012-2014) and Editor-in-Chief (2015-present) for the *IEEE Solid-State Circuits Magazine*,.

ARMED FORCES

6 years United States Marine Corps reserves (Fox Company, 2nd Battalion, 23rd Marines, 4th Marine Division), Honorable Discharge, October 23, 1987. Military Occupational Specialty was Machine Gunner (MOS 0331)

TEXTBOOKS AUTHORED

Baker, R. J., "CMOS Circuit Design, Layout and Simulation, Third Edition" *Wiley-IEEE*, 1174 pages. ISBN 978-0470881323 (2010) **Over 50,000 copies of this book's three editions in print.**

Baker, R. J., "CMOS Mixed-Signal Circuit Design," *Wiley-IEEE*, 329 pages. ISBN 978-0470290262 (second edition, 2009) and ISBN 978-0471227540 (first edition, 2002)

Keeth, B., Baker, R. J., Johnson, B., and Lin, F., "DRAM Circuit Design: Fundamental and High-Speed Topics", *Wiley-IEEE*, 2008, 201 pages. ISBN: 978-0-470-18475-2

Keeth, B. and Baker, R. J., "DRAM Circuit Design: A Tutorial", *Wiley-IEEE*, 2001, 201 pages. ISBN 0-7803-6014-1

Baker, R. J., Li, H.W., and Boyce, D.E. "CMOS Circuit Design, Layout and Simulation," *Wiley-IEEE*, 1998, 904 pages. ISBN 978-0780334168

BOOKS, OTHER (edited, chapters, etc.)

Saxena, V. and Baker, R. J., "Analog and Digital VLSI," chapter in the CRC Handbook on Industrial Electronics, edited by J. D. Irwin and B. D. Wilamowski, *CRC Press*, 2009 second edition.

Baker, R. J., "CMOS Analog Circuit Design," (A self-study course with study guide, videos, and tests.) IEEE Education Activity Department, 2000. ISBN 0-7803-4822-2 (with textbook) and ISBN 0-7803-4823-0 (without textbook)

Baker, R. J., "CMOS Digital Circuit Design," (A self-study course with study guide, videos, and tests.) *IEEE Education Activity Department*, 2000. ISBN 0-7803-4812-5 (with textbook) and ISBN 0-7803-4813-3 (without textbook)

Li, H.W., Baker, R. J., and Thelen, D., "CMOS Amplifier Design," chapter 19 in the CRC VLSI Handbook, edited by Wai-kai Chen, *CRC Press*, 1999 (ISBN 0-8493-8593-8) and the second edition in 2007 (ISBN 978-0-8493-4199-1)

INVITED TALKS AND SEMINARS

Have given over 50 invited talks and seminars at the following locations: AMD (Fort Collins), AMI semiconductor, Arizona State University, Beijing Jiaotong University, Boise State University, Carleton University, Carnegie Mellon, Columbia University, Dublin City University (Ireland), E.G.&G. Energy Measurements, Foveon, the Franklin Institute, Georgia Tech, Gonzaga University, Hong Kong University of Science and Technology, ICySSS keynote, IEEE Electron Devices Conference (NVMTS), IEEE Workshop on Microelectronics and Electron Devices (WMED), Indian Institute of Science (Bangalore, India), Instituto de Informatica (Brazil), Instituto Tecnológico y de Estudios Superiores de Monterrey (ITESM, Mexico), Iowa State University, Lawrence Livermore National Laboratory, Lehigh University, Lockheed-Martin, Micron Technology, Nascentric, National

Semiconductor, Princeton University, Rendition, Saintgits College (Kerala, India), Southern Methodist University, Sun Microsystems, Stanford University, ST Microelectronics (Delhi, India), Temple University, Texas A&M University, Tower Semiconductor (Israel), University of Alabama (Tuscaloosa), University of Arkansas, University of Buenos Aires (Argentina), University of Houston, University of Idaho, University of Illinois (Urbana-Champaign), Université Laval (Québec City, Québec), University of Macau, University of Maryland, Université de Montréal (École Polytechnique de Montréal), Xilinx (Ireland), University of Nevada (Las Vegas), University of Nevada (Reno), University of Toronto, University of Utah, Utah State University, and Yonsei University (Seoul, South Korea).

RESEARCH FUNDING (last 5 years while at UNLV)

Recent funding listed below. In-kind, equipment, and other non-contract/grant funding [e.g., MOSIS support, money for travel for invited talks, etc.] not listed.

- Baker, R. Jacob, (2017-2019) “Advanced Printed Circuit Board Design Methods for Compact Optical Transceiver,” U.S. Army/DOD, $299,605
- Baker, R. J., (2017-2019) "High-Efficiency Integrated Si APD Quantum Key Receiver," Defense MicroElectronics Activity (DMEA), $266,029
- Baker, R. Jacob, (2016-2018) "High-Sensitivity Monolithic Silicon APD and ROIC," U.S. Air Force/DOD, $299,665
- Baker, R. J., (2017) “Geiger Mode SiGe Receiver for Long-Range Optical Communications,” NASA, $30,000
- Baker, R. Jacob, (2016-2017) "Testing and development of BiCMOS photodetectors and diagnostic instrumentation," Department of Energy, National Security Technologies, LLC, $181,605
- Baker, R. Jacob, (2016-2017) "Dual-Mode, Extended Near Infrared, Focal Plane Arrays fabricated with a Commercial SiGe BiCMOS Process," DARPA, $41,892
- Baker, R. Jacob, (2015-2016) "Photodetectors and high-speed electronics using Silicon Germanium (SiGe) Bipolar/CMOS (BiCMOS) integrated circuits," Department of Energy, National Security Technologies, LLC, $100,000
- Baker, R. Jacob, (2015-2016) “Advanced Printed Circuit Board Design Methods for Compact Optical Transceiver,” U.S. Army/DOD, $45,000
- Baker, R. Jacob, (2015) "Quantum Cryptography Detector Chip," Defense MicroElectronics Activity (DMEA), $45,000
- Baker, R. Jacob, (2014-2015) "NSTec ASIC Integrated Circuit Collaboration," Department of Energy, National Security Technologies, LLC, $90,000
- Baker, R. Jacob, (2014-2015) "Silicon Photonic-Electronic System Level Integration," U.S. Air Force/DOD, $54,607
- Baker, R. Jacob, (2013-2014) "NSTec ASIC Integrated Circuit Collaboration," Department of Energy, National Security Technologies, LLC, $162,074
- Baker, R. Jacob, (2013) "Design Software Setup," Department of Energy, National Security Technologies, LLC, $10,999

DOCTORAL STUDENT SUPERVSION

7. Yiyan Li – Portable High Throughput Digital Microfluidics and On-Chip Bacteria Cultures (2016)
6. Yacouba Moumouni – Designing, Building, and Testing a Solar Thermoelectric Generation, STEG, for Energy Delivery to Remote Residential Areas in Developing Regions (2015)
5. Qawi IbnZayd Harvard – Low-Power, High-Bandwidth, and Ultra-Small Memory Module Design (2011)
4. Vishal Saxena – K-Delta-1-Sigma Modulators for Wideband Analog-to-Digital Conversion (2010)
3. Robert Russell Hay – Digitally-Tunable Surface Acoustic Wave Resonator (2009)

2. Xiangli Li (the first Boise State University College of Engineering PhD graduate) – MOSFET Modulated Dual Conversion Gain CMOS Image Sensors (2008)
1. Feng Lin, Research and Design of Low Jitter, Wide Locking-Range Phase-Locked and Delay-Locked Loops (2000)

MASTERS STUDENT SUPERVISION

73. Claire Tsagkari – Design, Fabrication and Testing of a Capacitive Sensor Using Delta-Sigma Modulation (2017)
72. Kevin Buck – Fast Transient Digitzer and PCB Interface (2015)
71. Marzieh Sharbat Maleki (2015)
70. Angsuman Roy – Design, Fabrication and Testing of Monolithic Low-Power Passive Sigma-Delta Analog-to-Digital Converters (2015)
69. Daniel Anderson – Design and Implementation of an Instruction Set Architecture and Instruction Execution Unit for the RZ9 Coprocessor System (2014)
68. Jared Gordon – Design and Fabrication of an Infrared Optical Pyrometer ASIC (2013)
67. Justin Butterfield (2012)
66. Adam Johnson – Methods and Considerations for Testing Resistive Memories (2012)
65. Ben Millemon – CMOS Characterization, Modeling, and Circuit Design in the Presence of Random Local Variation (2012)
64. Justin Wood (2012)
63. Chamunda Ndinawe Chamunda (2011)
62. Gary VanAckern – Design Guide for CMOS Process On-Chip 3D Inductors using Thru-Wafer Vias (2011)
61. Lucien Jan Bissey – High-Voltage Programmable Delta-Sigma Modulation Voltage-Control Circuit (2010)
60. Kaijun Li (2010)
59. Yingting Li (co-supervised with Maria Mitkova) (2010)
58. Lael Matthews (co-supervised with Said Ahmed-Zaid) (2010)
57. Priyanka Mukeshbhai Parikh (2010)
56. Todd Plum (co-supervised with Jeff Jessing) – Design and Fabrication of a Chemicapacitive Sensor for the Detection of Volatile Organic Compounds (2010)
55. Rahul Srikonda (2010)
54. Avani Falgun Trivedi (2010)
53. Kuang Ming Yap – Gain and Offset Error Correction for CMOS Image Sensors using Delta-Sigma Modulation (2010)
52. Mahesh Balasubramanian – Phase Change Memory - Array Development and Sensing Circuits using Delta-Sigma Modulation (2009)
51. Lincoln Bollschweiler (2009)
50. Shantanu Gupta (2009)
49. Qawi Harvard – Wide I_O DRAM Architecture Utilizing Proximity Communication (2009)
48. Avinash Rajagiri (2009)
47. Ramya Ramarapu (2009)
46. Harikrishna Rapole (2009)
45. Aruna Vadla (2009)
44. Hemanth Ande (2008)
43. Curtis Cahoon – Low-Voltage CMOS Temperature Sensor Design using Schottky Diode-Based References (2008)
42. Prashanth Busa (2008)
41. John McCoy III (2008)

40. Dennis Montierth – Using Delta-Sigma-Modulation for Sensing in a CMOS Imager (2008)
39. Rudi Rashwand (2008)
38. Barsha Shrestha (co-supervised with Zhu Han) – Wireless Access in Vehicular Environments using Bit Torrent and Bargaining (2008)
37. Eric Becker – Design of an Integrated Half-Cycle Delay Line Duty Cycle Corrector Delay Locked Loop (2007)
36. Matthew Leslie – Noise-Shaping Sense Amplifier for Cross-Point Arrays (2007)
35. Jose Monje (2007)
34. Sanghyun Park (2007)
33. Vishal Saxena – Indirect Feedback Compensation Techniques for Multi-Stage Operational Amplifiers (2007)
32. Meshack Appikatla (2006)
31. Eric Booth – Wide Range, Low Jitter Delay-Locked Loop Using a Graduated Digital Delay Line and Phase Interpolator (2006)
30. Sucheta Das (2006)
29. Krishna Duvvada – High Speed Digital CMOS Input Buffer Design (2006)
28. Krishnamraju Kurra (2006)
27. Soumya Narasimhan (2006)
26. Roger Porter (2006)
25. David Butler – Low-Voltage Bandgap Reference Design Utilizing Schottky Diodes (2005)
24. Dragos Dimitriu (2005)
23. Surendranath Eruvuru – Sensing Circuit Design for an Ion Mobility Spectrometer (2005)
22. Sandhya Sandireddy (2005)
21. Harish Singidi (2005)
20. Indira Vemula – Delta-Sigma Modulator Used in CMOS Imagers (2005)
19. Bhavana Kollimarla – A 1-Bit Analog-to-Digital Converter Using Delta Sigma Modulation for Sensing in CMOS Imagers (2004)
18. Sandeep Pemmaraju – High Voltage Charge Pump Circuit for an Ion Mobility Spectrometer (2004)
17. Ravindra Puthumbaka – Circuit Design for an Ion Mobility Spectrometer (2004)
16. Brandon Roth – Comparison of Asynchronous vs. Synchronous Design Technologies using a 16-bit Binary Adder (2004)
15. Jennifer Taylor – Reading and Writing Flash Memory Using Delta-Sigma Modulation (2004)
14. Jing Plaisted – Methods for Memory Testing (2003)
13. Murugesh Subramaniam – Flash Memory Sensing Using Averaging (2003)
12. Brian Johnson – Application of an Asynchronous FIFO in a DRAM Data Path (2002)
11. Scott Ward – Electrostatic Discharge (ESD) Protection in CMOS (2002)
10. Tyler Gomm – Design of a Delay-Locked Loop with a DAC-Controlled Analog Delay Line (2001)
9. Gexin Huang (2001)
8. Chris Atkins (2000)
7. Thaddeus Black (2000)
6. Zuxu Qin (2000)
5. Hao Chen (1999)
4. Doug Hackler (co-supervised with Steve Parke) – TMOS: A Novel Design for MOSFET Technology (1999)
3. Song Liu – Design of a CMOS 6-bit Folding and Interpolating Analog-to-Digital Converter (1999)
2. Ben Ba (1997)
1. Brent Keeth – A Novel Architecture for Advanced High Density Dynamic Random Access Memories (1996)

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148. Baker, R. J. and Parkinson, W. "NMOS regulated voltage reference," **9,753,481**, September 5, 2017.
147. Baker, R. J., "Digital Filters with Memory," **9,734,894**, August 15, 2017.
146. Baker, R. J. and Keeth, B., "Optical interconnect in high-speed memory systems," **9,697,883**, July 7, 2017
145. Baker, R. J., "Comparators for delta-sigma modulators," **9,641,193**, May 2, 2017.
144. Baker, R. J., "Quantizing circuits having improved sensing," **9,449,664**, September 20, 2016.
143. Baker, R. J., "Error detection for multi-bit memory," **9,336,084**, May 10, 2016.
142. Baker, R. J. and Keeth, B., "Optical interconnect in high-speed memory systems," **9,299,423**, March 29, 2016.
141. Baker, R. J., "Methods for sensing memory elements in semiconductor devices," **9,299,405**, March 29, 2016.
140. Baker, R. J., "Comparators for delta-sigma modulators," **9,135,962**, September 15, 2015.
139. Baker, R. J., "Resistive memory element sensing using averaging," **9,081,042**, July 14, 2015.
138. Baker, R. J., "Digital Filters with Memory," **9,070,469**, June 30, 2015.
137. Baker, R. J., "Reference current sources," **8,879,327**, November 4, 2014.
136. Baker, R. J. and Beigel, K. D., "Multi-resistive integrated circuit memory," **8,878,274**, November 4, 2014.
135. Baker, R. J., "Methods for sensing memory elements in semiconductor devices," **8,854,899**, October 7, 2014.
134. Baker, R. J., "Quantizing circuits with variable parameters," **8,830,105**, September 9, 2014.
133. Baker, R. J., "Integrators for delta-sigma modulators," **8,754,795**, June 17, 2014.
132. Baker, R. J., "Methods of quantizing signals using variable reference signals," **8,717,220**, May 6, 2014.
131. Baker, R. J. and Keeth, B., "Optical interconnect in high-speed memory systems," **8,712,249**, April 29, 2014.
130. Baker, R. J., "Resistive memory element sensing using averaging," **8,711,605**, April 29, 2014.
129. Baker, R. J., "Memory with correlated resistance," **8,681,557**, March 25, 2014.
128. Baker, R. J., "Reference current sources," **8,675,413**, March 18, 2014.
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126. Linder, L. F., Renner, D., MacDougal, M., Geske, J., and Baker, R. J., "Dual well read-out integrated circuit (ROIC)," **8,581,168**, November 12, 2013.
125. Li, W., Schoenfeld, A., and Baker, R. J., "Method and apparatus for providing symmetrical output data for a double data rate DRAM," **8,516,292**, August 20, 2013.
124. Baker, R. Jacob, "Resistive memory element sensing using averaging," **8,441,834**, May 14, 2013.
123. Qawi, Q. I., Drost, R. J., and Baker, R. Jacob, "Increased DRAM-array throughput using inactive bitlines," **8,395,947**, March 12, 2013.
122. Baker, R. Jacob, "Memory with correlated resistance," **8,289,772**, October 16, 2012.
121. Lin, F. and Baker, R. Jacob, "Phase splitter using digital delay locked loops," **8,218,708**, July 10, 2012.
120. Baker, R. Jacob, "Subtraction circuits and digital-to-analog converters for semiconductor devices," **8,194,477**, June 5, 2012.
119. Baker, R. J., "Digital Filters for Semiconductor Devices," **8,149,646**, April 3, 2012.
118. Baker, R. J., "Error detection for multi-bit memory," **8,117,520**, February 14, 2012.
117. Baker, R. J., "Integrators for delta-sigma modulators," **8,102,295**, January 24, 2012.

116. Baker, R. J., "Devices including analog-to-digital converters for internal data storage locations," **8,098,180**, January 17, 2012.
115. Baker, R. J. and Beigel, K. D., "Multi-resistive integrated circuit memory," **8,093,643**, January 10, 2012.
114. Baker, R. J., "Quantizing circuits with variable parameters," **8,089,387**, January 3, 2012.
113. Baker, R. J., "Reference current sources," **8,068,367**, November 29, 2011.
112. Baker, R. J., "Methods of quantizing signals using variable reference signals," **8,068,046**, November 29, 2011.
111. Baker, R. J., "Systems and devices including memory with built-in self-test and methods of making using the same," **8,042,012**, October 18, 2011.
110. Baker, R. J., "Memory with correlated resistance," **7,969,783**, June 28, 2011.
109. Baker, R. J. and Keeth, B., "Optical interconnect in high-speed memory systems," **7,941,056**, May 10, 2011.
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107. Li, W., Schoenfeld, A., and Baker, R. J., "Method and apparatus for providing symmetrical output data for a double data rate DRAM," **7,877,623**, January 25, 2011.
106. Lin, F. and Baker, R. J., "Phase splitter using digital delay locked loops," **7,873,131**, January 18, 2011.
105. Hush, G. and Baker, R. J., "Complementary bit PCRAM sense amplifier and method of operation," **7,869,249**, January 11, 2011.
104. Baker, R. J., "Subtraction circuits and digital-to-analog converters for semiconductor devices," **7,839,703**, November 23, 2010.
103. Baker, R. J., "Digital Filters with Memory" **7,830,729**, November 9, 2010.
102. Baker, R. J., "Systems and devices including memory with built-in self test and methods of making using the same," **7,818,638**, October 19, 2010.
101. Baker, R. J., "Integrators for delta-sigma modulators," **7,817,073**, October 19, 2010.
100. Baker, R. J., "Digital filters for semiconductor devices," **7,768,868**, August 3, 2010.
99. Baker, R. J., "Quantizing circuits with variable reference signals," **7,733,262**, June 8, 2010.
98. Baker, R. J., "Quantizing circuits for semiconductor devices," **7,667,632**, February 23, 2010.
97. Baker, R. J., and Beigel, K. D., "Multi-resistive integrated circuit memory," **7,642,591**, January 5, 2010.
96. Baker, R. J., "Offset compensated sensing for a magnetic random access memory," **7,616,474**, November 10, 2009.
95. Baker, R. J., "Resistive memory element sensing using averaging," **7,577,044**, Aug. 18, 2009.
94. Baker, R. J., "Quantizing circuits with variable parameters," **7,538,702**, May 26, 2009.
93. Baker, R. J., "Method and system for reducing mismatch between reference and intensity paths in analog to digital converters in CMOS active pixel sensors," **7,528,877**, May 5, 2009.
92. Baker, R. J., "Method and system for reducing mismatch between reference and intensity paths in analog to digital converters in CMOS active pixel sensors," **7,515,188**, April 7, 2009.
91. Taylor, J. and Baker, R. J., "Method and apparatus for sensing flash memory using delta-sigma modulation," **7,495,964**, February 24, 2009.
90. Baker, R. J., "Noise resistant small signal sensing circuit for a memory device," **7,489,575**, February 10, 2009.
89. Baker, R. J., "Per column one-bit ADC for image sensors," **7,456,885**, November 25, 2008.
88. Staples, T. and Baker, R. J., "Input buffer design using common-mode feedback," **7,449,953**, November 11, 2008.
87. Li, W., Schoenfeld, A., and Baker, R. J., "Method and apparatus for providing symmetrical output data for a double data rate DRAM," **7,421,607**, September 2, 2008.

86. Baker, R. J., "Methods for resistive memory element sensing using averaging," **7,372,717**, May 13, 2008.
85. Taylor, J. and Baker, R. J., "Method and apparatus for sensing flash memory using delta-sigma modulation," **7,366,021**, April 29, 2008.
84. Hush, G. and Baker, R. J., "Method of operating a complementary bit resistance memory sensor and method of operation," **7,366,003**, April 29, 2008.
83. Baker, R. J., "Noise resistant small signal sensing circuit for a memory device," **7,330,390**, February 12, 2008.
82. Baker, R. J., "Input and output buffers having symmetrical operating characteristics and immunity from voltage variations," **7,319,620**, January 15, 2008.
81. Staples, T. and Baker, R. J., "Method and apparatus providing input buffer design using common-mode feedback," **7,310,018**, December 18, 2007.
80. Baker, R. J., "Offset compensated sensing for a magnetic random access memory," **7,286,428**, October 23, 2007.
79. Baker, R. J., and Cowles, T. B., "Method and apparatus for reducing duty cycle distortion of an output signal," **7,271,635**, September 18, 2007.
78. Baker, R. J., and Cowles, T. B., "Method and apparatus for reducing duty cycle distortion of an output signal," **7,268,603**, September 11, 2007.
77. Hush, G., Baker, R. J., and Moore, J., "Skewed sense AMP for variable resistance memory sensing," **7,251,177**, July 31, 2007.
76. Hush, G. and Baker, R. J., "Method of operating a complementary bit resistance memory sensor," **7,242,603**, July 10, 2007.
75. Li, W., Schoenfeld, A., and Baker, R. J., "Method and apparatus for providing symmetrical output data for a double data rate DRAM," **7,237,136**, June 26, 2007.
74. Moore, J. and Baker, R. J., "Rewrite prevention in a variable resistance memory," **7,224,632**, May 29, 2007.
73. Baker, R. J., "Integrated charge sensing scheme for resistive memories," **7,151,698**, December 19, 2006.
72. Baker, R. J., "Adjusting the frequency of an oscillator for use in a resistive sense amp," **7,151,689**, December 19, 2006.
71. Baker, R. J., "Resistive memory element sensing using averaging," **7,133,307**, Nov. 7, 2006.
70. Lin, F. and Baker, R. J., "Phase detector for all-digital phase locked and delay locked loops," **7,123,525**, October 17, 2006.
69. Baker, R. J., and Beigel, K. D., "Integrated circuit memory with offset capacitor," **7,109,545**, September 19, 2006.
68. Baker, R. J., "Input and output buffers having symmetrical operating characteristics and immunity from voltage variations," **7,102,932**, September 5, 2006.
67. Baker, R. J., "Noise resistant small signal sensing circuit for a memory device," **7,095,667**, August 22, 2006.
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65. Baker, R. J., "System and method for sensing data stored in a resistive memory element using one bit of a digital count," **7,009,901**, March 7, 2006.
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63. Lin, F. and Baker, R. J., "Phase detector for all-digital phase locked and delay locked loops," **6,987,701**, January 17, 2006.
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55. Baker, R. J., "Dual loop sensing scheme for resistive memory elements," **6,914,838**, July 5, 2005.
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53. Baker, R. J., and Beigel, K. D., "Method for stabilizing or offsetting voltage in an integrated circuit," **6,913,966**, July 5, 2005.
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51. Baker, R. J., "Integrated charge sensing scheme for resistive memories," **6,901,020**, May 31, 2005.
50. Hush, G., Baker, R. J., and Moore, J., "Skewed sense AMP for variable resistance memory sensing," **6,888,771**, May 3, 2005.
49. Baker, R. J., "Method for reducing power consumption when sensing a resistive memory," **6,885,580**, April 26, 2005.
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47. Baker, R. J., "Integrated charge sensing scheme for resistive memories," **6,870,784**, March 22, 2005.
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28. Baker, R. J., "High speed digital signal buffer and method," **6,683,475**, January 27, 2004.
27. Baker, R. J., "High speed low power input buffer," **6,600,343**, July 29, 2003.
26. Baker, R. J., "Offset compensated sensing for magnetic random access memory," **6,597,600**, July 22, 2003.
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18. Baker, R. J., "Method and apparatus for receiving synchronous data," **6,424,684**, July 23, 2002.
17. Baker, R. J. and Beigel, K. D., "Comb-shaped capacitor for use in integrated circuits," **6,410,955**, June 25, 2002.
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INVITED TALKS (PARTIAL LISTING)

- Harvard, Q. I. and Baker, R. J., "Low-Power, High-Bandwidth, and Ultra-Small Memory Module Design," a presentation covering semiconductor packaging, DRAM architectures, and I/O circuits. The goal of this work is to investigate replacing the currently used dual in-line memory modules (DIMMs) with a smaller and a lower power memory module, a "Nano-Module."
- Baker, R. J., and Campbell, K. A., "Reconfigurable Analog Electronics using the Memristor."
- Baker, R. J., and Saxena, V., "A K-Delta 1-Sigma Modulator for Wideband Analog-to-Digital Conversion."
- Li, K., Saxena, V., and Baker, R. J., "The Baker ADC: An Overview,"
- Saxena, V., and Baker, R. J., "High-Speed Op-Amp Design: Compensation and Topologies for Two and Three Stage Designs,"
- Baker, R. J., "Circuit Design for MLC Flash: Towards a Semiconductor Replacement for the Hard Disk Drive."
- Baker, R. J., Terman Award Acceptance Speech, given at the Frontiers in Education Conference (FIE 2007), Milwaukee, WI, October 11, 2007.
- Baker, R. J., "The One-Transistor, One-Capacitor (1T1C) Dynamic Random Access Memory (DRAM), and its Impact on Society," presented at the Franklin Institute, in the symposium honoring Dr. Robert H. Dennard and his receipt of the 2007 Benjamin Franklin Medal in Electrical Engineering, April 25, 2007.
- Baker, R. J. and Saxena, V., "Design of Bandpass Delta-Sigma Modulators: Avoiding Common Mistakes."
- Baker, R. J., "Sensing Circuits for Resistive Memory."
- Hadrick, M. and Baker, R. J., "Sensing in CMOS Imagers using Delta-Sigma Modulation."
- Baker, R. J., "Design of High-Speed CMOS Op-Amps for Signal Processing," IEEE/EDS Workshop on Microelectronics and Electron Devices (WMED), April, 2005
- Baker, R. J., "Delta-Sigma Modulation for Sensing," IEEE/EDS Workshop on Microelectronics and Electron Devices (WMED), April, 2004
- Rivera, B. and Baker, R. J., "Design and Layout of Schottky Diodes in a Standard CMOS Process," MURI Review, November, 2001.

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75. Wu, W., Baker, R. J., Kumar, P., Garcia, F., and Mikkola, E., "A Linear High Gain Time Difference Amplifier Using Feedback Gain Control," *Proceedings of 12th IEEE Dallas Circuits and Systems Conference*, October 9-10, 2016.
74. Moumouni, Y. and Baker, R. J., "Analysis of a Residential 5kW Grid-tied Photovoltaic System," *Proceedings of the 2016 Clemson University Power Systems Conference*, March 8-11, 2016.
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50. Harvard, Q., Baker, R. J., and Drost, R., "Main Memory with Proximity Communication: A Wide I/O DRAM Architecture," *Proceedings of the IEEE/EDS Workshop on Microelectronics and Electron Devices (WMED)*, pp. 40-43, April 16, 2010.
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32. Knowlton, W. B., Araujo, D., Price, P.M., Brotherton, J., Coonse, K., Southwick III, R.G., Oxford, J., Moll, A., Baker, R. J., and Kuang, W., "Development of Biomolecular Nanostructure Sensor Arrays," presented at the Sensors and Sensor Technology session for the program of the 88th annual meeting of the AAAS, Pacific Division, June 2007, Boise, ID
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5. Chen, H. and Baker, R. J., "A CMOS Standard-Cell Library for the PC-based LASI Layout System," *Proceedings of the 41st International Midwest Symposium on Circuits and Systems," August 9-12, 1998.*
4. Liu, S. and Baker, R. J., "Process and temperature performance of a CMOS beta-multiplier voltage reference," *Proceedings of the 41st International Midwest Symposium on Circuits and Systems," August 9-12, 1998.*
3. Boyce, D.E. and Baker, R. J., "A Complete Layout System for the PC," *IEEE 40th International Midwest Symposium on Circuits and Systems*, 1997.
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1. Baker, R. J., "Step-recovery diodes sharpen pulses," *Engineering Design News Magazine*, pp. 154-156, May 10, 1990.

EXPERT WITNESS EXPERIENCE

The law firms and clients (underlined) whom I have provided expert witness services are listed below. I have been deposed 27 times and given expert testimony at 4 trials.

Fish & Richardson P.C. (Washington, DC)

Case – Ex Parte Reexamination

Case Number – 90/020,112. Request filed on July 31, 2017.

Case Subject Matter – Multi-level non-volatile floating gate memory, e.g. EPROM, EEPROM, and flash technologies.

Work Performed – Provided expert consulting services and wrote declaration.

K&L Gates LLP (Chicago, IL)

Case – *United Microelectronics Corp.*, *UMC Group (USA)*, *Semiconductor Manufacturing International Corp. (Shanghai and Beijing)*, and *SMIC (Americas)*, v. Lone Star Silicon Innovations LLC

Case Number – IPR2017-01513. Petition filed on July 20, 2017.

Case Subject Matter – CMOS circuit fabrication.

Work Performed – Provided expert consulting services and wrote declaration for inter partes review.

Kirkland & Ellis LLP (New York, NY and Washington, DC)

Case – Fundamental Innovation Systems International LLC v. *Samsung Electronics Co., LTD.*

Case Number – Texas, ED (Marshall) 2:17-cv-00145. Complaint filed May 15, 2017.

Case Subject Matter – Universal Serial Bus (USB) connections for data communications and charging.

Work Performed – Provided expert consulting services.

Paul Hastings LLP (Austin, TX and Washington, DC)

Case – *Samsung, Inc.* v. ProMOS Technologies, Inc.

Case Numbers – IPR2017-01412, IPR2017-01413, IPR2017-01414, IPR2017-01415, and IPR2017-01416. Petitions filed on May 12, 2017.

Case Subject Matter – Delay-Locked Loop (DLL) design, power supplies, and sensing in semiconductor memory.

Work Performed – Provided expert consulting services and wrote declarations for inter partes reviews.

Baker Botts LLP (Austin, TX, Dallas, TX, and Palo Alto, CA)

Case – *SanDisk LLC* v. Memory Technologies, LLC

Case Number – IPR2017-01420. Petition filed on May 10, 2017.

Case Number – IPR2017-01360. Petition filed on May 3, 2017.

Case Number – IPR2017-01116. Petition filed on March 20, 2017.

Case Number – IPR2017-01022. Petition filed on March 3, 2017.

Case Number – IPR2017-00868. Petition filed on February 9, 2017.

Case Subject Matter – Memory cards including PC cards, compact flash ("CF") cards, secure digital ("SD") cards, and multimedia cards ("MMC").

Work Performed – Provided expert consulting services for inter partes review and wrote declarations.

DLA Piper (Atlanta, GA and East Palo Alto, CA)

Case – Macronix International Co. v. *Toshiba, Inc.*

Case Number – ITC Investigation No. 337-TA-1046. Complaint filed March 7, 2017.

Case Subject Matter – Non-volatile memory, such as flash memory, and products containing the same.

Work Performed – Provided expert consulting services. Also provided Markman tutorial.

O'Melveny & Myers LLP (Newport Beach and Los Angeles, CA)

Case – Janus Semiconductor, LLC v. *Micron Technology, Inc.*

Case Number – Texas, ED (Marshall) 2:16-cv-01409. Complaint filed December 13, 2016.

Case Subject Matter – Self-timed and self-enabled distributed clocking in electronic integrated circuits.

Work Performed – Provided expert consulting services.

Baker Botts LLP (Austin, TX, Dallas, TX, and Palo Alto, CA)

Case – Memory Technologies, LLC v. *SanDisk LLC* and *Western Digital Corporation*

Case Number – ITC Investigation No. 337-TA-1034. Complaint filed November 30, 2016.

Case Subject Matter – SD Cards, microSD cards, eMMC (embedded Multi-Media Controller), and eMCP (embedded Multi-Chip Packages) products.

Work Performed – Provided expert consulting services and wrote declaration.

Kilpatrick Townsend & Stockton LLP (Denver, CO and Shanghai, China)

Case – *Broadcom, Ltd.* v. Invensas

Case Number – IPR2017-00171. Petition filed on October 31, 2016.

Case Subject Matter – Semiconductor random access memory circuit timing and operation.

Work Performed – Provided expert consulting services, wrote declaration, and was deposed.

Paul Hastings LLP (Washington, DC)

Case – *Samsung, Inc.* v. ProMOS Technologies, Inc.

Case Numbers – IPR2017-00036, IPR2017-00038, and IPR2017-00039. Petitions filed on October 7, 2016.

Case Subject Matter – Sensing in semiconductor memory integrated circuits.

Work Performed – Provided expert consulting services, wrote declarations for inter partes reviews, and was deposed twice.

Munck Wilson Mandala LLP (Dallas, TX)

Case – *ams AG*, *ams-TAOS*, and *Samsung* v. JJL Technologies and 511 Innovations, Inc.

Case Numbers – IPR2016-01788, IPR2016-01792, IPR2016-01793, IPR2016-01804, IPR2016-01810, IPR2016-01818, and IPR2016-01819. Petitions filed on September 14, 2016.

Case Number – IPR2016-01787. Petition filed on September 13, 2016.

Case Subject Matter – Color and optical measuring systems.

Work Performed – Provided expert consulting services and wrote declarations for inter partes reviews.

Mintz, Levin, Cohn, Ferris, Glovsky and Popeo, P.C. (Boston, MA and Washington, DC)

Case – *Netlist, Inc.* v. SK hynix

Case Number – ITC Investigation No. 337-TA-1023. Complaint filed on September 1, 2016.

Case Subject Matter – Memory modules and components and products containing same.

Work Performed – Provided expert consulting services including validity analysis, expert report, deposition, technology tutorial at trial, and trial testimony.

Mintz, Levin, Cohn, Ferris, Glovsky and Popeo, P.C. (Boston, MA and Washington, DC)

Case – *Netlist, Inc.* v. SK hynix

Case Number – California, CD 8:16-cv-01605. Complaint filed on August 31, 2016.

Case Subject Matter – Memory modules and components and products containing same.

Work Performed – Provided expert consulting services.

Baker & Hostetler LLP (Cleveland, OH)

Case – *Evolv, LLC* v. Joyetech and Wismec

Case Number – California, CD 8:16-cv-00459.

Complaint filed on March 9, 2016. Case Subject Matter – Electronic personal vaporizers (also known as electronic cigarettes) containing power and USB battery charging electronics and switching power supplies using CMOS and power MOSFETs.

Work Performed – Provided expert consulting services including lab testing and infringement analysis. Wrote declaration.

Vinson & Elkins LLP (San Francisco, CA)

Case – Polaris Innovations Limited v. Kingston Technology Company, Inc.

Case Number – California, CD 8:16-cv-300. Complaint filed on February 19, 2016.

Case Subject Matter – Semiconductor memory, circuits, and the design and fabrication of memory modules.

Work Performed – Provided expert consulting services.

Mintz, Levin, Cohn, Ferris, Glovsky and Popeo, P.C. (Boston, MA)

Case – *Advanced Silicon Technologies LLC* v. BMW, Fujitsu, Harman, Honda, NVIDIA, Renesas, Texas Instruments, Toyota, Volkswagen, and Audi

Case Number – ITC Investigation No. 337-TA-984. Complaint filed on December 28, 2015.

Case Subject Matter – Computing or graphics systems, components thereof, and vehicles containing same.

Work Performed – Provided expert consulting services and wrote declaration for claim construction.

DLA Piper (East Palo Alto, CA, Chicago, IL, and Reston, VA)

Case – Lincoln Electric v. *ESAB, Inc.*

Case Number – Texas, ED (Marshall) 2:15-cv-01404. Complaint filed on December 15, 2015.

Case Subject Matter – Power electronics including switching power supplies using power MOSFETs for welding equipment.

Work Performed – Provided expert consulting, claim construction, non-infringement analysis, invalidity analysis, expert reports, and was deposed twice.

Weil, Gotshal & Manges LLP (Houston, TX and Redwood Shores, CA)

Case – *Micron Technology, Inc.* v. Innovative Memory Systems LLC

Case Numbers – IPR2016-00320, IPR2016-00322, IPR2016-00325, IPR2016-00326, and IPR2016-00327. Petitions filed on December 14, 2015.

Case Subject Matter – Data conversion, semiconductor fabrication, flash memory, and semiconductor memory device operation/control.

Work Performed – Provided expert consulting services, wrote declarations for inter partes reviews, and was deposed three times.

Munck Wilson Mandala LLP (Dallas, TX) and O'Melveny & Myers LLP (Los Angeles, CA)

Case – 511 Innovations, Inc. v. *Samsung, Huawei, ZTE,* and *ams-TAOS*

Case Number – Texas, ED (Marshall) 2:15-cv-01526. Complaint filed on September 14, 2015.

Case Subject Matter – Color and optical measuring systems.

Work Performed – Provided expert consulting, claim construction, wrote declaration, expert reports, and was deposed twice.

Davis Wright Tremaine LLP (San Francisco, CA and Seattle, WA) and Mayer Brown LLP (Washington, DC)

Case – 511 Innovations, Inc. v. *Microsoft and Avago*

Case Number – Texas, ED (Marshall) 2:15-cv-01525. Complaint filed on September 14, 2015.

Case Subject Matter – Color and optical measuring systems.

Work Performed – Provided expert consulting services.

Weil, Gotshal & Manges LLP (Houston, TX, Redwood Shores, CA, and Washington, DC)

Case – *Micron Technology, Inc.* v. Limestone Memory Systems LLC

Case Numbers – IPR2016-00093, IPR2016-00094, IPR2016-00095, IPR2016-00096, and IPR2016-00097. Petitions filed on October 27, 2015.

Case Subject Matter – Semiconductor memory.
Work Performed – Provided expert consulting services and wrote declarations for inter partes reviews.

DLA Piper (East Palo Alto and Los Angeles, CA)
Case – *Apple, Inc.* v. Longitude Flash Memory Systems S.A.R.L.
Case Number – IPR2015-01933. Petition filed on September 21, 2015.
Case Numbers – IPR2015-01924 and IPR2015-01925. Petitions filed on September 17, 2015.
Case Numbers – IPR2015-01908 and IPR2015-01909. Petitions filed on September 14, 2015.
Case Subject Matter – Non-volatile semiconductor flash memory fabrication and design.
Work Performed – Provided expert consulting services and wrote declarations for inter partes reviews.

Paul Hastings LLP (New York City, NY and Washington, DC)
Case – *Samsung, Inc.* v. Elbrus International Limited
Case Numbers – IPR2015-01523 and IPR2015-01524. Petitions filed on June 26, 2015.
Case Subject Matter – High-speed, low-power data transfer.
Work Performed – Provided expert consulting services, wrote declarations for inter partes reviews, and was deposed.

Kilpatrick Townsend & Stockton LLP (Menlo Park and San Francisco, CA)
Case – Consultant for *SK hynix*, Inc. on matters relating to investigation of certain patents owned by Longitude Licensing Ltd.
Case Subject Matter – Semiconductor random access memory and communication interfaces.
Work Performed – Provided expert consulting services in 2015.

Ropes & Gray LLP (New York City, NY)
Case – *Samsung, Inc.* v. Imperium IP Holdings (Cayman), Ltd.
Case Number – IPR2015-01233. Petition filed on May 21, 2015.
Case Subject Matter – Data interface circuits that can be either a single-ended interface or a differential interface.
Work Performed – Provided expert consulting services, wrote declarations for inter partes review, and was twice deposed.

Morgan, Lewis & Bockius LLP (Palo Alto, CA)
Case – *Silergy Corporation* v. Monolithic Power Systems, Inc.
Case Numbers – IPR2015-00803 and IPR2015-00804. Petitions filed on February 24, 2015.
Case Subject Matter – Microelectronic packaging.
Work Performed – Provided expert consulting services, wrote declarations for inter partes reviews, and was deposed.

Weil, Gotshal & Manges LLP (Houston, TX, Redwood Shores, CA, and Washington, DC)
Case – Limestone Memory Systems LLC v. *Micron Technology, Inc.*
Case Number – California, CD 8:15-cv-00278. Complaint filed on February 17, 2015.
Case Subject Matter – Semiconductor memory.
Work Performed – Provided expert consulting, claim construction, non-infringement analysis, and invalidity analysis.

Jones Day LLP (San Diego, CA)
Case – *Micron Technology, Inc.* v. eDigital Corp.
Case Number – IPR2015-00519. Petition filed on December 31, 2014.

Case Subject Matter – Methods for memory management in non-volatile flash memories.
Work Performed – Provided expert consulting services and wrote declaration for inter partes review.

Fish & Richardson P.C. (Atlanta, GA and Washington, DC)
Case – *Micron Technology, Inc.* v. MLC Intellectual Properties and BTG USA/International Inc.
Case Number – IPR2015-00504. Petition filed on December 24, 2014.
Case Subject Matter – Multi-level non-volatile floating gate memory, e.g. EPROM, EEPROM, and flash technologies.
Work Performed – Provided expert consulting services and wrote declaration for inter partes review.

Weil, Gotshal & Manges LLP (Houston, TX and Redwood Shores, CA)
Case – Innovative Memory Systems LLC v. *Micron Technology, Inc.*
Case Number – Delaware, 1:14-cv-01480. Complaint filed on December 15, 2014.
Case Subject Matter – Data conversion, semiconductor fabrication, flash memory, and semiconductor memory device operation/control.
Work Performed – Provided expert consulting, claim construction, non-infringement analysis, and invalidity analysis.

Skadden, Arps, Slate, Meagher & Flom LLP & Affiliates (Palo Alto, CA)
Case – ALFRED T. GIULIANO, Chapter 7 Trustee of the Ritz Estate; CPM ELECTRONICS INC.; E.S.E. ELECTRONICS, INC. and MFLASH, INC., on Behalf of Themselves and All Others Similarly Situated v. *SanDisk Corp.*
Case Number – California, ND (Oakland) 4:10-cv-02787. Fourth amended complaint filed on September 24, 2014.
Case Subject Matter – Non-volatile semiconductor flash memory fabrication and design.
Work Performed – Provided expert consulting services.

DLA Piper (East Palo Alto and Los Angeles, CA)
Case – Longitude Licensing Ltd. and Longitude Flash Memory Systems S.A.R.L., v. *Apple, Inc.*
Case Number – California, ND 3:14-cv-04275. Complaint filed on September 23, 2014.
Case Subject Matter – Non-volatile semiconductor flash memory fabrication and design.
Work Performed – Provided expert consulting, claim construction, non-infringement analysis, and invalidity analysis.

Singularity LLP (Redwood Shores, CA)
Case – VIA Technologies, Inc. v. *ASUS Computer International, AUSTEK Computer, and ASMedia Technology, Inc.*
Case Number – California, ND (San Jose) 5:14-cv-03586. Complaint filed on August 7, 2014.
Case Subject Matter – USB 3.0 circuits.
Work Performed – Provided expert consulting services including: non-infringement, invalidity, and trade-secret analyses. Wrote expert reports, was deposed twice, and participated in mediation.

Paul Hastings LLP (New York City, NY and Washington, DC)
Case – Cascades Computer Innovation, LLC v. *Samsung Electronics Co., Ltd.*
Case Number - Illinois, ED 14-cv-05691. Complaint filed on July 24, 2014.
Case Subject Matter – DRAM memory data transfer.
Work Performed – Provided expert consulting, non-infringement analysis, and invalidity analysis.

Morgan, Lewis & Bockius LLP (Palo Alto, CA)
Case – Monolithic Power Systems, Inc. v. *Silergy Corporation*
Case Number – California, ND 3:14-cv-01745. First amended complaint filed on July 7, 2014.

Case Subject Matter – Microelectronic packaging.
Work Performed – Provided expert consulting, non-infringement analysis, and invalidity analysis.

Ropes & Gray LLP (East Palo Alto, CA, New York City, NY, and Washington, DC)
Case – Macronix International Co., Ltd. v. *Spansion, Inc.*, *Aerohive Networks*, *Allied Telesis*, *Ciena*, *Delphi Automotive*, *Polycom*, *Ruckus Wireless*, *ShoreTel*, *Tellabs*, and *TiVo*
Case Number – ITC Investigation No. 337-TA-922. Complaint filed on June 27, 2014.
Case Subject Matter – Devices containing non-volatile memory and products containing the same.
Work Performed – Provided expert consulting, non-infringement analysis, invalidity analysis, Markman tutorial, and expert report.

Ropes & Gray LLP (Boston, MA and New York City, NY)
Case – Imperium IP Holdings (Cayman), Ltd. v. *Samsung, Inc.*
Case Number – Texas, ED (Sherman) 4:14-cv-00371. Complaint filed on June 9, 2014.
Case Subject Matter – Data interface circuits that can be either a single-ended interface or a differential interface.
Work Performed – Provided expert consulting, non-infringement analysis, invalidity analysis, expert reports, deposition, and testimony at the trial.

Quinn Emanuel Urquhart & Sullivan, LLP (San Francisco, CA and Washington, DC)
Case – Freescale Semiconductor, Inc. v. *MediaTek, Inc.*, et. al.
Case Number – ITC Investigation No. 337-TA-920. Amended complaint filed on May 27, 2014.
Case Subject Matter – Semiconductor integrated circuits and devices containing the same.
Work Performed – Provided expert consulting services.

DLA Piper (East Palo Alto and San Diego, CA)
Case – *GSI Technology, Inc.* v. Cypress Semiconductor Corporation
Case Number – IPR2014-00419. Petition filed on February 7, 2014.
Case Subject Matter – Semiconductor static random access memory (SRAM) circuit design.
Work Performed – Provided expert consulting services and wrote declaration for inter partes review.

Ropes & Gray LLP (Washington, DC)
Case – Macronix International Co., Ltd. v. *Spansion, Inc.*, et al.
Case Number – Virginia, ED 3:13-cv-00679. Complaint filed on November 20, 2013.
Case Subject Matter – Non-volatile semiconductor flash memory fabrication and design.
Work Performed – Provided expert consulting, non-infringement analysis, and invalidity analysis.

Cooley LLP (San Diego, CA)
Case – HSM Portfolio LLC and Technology Properties Limited LLC v. Fujitsu, AMD, *Qualcomm, Inc.*, Elpida, SK Hynix, Micron, ProMOS, SanDisk, Sony, ST Micro, Toshiba, ON, and Zoran
Case Number – Delaware, 1:11-cv-00770. Third amended complaint filed on June 28, 2013.
Case Subject Matter – Semiconductor sensing circuits.
Work Performed – Provided expert consulting, non-infringement analysis, and invalidity analysis.

DLA Piper (East Palo Alto and San Diego, CA)
Case – Cypress Semiconductor Corporation v. *GSI Technology, Inc.*
Case Number – California, ND 3:13-cv-02013. Complaint filed on May 1, 2013.
Case Subject Matter – Semiconductor static random access memory (SRAM) circuit design.
Work Performed – Provided expert consulting, claim construction, non-infringement analysis, and invalidity analysis.

Montgomery McCracken Walker & Rhoads LLP (Philadelphia, PA)

Case – Simon Nicholas Richmond v. Winchance Solar Fujian Technology, *Target*, *Creative Industries*, et. al.

Case Number – New Jersey, 3:13-cv-01954. Amended complaint filed on March 27, 2013.

Case Subject Matter – Circuitry including solar cells, charging circuits, re-chargeable batteries, energy conversion for solar lighting.

Work Performed – Provided expert consulting, non-infringement analysis, and invalidity analysis.

DLA Piper (East Palo Alto, CA)

Case – Intellectual Ventures I/II LLC v. *Toshiba, Inc.*

Case Number – Delaware, 1:13-cv-00453. Complaint filed on March 20, 2013.

Case Subject Matter – Semiconductor memory and electronic interface circuits.

Work Performed – Provided expert consulting, non-infringement analysis, invalidity analysis, expert report, was deposed, and testified at trial.

Alston & Bird, DLA Piper, Gibson Dunn, Katten, O'Melveny, Orrick, and WilmerHale (various locations in the USA)

Case – Freescale v. *Funai, CSR, Zoran, MediaTek, Vizio, Sanyo, TPF, Top Victory Electronics, Envision Peripherals, AmTRAN,* and *Marvell*

Case Number – Texas, WD 1:12-cv-00644. Amended complaint filed on January 14, 2013.

Case Subject Matter – Semiconductor circuitry for voltage regulators, bus terminations, packaging, and signal processing.

Work Performed – Provided expert consulting, claim construction, non-infringement analysis, invalidity analysis, and Markman tutorial.

Amin, Turocy & Watson LLP (San Jose and San Francisco, CA)

Case – *InvenSense, Inc.* v. Robert Bosch GmbH

Case Subject Matter – Microelectromechanical systems (MEMS) sensor design and manufacture.

Work Performed – Provided expert consulting services in 2013.

Morrison & Foerster LLP (Los Angeles, Palo Alto, and San Francisco, CA)

Case – STMicroelectronics, Inc. v. *InvenSense, Inc.*

Case Number – California, ND 3:12-cv-02475. Complaint filed on May 16, 2012.

Case Subject Matter – Microelectromechanical systems (MEMS) sensors including Gyroscopes and accelerometers.

Work Performed – Provided expert consulting, non-infringement analysis, invalidity analysis, and wrote declaration.

Kilpatrick Townsend & Stockton LLP (Menlo Park and San Francisco, CA)

Case – Consultant for *SK hynix*, Inc. on matters relating to investigation of certain patents owned by Round Rock Research LLC

Case Subject Matter – Semiconductor random access memory.

Work Performed – Provided expert consulting services in 2012.

Keker & Van Nest LLP (San Francisco, CA)

Case – Round Rock Research LLC v. *SanDisk Corp.*

Case Number – Delaware, 1:12-cv-00569. Complaint filed on May 3, 2012.

Case Subject Matter – Semiconductor non-volatile flash memory.

Work Performed – Provided expert consulting including: invalidity analysis, non-infringement analysis, expert reports, and was deposed.

Perkins Coie LLP (San Diego, CA)

Case – *ASUS Computer International* v. Round Rock Research LLC

Case Number – California, ND 3:12-cv-02099. Complaint filed on April 26, 2012.
Case Subject Matter – Semiconductor memory and image sensors.
Work Performed – Provided expert consulting, claim construction, non-infringement analysis, invalidity analysis, expert reports, and was deposed.

Morgan, Lewis & Bockius LLP (Palo Alto, CA)
Case – Dr. Michael Jaffe' as insolvency administrator for Qimonda AG v. LSI, *Atmel Corp*, Cypress, MagnaChip, and ON Semiconductor
Case Number – California, ND 3:12-cv-03166 (San Francisco). Complaint filed on January 10, 2012.
Case Subject Matter – Semiconductor processing and manufacturing.
Work Performed – Provided expert consulting, non-infringement analysis, and invalidity analysis.

Useful Arts IP (Cupertino, CA)
Case – Tezzaron (formerly Tachyon Semiconductor) v. *Elm Technology Corporation*
Case Number – Patent Interference No. 105,859. Declared on December 1, 2011.
Case Subject Matter – Packaging of semiconductors and through silicon vias (TSVs).
Work Performed – Patent interference, wrote declaration, and was deposed.

Morgan, Lewis & Bockius LLP (Palo Alto, CA)
Case – Nanya Technology Corporation v. *Elpida Memory, Inc. and Kingston Technology Company, Inc.*
Case Number – ITC Investigation No. 337-TA-821. Complaint filed on November 21, 2011.
Case Subject Matter – Semiconductor DRAM design, fabrication, and manufacture.
Work Performed – Provided expert consulting and reports on validity, infringement, and domestic industry. Also provided declarations and was deposed.

Morgan, Lewis & Bockius LLP (Washington, DC)
Case – *Elpida Memory, Inc.* v. Nanya Technology Corporation
Case Number – ITC Investigation No. 337-TA-819. Complaint filed on November 15, 2011.
Case Subject Matter – Semiconductor DRAM design, fabrication, and manufacture.
Work Performed – Provided expert consulting and reports on infringement, domestic industry, and validity. Also provided Markman tutorial, declarations, deposition, and testimony at the trial.

Ropes & Gray LLP (New York City, NY)
Case – Intellectual Ventures v. *Sendai Nikon Corporation*
Case Number – Delaware, 1:11-cv-01025. Complaint filed on October 26. 2011.
Case Subject Matter – CMOS image sensor design and manufacture.
Work Performed – Provided expert consulting, non-infringement analysis, and invalidity analysis.

Farella Braun + Martel LLP (San Francisco, CA)
Case – Round Rock Research LLC v. *Dell, Inc.*
Case Number – Delaware, 1:11-cv-00976. Complaint filed on October 14, 2011.
Case Subject Matter – Semiconductor DRAM design and manufacture.
Work Performed – Provided expert consulting, non-infringement analysis, invalidity analysis, and wrote declaration.

Latham & Watkins LLP (San Francisco, CA)
Case – Altera Corp. v. *LSI Corp. and Agere Systems, Inc.*
Case Number – California, ND 4:11-cv-03139. Complaint filed on June 24, 2011.
Case Subject Matter – Semiconductor devices and electronics including phase-locked loops and clock recovery circuits.
Work Performed – Provided expert consulting, non-infringement analysis, and invalidity analysis.

Fish & Richardson P.C. (Washington, DC)

Case – Spansion LLC v. *Samsung Electronics Co., Ltd.*, Apple, Inc., Nokia Corp., PNY Technologies, Inc. Research In Motion Corporation, Transcend Information Inc.

Case Number – ITC Investigation No. 337-TA-735. Complaint filed on August 6, 2010.

Case Subject Matter – Semiconductor flash memory manufacture, fabrication, and design.

Work Performed – Provided expert consulting, non-infringement analysis, and invalidity analysis.

Jones Day LLP (Palo Alto, CA)

Case – LSI and Agere, Inc. v. *Xilinx, Inc.*

Case Number – New York, SD 1:09-cv-09719. Complaint filed on November 23, 2009.

Case Subject Matter – Semiconductor digital design and clocking.

Work Performed – Provided expert consulting, non-infringement analysis, and invalidity analysis.

Morrison & Foerster LLP (New York City, NY)

Case – Innurvation, Inc. et al v. *Fujitsu Microelectronics America, Inc.*, Sony Corporation of America, Toshiba America Electronics Components, Inc., and Freescale Semiconductor, Inc.

Case Number – Maryland, 1:09-cv-01416. Complaint filed on May 29, 2009.

Case Subject Matter – Semiconductor circuit layout.

Work Performed – Provided expert consulting, non-infringement analysis, and invalidity analysis.

Wilson Sonsini Goodrich & Rosati P.C. (Palo Alto, CA)

Case – Panavision Imaging, LLC, v. *OmniVision Technologies, Inc.*, Canon U.S.A., Inc., Micron Technology, Inc., Aptina Imaging Corporation, and Aptina, LLC.

Case Number – California, CD 2:09-cv-01577. Complaint filed on March 6, 2009.

Case Subject Matter – CMOS image sensor design, fabrication, and manufacture.

Work Performed – Provided expert consulting, non-infringement analysis, invalidity analysis, two expert reports, and wrote declaration.

McDermott Will & Emery (Menlo Park, CA)

Case – Volterra Semiconductor Corp. v. Primarion & *Infineon Technologies North America & Infineon Technologies, A.G.*

Case Number – California, ND 3:08-cv-05129. Complaint filed on November 12, 2008.

Case Subject Matter – High-performance analog and mixed-signal power management semiconductors and switching power supplies in CMOS using power MOSFETs.

Work Performed – Provided expert consulting, non-infringement analysis, invalidity analysis, two expert reports, and was deposed.

pre-2008 Minor expert witness work. Was deposed twice, once as an expert witness and the other time as a corporate witness.

EXHIBIT 2

Arthur W. Kelley, Ph.D.
1100 Pacific Marina, #410 2033 Weston Green Loop
Alameda, CA 94501 Cary, NC 27513
(until 12/20/2016) (after 12/20/2016)
awk@awkconsult.com
Cell: (919) 349-2580

Power electronics professional with over thirty years experience covering an exceptionally wide range of applications and technologies in academic, industry and intellectual property settings.

Expertise

Power supplies, power electronics, magnetics, power quality and power management integrated circuits.
Dc-to-dc converter topologies including forward, flyback, full-bridge, push-pull, buck, boost, buck/boost and SEPIC; synchronous rectifiers.
Application of discrete power semiconductor devices including gate drives.
Design for production of high-performance power management integrated circuits.
Magnetics (60-Hz and high-frequency switching) including magnetic materials and saturable magnetic devices (mag amps and ferroresonant transformers).
Experience in terrestrial, marine and aircraft power systems.
Recent power supply application areas include: Ac power supplies for consumer electronics, LED lighting, medical implants, line-interfaced photovoltaics, hybrid power air vehicle, connectorless or non-contact power and transmission level power flow control.

Laboratory test facilities

Agilent 4395A Network/Impedance/Spectrum Analyzer.
Tektronix TDS 3034C Digital Oscilloscope
Chroma 61502 Programmable Ac Power Source
AE Techron 7224 Single-Channel Industrial Amplifier
Agilent/HP 34401A Digital Multimeter (3)
Transistor Devices 50-60-1000A Electronic Load
Tektronix P5205A 100 MHz High Voltage Differential Probe
Tektronix TCP202 Current Probe
ESD Laboratory Bench and associated ESD control
Microscope, current sensors, thermocouple, etc.

Status

U.S. Citizen, previous security clearance Top Secret

Experience (reverse chronological order)

Current, Independent Consultant

Consulting research, design and analysis services for

Smart Wires, Inc., Union City, CA (headquarters San Francisco, CA). Transformer based power electronic product for improved utilization of electric power system transmission grid.

Expert witness for Power Integrations, Inc. (PI) represented by Fish & Richardson, Redwood City, CA in Petition for possible *Inter Partes* Review of U.S. Patent No. 6,107,851 vs. On Semiconductor (acquired Fairchild Semiconductor).

September 2007 to recent past, Independent Consultant

Expert witness for Power Integrations, Inc. (PI) represented by Fish & Richardson, Redwood City, CA in Petition for *Inter Partes* Review of U.S. Patent No. 6,212,079 vs. Silver Star Capital, LLC.

Silicium Energy, Inc., Palo Alto, CA. Micropower TEGs.

Expert witness for Power Integrations, Inc. (PI) represented by Fish & Richardson, Redwood City, CA in Civil Action No: C 09-5235 MMC, Power Integrations, Inc. vs. Fairchild Semiconductor International, Inc., Fairchild Semiconductor Corporation and System General Corporation. Trial took place in December 2015. Work included preparation of declaration, supplemental declaration, deposition and trial testimony.

U.S. patent to PI 6,212,079 Method and Apparatus for Improving Efficiency in a Switching Regulator at Light Loads

U.S. patent to PI 6,538,908 Method and Apparatus for Providing a Multi-function Terminal for a Power Supply Controller

Expert witness for Power Integrations, Inc. (PI) represented by Fish & Richardson, Redwood City, CA in Civil Action No: C 12-540-LPS Fairchild Semiconductor International, Inc., Fairchild Semiconductor Corporation and System General Corporation (FCS) vs. Power Integrations, Inc. Trial took place in May/June 2014. Work included preparation of declaration, supplemental declaration, deposition and trial testimony.

U.S. patent to PI 7,952,895 Method and Apparatus for Implementing Dormant Mode in a Power Converter

U.S. patent to PI 7,995,359 Method and Apparatus for Implementing an Unregulated Dormant Mode with an Event Counter in a Power Converter

U.S. patent to PI 8,115,457 Method and Apparatus for Implementing a Power Converter Input Terminal Voltage Discharge Circuit

U.S. patent to PI 6,229,366 Off-Line Converter with Integrated Softstart and Frequency Jitter

U.S. patent to FCS 7,259,972 Primary-Side-Control Power Converter Having a Switching Controller Using Frequency Hopping and Voltage and Current Control Loops

Expert witness for Terumo Cardiovascular Systems Corporation represented by Fish & Richardson, Minneapolis, MN in Civil Action No: 4:13-CV-03281 and in *Inter Partes* Review IPR2015-00263, Terumo Cardiovascular Systems Corporation, Inc. vs. Sheilah D. King and Allen Paige King including preparation of declaration. Case settled before reaching depositions.

U.S. patent to King 6,423,268 Blood Heating System with Mutually Exclusive Relay-Controlled Heat Exchangers

Consulting research, design and analysis services for
Logos Technologies, Alexandria, VA. Supporting Raleigh NC site. Architect hybrid electric propulsion system for a powered parafoil.

Adjunct Associate Professor, North Carolina State University – in conjunction with the Future Renewable Electric Energy Delivery Management (FREEDM) Systems Center, A National Science Foundation Engineering Research Center. Taught classes in power electronics.

Consulting research, design and analysis services for
Rambus, Inc., Chapel Hill, NC. Supporting LED Lighting Division, Brecksville, OH. Technology research, trade study and down selection of power supply architecture for LED lighting.

Expert witness for Power Integrations, Inc. represented by Fish & Richardson in Civil Action No: 08-309-JJF-LPS, Power Integrations, Inc. (PI) vs. Fairchild Semiconductor International, Inc., Fairchild Semiconductor Corporation and System General Corporation (FCS), Trial took place in April 2012. Work included preparation of declaration, supplemental declaration, deposition and trial testimony.

U.S. Patent to PI 6,107,851 Offline Converter with Integrated Softstart and Frequency Jitter

U.S. Patent to PI 6,249,876 Frequency Jittering Control for Varying the Switching Frequency of a Power Supply

U.S. Patent to PI 7,110,270 Method and Apparatus for Marinating a Constant Load Current with Line Voltage in a Switch Mode Power Supply

U.S. Patent to PI 7,834,605 Method and Apparatus for Maintaining a Constant load Current with Line Voltage in a Switch Mode Power Supply

U.S. Patent to FCS 7,259,972 Primary-Side-Control Power Converter Having a Switching Controller Using Frequency Hopping and Voltage and Current Control Loops

U.S. Patent to FCS 7,352,595 Primary-Side Controlled Switching Regulator

Expert witness for Ericsson, Inc. represented by McKool Smith, Washington, DC and Austin, TX in Civil Action No. 2:11-CV-054-TJW-CE, SynQor, Inc. v. Ericsson, Inc. including preparation of declaration, supplemental declaration and deposition in response to Motion for Preliminary Injunction. Parties settled in advance of ruling.

U.S. Patent to SynQor 7,072,190 High Efficiency Power Converter

U.S. Patent to SynQor 7,272,021 Power converter with isolated and regulated stages

U.S. Patent to SynQor 7,558,083 High Efficiency Power Converter

U.S. Patent to SynQor 7,564,702 High Efficiency Power Converter

U.S. Patent to SynQor 7,269,034 High Efficiency Power Converter

Consulting research, design and analysis services for

Innerpulse, Inc., Research Triangle Park, NC. Power supply for intravascular implantable defibrillator.
SolarBridge Technologies, Austin, TX. Transformer and power electronics design for grid-connected photovoltaics (formerly SmartSpark Energy Systems, Champaign, IL, now part of Sunpower, San Jose, CA)
Oriel Therapeutics, Durham, NC. Power supply for vibrating inhaler for administration of asthma medication.
Access Business Group, Ada, MI. Magnetically coupled connectorless power and communications for portable devices. One U.S. Patent issued.

November 2000 to September 2007, Senior Design Engineer

Linear Technology Corporation, Raleigh Design Center, Cary, NC (Headquarters Milpitas, CA)
Principal responsibility is design of high-performance analog integrated circuits for power management. At Linear "Senior Design Engineer" is essentially a Product Technical Lead whose responsibilities, in addition to design, include aspects of product definition, layout, manufacture, debug, ESD, functional test, life test, characterization, correlation, applications and datasheet. I designed the LTC3705/25 half of the LTC3705/25/06/26 innovative chipset in the then newest BiCMOS process. Design was completely from scratch (rare). Subsequently designed LTC3805 and LTC3805-5 flyback controller in CMOS. One U.S. Patent issued.

July 1993 to June 2001, Associate Professor (with tenure)
July 1987 to June 1993, Assistant Professor (tenure track)

North Carolina State University
Department of Electrical and Computer Engineering, Raleigh, NC
Developed funded research program including power electronics, power semiconductor devices, magnetics, power quality, power systems, motor drives and motors.
Funding from US Navy ONR Power Electronic Building Block (PEBB) program, electric utilities, power equipment manufacturers, and semiconductor manufacturers.
Of special note: developed several instruments including a calorimeter for measuring magnetic core loss, an impedance analyzer for energized power lines and instruments for semiconductor characterization.
Supervised numerous Graduate Research Assistants to the completion of their degrees.
Developed and taught undergraduate and graduate classes in power electronics.
Six U.S. Patents issued.

Consulting (while at NCSU)

Expert witness for insurance companies in two electronic product-failure litigations (one a boat fire and the other gasoline spill)
Technical consultant to Diamond Microelectronics Corporation (innovative diamond-based power-electronic devices).
Numerous other short-term technical consulting activities.

January 1985 to July 1987, Senior Engineer

Sundstrand Corporation (subsequently Hamilton-Sundstrand, now UTC Aerospace Systems), Rockford, IL
Aerospace applications of power electronics including commercial aircraft, military aircraft and spacecraft. (Top Secret security clearance)
One U.S. Patent issued.

Education

B.S., Electrical Engineering, Duke University 1979, *summa cum laude*, Phi Beta Kappa.
M.S. and Ph.D., Electrical Engineering Duke University 1981 and 1984, respectively.
James B. Duke Fellow

Service to the Profession

Editor in Chief, Newsletter, IEEE Power Electronics Society 2009 to 2012
Editor in Chief, IEEE Transactions on Power Electronics 2000-2001-2002
(the premier journal in my field)
Program Chair, Power Electronics Specialists Conference 1997
Recipient of 2003 IEEE Power Electronics Society Service Award
Numerous other volunteer positions with the IEEE Power Electronics Society

Publications

Kelley, A., Cavaroc, J., Ledford, J., Vassalli, L., Voltage Regulator For Contactor Ridethrough, IEEE Transactions on Industry Applications, Volume 36, Issue 2, March-April 2000, pp. 697 – 704.

Kelley, A.W., Edwards, S.W., Rhode, J.P., Baran, M.E., Transformer Derating For Harmonic Currents: A Wide-Band Measurement Approach For Energized Transformers, IEEE Transactions on Industry Applications, Volume 35, Issue 6, Nov.-Dec. 1999, pp. 1450 – 1457.

Baran, M.E., Maclaga, J., Kelley, A.W., Craven, K., Effects Of Power Disturbances On Computer Systems, IEEE Transactions on Power Delivery, Volume 13, Issue 4, Oct. 1998, pp. 1309 – 1315.

Baran, M.E., Jinxiang Zhu, Kelley, A.W., Meter Placement For Real-Time Monitoring Of Distribution Feeders, IEEE Transactions on Power Systems, Volume 11, Issue 1, Feb. 1996 pp. 332 – 337.

Baran, M.E., Kelley, A.W., A Branch-Current-Based State Estimation Method For Distribution Systems, IEEE Transactions on Power Systems, Volume 10, Issue 1, Feb. 1995, pp. 483 – 491.

Jungreis, A.M., Kelley, A.W., Adjustable Speed Drive For Residential Applications, IEEE Transactions on Industry Applications, Volume 31, Issue 6, Nov.-Dec. 1995, pp. 1315 – 1322.

Baran, M.E., Kelley, A.W., State Estimation For Real-Time Monitoring Of Distribution Systems, IEEE Transactions on Power Systems, Volume 9, Issue 3, Aug. 1994, pp. 1601 – 1609.

Kelley, A.W., Wilson, T.G., Owen, H.A., Jr., Analysis Of The Ferroresonant Transformer With A Rectified Output In The Low-Line-Voltage Minimum-Line-Frequency Full-Load Condition, IEEE Transactions on Power Electronics, Volume 9, Issue 3, May 1994, pp. 318 – 327.

Kelley, A.W., Yadusky, W.F., Rectifier For Minimum Line-Current Harmonics And Maximum Power Factor, IEEE Transactions on Power Electronics, Volume 7, Issue 2, April 1992, pp. 332 – 341.

Kelley, A.W., Measurement Of Spacecraft Power Transformer Acoustic Noise, IEEE Transactions on Magnetics, Volume 26, Issue 1, Jan 1990, pp. 281 – 289.

Kelley, A.W., Owens, W.R., Connectorless Power Supply For An Aircraft-Passenger Entertainment System, IEEE Transactions on Power Electronics, Volume 4, Issue 3, July 1989, pp. 348 – 354.

Baran, M., Mahajan, N.R., Kelley, A.W., Grainger, J.J., A Distribution System Simulator For Protection And Control, 2001 IEEE/PES Transmission and Distribution Conference and Exposition, Volume 1, 28 Oct.-2 Nov. 2001 pp. 307 – 310, vol.1.

Linkous, R., Kelley, A.W., Armstrong, K.C., An Improved Calorimeter For Measuring The Core Loss Of Magnetic Materials, 2000 IEEE Applied Power Electronics Conference and Exposition, Volume 2, 6-10 Feb. 2000, pp. 633 – 639.

Jones, M., Kelley, A.W., Wideband Circuit Model For Busbar Impedance, 2000 IEEE Applied Power Electronics Conference and Exposition, Volume 2, 6-10 Feb. 2000 Page(s):839 – 845.

Baran, M.E., Tocharoenchai, W., Craven, K., Kelley, A.W., Effects Of Power Supply Surges On Personal Computers, 2000 IEEE Industrial and Commercial Power Systems Technical Conference, 7-11 May 2000, pp. 141 – 146.

Kelley, A., Cavaroc, J., Ledford, J., Vassalli, L., Voltage Regulator For Contactor Ridethrough, 1999 IEEE.Industrial and Commercial Power Systems Technical Conference, 2-6 May 1999.

Kelley, A., Harris, M., Cavaroc, J., Jones, M., Linkous, R., Hartzell, D., Darch, D., Bus Connector For Coordinated Interconnect: Laboratory Measurement And Finite Element Simulation, 1999 IEEE Applied Power Electronics Conference and Exposition, 14-18 March 1999, pp. 325 – 331.

Kelley, A., Harris, M., Hartzell, D., Darcy, D., Coordinated Interconnect: A Philosophical Change In The Design And Construction Of Power Electronic Converters, The 1998 IEEE Industry Applications Conference, 12-15 Oct. 1998, pp. 1105 – 1110.

Rhode, J.P., Kelley, A.W., Baran, M.E., Complete Characterization Of Utilization-Voltage Power System Impedance Using Wideband Measurement, 1996 IEEE Industrial and Commercial Power Systems Technical Conference, 6-9 May 1996, pp. 123 – 130.

Jungreis, A.M., Kelley, A.W., The Axial Air Gap Wobble Motor-An Appropriate Topology For Magnetic Micromotors, 1995 IEEE Industry Applications Conference, 8-12 Oct. 1995, pp. 781 – 788.

Rhode, J.P., Kelley, A.W., Baran, M.E., Line Impedance Measurement: A Nondisruptive Wideband Technique, 1995 IEEE Industry Applications Conference, 8-12 Oct. 1995, pp. 2233 – 2240.

Kelley, A.W., Wilson, J.M., Rhode, J.P., Baran, M., On-Line Wideband Measurement Of Induction Motor Impedance, 1995 IEEE Industry Applications Conference, 8-12 Oct. 1995, pp. 647 – 654.

Kelley, A.W., Edwards, S.W., Rhode, J.P., Baran, M., Transformer Derating For Harmonic Currents: A Wideband Measurement Approach For Energized Transformers, 1995 IEEE Industry Applications Conference, 8-12 Oct. 1995, pp. 840 – 847.

Baran, M.E., Jinxiang Zhu, Kelley, A.W., Meter Placement For Real-Time Monitoring Of Distribution Feeders, 1995 IEEE Power Industry Computer Application Conference, Conference Proceedings, 7-12 May 1995 pp. 228 – 233.

Jungreis, A.M., Kelley, A.W., Simplified Adjustable Speed Drive For Residential Applications, 1994 IEEE Industry Applications Society Annual Meeting, 2-6 Oct. 1994, pp. 530 – 537.

Iwamuro, N., Baliga, B.J., Kurlagunda, R., Mann, G., Kelley, A.W., Comparison Of RBSOA Of ESTs With IGBTs And MCTs, 6th International Symposium on Power Semiconductor Devices and ICs, 31 May-2 June 1994, pp. 195 – 200.

Harris, M.B., Kelley, A.W., Rhode, J.P., Baran, M.E., Instrumentation For Measurement Of Line Impedance, 1994 IEEE Applied Power Electronics Conference and Exposition, 13-17 Feb. 1994, pp. 887 – 893.

Nance, J.L., Ramadurai, B., Kelley, A.W., Interactive Analysis And Design Program For Phase-Controlled Rectifiers Operating In The Closed-Loop Periodic-Steady-State And Transient Conditions, 1993 IEEE Applied Power Electronics Conference and Exposition, 7-11 March 1993, pp. 873 – 879.

Hallouda, M.A., Kelley, A.W., Adjustable Speed Drive For Residential Applications, 1993 IEEE Power Electronics Specialists Conference, 20-24 June 1993 pp. 928 – 934.

Kelley, A.W., Titus, J.E., Dc Current Sensor For PWM Converters, 1991 IEEE Power Electronics Specialists Conference, 24-27 June 1991, pp. 641 – 650.

Kelley, A.W., Nance, J.L., Moore, M.D., Interactive Analysis And Design Program For Phase-Controlled Rectifiers, 1991 IEEE Applied Power Electronics Conference and Exposition, 10-15 March 1991, pp. 271 – 277.

Kelley, A.W., Hallouda, M.A., Moore, M.D., Nance, J.L., Near-Unity-Power-Factor Single-Phase Ac-To-Dc Converter Using A Phase-Controlled Rectifier, 1991 IEEE Applied Power Electronics Conference and Exposition, 10-15 March 1991, pp. 387 – 392.

Kelley, A.W., Yadusky, W.F., Phase-Controlled Rectifier Line-Current Harmonics And Power Factor As A Function Of Firing Angle And Output Filter Inductance, 1990 IEEE Applied Power Electronics Conference and Exposition, 11-16 March 1990, pp. 588 – 597.

Kelley, A.W., Yadusky, W.F., Rectifier Design For Minimum Line Current Harmonics And Maximum Power Factor, 1989 IEE Applied Power Electronics Conference and Exposition, 13-17 March 1989, pp. 13 – 22.

U. S. Patents

8,731,116, M. Norconk, J. Schwannecke, C. Moore, J. Taylor, N. Kuyvenhoven, D. Liff, J. Amistadi, R. Gruich, A. Kelley, K. Armstrong, System and Method of Providing Communications in a Wireless Power Transfer System, May 20, 2014.

7,200,014, C. Hawkes, A. Kelley, System and Method for Transferring Duty Cycle Information in an Isolated DC/DC Converter or Other Circuit, April 3, 2007.

6,847,515, A. Kelley, J. Ledford, L. Vassalli, J. Cavaroc, Power Supply Systems And Methods That Can Enable An Electromagnetic Device To Ride-Through Variations In A Supply Voltage, January 25, 2005.

6,345,203/6,263,247/6,047,214, J. Mueller, H. T. Nagle, R. Gyurcsik, A. Kelley, System And Method For Powering, Controlling, And Communicating With Multiple Inductively-Powered Devices, February 5, 2002/July 17, 2001/April 4, 2000.

5,587,662, A. Kelley, M. Harris, Method And Apparatus For Nondisruptively Measuring Line Impedance At Frequencies Which Are Relatively Close To The Line Frequency, December 24, 1996

5,448,141, A. Kelley, M. Hallouda, A. Jungreis, Adjustable Speed Drive For Residential Applications, September 5, 1995.

4,833,337, A. Kelley, W. Owens, Inductive Coupled Power System, May 23, 1989.

EXHIBIT 3

Donald Y.C. Lie

K.S. Lu Regents Chair Professor
Department of Electrical and Computer Engineering
Edward E. Whitacre Jr. College of Engineering
Adjunct Professor
Dept. of Surgery, Texas Tech University Health Sciences Center (TTUHSC)
Texas Tech University, Lubbock, TX 79409-3102
Emails: (O) Donald.Lie@ttu.edu

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Donald Y. C. Lie *(S'86–M'87–SM'00-F'17)* received his B.S.E.E. degree from the National Taiwan University in 1987, and the M.S. and Ph.D. degrees in electrical engineering (minor in applied physics) from the Caltech, Pasadena, in 1990 and 1995, respectively. He has held technical and managerial positions at companies such as Rockwell International, Silicon-Wave (now Qualcomm), IBM, Microtune Inc., SYS Technologies, and Dynamic Research Corporation (DRC). He is currently the Keh-Shew Lu Regents Chair Professor in the Department of Electrical and Computer Engineering, Texas Tech University, Lubbock, Texas, and also an Adjunct Professor in the Department of Surgery, Texas Tech University Health Sciences Center (TTUHSC), supervising M.D./Ph.D students. He is instrumental in bringing in multi-million dollars research funding and also designed real-world commercial communication products sold internationally. He was a Visiting Lecturer to the ECE Department, University of California, San Diego (UCSD) during 2002-2007 where he taught upper-division and graduate-level classes and affiliated with UCSD's Center of Wireless Communications (CWC) and co-supervised Ph.D. students. Dr. Lie is currently serving as the General Chair of IEEE VLSI-DAT 2015-2017, and on the Executive/Steering Committees of the IEEE RFIC Symp., SiRF, MWSCAS, TSWMCS (Texas Wireless Symp.), the TPC Subcommittee Chair on large-signal circuits for IEEE RFIC Symp., and also as a TPC member for IEEE RWS, PAWR, SiRF, ISCAS, BIOCAS, ASICON, ICSSE, ICBBB and IEEE-NIH LiSSA. Dr. Lie was the Conference General Chair of IEEE BCTM 2014, IEEE SiRF 2014, and the TPC Chair/co-Chair for IEEE VLSI-DAT 2013-15, IEEE BCTM 2011-13, and IEEE SiRF'11. Dr. Lie has been awarded with the US NAVY SPAWAR SSC San Diego "Center Team Achievement Award", Spring 2007, won 3 DRC Silver Awards of Excellence, 2005-2007; received IBM "FIRST" chairman patent award, 2001-2002 and Rockwell International's "FIRST" engineering awards, 1996-1998. He and his students have won 14 Best Graduate Student Paper Awards and Best Paper Awards in international conferences for 1994, 1995, 2006, 2008 (twice), 2010 (thrice), 2011, 2012, 2013, 2014, 2015 and also 2016. Dr. Lie has served as a Guest Editor for IEEE Journal of Solid-State Circuits (JSSC) in Sept. 2009, Associate Editor of *IEEE Microwave and Wireless Components Letters (MWCL)* since 2010, Associate Editor-in-Chief for the *Open Journal of Applied Biosensor* since 2012, Special Topic Editor for *IEEE MWCL* in June 2012, and Guest Editor for *Biosensors, MDPI*, in Nov. 2016. Dr. Lie has consulted for several commercial IC design companies and an international research institute, and also on a couple of patents and trade secrets litigation cases with some of the largest business litigation firms in the US. Dr. Lie has authored/coauthored about 200 peer-reviewed technical papers and book chapters and holds seven U.S. patents. Dr. Lie's group has won 4 DARPA subcontracts in the past 5 years and published three *most downloaded TOP 100 papers* on highly efficient radio-frequency silicon power amplifier design in the IEEE *Xplore*™ among millions of publications in Sept. 2012, June 2012, and Sept. 2009 (ranked #80, #88, and #21 for these 3 months, respectively). His research interests are: (1) power-efficient RF/Analog IC and System-on-a-Chip (SoC) design and test, especially on radio-frequency silicon power amplifier (PA) design; and (2) interdisciplinary and clinical research on medical electronics, biosensors, oncology, and biosignal processing. He is a Fellow of IEEE and a member of ASCO (American Society of Clinical Oncology) and AAAS (American Association for the Advancement of Science).

More information on Dr. Lie's research group can be found HERE.

EDUCATION

Ph.D. Electrical Engineering, California Institute of Technology, Pasadena, CA, *1995*
M.S. Electrical Engineering**,** California Institute of Technology, Pasadena, CA, *1990*
B.S. Electrical Engineering**,** National Taiwan University, Taipei, Taiwan, *1987*

WORK EXPERIENCE

- **K.S. Lu Regents Chair Professor, ECE Dept., Texas Tech University, Lubbock, TX Sept. 1, 2012 – Present**
- **K.S. Lu Regents Chair Associate Professor (tenured), ECE Dept., Texas Tech University, Lubbock, TX July 9, 07 – Aug. 30, 2012 Present**
- **Adjunct Associate Professor, Department of Surgery, Texas Tech University Health Sciences Center (TTUHSC), 2008 - Present**
- **Director, RFIC Design and Test, Dynamic Research Corp. (DRC), San Diego, CA** ***03/05-06/07***
- **Director, RFIC Design and Test, SYS Technologies Inc., San Diego, CA** ***12/03-03/05***
- **Visiting Lecturer, ECE Dept., University of California, San Diego (UCSD)** ***03/02-06/07***
- **Director, RFIC Design and Applications, Microtune Inc., San Diego, CA** ***12/02-12/03***
- **Consultant for Various IC Design Companies, Institute or Law Firm** ***12/03-present***
- **Manager, RFIC Design Group, Lincom Wireless Corp., Vista, CA,** ***07/02-11/02***
- **Advisory RFIC Design Engineer, Communications Research and Development Center (CRDC), IBM Encinitas Design Center, CA, IBM Microelectronics** ***06/00-07/02***
- **Member of Technical Staff, RFIC Group, Silicon Wave (Now Qualcomm), San Diego, CA** ***01/99-06/00***
- **Staff Engineer, Rockwell International, Newport Beach, CA** ***10/95-01/99***
- **Motorola Inc., Semiconductor Research Corporation (SRC) Internship, Mesa, AZ** ***06/94-10/94***
- **Jet Propulsion Labs (JPL), Pasadena, CA** ***06/93-10/93***
- **Head Teaching Assistant, California Institute of Technology** ***09/90-06/94***
- **Graduate Research Assistant, California Institute of Technology** ***06/91-08/95***

LIST OF PUBLICATIONS

(I) Book and Book Chapters (highlighted: "in preparation")

1. ***Book Contract Awarded:*** "High-Efficiency SiGe BiCMOS RF Power Amplifier Design", **D.Y.C. Lie**, contract awarded and *in preparation*. Scheduled to be published by Cambridge University Press (*2018*)
2. ***Invited book chapter***: "Design Investigations for Robust and Continuous Online Heartbeat Monitoring using Wearable vs. Doppler-Based Non-Contact Vital Signs Biosensors", in "*Nanobiosensors for Personalized and Onsite Biomedical Diagnosis"*, V. Das, A Boothby, J. Lopez and **D.Y.C. Lie**, Chapter 25, edited by Pranjal Chandra and Ester Segal, The Institution of Engineering and Technology (IET), Michael Faraday House, Six Hills Way, Stevenage, Hertfordshire, SG1 2AY, United Kingdom http://www.theiet.org/, *ISBN: 978-1-84919-9506*, June, 2016
3. ***Invited book chapter:*** "Energy Efficiency Enhancement and Linear Amplifications: An Envelope-Tracking (ET) Approach", **D.Y.C. Lie**, Chapter 7, edited H. Wang and S. Kaushik, *RF and Mm-Wave Power Generation in Silicon*, Elsevier, Academic Press, pp. 183-208, Dec. *2015* (ISBN 978-0-12-408052-2) http://www.amazon.com/RF-mm-Wave-Power-Generation-Silicon/dp/0124080529/ref=sr_1_1?ie=UTF8&qid=1455394673&sr=8-1&keywords=RF+and+mm-Wave+Power+Generation+in+Silicon
4. ***Invited book chapter***: "It Pays to Do Cool Research for Electrical Engineers!" **D.Y.C. Lie**, Chapter 7, in "*Electrical Engineering for the Curious: Why Study Electrical Engineering? (For College Students - Best College Majors, College Scholarships, Educational Research, Career Choices, and Success)"*, edited by Kishor Vaidya (ISBN 978-1-925128-48-2; ASIN: B010UUANI8); The Curious Academic Publishing; 1st edition, pp. 1455-1667 (July 2, 2015)
5. ***Invited book chapter***: "The Design of Robust Real-Time Wearable Fall Detection Systems Aiming for Fall Prevention", D.Y.C. Lie, B.T. Nukala, J. Jacob, J. Tsay, P.E. Lie, N. Shibuya, A.I. Rodriguez, T. Q. Nguyen and S. Zupancic, "*Activities of Daily Living (ADL): Cultural Differences, Impacts of Disease and Long-Term Health Effects*", Chapter 3, Edited by Scott T. Lively, Series: "Public Health in the 21st Century", Nova Science Publishers, Inc., NY, 3rd Quarter, pp.51-76, 2015 https://www.novapublishers.com/catalog/product_info.php?products_id=53371 (ISBN 978-163463-9132)

6. ***Invited book chapter:*** "Envelope Tracking Techniques Applied to a Fully-Monolithic Silicon-Based RF Power Amplifier System" by Donald Y.C. Lie, Yan Li, and Jerry Lopez in the book "Envelope Tracking Techniques", *Wiley Encyclopedia of Electrical and Electronics Engineering* (EEE), Editor-in-Chief, Mihai Peterca; Published Online: 14 MAR 2014 pp. 1-13, John Wiley & Sons, Inc., *Online ISBN: 9780471346081; DOI: 10.1002/047134608X http://onlinelibrary.wiley.com/book/10.1002/047134608X; http://onlinelibrary.wiley.com/doi/10.1002/047134608X.W8209/pdf*
7. ***Invited book chapter:*** "Design of Portable High-Efficiency Polar Transmitters for Broadband Wireless Applications Using the Envelope-Tracking Technique" in *CMOS Nanoelectronics: Analog and RF VLSI Circuits*, **D.Y.C. Lie**, Y. Li and J. Lopez, ed. kris iniewski, McGraw Hill Professional, Ch. 3, pp. 91-133, July 19 (2011), ISDN 978-0-07-175565-8
8. ***Invited book chapter:*** "A 2.4GHz Non-Contact Biosensor System for Continuous Monitoring of Vital-Signs", **D.Y.C. Lie**, R. Ichapurapu, S. Jain, J. Lopez, R.E. Banister, T. Nguyen, and J. Griswold, Chap. 9, *Telemedicine Techniques and Applications*, ISBN 978-953-307-354-5, edited G. Graschew and S. Rakowsky, InTech, pp. 211-239, June 2011 http://www.intechopen.com/articles/show/title/a-2-4ghz-non-contact-biosensor-system-for-continuous-monitoring-of-vital-signs
9. ***Invited book chapter:*** chapter 9.2 in *Silicon Heterostructure Handbook: Materials, Fabrication, Devices, Circuits and Applications of SiGe and Si Strained-Layer Epitaxy*, "SiGe as an Enabler for Wireless Communications Systems", L.E. Larson and **D.Y.C. Lie**, ed. John Cressler, CRC Press, Boca Raton, FL, pp. 897-917 (2010) ISBN: 0849335590
10. ***Invited book chapter:*** "Simultaneous, Multi-Frequency, Multi-Beam Antennas Employing Synchronous Oscillator Arrays", J. Cothern, T. Heath, G. Hopkins, R. Kerr, **D. Lie**, J. Lopez, and B. Meadows, *Applications of Nonlinear Dynamics*, Understanding Complex Systems, ed. Visarath In, Patrick Longhini and Antonio Palacios, Springer Berlin Heidelberg, 2009, pp 395-401, ISBN: 978-3-540-85631-3.
11. ***Invited review book chapter*** on the prestigious "*Semiconductors and Semimetals*" series, Vol. 73 "Processing and Properties of Compound Semiconductors", edited by R. Willardson and E. Weber, Chap. 4 "Si/SiGe Processing", **D.Y.C. Lie** and K.L. Wang, pp.151-197, Academic Press, San Diego, (2001)
12. ***Invited review book chapter*** on: "Si/SiGe Heterostructures for Si-Based Nanoelectronics", **D.Y.C. Lie** and K.L. Wang, *Handbook of Advanced Electronic and Photonic Devices and Materials*, edited by H.S. Nalwa, Vol. 2 "Semiconductor Devices", Chapter 1, pp. 1-69, Academic Press, San Diego, (2001)

(II) Archived Peer-Reviewe Journal Articles

1. "Guest Editorial, a mini-special issue for IEEE RFIC Symposium 2016", IEEE Transactions on Microwave Theory and Techniques, Volume 65, Issue 2, Sept. 2017 (*in press*)
2. "Wireless Power Transfer (WPT) Using Strongly Coupled Magnetic Resonance (SCMR) at 5.8 GHz for Biosensors Applications : A Feasibility Study by Electromagnetic (EM) Simulations", B.T. Nukala, **D.Y.C. Lie**, J. Tsay, J. Lopez and Tam Q. Nguyen, accepted for International Journal of Biosensors & Bioelectronics (IJBSBE), 2017 (*in press*)
3. "An Efficient and Robust Artificial Neural Network (ANN) Classifier for Patients vs. Normal Gait Data using a Wireless Wearable Sensor" T. Nakano, B.T. Nukala, J. Tsay, A.I. Rodriguez, T. Q. Nguyen, S. Zupancic and D.Y.C. Lie, International Journal of Software Innovation (IJSI), Vol. 5, Issue 1, pp 17-29, January-March 2017
4. "A Review on the Design of Non-Contact Vital Signs (NCVS) Biosensors for Long-Term Continuous Monitoring", T. Hall, **D.Y.C. Lie**, J. Lopez, R.E. Banister and T. Nguyen, Journal of Biosensors & Bioelectronics, Vol. 7, Issue 4. 2016 (DOI: 10.4172/2155-6210.1000233; ISSN: 2155-6210)
5. "Real-Time Classification of Patients with Balance Disorders vs. Normal Subjects Using a Low-Cost Small Wireless Wearable Gait Sensor" B.T. Nukala, T. Nakano, A.I. Rodriguez, J. Tsay, T. Q. Nguyen, S. Zupancic and **D.Y.C. Lie**, *Special Issue of "Latest Wearable Biosensors", Biosensor, 2016, 6, 58, pp.1-22* (doi:10.3390/bios6040058 www.mdpi.com/journal/biosensors; ISSN 2079-6374)
6. "Excellent Wireless Power Transfer Unto Tiny Coil Using 4-Coil Strongly Coupled Magnetic Resonance (SCMR) for Implantable Devices and Biosensors", B.T. Nukala, **D.Y.C. Lie**, J. Lopez and Tam Q. Nguyen, International Journal of Industrial Electronics and Electrical Engineering, ISSN: 2347-6982 Volume-4, Issue-2, pp. 65-68, Feb.-2016 http://www.ijieee.org.in/volume.php?volume_id=229
7. "Epileptic Seizure Detection and Prediction Based on Continuous Cerebral Blood Flow Monitoring – a Review", S. Tewolde, K. Oommen, D.Y.C. Lie, Y. Zhang and M.-C. Chyu, *Journal of Healthcare Engineering*, Vol. 6, No. 2, pp. 159-178, 2015
8. ***Invited paper:*** "Wideband Envelope Modulator and System Design for Envelope-Tracking SiGe Power Amplifier (ET-PA) for Broadband Wireless Applications", Y. Li, J. Lopez and D.Y.C. Lie, *International*

Journal On Advances in Telecommunications (IARIA), pp. 35-47, v 8 n 1&2 June (2015) http://www.iariajournals.org/telecommunications/

9. "Highlights of IEEE SiRF 2014 from its General Chair: Support from the MTT Society Creates a Bright Future for SiRF", **D.Y.C. Lie**, IEEE Microwave Magazine, *(2014)*
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53. "Inntersubband transitions in pseudomorphic InGaAs/GaAs/AlGaAs multiple step quantum wells," H.S. Li, Y.W. Chen, K.L. Wang, and **D.Y.C. Lie**, *J. Vac. Sci. Tech. (B)*, 11, 1840 (1993)

(III) Peer-Reviewed Refereed Conference Proceedings (highlighted: "in preparation")

1. ***Invited paper:*** "High-Efficiency 5G RF Power Amplifier Design: Challenges and Opportunities", **Donald Y.C. Lie**, Jerry Tsay, J. Mayada, Teja Nukala and Jerry Lopez, Proc. Proc. IEEE VLSI-DAT Conference, pp. 1-4, Hsin-Chu, Taiwan, April 26-28 (2017)
2. "A Highly Efficent and Linear 15 GHz GaN Power Amplifier Design for 5G Communications", J. Mayeda, **D.Y.C. Lie**, and J. Lopez, submitted to IEEE Texas Symp. on Wireless and Microwave Circuits and Systems (TSWMCS), Waco, TX, March 30-31, (2017)
3. ***Invited paper:*** "Silicon Based Power Amplifiers for 4G/5G Handset Applications", Y. Li, J. Lopez and **D.Y.C. Lie,** accepted and to appear on the Proc. 16th IEEE International Conference on Solid-State and Integrated-Circuit Technology (ICSICT), Oct.25-28, Hangzhou, China (2016)
4. J. Tsay, J. Lopez and D.Y.C. Lie, "The Impacts of Base Bias Resistor and LTE 16QAM Signal Bandwidth on High-Efficiency Linear SiGe Power Amplifier Design", Proc. IEEE Bipolar/BiCMOS Circuits and Technology Meeting. 25-27 Sept. 2016. New Brunswick, New Jersey, USA
5. ***Invited paper:*** "High-Efficiency Silicon RF Power Amplifier Design - Current Status and Future Outlook", **Donald Y.C. Lie**, Jerry Tsay, Travis Hall, Teja Nukala and Jerry Lopez, Proc. 2016 IEEE International Symposium on Radio-Frequency Integration Technology (RFIT2016), Taipei, Taiwan, Aug. 24-26 (2016)
6. "A Phased Array Non-Contact Vital Sign Sensor System with Automatic Beam Steering for Tracking and Long-Term Continuous-Time Monitoring", T. Hall, N. A. Malone, B. Nukala, J. Tsay, J. Lopez, R.E. Banister, T. Nguyen and **D.Y.C. Lie**, Proc. 38th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC'16), Aug. 16-20, Orlando, FL (2016)
7. "An Efficient and Robust Artificial Neural Network (ANN) Classifier for Patients vs. Normal Gait Data using a Wireless Wearable Sensor" T. Nakano, B.T. Nukala, J. Tsay, A.I. Rodriguez, T. Q. Nguyen, S. Zupancic and D.Y.C. Lie, Proc. 7th International Workshop on Intelligent Computational Science (ICS 2016), in conjunction with IEEE/ACIS ICIS 2016, Okayama, Japan, June 26-29, *(2016)*
8. ***Best Student Poster Paper Award Winner; 3rd Place:*** "A Study on Linearity vs. LTE 16QAM Signal Bandwidth and Supply Voltage for High-Efficiency SiGe Power Amplifier Design with CW Load-Pull", J. Tsay, J. Lopez, J. C. Mayeda, T. Hall, B.T. Nukala and **D.Y.C. Lie**, Proc. IEEE Texas Symp. on Wireless and Microwave Circuits and Systems (TSWMCS), Waco, TX, March 31-April 1, (2016)
9. "Efficient Near-Field Inductive Wireless Power Transfer for Miniature Implantable Devices Using Strongly Coupled Magnetic Resonance at 5.8 GHz", B.T. Nukala, **D.Y.C. Lie**, J. Lopez and Tam Q. Nguyen, Proc. IEEE Texas Symp. on Wireless and Microwave Circuits and Systems (TSWMCS), Waco, TX, March 31-April 1, (2016)
10. ***Invited paper:*** "Recent Progress on High-Efficiency CMOS and SiGe RF Power Amplifier Design", **Donald Y.C. Lie**, Jerry Tsay, Travis Hall, Teja Nukala, Jerry Lopez and Yan Li, Proc. IEEE Topics in RF/microwave Power Amplifiers (PAWR), pp. 15-17, Austin, Jan. 24-27, (2016)
11. ***Best Paper Award Winner:*** "Excellent Wireless Power Transfer Unto Tiny Coil Using 4-Coil Strongly Coupled Magnetic Resonance (SCMR) for Implantable Devices and Biosensors", B.T. Nukala, **D.Y.C. Lie**, J.

Lopez and Tam Q. Nguyen, Proc. 18th ICRTET-2015 International Conference on Recent Trends in Engineering and Technology, Dec. 26, pp. 26-29, Taipei, Taiwan 2015

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14. "A Phased Array Non-Contact Vital Sign Sensor with Automatic Beam Steering", T. Hall, B. Nukala, C. Stout, N. Brewer, J. Tsay, J. Lopez, R.E. Banister, T. Nguyen and **D.Y.C. Lie**, Proc. IEEE International Microwave Symposium (IMS2015), pp. 1-4, Phoenix, Arizona, May 17-22 (2015)
15. "A Study of Highly Efficient Envelope-Tracking (ET) vs. Envelope Elimination and Restoration (EER) Techniques with a Bi-Directional Class E2 Resonant Converter and an X-Band GaN Power Amplifier", J. Tsay, M. Phamvu, T. Hall, J. Lopez, **D.Y.C. Lie**, S. Suko and M. Yu, Tech. Dig. IEEE GOMAC, March 23-26, St. Louis, MO, 2015
16. "Supply Modulation Demonstrations using a Bi-Directional Class E2 Resonant Converter and an X-Band GaN Power Amplifier as an Efficient Envelope-Tracking Power Amplifier (ET-PA)", Scott Suko, Mark Yu, John Weston, Nancy Jane Bailey, Ron Freitag Jerry Tsay, Jerry Lopez, and **Donald Y.C. Lie**, Tech. Dig. IEEE GOMAC, March 23-26, St. Louis, MO, 2015
17. "A Real-Time Fall Detection System Using a Wearable Wireless Gait Analysis Sensor and a Support Vector Machine (SVM) Classifier", N. Shibuya, B.T. Nukala, A.I. Rodriguez, J. Tsay, T. Q. Nguyen, S. Zupancic, and **D.Y.C. Lie**, Proc. IEEE 8th Int'l Conf. on Mobile Computing and Ubiquitous Networking, pp 66-67, Jan. 20-22, 2015, Hakodate City, Hokkaido, Japan
18. "Comparing Nape vs. T4 Placement for a Mobile Wireless Gait Analysis Sensor Using the Dynamic Gait Index Test", B.T. Nukala, A.I. Rodriguez, J. Tsay, T. Hall, T. Q. Nguyen, S. Zupancic, and **D.Y.C. Lie**, Proc. IEEE 8th Int'l Conf. on Mobile Computing and Ubiquitous Networking, pp. 68-69, Jan. 20-22, 2015, Hakodate City, Hokkaido, Japan
19. "A Wireless Gait Analysis Sensor for Real-Time Robust Fall Detection Using an Artificial Neural Network", B.T. Nukala, N. Shibuya, A.I. Rodriguez, J. Tsay, T. Q. Nguyen, S. Zupancic and **D.Y.C. Lie**, Proc. IEEE Point-of-Care Technologies Conf. pp. 219-222, Oct. 8-10, Seattle, WA, 2014
20. ***Invited Paper:*** "Design of Highly-Efficient Fully-Monolithic SiGe Envelope-Tracking Power Amplifiers (ET-PA) for Broadband Wireless Applications", **D.Y.C. Lie**, Y. Li, J. Lopez, and J. Tsay, Proc. IEEE Asia Pacific Microwave Conference (APMC'14), pp. 1085-1088, Sendai, Japan, Nov. 4-7 (2014)
21. "A Differential SiGe Power Amplifier Using Through-Silicon-Via and Envelope-Tracking for Broadband Wireless Applications", J. Tsay, M. Sapp, M. Phamvu, T. Hall, R. Geries, Y. Li, J. Lopez, and **D.Y.C. Lie**, Proc. IEEE BCTM, pp. 147-150, San Diego, CA, Sept. 28-Oct. 3 (2014)
22. "A Fully Integrated Low Noise CMOS Instrumentation Amplifier Design for Low-Power Biosensors", V. Das, **D.Y.C. Lie** and T. Nguyen, Proc. IEEE Midwest Symp. on Circuits and Systems (MWSCAS), pp. 535-538, College Station, TX, Aug. 3-6, 2014.
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26. "University-Industry Partnership in Semiconductor Engineering", T. Dallas, T. Karp, B. Nutter, **D.Y.C. Lie**, R.O. Gale, R. Cox, S. Bayne, Proc. 1211st Annual American Society for Engineering Education (ASEE), Indianapolis, Indiana, June 15-18, (2014) http://www.asee.org/public/conferences/32/papers/9363/view

27. "Extending the Range of Phased Array Non-Contact Vital Signs Monitoring in an Office Cubical Setting", T. Hall, C. Stout, N. Brewer, G. Dominguez, J. Tsay, A. Boothby, V. Das, J. Lopez, T. Nguyen, R.E. Banister and **D.Y.C. Lie**, Proc. IEEE Texas Symp. on Wireless and Microwave Circuits and Systems (TSWMCS), Waco, TX, April 7 – 8, pp. 1-4 (2014)
28. "Robust Phased Array Non-Contact Vital Signs Monitoring in an Office Cubicle Setting", T. Hall, G. Dominguez, J. Tsay, A. Boothby, J. Lopez, T. Nguyen and **D.Y.C. Lie**, Proc. 1st International Conference on Intelligent Green Building and Smart Grid (IGBSG 2014), pp. 1-4, Taipei, Taiwan 23-25 April (2014)
29. "Wideband Class J High Efficiency Envelope Tracked Power Amplifiers", C. Essary, D. Ferwalt, J. Gassmann, **D.Y.C. Lie**, J. Lopez, R. Mongia, S. Nelson, K. O, S. Shichijo, and M. Walker, Proc. IEEE GOMAC'14, Charleston, SC, March 31- April 3 (2014)
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31. "Coupling Effects on One-Dimensional RF Coupled Oscillator Arrays Using Monolithic LC-VCOs", R. Geries, J. Lopez and **D.Y.C. Lie**, Proc. 1st IEEE Texas Symposium on Wireless and Microwave Circuits and Systems (TSWMCS), pp. 1-4, April 4-5, Waco, Texas, USA (2013)
32. "Gait Analysis Using a Combined Gyroscope/Accelerometer Device for the Vestibular Evaluation", A.I. Rodriguez, J. Tsay, **D.Y.C. Lie**, C. Zahner, J.C. Wang, T. Q. Nguyen and S. Zupancic, presented at the American Academy of Audiology, AudiologyNow! Convention, April 3-6, 2013, Anaheim, CA (abstract http://www.abstractsonline.com/Plan/ViewAbstract.aspx?mID=3102&sKey=ecf9eb10-93f5-4326-a2f7-4bd7804cc588&cKey=a5bccbd6-9e9a-42f1-9210-83c3acbc93d7&mKey=%7b9BC6866A-5FF8-4047-B362-B143D1DD6B72%7d)
33. "A High Efficiency SiGe BiCMOS Envelope-Tracking Power Amplifier for W-CDMA Applications", Y.-T. Liu, R. Wu, J. Lopez, Y. Li, J. Tsay, and **D.Y.C. Lie**, Proc. 1st IEEE Texas Symposium on Wireless and Microwave Circuits and Systems (TSWMCS), pp. 1-4, April 4-5, Waco, Texas, USA (2013)
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35. "Wideband Class J High Efficiency Envelope Tracked Power Amplifiers", W. Choi, **D.Y.C. Lie**, J. Lopez, B. Ma, R. Mongia, S. Nelson, K.O, S. Shichijo and M. Walker, Proc. IEEE GOMAC, Las Vegas, March 11-14 (2013)
36. ***Best Graduate Student Paper Award Winner (1st Place):*** "A SiGe Bipolar-MOSFET Cascode Power Amplifier with Improved Linearity for LTE Applications", R. Wu, J. Lopez, Y. Li and **D.Y.C. Lie**, Proc. IEEE Topical Conference on RF Power Amplifiers for Wireless and Radio Applications (PAWR'13), pp. 22-24, Austin, TX, Jan. 23-25 (2013)
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120. ***Invited paper for plenary session:*** "RF-SoC: Low-Power Single Chip Radio Design Using the Si/SiGe BiCMOS Technology", **D.Y.C. Lie,** X. Yuan, L.E. Larson, A. Senior and J. Mecke, Proc. IEEE 3rd Int'l Conf. on Microwave and Millimeter Wave Technology (ICMMT2002), Beijing, China, pp. 30-37, August 18-21, (2002)
121. "RF Linearity Study of SiGe HBTs for Low Power RFIC Design, Part I", X. Yuan and **D.Y.C. Lie**, Proc. IEEE 3rd Int'l Conf. on Microwave and Millimeter Wave Tech. (ICMMT2002), Beijing, China, August 18-21, (2002)
122. "RF Linearity Study of SiGe HBTs for Low Power RFIC Design, Part II", X. Yuan and **D.Y.C. Lie**, Proc. IEEE 3rd Int'l Conf. on Microwave and Millimeter Wave Tech. (ICMMT2002), Beijing, China, August 18-21, (2002)
123. ***Invited paper:*** "How can RF IC designers benefit from Si/SiGe HBTs? From Device Physics to RF Circuit Design", **D.Y.C. Lie** and X. Yuan, Proc. 9th Int'l Symp. on Integrated Circuits, Devices & Systems (ISICDS), pp. 3-7, Sept.3, Singapore, (2001)
124. "Device selection for low noise amplifier (LNA) type of circuit design in IBM SiGe technology", X. Yuan and **D.Y.C. Lie**, Proc. 9th Int'l Symp. Integrated Circuits, Devices & Systems, pp. 8-11, Sept.3, Singapore, (2001)
125. "New experimental findings on process-induced hot-carrier degradation effects of deep-submicron N-MOSFETs", **D.Y.C. Lie**, J. Yota, W. Xia, A.B. Joshi, R. Williams, R. Zwingman, L.C. Chung, and D.L. Kwong, Proc. IEEE Int. Reliability Phys. Symp. pp.362-369 (IRPS), San Diego (1999)
126. "Hot-carrier degradation effects for deep-submicron NMOSFETs introduced by backend processing" **D.Y.C. Lie**, Wei Xia, J. Yota, A.B. Joshi, R. Zwingman, R. Williams, C.L. Wang, V. Kerametlian, D. Cerney, and D.L. Kwong, Proc. SPIE Devices Technology Microelectronic Manufacturing, 3212, 258-267 (1997)
127. "The influence of transient-enhanced diffusion (TED) on the anomalous increase of body constant for deep sub-micron buried-channel PMOSFETs," **D.Y.C. Lie**, Mat. Res. Soc. Symp. abstract E1.3, April 1, (1997)
128. ***Student Paper Contest Finalist*** "Solid phase epitaxial regrowth and dopant activation of arsenic-implanted metastable pseudomorphic $Ge_{0.08}Si_{0.92}$ and $Ge_{0.16}Si_{0.84}$ on Si(100)," **D.Y.C. Lie**, J.H. Song, M-A. Nicolet, N.D. Theodore, J. Candelaria, S.G. Thomas, M.O. Tanner, and K.L. Wang, Mat. Res. Soc. Symp. Proc. 379, 467 (1995)
129. "Microstructure of oxidized $Ge_{0.8}Si_{0.2}$ annealed in a reducing ambient," N.D. Theodore, W.S. Liu, **D.Y.C. Lie**, M-A. Nicolet, T.K. Carns and K.L. Wang, Mat. Res. Soc. Symp. Proc. 379, 127 (1995)
130. "The influence of impurities on the properties of the chromium/gold and chromium nitride/gold structures," **D.Y.C. Lie**, E. Kolawa, R. De Angelis, L. Lowry, and J. Scott-Monck, Mat. Res. Soc. Symp. Proc. ULSI-IX, 583 (1994)
131. "Dopant activation and epitaxial regrowth in P-implanted pseudomorphic $Ge_{0.12}Si_{0.88}$ layers on Si(100)," **D.Y.C. Lie**, F. Eisen, M-A. Nicolet, N.D. Theodore, T.K. Carns, and K.L. Wang, Mat. Res. Soc. Symp. Proc. 321, 485 (1994)
132. ***Student Paper Contest Award Winner*** "Steady-state versus rapid-thermal annealing of phosphorus implanted pseudomorphic $Si(100)/Ge_{0.12}Si_{0.88}$," **D.Y.C. Lie**, J.H. Song, N.D. Theodore, F. Eisen, M-A. Nicolet, T.K. Carns, and K.L. Wang, Mat. Res. Soc. Symp. Proc. 342, 51 (1994)
133. "Damage and strain in epitaxial $Ge_{0.10}Si_{0.90}$ after Si implantation from 40 to 150 °C," A. Vantomme, J. H. Song, **D.Y.C. Lie**, F. Eisen, M-A. Nicolet, T.K. Carns, and K.L. Wang, Mat. Res. Soc. Symp. Proc. 326, 121 (1994)
134. "Generation of defects and strain by Si ion implantation in Ge(100) single crystals, and in pseudomorphic Ge_xSi_{1-x} films grown on Si(100)," **D.Y.C. Lie**, A. Vantomme, F. Eisen, M-A. Nicolet, V. Arbet-Engels, and K.L. Wang, Mat. Res. Soc. Symp. Proc. 262, 1079 (1993)

135. "Electrical and material properties of heavily doped pseudomorphic $Ge_{0.12}Si_{0.88}$ films by ^{31}P ion implantation," **D.Y.C. Lie**, A. Vantomme, F. Eisen, M-A. Nicolet, T.K. Carns, and K.L. Wang, Proc. SRC-Techcon, 552, Atlanta, GA, September, 28-30 (1993)
136. "Epitaxial Ge_xSi_{1-x} films on Si: (1) oxidation and nitridation of Ge_xSi_{1-x} , (2) Ion implantation of Ge_xSi_{1-x}," M-A. Nicolet, **D.Y.C. Lie**, W.S. Liu, and A. Vantomme, Proc. 14th Solid State Phys. Symp. Semicon. Surf. Metal-Semicon. Interface, 1 (1992)

(IV) Magazine Articles and Internet Publicity

1. Blessings Magazine 恩福雜誌, Vol. 22 2007 "達爾文進化論可信嗎? Is Darwinian Evolutionism Believable?" http://www.bf21.org/magazine.aspx?id=badbf546-bc2f-4f5f-867d-c14e73e754b1&BookID=22
2. "Monitoring Vital Signs: Wireless Medical Sensors", **D.Y.C. Lie**, *Envision*, the Annual Research Magazine of College of Engineering, Texas Tech University, p. 14, Lubbock, Texas (2008)
3. Fall detection device and video featured Texas Tech's "*Discoveries*", Fall, 2012 in http://www.depts.ttu.edu/vpr/discoveries/Fall-2012/fall-detector.php
4. Featured in Texas Tech's "*Today in Texas Tech*", Aug. 2012 http://today.ttu.edu/2012/08/new-technology-could-detect-a-fall-before-it-happens/
5. TTUHSC *Pulse* Magazine Winter 2012 "Discoveries" on novel fall prevention/detection devices with TTUHSC doctors (pp. 14-18)
6. Featured in a Texas Instruments (TI) question and answer blog. at the TI E2E™ Community http://e2e.ti.com/blogs_/b/aroundti/archive/2012/04/30/braking-the-fall-ti-part-of-a-research-study-aimed-at-keeping-elderly-safe.aspx as a result of partnering with TI and made a Fall Detection Device on a research study aimed at the early detection and prevention of falls in elderly people. This device could significantly reduce falls in the geriatric population in the future. Also in http://www.ti.com/corp/docs/csr/news_fall_prevention.shtml
7. Featured on the *EETimes* "MEMS project aims to prevent elderly from falling" http://www.embedded.com/electronics-news/4372785/MEMS-project-aims-to-prevent-elderly-from-falling
8. Featured in a special interview by the Hospitals & Health Networks Magazine on our fall detection/prevention sensor. *H&HN* is the flagship publication of the American Hospital Association and the most trusted and credible management publication in the field (started in 1927).

(V) Patents

1. "Methods of doping strained-layer heterostructures devices"; N.D. Theodore, **D.Y.C. Lie**, T.C. Smith, J.W. Steele, US Patent #5565690 A (Oct 15, 1996)
2. "Low-power, low-noise dual gain amplifier topology and method"; **D.Y.C. Lie** and L.E. Larson; US Patent US Patent #6396347 (May 28, 2002)
3. "A novel way of maximizing the output power efficiency for Switch-mode RF Power Amplifiers", **D.Y.C. Lie** and J. Popp., US patent 7,205,835 (issued 17 April 2007)
4. "An Improved Open-Loop Method to Perform RF Transmitter Output Power Control and high efficiency for Switching-Mode Power Amplifier; Part I", **D.Y.C. Lie** and J. Popp., US patent #7420421 B1 (issued 2 Sept. 2008)
5. "An Improved Open-Loop Method to Perform RF Transmitter Output Power Control and high efficiency for Switching-Mode Power Amplifier; Part II", **D.Y.C. Lie** and J. Popp., US patent #7,593,702, issued on 22 September 2009
6. "Frequency Tuning and Phase Shifting Techniques using 1-Dimensional Coupled Voltage-Controlled-Oscillator Arrays for Active Antennas", **D.Y.C. Lie,** J. Lopez, J. Neff, J. Cothern and B. Meadows, US Patent #8558625, issued on 10/15/2013
7. "CMOS IC for micro-emitter based microdisplay", J. Day, J. Li, **D.Y.C Lie**, Z. Fan, J.-Y. Lin, and H.-X. Jiang, US Patent #9047818, issued on 06/02/2015
8. Several other patent applications filed with Texas Tech OTC (Office of Technology Commercialization) and pending to be filed to US Patent Office.
   a. "Miniaturized non-contact cyber-enabled biosensor SoC with beam-steering capabilities for continuous vital-signs and motion monitoring", Donald Lie and R. Banister, Provisional patent application filed 10/14/2009, Application Number: 61251700

b. “A Low-Cost Hybrid RFID system for Handwashing Monitoring”, Y.C. Donald Lie, R. Banister, and Dissanaike, Sharmila, Provisional patent application filed 02/18/2011

(VI) Invited Short Courses, Keynotes, Tutorials, Workshops, Panel Presenter, etc.

- Invited and presented in a NTU-MediaTek Workshop in Singapore's Nanyang Techological University (NTU), Jan. 2017. Arranged by Prof. Joseph Chang, Prof. Yuanjin Zheng and Dean Tsuhan Chen
- Invited and gave a seminar talk at the Texas A&M Analog Group Seminar, Texas A&M, College Station, TX, on Nov. 10, 2016. Arranged by Prof. Samuel Palermo and Pof. Jose Silva-Martinez
- Invited and gave a "Tech Talk" at Cirrus Logics, Austin, TX, on July, 2016.
- Invited and presented at National Chiao-Tung Univerisity (NCTU), Taiwan on 5G PA (power amplifier) design, Aug., 2016
- Invited and presented at ITRI, Taiwan on 5G PA design, Aug., 2016
- Invited to and discussed at USC (University of Southern California) on 5G PA design, Aug. 2016
- Invited and gave an IEEE SSCS/CASS Atlanta Joint Chapter Seminar at Georgia Tech on March 30, 2016. Talk title: "High-Efficiency Silicon RF Power Amplifier Design - Current Status and Future Outlook". Hosted by Professor Hua Wang and Professor John Cressler, Georgia Tech.
- Invited as a co-author for a workshop talk in IEEE RFIC Symp. Workshop 2015 on my group's work titled “Integrated and non-integrated Envelope Tracking Solutions -- Briefing and Studies”, by J. Lopez (presenter), Y. Li, R. Wu, and D.Y.C. Lie, IEEE RFIC Symp./IMS Workshop WSB "Digital and Analog Techniques for Power-Efficiency Enhancement in Wireless Transmitters", RFIC2015, Phoenix, Arizona, May, 17, 2015
- Invited and presented a talk titled “Design of Highly-Efficient Fully-Monolithic SiGe Envelope-Tracking Power Amplifiers (ET-PA) for Broadband Wireless Applications” at IEEE Asia Pacific Microwave Conference (APMC'14), Sendai, Japan, Nov. 4-7 (2014).
- Invited and presented a College Seminar at the Brown University, College of Engineering, Providence, Rhode Island on July 8, 2014 with talk title “Power-Efficient RF/Analog ICs and System Design for Wireless and Biomedical Applications”. Host: Prof. Lawrence Larson: Dean of School of Engineering and Rush C. Hawkins University Professor of Engineering, Brown University.
- Invited and presented a Friday Integrated Circuits Design Seminar at University of Southern California (USC), Department of Electrical Engineering, Los Angeles, CA on Jan 17, 2014 with talk title “Design of Silicon-Based Envelope-Tracking Power Amplifiers (ET-PA) for Highly-Efficient Broadband Wireless Applications; also a Briefing on Medical Electronics Research in My Group”. Host: Prof. Hossein Hashemi, Prof. Mike Chen and Prof. Martin Gundersen
- Invited and presented a seminar at Osaka University, Department of Electrical Engineering, Osaka, Japan on Aug. 2, 2013 with talk title “Power-Efficient RF/Analog ICs and System Design for Wireless and Biomedical Applications”. Host: Prof. Yagi Tetsuya, Osaka University, Japan.
- Invited to visit Tokushima University, Japan from July 30 to Aug. 2, 2013 and presented a seminar on **“**Power-Efficient RF/Analog ICs and System Design for Wireless and Biomedical Applications: also on the Cultures of Texas & Taiwan (米国テキサス州と台湾の文化と)". Host: Professor Nishio Yoshifumi, Tokushima University, Japan.
- Organized a most-attended IEEE RFIC Symp. Workshop among more than a dozen of all workshops for the entire IEEE RFIC Symp. 2013 on “High Efficiency Supply-Modulated RF Power Amplifier”, IEEE RFIC Symp./IMS Workshop WSB, Sunday June 2, Seattle, WA 2013.
- Invited and presented a talk on “Design of Monolithic Silicon-Based Envelope-Tracking Power Amplifiers for Broadband Wireless Applications”. Organizers: Prof. Donald Lie, PhD, Texas Tech University; Nick Cheng, PhD, Skyworks Solutions, Inc. Sponsor: IEEE RFIC Symp, June 2, Seattle, WA 2013
- Presented a 2 half-day tutorial in the Power IC Forum of NCKU, Dec. 5-6, 2012, invited by the Director of Green Energy Electronics Research Center (GREERC), Prof. Peter Liang of Taiwan. Talk title “Highly Efficient Silicon Power ICs for Broadband Wireless Power Amplifier Design Using Envelope Tracking (ET)”
- Presented a half-Day Tutorial, IEEE APCCAS 2012 (Asia Pacific Conference on Circuits and Systems, in Kaohsiung, Taiwan on Dec. 2, 2012). Title of the tutorial: “Design of High-Efficiency Silicon-Based Power Amplifier and Transmitters ICs for Mobile Broadband Wireless Communications”.

- Invited talk: "Design of Si-Based High-Efficiency RF Power Amplifiers and Transmitters Using Envelope-Tracking for Mobile Broadband Wireless Communications", CMOS Emerging Technologies Meeting (Communications, Microsystems, Optoelectronics and Sensors), July 18-20, Vancouver, BC, Canada (2012)
- Invited by the National Science Council (NSC), Taiwan and presented a talk at the Dept. of Electrical Engineering, National Cheng Kung University (NCKU), Tainan, Taiwan, April 26, 2012, Lecture title: "Monolithic Envelope Tracking Power Amplifier (ET-PA) for Broadband Wireless"
- Invited and presented a Seminar on "Design of SiGe High-Efficiency RF Power Amplifier for Broadband Wireless Communications" at Richwave Technology Corp., Taipei, Taiwan, April, 24, 2012
- Invited by the IEEE Solid-State Circuits Society (SSC), Taipei Chapter and presented a talk at the Dept. of Electronic Engineering, National Chiao Tung University (NCTU), sponsored, April 23, 2012, Hsin-Chu, Taiwan, Lecture title: "A Monolithic 1.85GHz 2-Stage SiGe Power Amplifier with Envelope Tracking for Improved Linear Power and Efficiency"
- Invited as one of the distinguished lecturers at IEEE CASS (Circuits and Systems Society) Summer School Aug. 29 – Sep. 2, 2011 at Dept. of EE, National Sun Yat-Sen University, Kaohsiung, Taiwan, website: http://vlsi.ee.nsysu.edu.tw/sschool_2011/ Lecture title: "Design of High-Efficiency Si-Based Power Amplifier and Transmitters ICs for Mobile Broadband Wireless Communications". The first IEEE CASS Summer School aims to provide both an objective and clear overview and an in-depth analysis of the state-of-the-art research on a variety of circuit, architecture, and system designs delivered by distinguished experts in these fields.
- Invited and presented a *keynote speech* titled "Design of Highly-Efficient Si-Based Transmitter ICs for Mobile Broadband Wireless Communications and Sensors Applications" at the 9th IEEE International NEWCAS Conference held in Bordeaux, France, on June 26 - 29, 2011 at the Mercure cité mondiale Hotel. This edition of IEEE NEWCAS Conference is organized by researchers from the University of Bordeaux, with support from The Strategic Alliance for Microsystems Research of Quebec (Canada). The wide range of topics has attracted a new record number of 298 paper submission with a 44% acceptance rate.
- Invited and presented a talk at Taiwan's CIC (Chip Implementation Center), April 25, 2011 on "Highly Power-Efficient Silicon-Based RF Power Amplifier Design"
- Invited to present in an IEEE Workshop on "Design of Si-Based High-Efficiency RF Power Amplifiers and Polar Transmitters for Mobile Broadband Wireless Communications", IEEE RFIC Symp./IMS Workshop WSK: "Efficiency Enhancement Techniques of Power Amplifiers and Transmitters for Mobile Applications" on Sunday June 5, 2011, Baltimore, MD, 2011
- Selected to be a presenter at the 2011 WBT Innovation Marketplace in Arlington, Texas on our technology named "An Intelligent RFID-Based Handwashing Compliance Monitoring and Prompting System for the Food Industry and the Healthcare Industry", March 22-23, 2011, developed at Texas Tech through the Texas Tech OTC (Office of Technology Commercialization)
- Invited and presented an 1-day Short Course on "Design of Si-Based High-Efficiency RF Power Amplifiers and Polar Transmitters for Mobile Broadband Wireless Communications" as a IEEE JSSC Short Course, invited by IEEE Solid-State Circuits Society, Taipei Chapter, Taiwan, July 23, 27, 2010
- Invited and presented a Short Course on "Design of Si-Based High-Efficiency RF Low-Noise Amplifier (LNA) and Polar Transmitters for Mobile Broadband Wireless Communications" in Richwave Technology Corp., Taipei, Taiwan, July, 20, 2010
- Invited and presented in the special evening session on "Can RF SoCs (Self) Test Their Own RF?" for IEEE International Conference on Solid-State Circuits Conference (ISSCC'10), San Francisco, CA., Feb. 9, 2010
- Invited and gave an IEEE RWS Workshop talk on "Design of Highly-Efficient RF Polar Transmitters Using SiGe Power Amplifiers and the Envelope-Tracking (ET) Technique", IEEE SiRF'10, New Orleans, LA, Jan. 11-13, 2010 (Workshop on "Advances in SiGe BiCMOS Technology and Circuits for Communication")
- Invited and presented a 2-day Short Course on "Design of Si-Based High-Efficiency RF Low-Noise Amplifier (LNA), Power Amplifier (PA) design and Polar Transmitters for Mobile Broadband Wireless Communications" in SiGe Semiconductor Inc., Aug. 11, Boston, MA, 2009
- Invited and gave a Workshop on "SiGe PA Design for WLAN/WiMAX and Handset Applications", IEEE RFIC Symp. Workshop WSF "Devices and Design Techniques for Advanced Handset/Mobile PAs", June 7, Boston, MA, 2009
- Invited and gave a Short Course on "RF Amplifier and Si-Based PA: Analog/RF IC Design and Technologies for Communications" for IEEE International Conference on Solid-State and Integrated-Circuit Technology (ICSICT), Beijing, Oct. 20, 2008. The lecture provides an in-depth review of RF low-noise amplifier design and

Si-based power amplifier implementation. Design constraints and tradeoffs between noise, efficiency, linearity and power are addressed with the consideration of technology options and improved design techniques.

- Invited and lectured a 2-day short course on "RFIC Design Fundamentals and Techniques for RF-SoC Applications", sponsored by the National Ministry of Education, The National Innovative Communication Education Program, Taiwan, at National Chiao-Tung University, Hsin-Chu, Taiwan, Aug. 23-24, 2004.
- Invited talks on "RF-SoC design" at National Chiao-Tung University and National Chung-Hsing University, Dept. of Electronic Engineering, Taiwan, Oct., 2003.
- Other Invited talks on "Si-Based RF SiGe PA Design", NTUEE, NHTU, NCTU, 2006; NCKU, NCTU, 2007; "RF-SoC Design", ECE294 Seminar, UCSD,2004 (invited by Prof. Yuhwa Lo); ASU, 2002 (invited by Prof. S. Kiaei), "Doping and Ion Implantation in Si/SiGe", UCSD, 1996 (invited by Prof. S.S. Lau)

(V) Editorial Experience

Associate Editor, IEEE Microwave and Wireless Components Letters, 2010-Present (MWCL; impact factor 2.236 to 2.7, acceptance rate 18-30%)

Associate Editor-in-Chief, Open Journal of Applied Biosensor (OJAB), Scientific Research Publishing Inc., *2012-present www.scirp.org/journal/ojab*

Guest Editor, Biosensors, Special Issue "Latest Wearable Biosensors" (ISSN 2079-6374; MDPI), 2016

Guest Editor, Special Issue of IEEE RFIC Symp. 2016, *IEEE Transaction on Microwave Theory and Techniques, 2017*

Special Topic Editor, IEEE Microwave and Wireless Components Letters (MWCL) in June 2012

Guest Editor, IEEE Journal of Solid-State Circuits (JSSC), Sept. 2009

Lead Guest Editor, International Journal "Active and Passive Electronic Components", Hindawi Publishing, 2010-2011,

Area Editor-in-Chief for *International Journal on Wireless and Optical Communications*, 2001-present

Editorial Board Member, *Open Journal of Applied Biosensor (OJAB), 2010-2012*

Editorial Board Member, i-manager's *Journal on Electrical Engineering*, 2009-present

International Interdisciplinary Advisory and Editorial Board (IIAEB), *International Journal of Interdisciplinary Research and Innovation (IJIRI)*, Research Publish Journals, 2014-Present

(VI) Certifications or professional registrations

- California state board *professional engineer* (PE) *Engineer-in-Training*. *License NO.: XE097319*.

EXHIBIT 4

Paul S. Min, Ph.D.
(Webpage : https://ese.wustl.edu/faculty/Pages/Paul-Min.aspx)

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Washington University in Saint Louis
One Brookings Drive, Bryan Hall 302A
Saint Louis, MO 63130, U.S.A.

Education

Year	College or University	Degree
1987	The University of Michigan	Ph.D. in Electrical Engineering
1984	The University of Michigan	M.S. in Electrical Engineering
1982	The University of Michigan	B.S. in Electrical Engineering

Professional Experience

From: 1990
To: Present
Organization: Washington University, St. Louis

Summary:

2015 -	Senior Professor - Department of Electrical Systems Engineering
2011 – 2014	Chair – Undergraduate Curriculum, Department of Electrical and Systems Engineering
2000 – 2002	Chair – Graduate Curriculum, Department of Electrical and Systems Engineering
2002 - 2014	Associate Professor - Department of Electrical and Systems Engineering
1997 - 2008	On leave from full-time duty at Washington University – as Presidents of MinMax Technologies and Erlang Technology.)
1996 - 2002	Associate Professor - Department of Electrical Engineering
1996	Promoted with Tenure
1990 - 1996	Assistant Professor - Department of Electrical Engineering

Teaching Experience

- "Transmission System and Multiplexing," Washington University, ESE 571
- "Electrical Laboratory I," Washington University, EE 250.
- "Communication Theory," Washington University, ESE 471.
- "Reliability and Quality Control," Washington University, ESE 405/505
- "Signaling and Control of Communications Networks," Washington University, ESE 572.
- "Introduction to Electronic Circuits," Washington University, ESE232
- "Queueing Systems and Discrete Stochastic Processes," Washington University, EE 536 / CS 567.
- "Digital Computer," Washington University, EE 260M / CS 260.
- "Data Networks," Washington University, EE 530.
- "Electrical Circuit Analysis," Washington University, ESE 230.
- "Computer/Communications System Analysis I," Washington University, EE 557/ CS 557.
- "Computer/Communications System Analysis II," Washington University, EE558 / CS 558.
- "Digital Systems Laboratory," Washington University, EE 455 / CS 455.

From:	1999
To:	2008
Organization:	Erlang Technology, Inc., St. Louis, Missouri
Title:	Founder and President
Summary:	Up to 70 employees, $40M in total capital raised from 5 VCs and 3 Corporations Received "Product of Year" Award from Analog Zone Magazine in 2004

From:	1997
To:	1999
Organization:	MinMax Technologies, Inc., St. Louis, Missouri
Title:	Founder and President
Summary:	Fabless semiconductor company, designing high performance switching ASICs

From:	September 1987
To:	August 1990
Organization:	Bellcore, New Jersey
Title:	Member of Technical Staff
Summary:	Member of New Network Architecture Development Group

From:	1983
To:	1987
Organization:	Department of Electrical Engineering, The University of Michigan

Title: Graduate Instructor
Summary: Instructor for senior level Electrical Engineering Laboratory Class. Received a Best "Best Graduate Instructor Award" from the Department of Electrical Engineering

Professional Affiliations, Achievements & Awards

- Technical Program Committee, COMCAS 2015, Tel Aviv, November 2017.
- Technical Program Committee, COMCAS 2015, Tel Aviv, October 2015.
- Past-Chair, Saint Louis Section of the Institute of Electrical and Electronics Engineers (IEEE), 2015
- Member of Executive Committee, Saint Louis Section of the IEEE, 2010-2015
- Chair, Saint Louis Section of the IEEE, 2014
- Technical Program Committee, COMCAS 2013, Tel Aviv, October 2013.
- Vice Chair, Saint Louis Section of the IEEE, 2013
- Treasurer, Saint Louis Section of the IEEE, 2012
- The Best Paper Award at MOBILITY 2011, October 2011, Barcelona, Spain
- Counselor, Student Chapter of the Year, the Institute of Electrical and Electronics Engineers, 2011
- Award of Appreciation, Saint Louis Section of the Institute of Electrical and Electronics Engineers, 2011, for contribution to various activities of the Saint Louis Section the Institute of Electrical and Electronics Engineers
- Secretary, Saint Louis Section of the IEEE, 2010
- Counselor, Student Chapter of the Year, the Institute of Electrical and Electronics Engineers, 2010
- Wall Street Journal Businessmen of Year, 2003.
- American Men and Women of Science, listed in 1997.
- Outstanding Achievement Award, Bellcore, 1990.
- 18th ISATA Award of Technical Excellence, the best paper award at ISATA 1988.
- Rockwell Fellow, Rockwell International, 1985, 1986.
- Outstanding Graduate Student Award, the University of Michigan, 1985.
- Outstanding Teaching Award, the University of Michigan, 1984, 1986.
- Member of Honor's College, the University of Michigan, 1979, 1980.
- Honor's Convocation, the University of Michigan, 1979.
- Outstanding Freshman Award, the University of Michigan, 1979.
- Woodhaven Rotary Club Scholarship, Woodhaven Rotary Club, 1978.
- Second Place Winner, the State of Michigan Mathematics Prize Competition, 1977.

- International Program Committee, *IASTED International Conference on Communications, Internet and Information Technology (CIIT 2005*), Cambridge, Massachusetts from October 31-November 2, 2005
- International Program Committee, *IASTED International Conference on Communications 2003*, Scottsdale, Arizona, 2003
- International Program Committee, *Wireless and Optical Communications 2003*, Banff, Canada, 2003.
- International Program Committee, Session Chair, *Wireless and Optical Communications 2002*, Banff, Canada, 2002.
- Invited participant, *NSF Workshop on Enhancing International Cooperation in CS/CE Research and Education*, Portland, 1997.
- Session Chair, *the 1993 Conference on Information Sciences and Systems,* Baltimore, March 1997.
- Member, Board of Editors, *Journal of Network and Systems Management*, 1996-1998.
- Program Committee, *International Symposium on Integrated Network Management*, San Diego, 1997.
- Guest Editor, *Journal of Network and Systems Management, Special Issue on Routing in Broadband Networks*, December 1995 and June 1996.
- Invited participant, *ARPA Workshop on Survivability of Large Scale Systems*, Washington D.C., 1996.
- Special Event Organizer, *International Symposium on Integrated Network Management*, Santa Barbara, 1995.
- Organizing Committee, *International Symposium on Integrated Network Management*, Santa Barbara, 1995.
- Local Arrangements Chair, *IEEE Information Theory Workshop on Information Theory Multiple Access and Queueing*, St. Louis, 1995.
- Chair, *Communications Chapter, St. Louis Section of the IEEE*, 1995.
- Participant, *IEEE Information Theory Workshop on Information Theory, Multiple Access and Queueing*, St. Louis, 1995.
- Participant, *ARPA/AFOSR Non-Linear Optics and Communication Workshop,* Denver, 1994.
- Participant, *CNRI Giga Bit Network Workshop*, Washington D.C., 1993.
- Participant, *IFIP/IEEE International Workshop on Distributed Systems*, New Jersey, 1993.
- Program Committee, *International Conference on Computer Communications and Networks*, San Diego, 1992.
- Session Chair, *ISMM International Conference*, New Orleans, 1990.
- Senior Member, *IEEE*.
- Member, *IEEE Committee on Network Operations and Management*.
- Member, *IEEE Committee on Computer Communications*.
- Registered Specialist, *Hong Kong Research Grant Council.*
- Reviewer, *IEEE Transactions on Communications*.

- Reviewer, *IEEE Transactions on Networking*.
- Reviewer, *IEEE Journal on Selected Areas in Communications.*
- Reviewer, *Journal of Network and Systems Management.*
- Reviewer, *Telecommunication Systems.*
- Reviewer, Computers and Electrical Engineering.
- Reviewer, *ETRI Journal*.
- Reviewer, *IEEE Transactions on Automatic Control*.
- Reviewer, *IEEE Communications.*
- Book Reviewer, *Prentice Hall*.
- Book Reviewer, *Morgan Kaufmann Publishers, Inc.*
- Book Reviewer, *Irwin Publishing Co.*

University Activities:

- Undergraduate Studies Committee, School of Engineering and Applied Science (2012 – Present)
- Faculty Advisor for IEEE Student Chapter (2009 – Present)
- Ambassador for McDonnell International Scholar Academy (2007 – 2013)
- Web Development Committee (2006 – 2008)
- University Judicial Board (1998 - 2000)
- Resource Generation Committee (1994 - 1995)
- Top 20 Committee (1992 - 1995)
- Telecommunications Committee, Chair (1991 - 1997)
- Library Planning Committee (1991 - 1992)
- Computer Engineering Committee (1990 - 1996)
- Communications Curriculum Committee (1990 - 1992)
- Resources Committee (1990 - 1992)

Patents

Patent No.	Date	Title
7,110,411	09/19/06	Method of and Apparatus for WFQ Scheduling Using a Plurality of Scheduling Queues to Provide Fairness, High Scalability, and Low Computational Complexity
7,106,738	09/12/06	Method of and Apparatus for High Speed Packet Switching Using Train Packet Queuing and Providing High Scalability
6,859,455	02/22/05	Method of and Apparatus for Building and Using Multi-Dimensional Index Trees for Multi-Dimensional Data Objects

6,614,789	09/02/03	Method of and Apparatus for Matching Strings of Different Lengths
6,359,885	3/19/02	Multi-Channel Packet Switching Apparatus Having Traffic Flow Controlling and Checking Functions
6,128,292	10/03/00	Packet Switching Apparatus with Multi-Channel and Multi-Cast Switching Functions and Packet Switching System Using the Same
5,788,161	12/13/98	Network Designer for Communication Networks
5,526,352	06/11/95	Integrable Low Complexity Multi-Channel Switch
5,440,549	08/08/95	Nonblocking Multi-Channel Switching with Multicasting Capability

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- Hung, C.P., and Min, P.S., "Simple Web Application Framework." Submitted for publication in the IEEE Transactions on Cloud Computing.
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Testimony Provided or Expected to Provide as Expert Witness (Last 5 Years)

Matter: Arbitration for Licensing
Law Firm: Alston Bird
Case Name: Nokia v. LG Electronics, International Chamber of Commerce Arb. No. 21326
Testifying Expert for Nokia.
Completed in October 2016.
(Expert reports submitted.)

Matter: Patent Infringement for Mobile Devices

Law Firm: Paul Hastings
Case Name: Odyssey Wireless, Inc,. v. Samsung Electronics Co., Ltd., et al, Case No. 3:15-cv-1738-H-RBB (U.S.D.C.S.D. Cal.)
Testifying Expert for Samsung.
Completed in October 2016.
(Expert reports submitted.)

Matter: Patent Infringement for Mobile Devices
Law Firm: Greenberg Traurig
Case Name: Mobile Telecommunications Technologies LLC v. Amazon.com, Inc., 2:13-cv-883-JRG-RSP (U.S.D.C. E.D. Texas)
Testifying Expert for Amazon.
Completed in April 2015.
(Expert reports submitted, and deposed.)

Matter: Patent Infringement for Mobile Devices
Law Firm: Mayer Brown
Case Name: Mobile Telecommunications Technologies LLC v. LG Electronics Mobilecomm U.S.A., Inc., 2:13-cv-947-JRG-RSP (U.S.D.C. E.D. Texas)
Testifying Expert for LG Electronics Mobilecomm.
Completed in February 2016.
(Expert reports submitted, and deposed.)

Matter: Patent Infringement for Semiconductor Devices
Law Firm: Mayer Brown
Case Name: Inter Parte Reexamination for U.S. Patent Nos. 6,895,520 and 6,899,332
Expert for LG Electronics.
Completed in February 2016.
(Expert declaration submitted, and deposed.)

Matter: Patent Infringement in Vehicular Electronics
Law Firm: Gardner, Linn, Burkhart & Flory, L.L.P
Case Name: *Magna Electronics Inc. v. TRW Automotive Holdings Corp. et al.*, Civil Action No. 1:12-cv-00654 (Western District of Michigan), and relating to the action styled *Magna Electronics Inc. v. TRW Automotive Holdings Corp. et al.*, Civil Action No. 1:13-cv-00324 (Western District of Michigan).
Testifying Expert for Magna Electronics
Completed in February 2016.
(Expert reports submitted, and deposed.)

Matter: Patent Infringement in Electronic Circuits

Law Firm: Ropes and Gray
Case Name: Certain Devices Containing Non-Volatile Memory and Product s Containing the Same (USITC Inv. Nos. 337-TA-922)
Testifying Expert for Spansion Inc.
Completed in February 2015.
(Expert reports submitted.)

Matter: Trade Secret Misappropriation in Software Method for Cable Television Advertisement
Law Firm: Brownstein Hyatt Farber Schreck
Case Name: Cross MediaWorks v. EMT Holdings, USDC Southern District of New York, Case No. 1:14-cv-00561-VSB
Testifying Expert for Cross MediaWorks.
Completed in April 2015.
(Testified during injunction hearing.)

Matter: Patent Infringement in Vehicular Electronics
Law Firm: Steptoe and Johnson
Case Name: Certain Vision-Based river Assistance System Cameras and Components Thereof (USITC Inv. Nos. 337-TA-899 and 907)
Testifying Expert for Magna Electronics
Completed in February 2015.
(Expert reports submitted, deposed, and testified during trial.)

Matter: Patent Infringement for Vehicular System
Law Firm: Susman Godfrey
Case Name: Eagle Harbor Holdings, LLC, and Mediustech, LLC, v. Ford Motor Company, 3:11-cv-05503-BHS (U.S.D.C. Western District of Washington at Tacoma)
Testifying Expert for Mediustech.
Completed in March 2015.
(Expert reports submitted, deposed, and testified during trial.)

Matter: Patent Infringement for Communication Networks
Law Firm: Davis Polk & Wardwell LLP
Case Name: Sprint Communications Company L.P., v. Comcast Cable Communications, LLC, Comcast IP Phone, LLC, and Comcast Phone of Kansas, LLC. 2:11-cv-02684-KHV-DJW (U.S.D.C. Kansas)
Testifying Expert for Comcast.
Retained in March 2012.
(Expert reports submitted, and deposed.)

Matter: Patent Infringement for Communication Networks
Law Firm: Quinn Emanuel
Case Name: France Telecom S.A. v. Marvell Semiconductor, Inc., 12-Civ-4986 (S.D.N.Y.)
Testifying Expert for Marvell.

Completed in September 2014.
(Expert reports submitted, deposed, and testified during trial.)

Matter: Wireless Image Distribution
Law Firm: Jones Day
Case Name: *Inter Partes* Review of U.S. Patent No. 8,437,797
Expert for Google Inc.
Completed in November 2014.
(Expert declaration submitted.)

Matter: Nonvolatile Semiconductor Memories
Law Firm: Jones Day
Case Name: *Inter Partes* Review of U.S. Patent Nos. 8,301,833 and 8,516,187
Expert for SanDisk.
Completed in May 2014.
(Expert declaration submitted.)

Matter: Communication Protocols for Wireless Device
Law Firm: Dorsey & Whitney, LLP
Case Name: Certain Point-To-Point Network Communication Devices and Products Containing Same (USITC Inv. No. 337-TA-892)
Testifying Expert for Toshiba
Completed in May 2014.
(Expert reports submitted, and deposed.)

Matter: Patent Infringement for Wireless Networks
Law Firm: Ropes and Gray
Case Name: In the Matter of Certain Wireless Devices With 3G and/or 4G Capabilities and Components Thereof (USITC Inv. No. 337-TA-868) InterDigital Comms., Inc. v. Huawei Techs. Co., Ltd., No. 13-00008 (D. Del., filed January 2, 2013), InterDigital Comms., Inc. v. ZTE Corp., No. 13-00009 (D. Del., filed January 2, 2013), InterDigital Comms., Inc. v. Nokia Corp., No. 1:13-cv-00010 (D. Del., filed January 2, 2013), InterDigital Comms., Inc. v. Samsung Elec. Co., Ltd., No. 13-00011 (D. Del., filed January 2, 2013)
Testifying Expert for Joint Defense Group.
Completed in February 2014.
(Expert reports submitted, deposed, and testified during trials.)

Matter: Patent Infringement for Mobile Communication
Law Firm: Finnegan, Henderson, Farabow, Garrett & Dunner, L.L.P.
Case Name: Certain Digital Media Devices, Including Televisions, Blu-Ray Disc Players, Home Theater Systems, Tablets and Mobile Phones, Components Thereof and Associated Software (USITC Inv. No. 337-TA-882)
Testifying Expert for LG Electronics, Inc.
Completed in February 2014.
(Expert reports submitted, deposed, and testified during trial.)

Matter: Patent Infringement for Data Storage
Law Firm: Ropes and Gray, Weil Gotshal
Case Name: Summit Data Systems, LLC v. EMC Corporation., et al. 1:10-cv-00749-GMS (U.S.D.C. Delaware)
Testifying Expert for EMC Corporation and Netapp, Inc.
Completed in December 2012.
(Expert reports submitted, and deposed.)

Matter: Patent Infringement for Wireless Mobile Device
Law Firm: Ashurst Australia
Case Name: Samsung v. Apple, Australian Federal Court Proceeding No. NSD 1243 of 2011
Testifying Expert for Samsung Electronics.
Completed in December 2012.
(Expert reports submitted, deposed, and testified during trial.)

Matter: Patent Infringement for Wireless Mobile Devices
Law Firm: Quinn Emanuel
Case Name: Apple Inc. v. Samsung Electronics Co., Ltd., et al., 4:11-cv-01846-LHK (N.D. Cal.) and Samsung Electronics Co., Ltd., et al. v. Apple Inc., 4:11-cv-02079 (N.D. Cal.)
Testifying Expert for Samsung Electronics.
Completed in July 2012.
(Expert reports submitted, and deposed.)

Matter: Patent Infringement for Wireless Mobile Device
Law Firm: Quinn Emanuel
Case Name: Certain Electronic Devices, Including Wireless Communication Devices, Portable Music And Data Processing Devices, And Tablet Computer, U.S.I.T.C. Inv. No. 337-TA-794
Testifying Expert for Samsung Electronics.
Completed in June 2012.
(Expert reports submitted, deposed, and testified during trial.)

Matter: Patent Infringement for Portable Storage Device
Law Firm: White and Case
Case Name: CERTAIN UNIVERSAL SERIAL BUS (“USB”) PORTABLE STORAGE DEVICES, INCLUDING USB FLASH DRIVES AND COMPONENTS THEREOF, US International Trade Commission Investigation No. 337-TA-788
Testifying Expert Witness for Trek
Completed in May 2012.
(Expert reports submitted, and deposed.)

Matter: Copyright Infringement for Petroleum Processing Software
Law Firm: Osha Liang LLP

Case Name: Aspen Technology, Inc. v. Tekin A. Kunt and M3 Technology, Inc., Case Number: H-10-1127, US District Court, Texas, Houston Division.
Testifying Expert for M3 Technology, Inc.
Completed in May 2012.
(Expert reports submitted, deposed, and testified during trial.)

Matter: Trade Secret Misappropriation for DC-DC converter
Law Firm: Covington & Burling, Haynes Boone
Case Name: Certain DC—DC Controllers and Products Containing Same, US International Trade Commission Investigation No. 337-TA-698
Testifying Expert for UPI.
Completed in March 2012.
(Expert reports submitted, deposed, and testified during trial.)

Matter: Patent Infringement for Parallel Processor
Law Firm: Orrick, Herrington, & Sutcliffe. Kirkland and Ellis.
Case Name: BIAX Corporation v. Nvidia and Sony Civil Action No. 09-cv-01257-PAB-MEH
Testifying Expert for Nvidia and Sony
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EXHIBIT 5

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http://knowme.usc.edu

Professional Experience

Murali Annavaram has been a faculty member in the Ming-Hsieh Department of Electrical Engineering at the University of Southern California from 2007. He currently holds the Robert G. and Mary G. Lane Early Career Chair. His research focuses on energy efficiency and reliability of computing platforms. In particular, he developed architecture and microarchtiecture techniques for improving power, performance and reliability of out of order processors, graphics processing units (GPUs), server systems. His group also designed wireless body area networks, mobile phone operating systems for improving batter life.

Prior to his appointment at USC he worked at Intel Microprocessor Research Labs from 2001 to 2007 working on energy efficient system design and die-stacking architectures. In 2007 he was a visiting researcher at the Nokia Research Center, Palo Alto working on mobile phone-based wireless traffic sensing using virtual trip lines.

Murali received the NSF CAREER award in 2010 and an IBM Faculty Partnership award in 2008. He received the Stevens Institute's Innovation Inside curriculum award for jointly developing a mobile systems design course.

Murali co-authored Parallel Computer Organization and Design, a widely used textbook to teach both the basic and advanced principles of computer architecture. This book is used in graduate computer architecture courses in several reputed universities around the world. He teaches several undergraduate and graduate computer architecture courses at USC covering topics such as: mobile systems design, wireless body area network design, use of mobile devices in wireless health, embedded systems programming, out of order processor design, memory system design, cache coherence and consistency models, chip multiprocessors, throughput processors, system level architecture issues.

Murali received the Ph.D. degree in Computer Engineering from the University of Michigan, Ann Arbor, in 2001. He is a Senior Member of IEEE and ACM.

- MING HSIEH ELECTRICAL ENGINEERING DEPARTMENT, UNIVERSITY OF SOUTHERN CALIFORNIA: Associate Professor
  August 2007 – Apr 2012 (Asst. Professor), Apr 2012-Current (Associate Professor)
- NOKIA RESEARCH CENTER: Visiting Faculty Researcher
  February 2007 – August 2007
- INTEL CORPORATION: Senior Research Scientist
  August 2001 – February 2007
- AT&T BELL LABS: Summer Intern
  May 1995 - Aug 1995
- WIPRO SYSTEMS: Software Engineer
  Sept 1993 - July 1994

Legal Experience

- June 2014-Oct 2015. Testifying expert in the damages phase of **Warf**-vs-Apple. Testified in a jury trial. Deposed by the defendant's counsel. Worked on patent analysis, source code review, and expert reports for damages.
- Nov 2015-Current. ITC matter **Immersion**-vs-Apple.
- Aug 2015-Current. **Futurelink**-vs-Intel.

Honors and Awards

- Patent on improving mobile system's battery efficiency exclusively licensed by Samsung from USC
- Inducted into the ACM SIGMICRO hall of fame for publishing eight papers at the MICRO conferences (one of 47 researchers over the last 48 years)
- Keynote speaker at the 2014 IEEE International On-Line Test Symposium, Spain.
- IEEE Micro Top Picks Award for the paper titled "KnightShift-Scaling Energy Proportionality Wall Through Server-level Heterogeniety."
- Holder of Robert G. and Mary G. Lane Early Career Chair 2011-Present
- NSF CAREER award 2010

- Best Paper Nomination at the 2012 IEEE International Symposium on Workload Characterization (IISWC) for his work "Wireless Body Area Networks: Where Does the Energy Go?"
- Best Paper Award at the 2009 IEEE International Conference on Distributed Computing in Sensor Systems (DCOSS) for his joint work on "Optimal Time-Resource Allocation for Activity-Detection via Multimodal Sensing."
- Winner of the 2009 Body Computing Award for project titled The KNOWME Network: Energy-Efficient Activity-Detection for Pediatric Obesity
- Senior Member of Association of Computing Machinery (ACM)
- Senior Member of Institute of Electrical and Electronics Engineers (IEEE)
- IBM Faculty Partnership Award 2008.
- USC Stevens Institute's Innovation Inside Curriculum Award for developing EE579 course on mobile application development at USC
- Nokia Exemplary Team Achievement award (highest award at the Nokia research labs)
- Two Intel divisional recognition awards (highest awards at the corporate technology division at Intel).
- University of Michigan EECS Department Fellowship, 1996-1997.
- 32nd Rank in AP Engineering and Medical Common Entrance Test.
- 14th Rank in State-wide High School Graduation Exam
- National Merit Scholarship, India 1987-1993.

Education

- The University of Michigan, Ann Arbor, MI; 1996-2001
  Ph.D. Computer Science and Engineering
  (Dissertation Title: Prefetch Mechanisms that Acquire and Exploit Application Specific Knowledge; Advisor: Prof. Edward Davidson)
- Colorado State University, Fort Collins, CO; 1994-1996
  M.S, Computer Science and Engineering
- National Institute of Technology, Warangal, India; 1989-1993
  B.Tech, Computer Science

Research Projects and Support

My research is supported through the following peer-reviewed research grants and industrial research gifts.

Active:

1. IARPA SuperTools: "ColdFlux: CAD Methodologies and Tools for Single Flux Quantum Based Superconductive Electronics," M. Annavaram (Co-PI, ~$500,000), M. Pedram (Prinicipal). Contract Awarded, Feb 1st 2017- Feb 1st 2022, Total Grant Amount ~$13M.

2. DARPA Dispersed Computing Grant: “APaC: Adaptive Pricing and Coding for Dispersed Computing, " M. Annavaram (Co-PI -33%, ~$1,106,782), S. Avestimehr (Prinicipal-33%), B. Krishnamachari (Co-PI-33%), Contract Awarded, Feb 1st 2017- Feb 1st 2021, Total Grant Amount $3.4M.
3. DARPA PERFECT Grant: “Embedded POWER Optimized Systems Using Near and Super-threshold Computing Fabric (EMPOWER), " M. Annavaram (Co-PI -33%), M. Pedram (Prinicipal-33%), K. Roy (Co-PI-33%), Funded Phase 3 for Aug 1st 2015- Oct 1st 2016, Total Grant Amount $2,155,102.
4. Ming-Hsieh Institute Mini Grant, “Creating the USC Technology Enabled Aging Mind Center (TEAMc)", S. Narayanan, U. Mitra and M. Annavaram, $8,996.
5. NSF CAREER Grant# 0954211, “From Nonstop-Monitoring to Nano-ISA: An Adaptive Multi-Dimensional Framework for Processor Reliability”, M. Annavaram (Principal-100%), Funded, August 1, 2010-July 31, 2017, $427,664.
6. Dell/EMC Equipment Grant. Intelligent SSD Design Board, Funded Jan 2017, $8,000.
7. Altera Equipment Grant. Two A7 (5SGXEA7K3F40C3N) FPGAs, Funded Dec 2016, $8,000.

Pending:

8. NSF, “SHF:Medium Cross-Layer Design and Configuration of Lifetime-Aware Energy-Efficient IoT Designs,” M. Annavaram (Co-PI, 33%), P. Beerel (PI, 33%), S. Gupta (Co-PI, 33%) May 15th 2017 – May 14th 2021, Total Grant Amount $1,199,768.
9. NSF, “SHF:Small Semantically Aware Graph Storage and Processing,” M. Annavaram (PI-75%), A. Ortega (Co-PI, 25%), May 15th 2017 – May 14th 2021, Total Grant Amount $500,000.
10. JPL, “Low-Cost Fault Detection and Correction for Graphics Processing Units in Space,” M. Annavaram (USC PI 65%), S. Sburlan (JPL PI), Oct 1st, 2016 – Sept 30th 2019, Total Grant Amount $100,000.
11. DARPA, “HIVE: Processing and Memory Sub-System Architectures for Near-memory Graph Analytics,” M. Annavaram (Co-PI, $1,077,178), N. Kim (PI, University of Illinois Urbana Champaign) April 1st 2017 – Sept 30th 2021, Total Grant Amount $10,257,788.

Completed:

12. NSF Grant# 1219186, “SHF:Small: Benchmarking of Transient and Intermittent Errors and Their Application to Microarchitecture”, M. Annavaram (Principal-50%), M. Dubois (Co-PI-50%), Funded starting Sept 1, 2012 – August 31 2017, $400,000.
13. DARPA PERFECT Grant: “Low-power and Error-resilient Digital Components Realized in Deeply-scaled CMOS (LEDRA), “ M. Annavaram (Co-PI -0%), M. Fritze (Prinicipal), Funded Phase 1 for about $1.5M Dec 1st 2012-Dec 1st 2014, Total Grant Amount: $8,000,000. Grant money returned due to publication restrictions.

14. DARPA IRIS Grant: “Techniques for Estimating Reliability in COTS ICs (TERCI), “ M. Annavaram (Co-PI -10%), Funded March 1st 2013-March 1st 2014, $125,000.
15. NSF Grant# 0954211, “IEEE International Symposium on Workload Characterization (IISWC) Student Subsidy Proposal”, M. Annavaram (Principal-100%), Funded Jan 1, 2011-Dec 31, 2011, $5,000.
16. NSF Grant# 0831545, “A Game Theoretic Framework for Privacy Preservation in Community-Based Mobile Applications”, M. Annavaram (Principal-50%), B. Krishnamachari (Co-PI-50%), Funded October 1, 2008 – September 30, 2011, $249,999.
17. NSF REU Supplement Grant# 0939625, “A Game Theoretic Framework for Privacy Preservation in Community-Based Mobile Applications”, M. Annavaram (Principal-50%), B. Krishnamachari (Co-PI-50%), Funded June 1, 2009 – September 30, 2011, $16,000.
18. NSF Grant# 0834798, “A Holistic Design Approach to Reliability Using 3D Stacked Monitoring”, M. Annavaram (Principal-100%), Funded Sept 1, 2008 – August 31 2011, $402,904.
19. NSF REU Supplement Grant# 0939623, “A Holistic Design Approach to Reliability Using 3D Stacked Monitoring”, M. Annavaram (Principal-100%), Funded July 7, 2009 – August 31 2011, $16,000.
20. NSF Grant# 0834799, “Trade-offs Between Static Power, Performance and Reliability in Future Chip Multiprocessors”, M. Annavaram (Principal-50%), M. Dubois (Co-PI-50%), Funded September 1, 2008 – August 31, 2010, $200,000.
21. NIH/National Center for Minority Health and Health Disparities, Grant# 53-4503-6037, “Mobile device biomonitoring to prevent and treat obesity in underserved minority youth (KnowMe Study)” M. Annavaram (Principal-30%), D. Metz (Principal-30%), U.Mitra (Co-PI-10%), S. Narayanan (Co-PI-10%), G. Sukhatme (Co-PI-10%), N. Medvidovic (Co-Principal-10%), Funded May 1, 2008 – April 30, 2010, $948,348.
22. Qualcomm Research Grant, “Mobile Metabolic Health Monitoring”, M. Annavaram (Co-PI -10%), D. Metz (Co-PI-10%), U.Mitra (Co-PI-10%), S. Narayanan (PI-50%), G. Sukhatme (Co-PI-10%), Funded August 1, 2008 – July 31, 2009, $50,000.
23. Oracle Equipment Grant. Virtex-5 OpenSPARC Research Platform Boards, Funded August 2011, $16,000.
24. Qualcomm Equipment Grant. SnapDragon Mobile Development Platform Boards, MSM8660, Funded August 2011, $13,500.
25. Nokia Equipment Grant. 50 Lumia900 Phones, Funded Jan 2013, $40,000.
26. Annenberg Micro Seminar series grant. Funded Aug 2011, $2,500.
27. Rose Hills Foundation Science and Engineering Fellowship grant. Funded June 2011, $2,000.
28. Ming-Hsieh Institute Mini Grant, “The Smartphone In Your Pocket – Refreshing The Hardware Of EE579”, M. Annavaram, Funded Jan 2011, $8,996.
29. Nokia Research Gift, “Mobile Energy Efficiency”, M. Annavaram (PI -100%), Funded September 1, 2007, $50,000.

30. Nokia Research Gift, “Mobile Systems for Health”, M. Annavaram (PI -100%), Funded May 1, 2008, $50,000.
31. Nokia Research Gift, “Mobile Systems for Health”, M. Annavaram (PI -100%), Funded April 1, 2009, $50,000.
32. IBM Faculty Award Researc Gift, “3D Stacking for Reliability”, M. Annavaram (PI -100%), Funded August 2008, $25,000.
33. USC Startup Package, Funded August 15th 2007, $70,000 Equipment, $50,000 Research Expenses, $120,000 RA Support, 4 Summer Months Salary

Student Advising

Current Phd Students
1. Qiumin Xu
2. Gunjae Koo
3. Abdulaziz Tabbakh
4. Krishna Narra
5. Zhifeng Lin
6. Hanieh Hashemi

Phd Students Graduated	Graduation Date	First Employment
1. Kimish Patel (co-advised with Prof. Pedram)	Sept 2010	Nvidia
2. Yi Wang (co-advised with Prof. Krishnamachari)	March 2011	Juniper
3. Jinho Suh (co-advised with Prof. Michel Dubois)	Jan 2012	Intel
4. Bardia Zandian	Nov 2012	Qualcomm
5. Waleed Dweik	Dec 2014	Asst. Professor, University of Jordan, Amman
6. Daniel Wong	June 2015	Asst. Professor, UC, Riverside
7. Hyeran Jeon	June 2015	Asst. Professor, San Jose State University
8. Sangwon Lee	Dec 2015	Postdoctoral researcher, USC. Now at VMWare

9. Mohammad Abdel-Majeed	Feb 2016	Asst. Professor, University of Jordan, Amman

MS Students Advised	Graduation Date	First Employment
1. Sabyasachi Ghosh	June 2012	Riverbed Networks
2. Suk Hun Kang	June 2010	Samsung
3. Kumar Dabbiru	June 2012	Google
4. Melina Demertzi	June 2013	Oracle

BS Students Mentored	Graduation Date	First Employment
1. Thomas Punihaole	June 2010	UCLA, MS
2. Willy Long	June 2013	Duke, PhD
3. Justin Kuang	June 2014	Stanford, MS
4. Zhifeng Lin	June 2013	USC, PhD
5. Francisco Romero	June 2015	Stanford, PhD
6. Julia Chen	June 2014	Oracle

Phd Student Thesis Committee Member
1. Richard Hankins
2. Weirong Jiang
3. Hua Liu
4. Jianwei Chen
5. Mehrtash Manochehri

Teaching and Course Development at USC

- EE579: Wireless and Mobile Networks Design and Laboratory. Developed this course from ground-up to focus on challenges associated with mobile phone design challenges and usage models. The course covers issues related to energy efficiency in mobile technologies and data privacy issues.
- EE599: Energy Efficiency and Reliability in Information and Communication Technologies. Developed this new experimental course focusing on topics related to energy proportional computing, datacenter power usage efficiency, server reliability and methods to tradeoff energy efficiency and reliability.

- EE357, EE457 and EE557: Enhanced computer architecture course sequence to bring parallel architecture and software development issues into mainstream architecture courses.

Textbook Co-Authorship

- Parallel Computer Organization and Design. Michel Dubois, Murali Annavaram and Per Stenström. Cambridge Press. Published in August 2012.

Professional Activities and Service

- Associate Editor
  - ACM Transactions on ACM Transactions on Design Automation of Electronic Systems (2011-2014)
- Journal Reviewer
  - ACM Transactions on Computers
  - ACM Transactions on Embedded Computing Systems
  - ACM Computing Surveys
  - ACM Transactions on Architecture and Code Optimization
  - IEEE Top Picks in Microarchitecture 2010, 2015, 2016.
- Program committee member
  - International Symposium on Computer Architecture (ISCA), 2015, 2016.
  - Dependable Systems and Networks (DSN), 2015.
  - Design Automation and Test in Europe (DATE), 2015, 2016
  - IEEE/ACM International Symposium on Microarchitecture (MICRO) 2007, 2011, 2014, 2015, 2016
  - IEEE High Performance Computer Architecture (HPCA) 2009, 2010, 2014
  - International Parallel and Distributed Processing Systems (IPDPS) 2014, 2015.
  - IEEE International Symposium on Performance Analysis of Software and Systems (ISPASS) 2011, 2012
  - International Conference on Mobile Computing, Applications, and Services (MobiCASE) 2011
  - IEEE Workshop of Energy Efficient Design (WEED) 2011, 2012
  - IEEE International Symposium on Workload Characterization (IISWC) 2010, 2012, 2014
  - IEEE/ACM International Conference on Parallel Architecture and Compilation Techniques (PACT) 2010
  - International Conference on Mobile Computing, Applications, and Services (MobiCASE) 2009, 2010, 2011
- Program chair
  - Design Automation and Test in Europe (DATE), Track Chair: Green Computing, 2016.

    - High Performance Computing (HiPC), Vice chair for computer architecture track, 2014
    - Workshop on Exascale Evaluation and Research Techniques (EXERT) 2010, 2011
    - Workshop on Duplicating, Deconstructing, and Debunking (WDDD) 2011, 2012, 2013. 2014, 2015
- Local arrangements chair HPCA 2004, Registration chair for HPCA 2005 and HPCA 2006, Registration chair for PACT 2010, Finance Chair for IISWC 2010.
- Reviewer for IEEE Micro Special Issue on Hardware/Software Interactions 2008, MICRO 2006, MICRO 2005, ISCA 2005, HPCA 2004, ISCA 2003, HPCA 2001, MICRO 2001, ASPLOS 2000, ISCA 2000, PACT 1999, ISCA 1998, MICRO 1998, MICRO 1997, HPCA 1997.
- Multiple NSF proposal review panels

Graduate Student Experience

- Research Assistant: *Jan 1998 - Aug 2001, The University of Michigan.*
    - I worked as a research assistant under Prof. Edward Davidson working on my Ph.D. thesis. My dissertation research focused on reducing cache miss stalls of irregular applications such as databases by hardware and software assisted prefetching.
- Teaching Assistant: *Sept 1996 – Dec 1997, The University of Michigan.*
    - Teaching assistant for a programming and introductory data structures course (one semester) and a graduate level operating systems course (two semesters). Job responsibilities included leading weekly class discussions, designing homework for the operating systems class and grading homework and exams.
- Research Assistant: *May 1996 - Aug 1996, Colorado State University*
    - I worked as a research assistant under Prof. Walid Najjar in the Pebbles research group at Colorado State University. I enhanced a Machine Independent Dataflow Code (MIDC) format that is used by a Sisal compiler for automatic generation of blocking threads from Sisal programs. I also enhanced a cycle accurate multithreaded machine simulator, called ID, to execute the blocking threads. This simulation infrastructure is used for evaluating the memory system performance of multithreaded machines (more details are available in conference paper [16]).
- Teaching Assistant: *August 1994 – May 1996, Colorado State University*
    - Teaching assistant for introductory personal computing course (two semesters), introductory programming language course (one semester) and automata theory course (one semester). Job responsibilities included leading weekly class discussions, lab in-charge and grading homework and exams.

Refereed Publications

Short note on Conference Publications: Here I am paraphrasing information from three relevant articles (1) "Evaluating Computer Scientists and Engineers For Promotion and Tenure," by Prof. David Patterson, *et Al.* (2) "Committee on Academic Careers for Experimental Computer Scientists," by National Research Council (3) "Judging the Impact of Conference and Journal Publications in Computer Architecture," University of California, San Diego Computer Engineering Research Guidelines. In my research area, primarily Computer Architecture, our top tier publication venues are conferences where the conference paper quality meets or exceeds journal publication. Conferences in our field exceed journals in selectivity, visibility, circulation, number of reviews, expertise of reviewers and program committee members. Our conferences have about 5 reviewers and each submitted paper is 20-25 pages in length. Our conference papers represent high quality finished research as they report full evaluations with detailed simulations or models. The program committee consists of about 25 world-renowned researchers and the acceptance rates are less than 30%; I listed acceptance rates where I was able to get the data. Hence, I will first list the refereed full conference papers with acceptance rates wherever available, followed by journals related to my inter-disciplinary work and finally workshop papers. In the list below * represents authors are my PhD students either advised solely by me or co-advised. Underline represents the primary senior author. If multiple primary senior authors they are all underlined in the author list.

Conference Papers

1. **[HPCA]** M. Abdel-Majeed*, H. Jeon*, A.S. Bejestan, M. Pedram, and **Murali Annavaram**. Pilot Register File: Energy Efficient Register File for GPUs. In *proceedings of the International Conference on High-Performance Computer Architecture (HPCA)*, Feb 2017. (Acceptance rate 50/224, 22%)
2. **[HPCA]** Z. Liu, S. Gilani, **Murali Annavaram,** and N.S. Kim. G-Scalar: Cost-effective generalized scalar execution architecture for power-efficient GPUs. In *proceedings of the International Conference on High-Performance Computer Architecture (HPCA)*, Feb 2017. (Acceptance rate 50/224, 22%)
3. **[ISCA]** Q. Xu*, H. Jeon*, K. Kim*, W. Ro, **M. Annavaram**. Efficient Intra-SM Slicing through Dynamic Resource Partitioning for GPU Multiprogramming. In *proceedings of the International Symposium on Computer Architecture (ISCA)*, June 2016. (Acceptance rate 57/291, 20%)
4. **[ISCA]** M. Yoon*, S. Lee*, K. Kim*, G. Koo*, W. Ro and **M. Annavaram**. Virtual Thread: Maximizing Thread-Level Parallelism beyond GPU Scheduling Limit. In *proceedings of the International Symposium on Computer Architecture (ISCA)*, June 2016. (Acceptance rate 57/291, 20%)
5. **[ISCA]** Y. Oh, K. Kim*, M. Yoon*, J. Park, Y. Park, W. Ro, and **M. Annavaram**. APRES: Improving Cache Efficiency by Exploiting Load Characteristics on GPUs. In *proceedings of the International Symposium on Computer Architecture (ISCA)*, June 2016. (Acceptance rate 57/291, 20%)
6. **[ICS]** M. Abdel-Majeed*, D. Wong*, J. Kuang and **M. Annavaram**. Origami: Folding Warps for Energy Efficient GPUs. In *proceedings of the International conference on Supercomputing (ICS)*, June 2016. (Acceptance rate 43/183, 23%)

7. **[HPCA]** D. Wong*, N. Kim and **M. Annavaram**. Warped-Approximation: Using Value Similarity for approximate computing on GPUs. In *proceedings of the International Conference on High-Performance Computer Architecture (HPCA)*, March 2016. (Acceptance rate 53/240, 23%)
8. **[HPCA]** K. Kim*, S. Lee, M. Yoon, G. Koo, W. Ro and **M. Annavaram**. Warped-Preexecution: A GPU Prexecution Approach to Improve Latency Hiding. In *proceedings of the International Conference on High-Performance Computer Architecture (HPCA)*, March 2016. (Acceptance rate 53/240, 23%)
9. **[MICRO]** H. Jeon*, G. Ravi, N.S. Kim and **M. Annavaram**. GPU register file virtualization. In proceedings of the *IEEE International Symposium on Microarchitecture,* Dec 2015. (Acceptance rate 61/283, 22%)
10. **[IISWC]** G. Koo*, H. Jeon* and **M. Annavaram**. Revealing Critical Loads and Hidden Data Locality in GPGPU applications. In proceedings of the *IEEE International Symposium on Workload Characterization (IISWC),* October 2015.
11. **[IISWC]** D. Wong*, J. Chen* and **M. Annavaram**. Traveling to the Edge of Energy Proportionality. In proceedings of the *IEEE International Symposium on Workload Characterization (IISWC),* October 2015.
12. **[DSN]** M. Abdel-Majeed*, W. Dweik*, H. Jeon* and **M. Annavaram**. Warped-RE: Low-Cost Fault Detection and Correction in GPUs. In proceedings of the *International Conference on Dependable Systems and Networks (DSN),* June 2015.
13. **[ISCA]** S. Kim, K. Kim, G. Koo, H. Jeon, W. Ro, and **M. Annavaram**. Warped-Compression: Enabling Power Efficient GPUs Through Register Register Compression. In proceedings of the *International Symposium on Computer Architecture (ISCA),* June 2015.
14. **[ITC]** H. Jeon*, G. Loh and **M. Annavaram**. " RAS Support for Wide-I/O Stacked DRAM". In proceedings of the *IEEE International Test Conference (ITC),* Nov 2014.
15. **[IISWC]** Q. Xu*, H. Jeon*, and **M. Annavaram**. " Characterization and analysis of GPGPU design for Graph Applications". In proceedings of the *IEEE International Symposium on Workload Characterization (IISWC),* Oct 2014.
16. **[PACT]** Q. Xu* and **M. Annavaram**. "PATS: Pattern Aware Scheduling and Power Gating for GPGPUs". In proceedings of the *International Conference on Parallel Architecture and Compilation Techniques (PACT),* Aug 2014.
17. **[DSN]** W. Dweik*, M. Abdel-Majeed* and **M. Annavaram**. "Warp-Shield: Tolerating Hard Faults in GPGPUs". In proceedings of the *International Conference on Dependable Systems and Networks (DSN),* June 2014.
18. **[GOMAC]** W. Dweik* and **M. Annavaram**. SignTest: Signature-based Adaptive Periodic Testing. I*n Government Microcircuit Applications and Critical Technology Conference, (GOMACTech),* April 2014.
19. **[GOMAC]** W. Dweik*, M. Dubois and **M. Annavaram**. Reliability-Aware Exceptions: Tolerating Intermittent Faults in Microprocessor Array Structures. In *Government Microcircuit Applications and Critical Technology Conference, (GOMACTech),* April 2014.

20. **[DATE]** W. Dweik*, M. Dubois and **M. Annavaram**. Reliability-Aware Exceptions: Tolerating Intermittent Faults in Microprocessor Array Structures. In proceedings of the *Design Automation and Test in Europre (DATE),* March 2014.
21. **[HPCA]** D. Wong *, and **M. Annavaram**. Implications of High Energy Proportional Servers on Cluster-wide Energy Proportionality. In *proceedings of* the *International Conference on High-Performance Computer Architecture (HPCA)*, Feb 2014.
22. **[MICRO]** M. Abdel-Majeed*, D. Wong* and **M. Annavaram**. Warped Gates: Gating Aware Scheduling and Power Gating for GPGPUs. In *proceedings of the International Symposium on Microarchitecture (MICRO)*, Dec 2013.
23. **[DSN]** J. Suh*, M. Dubois and **M. Annavaram**. PHYS: Profiled-Hybrid Sampling for Soft Error Reliability Benchmarking. In proceedings of the *International Conference on Dependable Systems and Networks (DSN),* June 2013.
24. **[HPCA]** M. Abdel-Majeed*, and **M. Annavaram**. Warped Register File: A Power Efficient Register File for GPGPUs. In *proceedings of the International Conference on High-Performance Computer Architecture (HPCA)*, Feb 2013.
25. **[MICRO]** H. Jeon* and **M. Annavaram**. Warped-DMR: Light-weight Error Detection for GPGPUs. In *proceedings of the International Symposium on Microarchitecture (MICRO)*, Dec 2012.
26. **[MICRO]** D. Wong* and **M. Annavaram**. Scaling the energy proportionality wall through server-level heterogeneity. In *proceedings of the International Symposium on Microarchitecture (MICRO)*, Dec 2012.
27. **[IISWC]** S. Lee* and **M. Annavaram**. Wireless Body Area Networks: Where Does the Energy Go?. In *proceedings of the IEEE International Symposium on Workload Characterization (IISWC),* Nov 2012. **(Best Paper Award Nominee)**
28. **[IISWC]** M. Demertzi*, B.Zandian*, R. Rojas* and **M. Annavaram**. Benchmarking Instruction Set Architecture for Non-Transient Errors. In proceedings of the *IEEE International Symposium on Workload Characterization (IISWC),* Nov 2012.
29. **[DSN]** B. Zandian* and **M. Annavaram**. Software-based Infield Wearout Monitoring for Synchronous Digital Chips. In proceedings of the *International Conference on Dependable Systems and Networks (DSN) – Fast Abstracts,* June 2012.
30. **[DSN]** W. Dweik* and **M. Annavaram**. Signature-based Online Periodic Fault Tolerance for Microprocessors. In proceedings of the *International Conference on Dependable Systems and Networks (DSN) – Fast Abstracts,* June 2012.
31. **[SECON]** Y.Wang*, B. Krishnamachari, and **M. Annavaram**. Semi-Markov State Estimation and Policy Optimization for Energy Efficient Mobile Sensing. In *proceedings of 9th Annual IEEE Communications Society Conference on Sensor, Mesh and Ad Hoc Communications and Networks (SECON), 2012*.
32. **[ISQED]** M.Abdel-Majeed*, S.Chen and **M. Annavaram**. A case for 3D stacked analog circuits in high-speed sensing systems. In *proceedings of the IEEE International Symposium on Quality Electronics Design (ISQED),* March 2012.
33. **[HPCA]** J. Suh*, **M. Annavaram** and M. Dubois. MACAU: A Markovian Model for Reliability Evaluation of Caches Under SBUs and MBUs. In proceedings of

the *International Symposium on High Performance Computer Architecture (HPCA)*, Feb 2012 (Acceptance rate 36/210, 17%).

34. **[IISWC]** M.Demertzi*, **M. Annavaram** and M. Hall. Analyzing the effect of compiler optimizations on application reliability. In *proceedings of the 2011 IEEE International Symposium on Workload Characterization (IISWC),* Nov 2011.
35. **[EMBC]** S. Kim, M. Li, S. Lee*, U. Mitra, A. Emken, D. Spruijt-Metz, **M. Annavaram**, S. Narayanan. High-level Descriptions of Real-Life Physical Activities Using Latent Topic Modeling of Multimodal Sensor Signals. In proceedings of the *33rd Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC),* Aug 2011.
36. **[DSN]** B.Zandian* and **M. Annavaram**. Cross Layer Resilience Using Wearout Aware Design Flow. In proceedings of the *International Conference on Dependable Systems and Networks (DSN),* pages 279-290, June 2011 (Acceptance rate 26/148, 18%).
37. **[ISCA]** M. Manocheri*, **M. Annavaram** M. Dubois. CPCC: Correctable Parity Protected Cache. In *proceedings of* the *International Symposium on Computer Architecture (ISCA)*, pages 223-234, June 2011 (Acceptance rate 40/208, 19%).
38. **[SIGMETRICS]** J. Suh*, M. Manocheri, **M. Annavaram** and M. Dubois. Soft Error Benchmarking of L2 Caches with PARMA. To appear in the *International Conference on Measurement and Modeling of Computer Systems (SIGMETRICS)*, pages 85-96, June 2011 (Acceptance rate 26/177, 15%).
39. **[HPCA]** N. Madan*, A. Buyuktosunoglu, P. Bose and **M. Annavaram**. Guarded Power Gating in a Multi-Core Setting. In *proceedings of the International Symposium on High Performance Computer Architecture (HPCA)*, pages 291-300, Feb 2011 (Acceptance rate 46/238, 19%).
40. **[MICRO]** J. Chen, K. Dabbiru*, D. Wong*, **M. Annavaram** and M. Dubois. Adaptive and Speculative Slack Simulations of CMPs on CMPs. In *proceedings of the International Symposium on Microarchitecture (Micro)*, pages 523-534, Dec 2010. (Acceptance rate: 45/245, 18%)
41. **[DSN]** B. Zandian*, W. Dweik*, S. Kang*, T. Punihaole* and **M. Annavaram**. Continuous Reliability Monitoring Using Adaptive Critical Path Testing. In *proceedings of the International Conference on Dependable Systems and Networks (DSN),* pages 151-160, July 2010 (Acceptance rate: 39/170, 23%)
42. **[IPSN]** Y.Wang*, B. Krishnamachari, Q. Zhao and **M. Annavaram**. Markov-Optimal Sensing Policy for User State Estimation in Mobile Devices. In *proceedings of 9th International Conference on Information Processing in Sensor Networks 2010 - IP Track (IPSN-2010)*, pages 268-278, Apr 2010 (Acceptance rate: 20/117, 17%).
43. **[ITC]** T-Y. Hsieh, M. Breuer, **M. Annavaram**, S. Gupta, K-J. Lee. Tolerance of Performance-degrading Faults for Effective Yield Improvement. In *Proceedings of the 40th Annual International Test Conference (ITC)*, Pages 1-10, Nov 2009.
44. **[MOBICASE]** Y.Wang*, B. Krishnamachari, Q. Zhao and **M. Annavaram**. Towards the Tradeoff between Energy Efficiency and User State Estimation Accuracy in Mobile Sensing. In *Proceedings of the International Conference on Mobile Computing, Applications, and Services (MOBICASE),* Oct 2009.

45. **[EMBC]** G. Thatte, M. Li, A. Emken, U. Mitra, S. Narayanan, **M. Annavaram** and D. Spruijt-Metz. Energy-Efficient Multihypothesis Activity-Detection for Health-Monitoring Applications. *In Proceedings of the 31st Annual International Conference of IEEE Engineering in Medicine and Biology (EMBC09)*, September 2009.
46. **[ICPP]** J. Chen, **M. Annavaram** and M. Dubois. Exploiting Simulation Slack to Improve Parallel Simulation Speed. In *Proceedings of the 2009 International Conference on Parallel Processing (ICPP),* pages 371-378, Sept 2009. (Acceptance Rate: 30%)
47. **[DCOSS]** G. Thatte, V. Rozgic, M. Li, S. Ghosh*, U. Mitra, S. Narayanan, **M. Annavaram**, and D. Spruijt-Metz. Optimal allocation of time-resources for multi hypothesis activity-level detection. In *Proceedings of the 5th IEEE International Conference on Distributed Computing in Sensor Systems (DCOSS'09)*, June 2009. **(Best Paper Award)**
48. **[MOBISYS]** Y. Wang*, J. Lin, **M. Annavaram**, Q. A. Jacobson, J. Hong, B. Krishnamachari and N. Sadeh. A Framework of Energy Efficient Mobile Sensing for Automatic User State Recognition. In *proceedings of 7th Annual International Conference on Mobile Systems, Applications and Services (MobiSys)*, pages 179-192, June 2009 (Acceptance Rate, 26/128, 20%).
49. **[SIGMETRICS]** J. Chen, **M. Annavaram**, M. Dubois. Slacksim: : A Platform for Parallel Simulations of CMPs on CMPs. In *proceedings of International Conference on Measurement and Modeling of Computer Systems (SIGMETRICS)*, June 2009. (Acceptance Rate: 26%)
50. **[MSWIM]** H. Liu, B. Krishnamachari and **M. Annavaram**. Game theoretic approach to location sharing with privacy in a community-based mobile safety application. In *Proceedings of the 11th international Symposium on Modeling, Analysis and Simulation of Wireless and Mobile Systems* MSWiM '08. Pages 229-238, October 2008.
51. **[MOBISYS]** B. Hoh, M. Gruteser, R. Herring, J. Ban, D. Work, J. Herrera, A.M. Bayen, **M. Annavaram**, and Q. Jacobson. Virtual trip lines for distributed privacy-preserving traffic monitoring. In *Proceeding of the 6th international Conference on Mobile Systems, Applications, and Services*, pages 15-28, June, 2008. (Acceptance Rate: 22/123, 18%)
52. **[HPCA]** **M. Annavaram**, E. Grochowski, and P. Reed. Implications of Device Timing Variability on Full Chip Timing. In *Proceedings of the 13th International High-Performance Computer Architecture*, pages 37-45, Feb 2007. (Acceptance rate 32/184, 17%)
53. **[MICRO]** B. Black, **M. Annavaram**, N. Brekelbaum, J. DeVale, L. Jiang, G.H. Loh, D. McCauley, P. Morrow, D.W. Nelson, D. Pantuso, P. Reed, J. Rupley, S. Shankar, J. Shen, and C. Webb. Die Stacking (3D) Microarchitecture. In *Proceedings of the 39th International Symposium on Microarchitecture*, pages 469-479, Dec 2006 (Acceptance Rate :42/174, 24%). (B.Black and M. Annavaram are senior authors with equal contributions)
54. **[ISCA]** **M. Annavaram**, E. Grochowski, J. Shen. Mitigating Amdahl's Law Through EPI Throttling. In *Proceedings of the 32nd International Symposium on*

Computer Architecture, pages 298-309, June 2005 (Acceptance Rate 45/194, 23%).

55. **[MICRO] M. Annavaram**, R. Rakvic, M. Polito, J. Bouguet, R. Hankins, B. Davies. The Fuzzy Correlation between Code and Performance Predictability. In *Proceedings of the 37th International Symposium on Microarchitecture*, pages 93-104, Dec 2004 (Acceptance Rate: 29/158, 18%).
56. **[MICRO]** R. Hankins*, T. Diep, **M. Annavaram**, B. Hirano, H. Eri, H. Nueckel, and J. Shen. Scaling and Characterizing Database Workloads: Bridging the Gap between Research and Practice. In *Proceedings of the 36th International Symposium on Microarchitecture*, pages 151-162, Dec 2003 (Acceptance Rate: 35/134, 26%)
57. **[ICCD] M. Annavaram**, T. Diep and J. Shen. Branch Behavior of a Commercial OLTP Workload on Intel IA32 Processors. In *Proceedings of the International Conference on Computer Design*, pages 242-248, Sept 2002.
58. **[ISCA] M. Annavaram**, J. M. Patel and E. S. Davidson. Data Prefetching by Dependence Graph Precomputation. In *Proceeding of the 28th International Symposium on Computer Architecture*, pages 52-61, July 2001 (Acceptance Rate 24/163, 15%). (E.S. Davidson is Annavaram's PhD Thesis advisor)
59. **[HPCA] M. Annavaram**, J. M. Patel and E. S. Davidson. Call Graph Prefetching for Database Applications. In *Proceedings of the Seventh International High-Performance Computer Architecture*, pages 281-290, Jan 2001 (Acceptance Rate: 26/110, 24%)
60. **[ISPASS] M. Annavaram**, G. S. Tyson and E. S. Davidson. Instruction Overhead and Data Locality Effects in Superscalar Processors. In *Proceedings of the International Symposium on Performance Analysis of Systems and Software,* pages 95-100, April 2000.
61. **[IPDPS] M. Annavaram**, W. Najjar. Comparison of Two Storage Models in Data-Driven Multithreaded Architectures. In *proceedings of the Symposium on Parallel Distributed Computing,* pages 100-110, October 1996. (W. Najjar is MS Thesis advisor)

Journal Papers

1. **[IEEE TOC]** S. Lee, K. Kim, G. Koo*, H. Jeon*, **M. Annavaram** and W. Ro. Improving Energy Efficiency of GPUs through Data Compression and Compressed Execution. IEEE Transactions on Computers, Vol.PP, Issue 99, Oct 2016.
2. **[IEEE TOC]** M. Manocheri*, **M. Annavaram** M. Dubois. CPCC: Correctable Parity Protected Cache. IEEE Transactions on Computers, Vol.63, Issue 10, Oct 2014.
3. **[MICRO TOPPICKS]** D. Wong* and **M. Annavaram**. Scaling the energy proportionality wall through server-level heterogeneity. To appear in *proceedings of the IEEE MICRO TOPPICKS*, June 2013.
4. **[IEEE TOC]** K. Patel*, **M. Annavaram and M. Pedram**. NFRA: Generalized Network Flow Based Resource Allocation for Hosting Centers. To *appear in IEEE Transactions on Computers,* June 2013.

5. **[COMM]** U. Mitra, A. Emken, S. Lee, M. Li, V. Rozgic, G. Thatte, H. Vathsangam, D. Zois, M. Levorato, **M. Annavaram**, S, Narayanan and D. Spruijt-Metz, G Sukhatme. KNOWME: A Case Study in Wireless Body Area Sensor Network Design. *Accepted for publication in IEEE Communication Magazine,* March 2012.
6. **[JPAH]** A. Emken, M. Li, G. Thatte, S. Lee*, **M. Annavaram**, U. Mitra, S, Narayanan and D. Spruijt-Metz. Recognition of Physical Activities in Overweight Hispanic Youth Using KNOWME Networks. *Accepted for publication in Journal of Phyiscal Activity and Helath,* March 2011.
7. **[ToMC]** B. Hoh, M. Gruteser, R. Herring, J. Ban, D. Work, J. Herrera, A.M. Bayen, **M. Annavaram**, and Q. Jacobson. Virtual trip lines for distributed privacy-preserving traffic monitoring. *Accepted for publication in IEEE Transactions on Mobile Computing,* March 2011.
8. **[TSP]** G. Thatte, M. Li, S. Lee*, A. Emken, **M. Annavaram**, S. Narayanan, D. Spruijt-Metz and U. Mitra. Optimal Time-Resource Allocation for Energy-Efficient Physical Activity Detection. *IEEE Transactions on Signal Processing,* 59(4), 1843-1857, April 2011.
9. **[LNCS]** N. Madan*, A. Buyuktosunoglu, P. Bose, and, **M. Annavaram**. Guarded Power Gating in a Multi-Core Setting. *Lecture Notes in Computer Science*, Springer Publication, Vol 6161, Feb 2011.
10. **[LNCS]** S. Ghosh*, M. Redekopp and **M. Annavaram**. KnightShift: Shifting the I/O Burden in Datacenters to Management Processor for Energy Efficiency. *Lecture Notes in Computer Science*, Springer Publication, Vol 6161, Feb 2011.
11. **[ToNSRE]** M. Li, V. Rozgic, G. Thatte, S. Lee*, A. Emken, **M. Annavaram**, U. Mitra, D. Spruijt-Metz and S, Narayanan. Multimodal Physical Activity Recognition by Fusing Temporal and Cepstral Information. *Transactions on Neural Systems & Rehabilitation Engineering,* 18(4), pages 369-380*,* 2010.
12. **[TECS]** G. Thatte, M. Li, S. Lee*, A. Emken, S. Narayanan, U. Mitra, D. Spruijt-Metz and **M. Annavaram**. KNOWME: An Energy-Efficient and Multimodal Body Area Sensing System for Physical Activity Monitoring. *ACM Transactions in Embedded Computing Systems (TECS), Special Issue on Wireless Health Systems.* August 2010.
13. **[CAN]** J. Chen, **M. Annavaram**, and M. Dubois. SlackSim: a platform for parallel simulations of CMPs on CMPs. *SIGARCH Computer Architecture News*, 37(2) 20-29, July 2009.
14. **[TOCS] M. Annavaram**, J. M. Patel and E. S. Davidson. Call Graph Prefetching for Database Applications. *ACM Transactions on Computer Systems,* 21(4), pages 412-444, Nov 2003.

Workshop and Invited Papers

1. **[GPUDEPEND]** W. Dweik*, M. Abdel-Majeed* and **M. Annavaram**. Tolerating Hard Faults in GPGPUs. In the *International Workshop on Dependable GPU Computing*, March 2014.
2. **[WEED]** D. Wong* and **M. Annavaram**. Evaluating A Prototype KnightShift-enabled Server. In the *Workshop on Energy Efficient Design*, June 2012.

3. **[MOBS]** J.Chen, K. Dabbiru*, **M. Annavaram** and M. Dubois. Adaptive and Speculative Slack Simulations of CMPs on CMPs. In the Sixth Annual Workshop on Modeling, Benchmarking and Simulation *(MOBS)*, June 2010.
4. **[MOBS]** J. Suh*, **M. Annavaram** and M. Dubois. Soft Error Benchmarking for L2 Cache with PARMA. In the Sixth Annual Workshop on Modeling, Benchmarking and Simulation *(MOBS)*, June 2010.
5. **[WEED]** S. Ghosh*, M. Redekopp and **M. Annavaram**. KnightShift: Shifting the I/O Burden in Datacenters to Management Processor for Energy Efficiency. In the *Workshop on Energy Efficient Design*, June 2010.
6. **[WEED]** N. Madan*, A. Buyuktosunoglu, P. Bose, and, **M. Annavaram**. Guarded Power Gating in a Multi-Core Setting. In the *Workshop on Energy Efficient Design*, June 2010.
7. **[CENS]** G. Thatte, M. Li, A. Emken, U. Mitra, S. Narayanan, **M. Annavaram** and D. Spruijt-Metz. Energy-Efficient Activity-Detection via Multihypothesis Testing for Pediatric Obesity. In the *7th Annual CENS Research Review*, October 2009.
8. **[mHealth]** D. Spruijt-Metz, S. Narayanan, U. Mitra, G. Sukhatme, M. Li, G. Thatte, A. Emken, S. Lee, H. Vathsangam and **M. Annavaram**. KNOWME Networks: Mobile Device Biomonitoring to Prevent and Treat Obesity in Underserved Minority Youth. In *the mHealth Summit*, October 2009.
9. **[BIC]** S. Lee*, **M. Annavaram**, G. Thatte, V. Rozgic, M.Li, U. Mitra, S. Narayanan, A. Emken, and D. Spruijt-Metz. Sensing for Obesity: KNOWME Implementation and Lessons for an Architect. In Workshop on Biomedicine in Computing: Systems, Architectures, and Circuits (BiC), June 2009.
10. **[ICDAM]** D. Spruijt-Metz, M. Li, G. Thatte, G. Sukhatme, **M. Annavaram**, S. Ghosh, V. Rozgic, U. Mitra, N. Medvidovic, B. Belcher, and S. Narayanan. Differentiating physical activity modalities in youth using heartbeat waveform shape and differences between adjacent waveforms. To appear *in proceedings of the 7th International Conference on Diet and Activity Methods (ICDAM 7)*, June 2009.
11. **[BodyNets]** G. Thatte, V. Rozgic, M. Li, S. Ghosh*, U. Mitra, S. Narayanan, **M. Annavaram**, and D. Spruijt-Metz. Optimal time-resource allocation for activity-detection via multimodal sensing. To appear *at the Fourth International Conference on Body Area Networks*, April 2009.
12. **[URBANSENSE]** **M. Annavaram**, N. Medvidovic, U. Mitra, S. Narayanan, G. Sukhatme, Z. Meng, S. Qiu, R. Kumar, G. Thatte, and D. Spruijt-Metz. Multimodal sensing for pediatric obesity applications. In *Proceedings of UrbanSense08,* November 2008.
13. **[MODUS]** **M. Annavaram**, Q. Jacobson. HangOut: A Privacy Preserving Location Based Social Networking Service. In *Workshop on Mobile Devices and Urban Sensing*, **(Invited Paper)** April 2008.
14. **[ISPD]** **M. Annavaram**, E. Grochowski, and P. Reed. Implications of Device Timing Variability on Full Chip Timing. In *Proceedings of the International Symposium on Physical Design*, **(Invited Paper)** April 2008.
15. **[CAECW]** R. Hankins*, **M. Annavaram**, B. Hirano, J. Patel and J. Shen. Comparing OLTP Scaling Behavior on Intel® Xeon™ and Itanium® 2

Processors. In *the seventh Workshop on Computer Architecture Evaluation using Commercial Workloads*, Feb 2004.

16. **[MEM]** P. Kundu, **M. Annavaram**, T. Diep and J. Shen. A Case for Shared Instruction Cache on Chip Multiprocessors Running OLTP. In *the Memory Performance: Dealing With Applications, Systems and Architectures Workshop*, Sep 2003.
17. **[CAECW]** T. Diep, **M. Annavaram**, B. Hirano and J. Shen. Analyzing Performance Characteristics of OLTP Cached Workloads by Linear Interpolation. In *the sixth Workshop on Computer Architecture Evaluation using Commercial Workloads*, Feb 2003.
18. **[WWC]** J. Rupley II, **M. Annavaram**, J. DeVale, T. Diep and B. Black. Comparing and Contrasting a Commercial OLTP Workload with CPU2000 on IPF. In *the fifth Workshop on Workload Characterization*, Nov 2002.
19. **[EPIC]** R. Rakvic, E. Grochowski, B. Black, **M. Annavaram**, T. Diep and J. Shen. Performance Advantage of the Register Stack in Intel Itanium Processors. In *the second Workshop on Explicitly Parallel Instruction Computing Architecture and Compilers*, Nov 2002.

Patents

1. 2012– Patent Issued: Runtime Selection Of Most Energy-Efficient Approach For Services Requested By Mobile Applications
2. 2010– Patent Issued: Method and Apparatus for Continuous Circuit Reliability Monitoring Using Self Managed Adaptive Critical Path Testing
3. 2008 – Patent Issued: Methods, Apparatuses, And Computer Program Product For Traffic Data Aggregation Using Virtual Trip Lines And Gps-enabled Mobile Handsets
4. 2006 – Patent Issued: Method And Apparatus For Reducing Bank Conflicts In 3d Stacked L3 Dram With Prefetching Into L2
5. 2006 – Patent Pending: Transferring Data From Stacked Memory
6. 2005 – Patent Pending: Load Balancing For Multi-Threaded Applications Via Asymmetric Power Throttling
7. 2005 – Patent Issued: Method, System, And Apparatus For Detecting And Recovering From Timing Errors
8. 2005 – Patent Issued: Method And Apparatus For Late Timing Transition Detection
9. 2004 - Patent Issued: Method and Apparatus for Varying Energy Per Instruction According to the Amount of Available Parallelism
10. 2003 - Patent Issued : Method and Apparatus for a Variable Pop Hardware Return Address Stack.

EXHIBIT 6

John D. Villasenor

Education

1986 – 1989 **Stanford University**
Ph.D. in Electrical Engineering

1985 – 1986 **Stanford University**
M.S. in Electrical Engineering

1982 – 1985 **University of Virginia**
B.S. in Electrical Engineering

Appointments

Since 1992 **University of California, Los Angeles** **Los Angeles, CA**
Current Position: Professor of Electrical Engineering, Public Policy, and Management
Visiting Professor of Law
Conducting research on innovative communications, networking, security, information processing, and computing technologies and their broader implications. Recent areas of work have include cybersecurity, robotics (including drones and driverless cars), digital financial services, and privacy. See http://johnvillasenor.com for more information, including publications.

Since 2011 **The Brookings Institution** **Washington, DC**
Nonresident Senior Fellow, Governance Studies Program
Examining a broad range of issues at the intersection of technology, policy, and law, generally related to the topics listed above. Co-direct the Brookings Financial and Digital Inclusion Project, an effort to increase access by traditionally underserved populations to the financial and digital ecosystem. See https://www.brookings.edu/experts/john-villasenor/ for more information.

2014-2016 **Stanford University** **Stanford, CA**
National Fellow (2014-2016), Visiting Fellow (since 2016), The Hoover Institution
Affiliate, Center for International Security and Cooperation (CISAC)
See http://cisac.fsi.stanford.edu/people/john_villasenor

1990 – 1992 **Jet Propulsion Laboratory** **Pasadena, CA**
Developed new techniques for imaging and mapping the earth from space.

Other Professional Activities

- Member, Council on Foreign Relations
- Direct a Department of Homeland Security-supported project aimed at improving cybersecurity in U.S. critical infrastructure. See http://cisac.fsi.stanford.edu/docs/cybersecurity-assurance-for-critical-infrastructure
- Appointed in 2012 (term ended mid-2014) by the World Economic Forum to the Global Agenda Council on the Intellectual Property System. From 2013 to 2014, vice chair of the council.

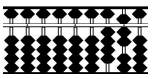
- Mid-2014 to mid-2016: Member of the World Economic Forum's Global Agenda Council on Cybersecurity
- Have contributed to international standards organizations and industry consortia for the development of new communications standards.
- Have provided expert testimony in multiple intellectual property matters in Federal District Court, at the U.S. International Trade Commission in Washington, and before the U.S. Patent and Trademark Office.
- Have provided congressional testimony before the House Judiciary Committee in 2013 and 2014, before the Senate Commerce Committee in 2015 and 2017, and before the House Energy and Commerce Committee in 2015. See http://johnvillasenor.com/publications/congressional-testimony/
- Served as Vice Chair of the International Center for Missing and Exploited Children's Digital Economy Task Force
- Developed and implemented an online training program covering patents, copyright, trademarks, and trade secrets. The program was adopted and implemented by the University of California. See https://techtransfer.universityofcalifornia.edu/IPAwareness/story.html
- Active in early stage technology venture capital since the 1990s
- Participant in the Uniform Law Commission's study committees on 1) state regulation of driverless cars and 2) vehicle event data recorders

Publications and Patents

- Over 150 academic papers published in venues including engineering journals and conference proceedings (see http://johnvillasenor.com). "H-index" of 49 (as of April 2017). Articles and commentary also published in broader interest venues including the *Atlantic*, *Billboard*, the *Chronicle of Higher Education*, *Fast Company*, *Forbes*, the *Huffington Post*, the *Los Angeles Times*, the *New York Times*, *Scientific American*, *Slate*, and the *Washington Post*.
- Approximately 20 issued and pending U.S. patents in areas including communications, information processing, and cybersecurity.

EXHIBIT 7

Trevor Mudge
Bredt Family Chair of Computer Engineering



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Education

- Ph.D. Computer Science, University of Illinois, Urbana, Illinois, 1977. Thesis: A Computer Hardware Design Language for Multiprocessor Systems.
- M.S. Computer Science, University of Illinois, Urbana, Illinois, 1973. Thesis: SEMANTRIX: A Semantically Guided Digital Electronic Machine.
- B.Sc. (Hons.) Cybernetics, University of Reading, England, 1969.

Work History

- 2002-present: The Bredt Family Chair of Computer Engineering and Professor Electrical Engineering and Computer Science, Dept. of Electrical Engineering and Computer Science, The University of Michigan, Ann Arbor
- 1990-88: Professor Electrical Engineering and Computer Science, The University of Michigan, Ann Arbor
- 1990-88: Professor Electrical Engineering and Computer Science, The University of Michigan, Ann Arbor
- Director of the Advanced Computer Architecture Lab., The University of Michigan, Ann Arbor
- 1984-1990: Associate Professor Electrical Engineering and Computer Science, The University of Michigan, Ann Arbor
- 1977-1983: Assistant Professor Electrical Engineering and Computer Science, The University of Michigan, Ann Arbor
- 1974-1977: Research Assistant, Digital Systems Research Group, Coordinated Science Laboratory, University of Illinois. Research in the areas of digital systems design languages, parallel processing, and fault tolerant computing.
- 1970-1974: Research Assistant, Information Engineering Group, Digital Computer Laboratory, University of Illinois. Design and construction of several digital machines.

Professional Society Membership

- Fellow IEEE and member of the IEEE Computer Society
- Fellow of the Association for Computing Machinery and ACM Sigarch
- Member of the IET: The Institution of Engineering and Technology (was Institution of Electrical Engineers)
- Member of the British Computer Society
- Member of Sigma Xi

Awards

- **Fellow of the Association of Computing Machinery**, "For contributions to power aware computer architecture," 2017.
- **Top Pick: selected as one of the 12 best papers in computer architecture for 2015** J. Hauswald, M. A. Laurenzano, Y. Zhang, C. Li, A. Rovinski, A. Khurana, R.G. Dreslinski, T. Mudge, V. Petrucci, L. Tang, J. Mars. Sirius: An Open End-to-end Voice and Vision Personal Assistant and Its Implications For Future Warehouse Scale Computers. *IEEE MICRO* May/June 2016, vol. 36, no. 3, pp. 42-53.
- **International Conference on Supercomputing 25th Anniversary Issue 1987-2011 (35 most influential papers)**. For the paper: Improving data cache performance by pre-executing instructions under a cache miss. (James Dundas and Trevor Mudge) Proc. 1997 ACM Int. Conf. on Supercomputing, July 1997. Reprinted in the anniversary issue, U. Banerjee Editor, 2014.
- **Best paper** for: Sources of Error in Full System Simulation. *2014 IEEE Int. Symp. on Performance Analysis of Systems and Software (ISPASS)*, Monterey, CA, March 2014, pp. 13-22.
- **Distinguished Achievement Award** from the University of Illinois Computer Science Department as an "outstanding educator and researcher whose work has advanced the field of low-power computer architecture and its interaction with technology." Given at the Department's CS @ Illinois 50th Anniversary Celebration, October 20th , 2014.
- **2014 ACM/IEEE CS Eckert-Mauchly Award.** For pioneering contributions to low-power computer architecture and its interaction with technology. June 2014.
- **Chartered IT Professional (CTIP),** British Computer Society, c. 2014.
- **Life Fellow of the IEEE**, 2013
- **International Conference on Computer-Aided Design's Ten Year Retrospective Most Influential Paper Award in 2012**. For the paper: Combined dynamic voltage scaling and adaptive body biasing for lower power microprocessors under dynamic workloads. (S. Martin, K. Flautner, D. Blaauw, and T. Mudge.) Appeared in *Proc. Int. Conf. of Computer Aided Design (ICCAD-2002)*, San Jose, CA, Nov. 2002, pp. 721-725.
- **Winner in the 11th Annual International VLSI Symposium Low Power Design Contest.** For the paper: SWIFT: A 2.1Tb/s 32x32 Self-Arbitrating Manycore Interconnect Fabric. (S. Satpathy, R. Dreslinski, T. Ou, D. Sylvester, T. Mudge, D. Blaauw.) Appeared in the *Symposium on VLSI Technology and Circuits*. Kyoto, Japan, June 2011, pp.138-139.
- **Winners of the DAC/ISSCC Student Design Contest for 2011** Mentor for (With David Blaauw and Dennis Sylvester) their project "Design and Implementation of Centip3De, a 7-layer Many-Core System", D. Fick, R. Dreslinski, B. Giridhar, G. Kim, S. Seo, M. Fojtik, S. Satpathy, Y. Lee, D. Kim, N. Liu, M. Wiekowski, G. Chen, T. Mudge, D. Sylvester, and D. Blaauw. Proc. of the ACM/IEEE Design Automation Conference (DAC), San Francisco, CA, June, 2011.
- **Top Pick: selected as one of the 12 best papers in computer architecture for 2009** M. Woh, S. Seo, S. Mahlke, T. Mudge, C. Chakrabarti, and K. Flautner. AnySP: Anytime Anywhere Anyway Signal Processing. *36th Int. Symp. on Computer Architecture*, Austin, TX, June, 2009, pp. 128-139.
- **Ted Kennedy Family Team Excellence Award** for 2008-9 from the College of Engineering, University of Michigan, April 2009.
- **Top Pick: selected as one of the 12 best papers in computer architecture for 2008** K. Lim, P. Ranganathan, J. Chang, C. Patel, T. Mudge, S. Reinhardt. Understanding and designing new server architectures for emerging warehouse-computing environments. *35th Int. Symp. on Computer Architecture*, Beijing, China, June, 2008, pp. 315-326.

- **Best paper** for: From SODA to Scotch: The Evolution of a Wireless Baseband Processor. *41st IEEE/ACM Int. Symp. on Microarchitecture (MICRO*), Lake Como, Italy, Nov. 2008, pp. 152-163.
- **Best Paper Nomination** for: B. Zhai, R. Dreslinski, D. Blaauw, T. Mudge, and D. Sylvester. Energy Efficient Near-threshold Chip Multi-processing. Int. Symp. on Low Power Electronics and Design - 2007 (ISLPED), Aug. 2007, pp. 32-37.
- **Best paper** for: Next Generation Challenge for Software Defined Radio. M. Woh, S. Seo, H. Lee, Y. Lin, S. Mahlke, T. Mudge, C. Chakrabarti, and K. Flautner. *SAMOS VII,* Greece, April 2007, pp. 343-354.
- **Top pick paper selected as one of the 12 best papers in computer architecture for 2006,** for: Y. Lin, H. Lee, M. Woh, Y. Harel, S. Mahlke, T. Mudge, C. Chakrabarti, K Flautner. SODA: A low-power architecture for software radio. *Proc. 33rd Ann. Int. Symp. on Computer Architecture*, Boston, MA USA, June 2006, pp. 89-101.
- **Microprocessor Report Innovation Award:** "RAZOR—Error-Tolerant Approach Supports Speculative Correctness" MPR Analysts' Choice Award in the Innovation category – 2/26/07. (Microprocessor Report has been the leading technical publication for the microprocessor industry since 1987.)
- **Top pick paper selected as one of the 12 best papers in computer architecture for 2003**, for: D. Ernst, N. Kim, S. Das, S. Pant, T. Pham, R. Rao, C. Ziesler, D. Blaauw, T. Austin, T. Mudge, and K. Flautner. Razor: A low-power pipeline based on circuit-level timing speculation. *36th Ann. IEEE/ACM Symp. Microarchitecture (MICRO-36)*, Dec. 2003, pp. 7-18.
- **Best paper** for: D. Ernst, N. Kim, S. Das, S. Pant, T. Pham, R. Rao, C. Ziesler, D. Blaauw, T. Austin, T. Mudge, and K. Flautner. Razor: A low-power pipeline based on circuit-level timing speculation. *36th Ann. IEEE/ACM Symp. Microarchitecture (MICRO-36)*, Dec. 2003, pp. 7-18.
- **Bredt Family Chair of Engineering**, conferred by the College of Engineering in 2003.
- **Heaviside Premium**. Awarded by the Institution of Electrical Engineer for he best paper of the year: A comparison of two common pipeline structures. *Proc. Computers and Digital Techniques*, 1996.
- **Research Excellence Award** for 1995-96 from the College of Engineering, University of Michigan, Feb. 1997.
- **Fellow of the Institute of Electrical and Electronics Engineers**, "For contributions to the design and analysis of high performance processors," 1995.
- **Research Excellence Award** for 1994-95 EECS Department , University of Michigan, Feb. 1995.
- **Best paper nomination** for "Analysis and design of latch-controlled synchronous digital circuits," (15 out of 377) at the 27-th Design Automation Conference, June 1990.
- **Best IEEE MICRO article** of 1986 for "A Microprocessor-based Hypercube Supercomputer."
- **Outstanding Teaching** in Engineering. Awarded by the College of Engineering, University of Michigan, Dec.1983.
- **Quest for Technology** Awards (2). Awarded by Control Data Corporation, Oct. 1982.
- **Best paper runner-up**. Honorable mention from the editors of the IEEE Trans. on Education for runner-up best paper published in 1981: "A Course Sequence in Microprocessor-Based Digital Systems Design."
- **John A. Curtis Award**. Awarded by The Computers in Education Division of the American Society of Engineering Educators, June 1981, for the paper: Teaching Assembly Language Using an Assembly Language Interpreter.
- **Best paper**. Awarded by The Instrument Society of America at their 27-th Int. Symposium, Apr. 1981, for the paper: VLSI Implementation of a Numerical Processor for Robotics.

Ph.D. Theses Chaired

1. Datacenter Design for Future Cloud Radio Access Network, Qi Zheng, The University of Michigan, 2016.
2. Dense Server Architectures, Anthony Thomas Gutierrez, The University of Michigan, 2015.
3. Scaling High-Performance Interconnect Architectures to Many-Core Systems, Korey LaMar Sewell, The University of Michigan, 2012.
4. Near-Threshold Computing: From Single Core to Many-Core Energy Efficient Architectures, Ronald G. Dreslinski Jr., The University of Michigan, 2011.
5. Energy-efficient Architecture For Mobile Signal Processing, Sangwon Seo, The University of Michigan, 2011.
6. Architecture And Analysis For Next Generation Mobile Signal Processing, Mark Woh, The University of Michigan, 2011.
7. A Hardware/Software Approach for Alleviating Scalability Bottlenecks in Transactional Memory Applications, Geoffrey Wyman Blake, The University of Michigan, 2011.
8. Efficient Data Center Architectures Using Non-Volatile Memory and Reliability Techniques, David Andrew Roberts, The University of Michigan, 2010.
9. Disaggregated Memory Architectures for Blade Servers, Kevin Te-Ming Lim, The University of Michigan, 2010. (Co-chairman Steven Reinhardt)
10. Cache Resource Allocation in Large Scale Chip Multiprocessors, Lisa Rufeng Hsu, The University of Michigan, 2009. (Co-chairman Steven Reinhardt)
11. Full-System Critical-Path Analysis and Performance Prediction, Ali Ghassan Saidi, The University of Michigan, 2009. (Co-chairman Steven Reinhardt)
12. Microarchitecture Choices And Tradeoffs For Maximizing Processing Efficiency, Deborah T. Marr, The University of Michigan, 2008.
13. Realizing Software Defined Radio – A Study in Designing Mobile Supercomputers, Yuan Lin, The University of Michigan, 2008. (Co-chairman Scott Mahlke)
14. The Fast, Efficient, And Representative Benchmarking Of Future Microarchitectures, Jeffrey Stuart Ringenberg, The University of Michigan, 2008.
15. Architecting Energy Efficient Servers, Tae Ho Kgil, The University of Michigan, 2007.
16. A Baseband Processor For Software Defined Radio Terminals, Hyunseok Lee, The University of Michigan, 2007.
17. Improving Performance and Energy Consumption in Region-Based Caching Architectures, Michael J. Geiger, The University of Michigan, 2006. (Co-chairman Gary Tyson)
18. Application-Specific Architecture Framework for High-Performance Low-Power Embedded Computing, Allen Chao-Hung Cheng, The University of Michigan, 2006. (Co-chairman Gary Tyson)
19. Virtualizing Register Context, David W. Oehmke, The University of Michigan, 2005.
20. Circuit and Microarchitectural Techniques for Processor On-Chip Cache Leakage Power Reduction, Nam Sung Kim, The University of Michigan, 2004.
21. Design, Implementation and use of an Experimental Compiler for Computer Architecture Research, David Anthony Greene, The University of Michigan, 2003.
22. Limits and Misconceptions in Branch Prediction, Avinoam Nomik Eden, The University of Michigan, 2001.

23. Compiler and Microarchitecture Mechanisms for Exploiting Registers to Improve Memory Performance, Matthew Allan Postiff, The University of Michigan, 2001.
24. Automatic Monitoring for Interactive Performance and Power Reduction, Krisztian Flautner, The University of Michigan, 2001.
25. Modern DRAM Architectures, Brian Thomas Davis, The University of Michigan, 2001. (Co-chairman Bruce Jacob)
26. Efficient Execution of Compressed Programs, Charles Robert Lefurgy, The University of Michigan, 2000.
27. Pseudo-Vector Machines for Embedded Applications, Lea Hwang Lee, The University of Michigan, 2000.
28. The Impact of Computer Architecture Features on Image Processing Application Execution times: A Case Study Using MPEG Image Sequence Compression on the IBM SP2, Jeremy Alan Salinger, The University of Michigan, 2000. (Co-chairman Gregory Wakefield)
29. Functional Design Verification for Microprocessors by Error Modeling, David Van Campenhout, The University of Michigan, 1999.
30. Improving Processor Performance by Dynamically Pre-Processing the Instruction Stream, James David Dundas, The University of Michigan, 1998.
31. Optimizing High Performance Dynamic Branch Predictors, Chih-Chieh Lee, The University of Michigan, 1997.
32. Enhancing Instruction Fetching Mechanism Using Data Compression, I-Cheng Chen, The University of Michigan, 1997.
33. Software-Oriented Memory-Management Design, Bruce Ledley Jacob, The University of Michigan, 1997.
34. Reducing the Penalty of Branch and Load Hazards in Pipelined Microprocessors, Michael Leonard Golden, The University of Michigan, 1995.
35. OS/Architecture Interactions and Influence on Computer Architecture, David Frederick Nagle, The University of Michigan, 1995.
36. Cache Behavior in the Presence of Speculative Execution - The Benefits of Misprediction, James E. Pierce, The University of Michigan, 1995.
37. Architectural Macro-Modeling of Processor Memory Components, Ghazanfar Ali Khan, The University of Michigan, 1995.
38. Trace-driven Memory Simulation, Richard Albert Uhlig, The University of Michigan, 1995.
39. Architectural Trade-offs in a Latency Tolerant Gallium Arsenide Microprocessor, Michael Douglas Upton, The University of Michigan, 1994. (Co -chairman Richard Brown)
40. Loop Optimization Techniques on Multi-Issue Architectures, Dan Richard Kaiser, The University of Michigan, 1994.
41. Technology-Organization Trade-offs in the Architecture of a High Performance Processor, Oyekunle Ayinde Olukotun, The University of Michigan, 1991.
42. Run-Time Support for Parallel Programs, Russell Mace Clapp, The University of Michigan, 1991.
43. Design of a Non-Interfering Debugger for Embedded Real-Time Systems, Venu Prabhakar Banda, The University of Michigan, 1990. (Co-chairman Richard Volz)
44. Machine Recognition and Attitude Estimation of Three-Dimensional Objects, Paul Gunther Gottschalk III, The University of Michigan, 1990.
45. A Distributed Real-Time Language and Its Operational Semantics, Padmanabhan Krishnan, The University of Michigan, 1989. (Co-chairman Richard Volz)

46. Parallel Processing of Best-First Branch and Bound Algorithms on Distributed Memory Multiprocessors, Tarek Saad Abdel-Rahman, The University of Michigan, 1989.
47. Bus and Cache Memory Organizations for Multiprocessors, Donald Charles Winsor, The University of Michigan, 1989.
48. High Performance Communications for Hypercube Multiprocessors, Gregory Dean Buzzard, The University of Michigan, 1988.
49. Recognition of Partially Occluded Parts, Jerry Lee Turney, The University of Michigan, 1986.
50. A Study in Memory Interference Models, H.B. Humoud, The University of Michigan, 1985.
51. A Stochastic Model of Multiprocessing, Brad Alan Makrucki, The University of Michigan, 1984.

Patents

Applications

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- T. Mudge, A. Pellegrini, B. VanderSloot, J. Pusdesris Y. Kang. Data Processing Apparatus with Memory Rename Table for Mapping Memory Addresses to Register. USPTO Application number 14/186,257. Filed February 21, 2014.

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- G. Blake, T. Mudge, S. Biles, R. Dreslinski, E. Özer, N. Chong. Contention Management for Hardware Transactional Memory. Application Number 12/292,565. November 20, 2008.

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- K. Flautner, D. Blaauw, T. Mudge, N. Kim, S. Martin. Drowsy Cache Data Processor Memory Circuit. USPTO 7,055,007. Issued May 30, 2006.

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- R. Lougheed, T. Mudge. Design Rule Checking Using Serial Neighborhood Processors. USPTO 4,510,616. Issued April 9, 1985.

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- R. Lougheed, T. Mudge. Design Rule Checking Using Serial Neighborhood Processors. USPTO 4,441,207. Issued April 3, 1984.

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- S. Bang, J. Wang, Z. Li, C. Gao, Y. Kim, Q. Dong, Y.P. Chen, L. Fick, X. Sun, R.G. Dreslinski, T. Mudge, H-S. Kim, D. Blaauw, D. Sylvester. A 288uW Programmable Deep Learning Processor with 270kB On-chip Weight Storage Using Non-uniform Memory Hierarchy for Mobile Intelligence. *2017 International Solid-State Circuits Conference*, to appear
- N. Pinckney, L. Shifren, B. Cline, S. Sinha, S. Jeloka, R. Dreslinski, T. Mudge, D. Sylvester, D. Blaauw. Impact of FinFET on Near-Threshold Voltage Scalability. *IEEE Design & Test*, to appear.
- T. Mudge, R. Sendag, F. Chong, J. Yi, I. Markov, D. Chiou. Impact of Future Technologies on Architecture. *IEEE MICRO*, the 4th Workshop on Computer Architecture Research Directions (CARD) in conjunction with ISCA, Portland, June 2015, to appear.
- H-M. Chen, S. Jeloka, A. Arunkumar, D. Blaauw, C-J. Wu, T. Mudge, C. Chakrabarti. Using Low Cost Erasure and Error Correction Schemes to Improve Reliability of Commodity DRAM Systems. *Transactions on Computers*, to appear.

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- H-M. Chen, C-J. Wu, T. Mudge, C. Chakrabarti. RATT-ECC: Rate Adaptive Two-Tiered Error Correction Codes for Reliable 3D Die-Stacked Memory. *ACM Transactions on Architecture and Code Optimization* (TACO), vol. 16, issue 3, September 2016, article 24, 24 pp.
- Y. Chen, N. Chiotellis, Li.-X. Chuo, C. Pfeiffer, Y. Shi, R. Dreslinski, A. Grbic, T. Mudge, David D. Wentzloff, D. Blaauw, and H.-S. Kim. Energy-Autonomous Wireless Communication for Millimeter-Scale Internet-of-Things Sensor Nodes. *IEEE Journal on Selected Areas in Communications-Series on Green Communications and Networking*: 3rd Issue, 2016

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- J. Hauswald, M. A. Laurenzano, Y. Zhang, C. Li, A. Rovinski, A. Khurana, R.G. Dreslinski, T. Mudge, V. Petrucci, L. Tang, J. Mars. Sirius Implications For Future Warehouse-scale Computers. *IEEE MICRO,* May/June 2016, vol. 36, no. 3, pp. 42-53. [**Top Pick: selected as one of the 12 best papers in computer architecture for 2015**]
- J. Hauswald, M. A. Laurenzano, Y. Zhang, C. Li, A. Rovinski, A. Khurana, R.G. Dreslinski, T. Mudge, V. Petrucci, L. Tang, J. Mars. Designing Future Warehouse Scale Computers for Sirius, an Open End-to-End Voice and Vision Personal Assistant. *ACM Trans. On Computer Systems*, 34, 1, Article 2, April 2016, 32 pp.
- Y. Chen, S. Lu, H-S. Kim, D. Blaauw, R.G. Dreslinski, T. Mudge. A Low Power Software-Defined-Radio Baseband Processor for the Internet of Things. *Proc. 22nd IEEE Int. Symp. on High Performance Computer Architecture (HPCA-22)*, March 2016, Barcelona, Spain, to appear.

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- T. Mudge. Special purpose VLSI processors for industrial robots. (text accompanying invited panel participation), *Proc. of the IEEE Computer Society's 5th Int. Computer Software and Applications Conf.*, Nov. 1981, pp. 270-271.
- L. Siegel, E. Delp, T. Mudge, and H. Siegel. Block truncation coding on PASM. *Proc. of the 19th Ann. Allerton Conf. Communications, Control, and Computing*, Oct. 1981, pp. 891-900.
- T. Mudge. Teaching assembly language using an assembly language interpreter. *Proc. of the 1981 National Conf. of the American Society for Engineering Education*, University of Southern California, June 1981, pp. 22-27. [**Winner of the Curtis Award for best paper in the Computers in Education Division.**]
- J. Turney and T. Mudge. VLSI implementation of a numerical processor for robotics. Proc. of the 27th Int. Instrumentation Symp., Indianapolis, Indiana, Apr. 1981, pp. 169-175. **[Received a Best Paper Award.]** Also presented at the Instrument Society of America Anaheim Conf., Oct., 1981.
- T. Mudge, R. Lougheed, and W. Teel. Cellular image processing techniques for checking VLSI circuit layouts. *Proc.of the 15-th Ann. Conf. on Information Sciences and Systems*, The Johns Hopkins University, Mar.1981, pp. 315-320.
- T. Mudge, R. Lougheed, and W. Teel. Cellular image processing techniques for checking VLSI circuit layouts. (Abstract) *Abstracts of the 1981 ACM Computer Science Conf.*, St. Louis, Feb. 1981, p. 29.
- T. Mudge. A course sequence in microprocessor-based digital systems design. *IEEE Trans. Education*, vol. E-24, no. 1, Feb. 1981, pp. 14-21. [**Honorable mention for runner-up to the best paper published in the Trans. in the year 1981**.]
- T. Mudge. Design language for asynchronous multiprocessor systems. (Abstract) *Report on the Workshop on Self-Timed Systems*, MIT, May 1980, p. 13.
- T. Mudge. A distributed operating system machine. Proc. of the Louisiana Computer Exposition on Distributed Systems Based on Mini and Micro Computers, University of Southwestern Louisiana, Mar. 1979, pp. 143-166.
- T. Mudge. A distributed operating system machine. *Proc. of the 1979 Conf. Information Sciences and Systems*, The Johns Hopkins University, Mar. 1979, pp. 472-477.
- T. Mudge. A computer architecture for parallel processing. *Proc. of the 16th Ann. Allerton Conf. Communications, Control, and Computing*, Oct. 1978, p. 596.
- T. Mudge. A data driven computer architecture. *Proc. of the 1978 Conf. Information Sciences and Systems*, The Johns Hopkins University, March 1978, pp. 365-370.

- J. Smith and T. Mudge. Characteristics of some augmented Petri nets. *Proc. of the 14th Ann. Allerton Conf. Circuit and System Theory*, Oct. 1976, pp. 606-615.
- T. Mudge. Specifying a design language for digital systems. *Proc. of the 13th Ann. Allerton Conf. Circuit and System Theory*, Oct. 1975, pp. 906-915.

Service

Editorships and Committees

- IEEE Fellows Committee 2008-9
- ACM SIGBED executive Committee, 2003-present
- ACM TECS Associate Editor, 2003-2010

Steering Committees

- Int. Conf. on Compilers, Architectures and Synthesis for Embedded Systems (CASES): 2005 – present
- Embedded Systems Week (ESWeek): 2006 – present
- Int. Symp. on High Performance Computer Architecture (HPCA): 2004 - present

Conference General Chair

- Int. Conf. on Compilers, Architectures and Synthesis for Embedded Systems (CASES) , Oct. 2002 (co-chair)
- Annual IEEE/ACM International Symposium on Microarchitecture (MICRO-28), Dec. 1995

Program Chair

- 13th Int. Symp. on High Performance Computer Architecture (HPCA), 2006 (co-chair)
- Int. Conf. on Compilers, Architectures and Synthesis for Embedded Systems (CASES), Nov. 2001 (co-chair)
- 24th Int. Symp. on Computer Architecture (1997), Ann Arbor, Michigan (vice-chair)
- Vice-Chair for the IPPS-94
- 21st Int. Conf. on Parallel Processing (ICPP), (co-chair)
- 11th Int. Symp. on Computer Architecture (1984), Ann Arbor, Michigan (vice-chair)

Program Committee

- Int. Symp. on Computer Architecture

  ISCA-33 2006; ISCA-28 2001; ISCA-26 1999; ISCA-24 1997; ISCA-23 1996; ISCA-20 1993; ISCA-18 1991; ISCA-16 1989; ISCA-15 1988; ISCA-7 1980
- Annual IEEE/ACM International Symposium on Microarchitecture

  MICRO-42 2009; MICRO-33 2000; MICRO-30 1997; MICRO-29 1996; MICRO-27 1994
- Int. Symp. on High Performance Computer Architecture

HPCA-8 2002; HPCA-7 2001; HPCA-6 2000; HPCA-3 1996; HPCA-1 1994

- Int. Symp. on Low Power Electronics and Design (ISLPED) 2006
- Design Automation Conf. (DAC) 2005
- 5th International Conference on Supercomputing, Sorrento, Italy, June, 2001
- South African Inst. of Comp. Scientists & Info. Technologists, Ann. Res. Conf., 2000.
- Architectural Support for Programming Languages and Operating Systems IX (ASPLOS), Dec. 2000
- Advanced Research in VLSI, Sep. 1997
- 6th Ann. ACM Symp. on Parallel Algs and Archs (SPAA '94)
- Int. Symp. on High Performance Distributed Computing

  HPDC-3; HPDC-2

Workshops

- 4th Workshop on Multithreaded Execution, Architecture and Compilation (MTEAC-4)
- Workshop Chairman 16th Symp. on Computer Architecture (1989), Eilat, Israel

Workshops and Reviewing--numerous

Consulting—upon request

EXHIBIT 8

Michael C. Brogioli, Ph.D.

Contact Information

Michael C. Brogioli, Ph.D.
Polymathic Consulting
100 Congress Avenue, Suite 2000
Austin, TX 78701 USA

Office: (512) 370-4936
Cell (preferred): (713) 732-0217
Fax: (512) 469-6306
E-mail: michael@polymathicconsulting.com

Education

Rice University, Houston, Texas USA

Ph.D., Electrical and Computer Engineering, 2007

- Dissertation Topic: "Reconfigurable Heterogeneous DSP/FPGA Based Embedded Architectures for Numerically Intensive Embedded Computing Workloads."
- Advising Committee: Dr. Joseph R. Cavallaro, Dr. Keith D. Cooper, Dr. Scott Rixner

Rice University, Houston, Texas USA

M.S., Electrical and Computer Engineering, 2003

- Dissertation Topic: "Dynamically Reconfigurable Data Caches in Low Power Computing."
- Advising Committee: Dr. Keith D. Cooper, Dr. Scott Rixner, Dr. Robert Jump

Rensselaer Polytechnic Institute, Troy, New York USA

B.S., Electrical Engineering, Cum Laude - 1999

- Advisor: Dr. William Pearlman

Professional Experience

Polymathic Consulting, TX USA
Managing Director **2011 - Present**
Founder and managing director of Polymathic Consulting, servicing clients ranging from early stage technology start up endeavors to Fortune 100 and beyond. Clients turn to Polymathic for expansive, proven engineering, research and development, intellectual property and technical leadership to effectively advance their real world business needs.

IEEE and ACM Design Automation Conference, USA
Chair, Embedded Systems and Software Track **2016 - Present**
Design Automation Conference is the premiere technical conference and trade show specializing in Hardware, Software, Internet of Things, Embedded Systems and related Design Methodologies. Conference chair, responsible for the review, critique, and acceptance of academia and industry based publications in the areas of embedded systems, embedded software, and embedded system design.

Rice University, TX USA
Adjunct Professor, Electrical and Computer Engineering **2009 - Present**
Professor of Ph.D. candidate level courses in wireless telecommunications, embedded computing software, embedded computing hardware, and software/hardware optimization in modern computing systems utilizing modern high level programming languages. Advisor of senior and graduate student based projects revolving around multi-core heterogeneous systems as they pertain to wireless telecommunications, medical and video.

Freescale Semiconductor, TX USA
Chief Architect, Senior Member Technicial Staff **2009 - 2011**
Technical architect of Freescale's DSP compilers and related technology. Responsible for management of technology, engineering roadmaps, design lead on compiler infrastructure and optimizations (high level and low level), next generation ABI definitions and next generation architecture solutions.

Technical lead on multi-year engagement with processor architects in design of next generation DSP cores. Developed software infrastructure for migrating OEM competitor software stacks to Freescale solutions, tools generation, software packages, migration strategies and white papers. Technical lead on Tier-1 OEM customer relationships, evaluations of 3rd party technologies for potential partnerships and acquisitions, lead various university research collaborations on behalf of Freescale. Development and deployment of internal software engineering policies and practices.

Freescale Semiconductor, TX USA
Senior Compiler Engineer V
High Performance Compiler Design, Processor Architecture **2008 - 2009**
Team leader on compiler engineering effort to provide intuitive, interactive end user experience for DSP compiler tool suite. Designed a framework to guide users in achieving highly optimized compiled VLIW code. Assembly listing reports for optimization failure advice, porting advice when migrating from competitor architectures, advice on code modifications for optimization enablement. Lead designer, engineering effort director, project planning and scoping, release schedule, and drafting of specification. Development of various compiler optimizations for VLIW processing as well as software emulation layers for running competitor software solutions on Freescale silicon.

Advising of next-gen DSP core architecture team in creating a highly orthogonal, compiler targetable multi-clustered VLIW based digital signal processor architecture. Work with future basestation architecture teams on designing next-gen basestation architecture for 4G LTE incorporating control and data plane processing with appropriate programming models.

Method Seven, MA USA
Technical Co-Founder
High Performance Software and Hardware Systems Architecture **2006 - 2007**
Founded Method Seven, a financial engineering company applying biologically inspired machine learning to financial market analysis. Principal software systems architect and hardware systems architect for both research and deployment platforms. Lead research and development of platform for scans and overlays covering the NASDAQ, NYSE, and AMEX markets using proprietary technologies.

Texas Instruments, TX USA
Advanced Architecture and Chip Technologies
Microprocessor and Systems Architecture **2005**
System modelling and architectural exploration of Davinci^{TM}system-on-chip (SOC) architecture designed for embedded video processing. SystemC based simulation models of on–chip crossbars, bus arbitration and bridge technology, as well as on–chip and off–chip memory controllers within application specific heterogeneous SOC architectures.

Fulbright and Jaworski LLP, TX USA
Technical Expert, Intellectual Property **2005 - 2007**
Intellectual property consultant and technology advisor on litigation and prosecution work including, but not limited to: CDMA2000 3G wireless standards, wireless communications systems, embedded computing, and large scale modular software systems. Reverse engineering of source code varying from VHDL to high level object oriented applications, as well at patent prosecution and litigation work.

Intel Corporation, CA USA
Microprocessor Research Labs
Compiler Engineering **2000**
Implemented speculative multi–threading support in Intel's IA–64 compiler. Developed new program analysis and back end code generation phases to support speculatively launching threads at runtime. Analyzed the performance potentials of SPEC95 benchmarks with respect to speculatively multi–

threaded execution.

Vicarious Visions, NY USA
Lead Software Engineer **1999**
Principal engineer on Activision's "AMF Extreme Bowling" for Nintendo's Color Gameboy gaming console. Developed PC based audio and graphics development tools suite for use with Color Gameboy game production. Coded innovative, highly optimized assembly routines for real time speech and full motion video on the console's limited Zilog Z80 processor resources.

Stratus Computer, MA USA
Hardware Engineering **1997 - 1998**
Debugged locked step CPU operation and memory management issues in Stratus' fault tolerant UNIX release 3.4. Qualified Hewlett Packard PA–8000 series CPU modules under Stratus' proprietary OS release, VOS 14.0, during alpha and beta test phases. Wrote C code and UNIX shell scripts for recreating documented system failures, and to automate remote kernel updates and OS installs as well as data logging.

Rensselaer Polytechnic Institute, NY USA
Digital Microelectronics Design (Undergraduate Instructor) **1997 - 1998**
Undergraduate instructor of undergraduate courses in digital microelectronics and circuit design. Instructed weekly lessons, computer design labs, graded exams and problem sets.

Rensselaer Electric Motor Sports, NY USA
Hardware and Software Engineering **1995 - 1997**
Hardware and software co-design of embedded operating system and hardware platform for electrical vehicle prototypes, running on 16-bit Motorola 68K dual processor platform. Designed power enginering test platform for dynamometers. This project was funded by, and led by General Motors Corporation and Honda of America.

Books and Contributed Chapters

Brogioli, M. C., *On Cloud Computing, Data Security, and Medical Devices*, Software Development for Networking Applications – Expert Guides Series, pp. TBD, Elsevier Publishing, Atlanta, GA, 2017 (print).

Brogioli, M. C., *A Brief History of Wireless Telecommunications Networks*, Software Development for Networking Applications – Expert Guides Series, pp. TBD, Elsevier Publishing, Atlanta, GA, 2017 (print).

Brogioli, M. C., *Networking Protocols, OSI 7 Layer Model In Networking and Communications Protocols for Data, Voice, and Beyond.*, Software Development for Networking Applications – Expert Guides Series, pp. TBD, Elsevier Publishing, Atlanta, GA, 2017 (print).

Brogioli, M. C., *Case Study: Mobile Computing, Cloud Computing, and Data Security*, Software Development for Networking Applications – Expert Guides Series, pp. TBD, Elsevier Publishing, Atlanta, GA, 2017 (print).

Wu, Michael and Sun, Yang and Wang, Guohui and Brogioli, M.C. and Cavallaro, J. R., *Implementation of a High Throughput 3GPP Turbo Decoder on GPU Architectures*, Software Development for Networking Applications – Expert Guides Series, pp. TBD, Elsevier Publishing, Atlanta, GA, 2017 (print).

Brogioli, M. C., *On The C++ Programming Language for Embedded Software, Systems, and Platforms*, Software Engineering for Embedded Systems – Expert Guides Series, Elsevier Publishing, Atlanta, GA, 2013.

Brogioli, M. C., *Software Optimizations for Memory Performance in Embedded Systems*, Software Engineering for Embedded Systems – Expert Guides Series, Elsevier Publishing, Atlanta, GA, 2013.

Invited Co-Author, *Signal Processing Systems Handbook, Second Edition*, Springer Publishing Company, 11 West 42nd Street, New York, NY, 2012.

Brogioli, M. C., *Software Programmable DSP Architectures*, Expert Guide DSP for Embedded and Real-Time Systems, pp. 63-75, Elsevier Publishing, Atlanta, GA, 2012.

Brogioli, M. C., *The DSP Hardware / Software Continuum*, Expert Guide DSP for Embedded and Real-Time Systems,, pp. 103-113, Elsevier Publishing, Atlanta, GA, 2012.

Brogioli, M. C., *DSP Optimization - Memory Optimization*, Expert Guide DSP for Embedded and Real-Time Systems, pp. 217-241, Elsevier Publishing, Atlanta, GA, 2012.

Brogioli, M. C. and Dew, Stephen, *Optimizing DSP Software - High level Languages and Programming Models*, Expert Guide DSP for Embedded and Real-Time Systems,, pp. 167-179, Elsevier Publishing, Atlanta, GA, 2012.

Sun, Yang, Amiri, Kiarash, Brogioli, Michael, Wang, Guohui, and Cavallaro, Joseph R., *DSP Hardware Accelerator Architectures for Communication Applications*, Springer Publishing, New York, NY, Spring 2012.

Invited Co-Author, *Signal Processing Systems Handbook, First Edition*, Springer Publishing Company, 11 West 42nd Street, New York, NY, 2010.

Publications and Invited Papers

Moats, Richard, and Games, Bill, and Brogioli, M. C., *Network Native - The Next Wave of Connected Embedded Development*, Network Native Inc., Austin, Texas, 2017.

Moats, Richard, and Games, Bill, and Brogioli, M. C., *Arch - A New Language For The Next Wave of Network Cconnected Embedded Development*, Design Automation Conference, Austin, Texas, 2017 (submitted).

Invited Paper, Arokia I, Brogioli, Michael, Jain, Nitjin and Garg, Umang, *LTE Layer 1 Software Design on Heterogeneous Multicore DSP Platforms*, IEEE 45th Asilomar Conference on Signals, Systems and Computers, Pacific Grove, CA, 2011.

Kyriakopoulous, Konstantinos, Brogioli, Michael C., and Zhang, Ruihao, *Improving Software Systems Quality through Well Defined Development Methodologies*, 2011 Test Methodology and Efficiency Symposium, Freescale Semiconductor, Austin, TX, USA, 2011.

Brogioli, M.C., and Cavallaro, J.R., *Compiler Driven Architecture Design Space Exploration for Embedded DSP Workloads: A Study in Software Programmability Versus Hardware Acceleration*, IEEE 43rd Asilomar Conference on Signals, Systems and Computers, Pacific Grove, CA, 2009.

Brogioli, M.C., and Zhang, Ruihao, *Compiler Feedback: Guiding Performance of Compiled C Code*, Freescale Semiconductor White Paper, Austin, TX, 2009.

Brogioli, M.C., and Cavallaro, J., *RISD: A Retargetable Compiler Infrastructure for Scalable Multi-Clustered VLIW DSP Architectures*, IEEE 5th Dallas Circuits and Systems Workshop, Dallas, TX, 2007.

Brogioli, M.C., Radosavljevic, P., and Cavallaro, J., *A General Hardware/Software Codesign Methodology for Embedded Signal Processing and Multimedia Workloads*, IEEE 40th Asilomar Conference

on Signals, Systems, and Computers, Pacific Grove, CA, 2006.

Brogioli, M.C., Radosavljevic, P., and Cavallaro, J., *Hardware/Software Co-design Methodology for DSP/FPGA Partitioning: A Case Study for Meeting Real-Time Processing Deadlines in 3.5G Mobile Receivers*, 49th IEEE International Midwest Symposium on Circuits and Systems, San Juan, Puerto Rico, 2006.

Brogioli, M.C., Willmann, P.D., and Rixner, S., *Parallelization Strategies for Network Interface Firmware*, IEEE/ACM 4th Annual Workshop on Optimizations for DSP and Embedded Systems (In Conjunction with IEEE/ACM International Symposium on Code Generation and Optimization), Manhattan, NY, 2006.

Brogioli, M.C., Gadhiok, M., and Cavallaro, J., *Design and Analysis of Heterogeneous DSP/FPGA Based Architectures for 3GPP Wireless Systems*, IEEE Real-Time and Embedded Technology and Applications Symposium Work-in-Progress Sessions, San Jose, CA, 2006.

Brogioli, M.C., and Cavallaro, J., *Modelling Heterogeneous DSP-FPGA Based System Partitioning with Extensions to the Spinach Simulation Environment*, IEEE 39th Asilomar Conference on Signals, Systems, and Computers, Pacific Grove, CA, 2005.

Brogioli, M.C., Pai, V.S., Willmann, P.D., *Spinach: A Liberty–Based Simulator For Programmable Network Interface Architectures*, ACM SIGPLAN/SIGBED Conference on Languages Compilers and Tools for Embedded Systems, San Diego, CA, 2004.

Brogioli, M.C., *Dynamically Reconfigurable Data Caches in Low Power Computing*, Masters Thesis, Rice University, Houston Texas, 2002.

Patents

Michael C. Brogioli, Ph.D., Cesar Taylor M.D., and Howard Roberts, *Location Agnostic Platform for Medical Condition Monitoring and Prediction and Method of Use Thereof*, Patent No: 147145.010100/US, 2014.

Cesar Taylor M.D., and Michael C. Brogioli Ph.D., and Howard Roberts, *System for Holistic Pain Monitoring and Prediction and Method of User Thereof*, Patent No: 147145.010200/US, 2014.

Cesar Taylor M.D., and Michael C. Brogioli Ph.D., and Howard Roberts, *System for Prevention of Narcotic Diversion and Method of Use Thereof*, Patent No: 147145.010300/US, 2014.

Howard Roberts, Cesar Taylor M.D., and Michael C. Brogioli Ph.D., *Magnetometer Breathing Sensor and Method of User Thereof*, Patent No: 147145.010400/US, 2014.

Corporate Board Membership

Southwest Angel Network for Social Impact, TX USA
Board of Directors, Co-Founder **2015 - Present**
The Southwest Angel Network for Social Impact (SWAN Impact) is a community of like-minded investors who enjoy working together to *Make the world a better place, one company at a time.* We believe that we can have the most significant impact by funding for-profit start-up companies who are building sustainable businesses.

Network Native, TX USA
Board of Directors, Co-Founder **2015 - Present**
Board member and co-inventor, advising in the areas of Internet of Things technologies, specifically related to product developer solutions, programming languages and platforms, security and infrastrucure. Business development, marketing, and fund raising.

NewCrew, TX USA
Advisory Board **2015 - 2016**
Board member advising in the areas of mobile computing, social computing, and geofencing technologies. Business development, marketing, and fund raising.

AngelSpan, TX USA
Advisory Board **2015 - 2016**
Board member advising in the areas of professional investor relations to startups, resource allocation, and a platform for increased efficiency and valuation of early stage companies and venture capital portfolios.

Capital Factory, TX USA
Mentor **2014 - Present**
Mentor, advisor and investor in one of the most successful start-up accelearators in the United States.

Student Loan Genius, TX USA
Advisory Board **2013 - 2015**
Board member advising in the areas of financial transactions systems and enterprise software, as they pertain to solving the student loan debt crisis for early stage science, technology, engineering and medicine (STEM) employees. Technology, recruiting, fund raising.

HealthBits, TX USA
Board Member, Co-Inventor **2013 - 2014**
Board member advising in the areas of large scale enterprise software systems, real-time computing and medical sensing devices across complex event processing systems.

Incubation Station, TX USA
Mentor **2013 - 2014**
Incubation Station is an accelerator that brings together a consortium of Austins notable entrepreneurs, investors and advisors for the purpose of mentoring high-potential, market-validated consumer product companies to more effectively manufacture, distribute, market and grow their products and services.

Osmek, TX USA
Interim CTO, Advisory Board **2012 - 2014**
Interim CTO and board member advising in the areas of large scale cloud based content management software systems. Providing innovative media content management for heterogeneous web enabled devices with geolocational services, primarily using PHP and Python programming languages.

Academia

Rice University, Houston, Texas USA
DSP Compiler Design **2005 - 2009**
Developed *RISD*, a retargetable compiler infrastructure for clustered VLIW DSP architectures. By taking pre-existing code schedules and binaries for existing DSP applications, RISD takes a flexible machine definition for which the code should be recompiled. Users can specify the number of VLIW clusters, functional units per VLIW cluster, functional unit mix per VLIW cluster, register file sizes, cluster interconnect topology (point-to-point versus 2d mesh network), multi-cluster scheduling algorithms, and inter-cluster cross-register file bandwidth and latencies.

Compiler framework was used to perform compiler driven design space exploration of massively multi-clustered VLIW based architectures versus FPGA and ASIP implementations of software kernels. RISD was used in studies comparing tradeoffs in computational throughput versus gates required to implement programmable DSP cores containing many register files and VLIW compute clusters, versus FPGA efficiency when including routing overhead for large scale problems.

Rice University, Houston, Texas USA
DSP/FPGA Based System-On-Chip Architectural Simulator Design **2004 - 2009**
Developed *Spinach DSP-FPGA*, a modular and composable simulator design infrastructure for programmable and reconfigurable embedded SOC architectures. Designed and developed modular and composable software modules to bit-true, cycle accurately simulate Texas Instruments C62x and C64x DSPs and MIPS style processors. Additionally designed and developed support for SRAM and DRAM style memories, heterogeneous memory systems, heterogeneous clock domains, as well as runtime reconfigurable Xilinx Virtex II based FPGA computing elements, cache and memory controllers, bus arbiters, and on chip interconnect fabric.

System was validated against compiled code DSP firmware from Texas Instruments' Code Composer Studio running on the simulator versus actual hardware benchmarks. Simulation platform was used to investigate highly heterogeneous multi-processor DSP based SOC architectures containing one or more Xilinx style FPGA based hardware coprocessors. Studies in 3.5G wireless telecommunications as well as H.26x video processing were performed to gain insight into overall system bottlenecks, hardware and software partitioning strategies, and tradeoffs of overall system design.

Rice University, Houston, Texas USA
Programmable Network Interface Architecture Simulator Design **2002 - 2004**
National Science Foundation Grant Nos. CCF-0532448 and CNS-0532452
Developed *Spinach*, a simulator design toolset for modelling programmable network interface architectures. Spinach models system components common to all programmable environments (ALUs, control and data paths, register files, instruction processing), as well as components specific to embedded computing (software controlled SRAM scratchpad memory, hardware assists for DMA and medium access control). Spinach is a simulator design infrastructure, rather than a simulator per se. As such, the same underlying C code framework is used to model a uniprocessor Gigabit network interface, a multi-processor Gigabit network interface, or a 10 Gigabit multi-processor network interface with highly heterogeneous memory system. Only a small number of lines of high level scripting language code is required to describe each of the various systems.

Spinach was validated by modeling the Tigon-2 programmable Ethernet controller by Alteon Websystems, running actual compiled code Ethernet processing firmware and by comparing the reported results to actual hardware benchmarks. Spinach was also used to obtain new insights into the performance of Gigabit and 10 Gigabit network interfaces both in terms of hardware architecture and firmware parallelization strategies. *Public Website: https://sourceforge.net/projects/spinach/*

Rice University, Houston, Texas USA
Software Engineering and Consulting **2000**
Implemented instruction selection and register allocation optimizations in UHFFT, an adaptive and portable software library for the Fast Fourier Transform. Performed in depth analysis of register pressure, compiler generated spill code, memory hierarchy utilization, and instruction selection for non–trivially sized FFT matrices running on commercially available hardware platforms. Utilized reverse Cuthill–McKee technique to achieve near optimal computation orderings and minimize live data set sizes, as well as optimize register allocation and instruction selection phases of compilation.

Appointed Conference Committees and Organizations

IEEE and ACM Design Automation Conference, USA
Program Committee, Embedded Systems and Software **2014 - 2015**
Program Committee member responsible for the review, critique, and acceptance of academia and industry based publications in the areas of embedded systems, embedded software, and embedded system design. Design Automation Conference is an annual technical conference and trade show specializing in electronic systems.

IEEE and ACM Design Automation Conference, USA
Program Committee, Designer and User Track **2011 - 2015**

Program Committee member responsible for the review, critique, and acceptance of academia and industry based publications in the areas of automated system design, both of hardware, software, and system analysis. Design Automation Conference is an annual technical conference and trade show specializing in electronic systems.

Rice Alliance for Technology and Entrepreneurship Austin, Texas, USA
Executive Committee **2009 - Present**
The Rice Alliance for Technology and Entrepreneurship strives to improve the entrepreneurial ecosystem of Central Texas by: helping entrepreneurs successfully found, fund, grow and exit new companies, helping investors successfully identify and engage with promising new ventures, and showcasing emerging technologies and business models to further educate and engage the community.

OwlSpark - Rice University, Houston, Texas, USA
Mentor **2014**
Mentor and advisor to university based early stage technology companies withing Rice University's accelerator program.

ACM Great Lakes Symposium on VLSI, Stresa-Lago Maggiore, Italy
Reviewer **2007**
Reviewer and committee member in the area of system-on-chip architectures, VLSI design, and compiler driven architecture design space exploration.

Expert Witness, Consultant

Certain Memory Modules and Components Thereof, and Products Containing Same, Investigation No. 337-TA-1023
Mintz Levin Cohn Ferris Glovsky and Popeo PC, Boston, MA, USA
Expert Witness in Computer Architecture and Memory Systems **2017 - Present**
Expert witness in computer architecutre as it pertains to computer memory systems and DRAM technology.

Certain Audio Processing Hardware, Software, and Products Containing Same, Inv. No. 337-TA-1026
Andrea Electronics Corporation Pepper Hamilton, LLP, Washington, DC, USA
Expert Witness in Audio Processing Hardware and Software **2017 - Present**
Expert witness in hardware/software based digital signal processing systems tailored for audio processing and noise cancellation technology.

Specialized Monitoring Solutions, LLC v. Lutron Electronics Co., Inc.
Vinson & Elkins LLP, Texas USA
Expert Witness in Embedded and Distributed Software Systems **2017**
Expert witness in embedded software and hardware systems, as well as distributed data storage and sensing.

Huawei Technologies Co., Ltd., v. Samsung Electronics America, Inc. et al
Sidley Ausin LLP, California USA
Expert Witness in 4G and Legacy Cellular Technologies **2016 - Present**
Expert witness in 4G and legacy cellular technologies as they pertain to handoff between core network infrastructure.

Godo Kaisha IP Bridge 1 v. Broadcom Limited et. al
Ropes & Gray LLP, New York USA
Consultant in Embedded Computer Architecutre **2016 - Present**
Consultant in the area of ARM based embedded computing architecture and system on chip technology. Reverse engineering of VHDL, Verilog and RTL based technologies, as it pertains to multicore system architecutres.

Andrea Electronics Corporation
Pepper & Hamilton LLP, Massachusetts USA
Expert Witness in Digital Signal and Audio Processing **2016 - Present**
Expert witness in hardware/software based digital signal processing systems tailored for audio processing and noise cancellation technology.

Huawei Technologies Co. Ltd. v. T-Mobile US, Inc. and T-Mobile USA, Inc.
Fish & Richardson P.C., Texas USA
Expert Witness in 4G and Legacy Cellular Technologies **2016 - Present**
Expert witness in 4G and legacy cellular technologies as they pertain to handoff between core network infrastructure.

ACI Worldwide Corp. v. Mastercard International Incorporated
Armstrong Teasdale LLP, Missouri, USA
Expert witness regarding financial transaction systems **2016 - Present**
Expert witness in trade secret misappropriation as it pertains to middleware message passing systems and financial transaction networks.

Sony Computer Entertainment America LLC v. Rothschild Digital Media Innovations LLC
Carey Rodriguez Milian Gonya, LLP, Florida, USA
Expert witness regarding distributed multimedia systems **2016**
Expert witness in the area of distributed computing systems and multimedia technologies.

Undisclosed Technology Company
Merger and Acquisition, Asset Monetization, California, USA
Venture Capital Fund Raising, Portfolio Valuation **2015 - 2016**
Analyzed patent portfolio of target companies, valued assets, assessed total addressable market size, and raised appropriate venture capital.

DTS, Inc., et al. v. Nero AG, et al.
Glaser Weil Fink Jacobs Howard Avchen & Shapiro, Los Angeles CA, USA
Expert Witness in Audio and Video Software, Intellectual Property **2015 - 2016**
Expert witness in the area of software solutions for audio and video codecs.

Advanced Silicon Technologies
Mintz Levin Cohn Ferris Glovsky and Popeo PC, Boston, MA, USA
Expert Witness in Microprocessor Architecture, Intellectual Property **2015 - 2016**
Consultant in the area of computer architecture and microprocessor technologies.

Certain Audio Processing Hardware and Software and Products Containing the Same, ITC Inv. No. 337-TA-949
Lenovo (United States), Inc.
Toshiba Corp
Akin Gump Strauss Hauer & Feld LLP, Philadelphia, PA, USA
Expert Witness in Digital Signal Processing, Intellectual Property **2015 - 2016**
Expert witness in hardware/software based digital signal processing systems tailored for audio processing and noise cancellation technology.

Intel Corporation v. Future Link Systems
Irell & Manella LLP, Los Angeles, CA USA
Expert Witness in Computer Architecture and System Interconnect Technology **2015 - Present**
Expert witness in the areas of computer architecutre, system-on-chip technology, and computer bus architecutres.

Advanced Touchscreen and Gesture Technologies, LLC v. Samsung Electronics, America, Inc., et al.
Robins Kaplan LLP, Intellectual Property, Minnesota, USA
Expert Witness in Software Systems for Mobile Devices and User Interfaces **2015 - Present**
Expert witness in the analysis and reverse engineering of software systems pertaining to mobile devices, and human computer interfaces.

Intellectual Ventures v. Ericsson et al.
Dechert LLP, Los Angeles, CA, USA
Expert Witness in 3GPP standards and LTE Technologies, Intellectual Property **2014 - 2016**
Expert witness in 3GPP standards as they pertain to LTE cellular communications networks, in addition to system hardware and software design.

Papst Licensing GMBH & Co. KG.
DiNovo & Price Ellwanger Hardy, Austin, TX USA
Consultant in FPGA Technologies, Intellectual Property **2014 - 2015**
Consultant in FPGA computing platforms and design flow processes, prior art, and infringement analysis.

Locata LBS v. Paypal Inc., et al.
Glaser Weil Fink Jacobs Howard Avchen & Shapiro, Los Angeles, CA, USA
Expert Witness in Geofencing Systems, Intellectual Property **2014 - 2015**
Expert witness in geofencing technology, geolocational technology, and systems architecture as it pertains to mobile cellular telecommunications and enterprise software systems.

Cell and Network Selection LLC v. AT&T Mobility LLC and MetroPCS Communications Inc.
Pillsbury, Winthrop Shaw & Pittman, San Diego, CA, USA
Expert Witness in 3G/4G Cellular Handset Technology, Intellectual Property **2014 - 2015**
Expert witness in technology pertaining to 3G, 3.5G, 3.75G and 4G wireless handset technology.

CA Inc. D/B/A CA Technologies v. AppDynamics, Inc.
Bracewell & Giuliani, Houston, TX, USA
Holland & Knight, Boston MA USA
Expert Witness in Computer Performance Monitoring, Intellectual Property **2014 - 2015**
Expert witness in technology pertaining to dynamic runtime profiling of distributed software applications, specifically around Java and C technologies. Expert report generation, source code review, deposition testimony, pending trial testimony.

M Seven System Limited v. Leap Wireless International, Inc., et al.
Glaser Weil Fink Jacobs Howard Avchen & Shapiro, Los Angeles, CA, USA
Expert Witness in 3G/4G Feature Phone Software Systems, Intellectual Property **2014**
Expert witness in the area of mobile telecommunications technology, particularly cellular telephone hardware and software design.

Lunareye v. Gordon Howard Associates, Inc.
Conley Rose, P.C., Austin, Austin, TX, USA
Expert Witness in Cellular Communications Software and Hardware Systems **2014**
Technical expert in the area of mobile telecommunications technology, particularly cellular telephone hardware and software design.

Certain Wireless Devices With 3G and/or 4G Capabilities and Components Thereof, ITC Inv. No. 337-TA-868
Interdigital, Inc. Wilson, Sonsini, Goodrich & Rosati LLP, Austin, TX, USA

Expert Witness in 3G/4G Software and Hardware systems, Intellectual Property **2013 - 2015**
Expert witness in software systems and hardware systems, as they pertain to 3G/4G cellular communications and standards.

Investment Technology Group v. United States Internal Revenue Services
Investment Technology Group, New York, NY USA
Expert Witness in Financial Services Technology **2013**
Expert witness in the area of high performance software systems targeting financial market services.

Carrier Corporation v. Goodman Manufacturing, et al.
Baker Botts LLP, Houston, TX USA
Expert Witness in Software and Hardware Systems, Intellectual Property **2013 - 2014**
Expert witness in the area of microprocessor based, serial distributed communications systems.

Gametek LLC v. Facebook Inc. et al.
Collins, Edmonds, Porgorzelski, Schlather & Tower PLLC, Houston, TX USA
Expert Witness in Internet Based Gaming Technologies, Intellectual Property **2013**
Expert witness in internet based client-server software systems for mobile and web browser based gaming technology.

Ultimate Pointer LLC v. Nintendo Co. LTD et al.
Conley Rose P.C., Houston, TX USA
Expert Witness in Console Based Video Game Technology, Intellectual Property **2013 - 2015**
Expert witness in hardware and software systems for console based video game technology.

Alliantgroup, L.P. v. Tax Point Advisors
Jeffrey Feingold and Tax Point Advisors, Houston, TX USA
Expert Witness in Internet Technology **2013**
Expert witness in IP based internet technology, packet spoofing and information systems.

Kerry T. Thibodeaux, M.D. v. American Lifecare Inc.
Cox, Cox Filo, Camel & Wilson, Lake Charles, LA USA
Expert Witness in Medical Software Systems **2013**
Expert witness in medical billing and expense recording enterprise software systems.

Opelousas General Hospital Authority et al v. Fairpay Solutions Inc
Cox, Cox Filo, Camel & Wilson, Lake Charles, LA USA
Expert Witness in Medical Software Systems **2013**
Expert witness in medical billing and expense recording enterprise software systems.

Wi-LAN USA, Inc. and Wi-LAN, Inc. v. Alcatel-Lucent USA Inc.
Vinson Elkins LLP, Dallas, TX USA
Expert Witness in 3GPP LTE Technology, Intellectual Property **2012 - 2013**
Reverse engineering, analysis and education of counsel in the 3GPP LTE specification, and related software and hardware systems.

Wi-LAN USA, Inc. and Wi-LAN, Inc. v. Ericsson Inc., and Telefonaktiebolaget LM Ericsson
Vinson Elkins LLP, Dallas, TX USA
Expert Witness in 3GPP LTE Technology, Intellectual Property **2012 - 2013**
Reverse engineering, analysis and education of counsel in the 3GPP LTE specification, and related software and hardware systems.

E-Contact Technologies, LLC v. Dell Inc., et al.

Baker Botts LLP, Houston, TX USA
Expert Witness in Android Operating System and Related Technology, Intellectual Property **2012**
Reverse engineering and analysis of the Android operating system as it pertained to mobile and tablet computing devices. Source code reverse engineering, system architecture and related analysis.

CheckFree Corporation and CashEdge, Inc. v. Metavante Corporation and Fidelity National Information Services, Inc.
Paul, Weiss, Rifkind, Wharton & Garrison LLP, New York, NY USA
Expert Witness in Banking and Billing Software Systems, Intellectual Property **2012**
Software systems analysis and reverse engineering of large scale software based financial billing systems. Source code reverse engineering, claim chart generation, expert report generation and testimony.

Realtime Data, LLC v. NASDAQ, Chase Bank, Goldman Sachs et al.
Proskauer Rose LLP, New York, NY USA
Expert Witness High Performance Software Systems, Intellectual Property **2012**
Expert witness for joint defense counsel in the matter of large scale high frequency financial data aggregation platforms. Claim chart generation, expert report generation and deposition with testimony pending.

Realtime Data, LLC v. Thomson Reuters et al.
Vinson & Elkins LLP, Austin, TX USA
Consultant in High Performance Software Systems, Intellectual Property **2011 - 2012**
Software systems analysis and reverse engineering of large scale high frequency financial data aggregation platforms, as it pertains to data throughput and compression technology. Computer source code reverse engineering, claim chart generation, assistance with claim construction, and education of counsel.

General Electric Co. v. Mitsubishi Heavy Industries Ltd.
Weil, Gotshal & Manges LLP, Dallas, TX USA
Expert Witness in Hardware/Software Analysis, Intellectual Property Litigation **2010 - 2011**
Reverse engineering of real-time embedded system software source code and hardware system architecture pertaining to variable speed wind turbines and FPGA based sub-systems.

Atlantic Specialty Insurance et al v. AE Outfitters Retail Company, et al
Smith Mazure Director Wilkins Young & Yagerman, P.C. New York, NY USA
Expert Witness in Embedded Hardware/Software Systems **2011**
Hardware and software system analysis of real-time networked embedded computing systems as it pertains to fire alarm infrastructure and fault handling.

Gamestop, Inc v. Bexar Appraisal
Brusniak and Blackwell PC, Dallas, TX USA
Expert Witness in Software Analysis, Intellectual Property Litigation **2011**
Expert witness on the tangibility of software as it pertains to embedded computing, networking, and gaming platforms. Expert report production, tentative depositions and trial services.

Quality Analytic Systems, Inc. v. Zebec Data Systems
Rymer, Moore, Jackson & Echols, P.C., Houston, TX USA
Expert Witness in Software Systems **2011**
Reverse engineering and software analysis of enterprise level internet based medical billing software systems.

Passlogix, Inc. v. 2FA Inc.
Expert Witness in Smart Card Middleware Solutions, Trade Secret Exposure **2010**

Trade secret analysis of software and systems architecture as it pertains to optimal selection of smart card middleware solutions on a given computer system.

Terra Nova Sciences et al. v. JOA Oil and Gas, B. V. et al.
Abraham & Watkins et al. LLP, Houston, TX USA
Expert Witness in Software Systems, Intellectual Property Litigation **2010**
Expert software analyst of algorithms and geomechanics modeling systems as they pertain to oil well reservoirs.

Paltalk Holdings, Inc. v. Sony Computer Entertainment America Inc. et al.
Heim Payne & Chorush LLP, Houston, TX USA
Software Analysis Expert, Intellectual Property Litigation **2010**
Reverse engineering of internet based client-server video game console and server software architecture. Claim chart construction and report generation, software reverse engineering.

Technomedia International, Inc. v. International Training Services, Inc., et al.
Bracewell & Giuliani, LLP, Houston, TX USA
Expert Witness in Software Analysis, Intellectual Property Litigation **2010**
Reverse engineering and analysis of web enabled teaching materials as it pertains to oil well drilling. Analysis of internet based audio and video content delivery mechanisms and related website architecture. Expert report generation, software reverse engineering.

Gamestop, Inc v. Bexar Appraisal
Brusniak and Blackwell PC, Dallas, TX USA
Expert Witness in Software Analysis, Intellectual Property Litigation **2009 - 2010**
Expert witness on the tangibility of software as it pertains to embedded computing, networking, and gaming platforms. Expert report production.

Whetstone Electronics, LLC v. Epson America, et al.
DiNovo & Price Ellwanger Hardy, Austin, TX USA
Expert Witness in System Analysis, Intellectual Property Litigation **2009 - 2011**
Expert witness on embedded computing systems pertaining to printer acceleration hardware. Reverse engineering of software systems, hardware systems, memory system usage, and FPGA functionality.

Whetstone Electronics, LLC v. Xerox Corporation, et al
DiNovo & Price Ellwanger Hardy, Austin, TX USA
Expert Witness in System Analysis, Intellectual Property Litigation **2009 - 2011**
Expert witness on embedded computing systems pertaining to printer acceleration hardware. Reverse engineering of software systems, hardware systems, memory system usage, and FPGA functionality.

General Electric, Inc. v. Mitsubishi Heavy Industries, Inc.
Vinson & Elkins LLP, Austin, TX USA
Expert Witness in Hardware and Software Analysis, Intellectual Property Litigation **2008 - 2009**
Reverse engineering of real-time embedded system source code and system architecture pertaining to variable speed wind turbines and FPGA based sub-systems. On-site visits to opposing counsel. Expert reports produced. Deposed witness for United States International Trade Commission.

Paltalk Holdings, Inc. v. Microsoft Corporation
Heim Payne & Chorush LLP, Houston, TX USA
Technical Expert, Intellectual Property Litigation **2007 - 2008**
Reverse engineering of internet based client-server console gaming architecture source code productions. Claim chart construction and report generation.

SuperSpeed Software, LLC v. IBM Corporation
Heim Payne & Chorush LLP, Houston, TX USA
Technical Expert in Software Analysis, Intellectual Property Litigation **2007 - 2008**
Reverse engineering of multiple source code productions relating to parallel file systems, database functionality, and clustered computing. Report generation of findings and claim chart construction.

QPSX Developments 5 Pty Ltd. v. Juniper Networks, Inc.
Fulbright and Jaworski LLP, Houston, TX USA
Technical Advisor, Intellectual Property Litigation **2006 - 2007**
Patent infringement, code review, prior art and invalidity analysis pertaining to data discard algorithms in packet based computer networks.

Commonwealth Scientific and Indus. Research Org. v. Buffalo Tech. Inc.
Fulbright and Jaworski LLP, Houston, TX USA
Technical Advisor, Intellectual Property Litigation **2006 - 2007**
Patent infringement, prior art and invalidity analysis pertaining to high speed data rate wireless local area networking.

Microsoft Corporation v. Commonweatlh Scientific and Indus. Research Org.
Fulbright and Jaworski LLP, Houston, TX USA
Technical Advisor, Intellectual Property Litigation **2006**
Patent infringement, prior art and invalidity analysis pertaining to high speed packet discard algorithms in high speed computer networking technology.

Tantivy Communications, Inc. v. Lucent Technologies, Inc.
Fulbright and Jaworski LLP, Houston, TX USA
Technical Advisor, Intellectual Property Litigation **2004 - 2005**
Patent infringement, prior art and invalidity analysis pertaining to CDMA2000 based 3G cellular networks.

Honors and Awards

Texas Instruments Fellowship Recipient
Rice University Fellowship Recipient
Rensselaer Alumni Scholarship Recipient
Linear Tech / Mueller Scholarship Recipient
Rensselaer Polytechnic Institute: Graduated Cum Laude, Deans List All Semesters
Eta Kappa Nu - National Electrical and Computer Engineering Honors Society
IEEE Member - Institute of Electrical and Electronics Engineers (brogioli@ieee.org)

EXHIBIT 9

Tim Arthur Williams, Ph.D.
Curriculum Vitae

Dr. Williams has thirty-seven years of professional experience in wireless communications and telecom technology. He is an entrepreneur who has participated in the organization and operation of start up companies that brought wireless LAN, software VoIP PBX, and 2-way paging technology to the marketplace. Dr. Williams holds numerous patents in wireless and signal processing technology. He is an experienced litigation support consultant with experience in patent infringement matters. Dr. Williams is also a registered Patent Agent.

- Wireless LAN
- Cellular and PCS Standards
- Cellular Telephone Architecture
- Digital Signal Processing
- Telecommunications Technology
- VoIP Technology
- Computer Networking
- Wireless Networks & Protocols

Year	College or University	Degree
1991	University of Texas at Austin	MBA
1985	University of Texas at Austin	Ph.D. Dissertation: "Digital Signal Processing Techniques for Acoustic Log Data".
1982	University of Texas at Austin	MSEE, Dissertation: "Cepstral Processing of Speech Signals"
1976	Michigan Technological University	BSEE

Tim Arthur Williams, Ph.D.
Curriculum Vitae

Professional Experience

From: 2008
To: 2010
Organization: Expressume, Inc / Montage Inc. – Milwaukee, WI
Title: Board Member
Summary: This company sells software for human resource recruiting.

From: 2008
To: Present
Organization: Faculte, Inc. – San Jose, CA
Title: Board Member
Summary: This company provides SaaS (Software as a Service) web video based communication products.

From: 2008
To: 2010
Organization: BitRail Networks Inc. – Miami, FL
Title: Founder, Board Member
Summary: This company sells computer networking solutions.

From: 2008
To: Present
Organization: Calumet Venture Management – Madison, WI
Title: Member
Summary: This company provides seed capital and management expertise to small companies.

From: 2006
To: 2012
Organization: BEEcube Inc. – Fremont, CA
Title: Founder, Board Member
Summary: This company builds EDA solutions for the IC industry.

Tim Arthur Williams, Ph.D.
Curriculum Vitae

From:	2006
To:	Present
Organization:	Topaz Equity, LLC
Title:	Founder, Board Member
Summary:	This is a private equity investment company.

From:	2004
To:	Present
Organization:	DoceoTech Inc. – Danville, CA
Title:	Founder, Chairman
Summary:	This is a training company that provides training for engineers in Wireless, Networking, and Telephony technologies.

From:	2004
To:	2006
Organization:	SiBEAM Inc. – Sunnyvale, CA
Title:	Founder, Chief Executive Officer
Summary:	This is a fabless semiconductor company that is developing high-speed wireless networking ICs. This company was sold to Silicon Image, Inc. in Apr 2011.

From:	2001
To:	2004
Organization:	JetQue, Inc. – Danville, CA
Title:	Founder, Chief Executive Officer
Summary:	This company created messaging solutions for the mobile professional.

From:	1999
To:	2000
Organization:	Atheros Communications, Palo Alto, CA
Title:	Interim CEO, Advisory Board Member
Summary:	This company builds wireless LAN ICs. Atheros became a public company in May 2004. (ATHR) This company was sold to QCOM in Jan 2011.

From:	1998
To:	2000
Organization:	Picazo Communications – San Jose, CA
Title:	Chief Technology Officer, Advisory Board Member

Summary: This company built software PBXs. The company was purchased by Intel.

From: 1996
To: Present
Organization: Beach Technologies, LLC – Danville, CA
Title: Chief Executive Officer
Summary: This is a consulting company that provides IP services.

From: 1991
To: 1998
Organization: Wireless Access, Inc. – Santa Clara, CA
Title: Co-Founder, Chief Technical Officer, Vice President of Engineering, Vice President of Business Strategy
Summary: This was a startup company focusing on the Narrow Band PCS equipment market. The company developed the over the air protocols, the subscriber equipment and the ICs to deploy 2-way paging services. The company was sold to Glenarye Electronics.

From: 1979
To: 1991
Organization: Motorola, Inc. – Austin, TX – Semiconductor Sector
Title: Sr. Engineer, Member Technical Staff, Sr. MTS
Summary: Business manager, project leader, and senior technical member of the teams which were responsible for product development of the following systems:

- ADPCM transcoder,
- ISDN U-reference point transceiver,
- CT-2 voice codec and channel modem,
- GSM voice codec and channel modem,
- TDMA voice codec and channel modem
- CDMA voice codec and channel modem, and
- Japanese Digital Cellular voice codec and channel modem.

From: 1976
To: 1979
Organization: Motorola Inc. - Chicago, IL - Communications Sector - Digital Voice Privacy Group

Tim Arthur Williams, Ph.D.
Curriculum Vitae

Title: Engineer

Summary: This group built the first commercial digitally encrypted two-way FM land mobile radio system.

Professional Certifications

▪Patent Agent – U.S. Patent and Trademark Office #50,790 (Jan 2002)

Issued Patents

Patent	Date	Description
6,781,962	2004	Apparatus and Method for Stored Voice Message Control
6,600,481	2003	Data entry apparatus and method
6,088,457	2000	Method and apparatus for over the air programming a communication device
5,854,595	1998	Communications apparatus and method with a computer interchangeable integrated circuit card
5,557,642	1996	Direct conversion receiver for multiple protocols
5,428,638	1995	Method and apparatus for reducing power consumption in digital communications devices
5,345,406	1994	Bandpass sigma delta converter suitable for multiple protocols
5,101,344	1992	Data processor having split level control store
5,001,661	1991	Data processor with combined adaptive LMS and general multiplication functions
4,989,169	1991	Digital tone detector using a ratio of two demodulators of differing frequency
4,972,356	1990	Systolic IIR decimation filter
4,947,363	1990	Pipelined processor for implementing the least-mean-squares algorithm
4,965,762	1990	Mixed size radix recoded multiplier
4,843,585	1989	Pipelineable structure for efficient multiplication and accumulation operations
4,862,169	1989	Oversampled A/D converter using filtered, cascaded noise shaping modulators
4,876,542	1989	Multiple output oversampling A/D converter with each output containing data and noise
4,843,390	1989	Oversampled A/D converter having digital error correction
4,796,219	1989	Serial two's complement multiplier
4,737,925	1988	Method and apparatus for minimizing a memory table for use with nonlinear monotonic arithmetic functions

4,734,876	1988	Circuit for selecting one of a plurality of exponential values to a predetermined base to provide a maximum value
4,727,508	1988	Circuit for adding and/or subtracting numbers in logarithmic representation
4,722,067	1988	Method and apparatus for implementing modulo arithmetic calculations
4,682,302	1987	Logarithmic arithmetic logic unit
4,618,946	1986	Dual page memory system having storage elements which are selectively swapped between the pages
4,406,010	1983	Receiver for CVSD modulation with integral filtering
4,398,262	1983	Time multiplexed n-ordered digital filter

Case Name	Law Firm	Client	Status
Technology Properties Limited LLC ("TPL"); Phoenix Digital Solutions LLC ("PDS") and Patriot Scientific Corporation ("PTSC") v Samsung Electronics Co. ltd. And Samsung Electronics America Inc.	DLA Piper LLP	Samsung	Complete
MOSAID v Cisco	Mayer Brown LLP	MOSAID	Complete
Comerica v Maxim Integrated Products	McKenna Long & Aldridge LLP	Comerica	Ongoing
Intellectual Ventures I LLC and Intellectual Ventures II LLC v. AT&T Mobility LLC; AT&T Mobility II LLC; New Cingular Wireless Services Inc.; SBC Internet Services Inc.; Wayport Inc.; T-Mobile USA Inc.; Nextel Operations Inc.; Sprint Spectrum L.P.; United States Cellular Corporation; and Telephone and Data Systems Inc	Dechert LLP	Intellectual Ventures I LLC and Intellectual Ventures II LLC	Ongoing
Barnes & Noble v LSI	Quinn Emanuel LLP	Barnes & Noble	Complete

Case Name	Law Firm	Client	Status
Parkervision v Qualcomm	Cravath LLP	Qualcomm	Complete
Sprint Communications v Time Warner Cable et al.	Latham & Watkins LLP	Time Warner Cable	Ongoing
Golden Bridge v Motorola.	Kilpatrick Townsend LLP	Motorola	onhold
Kodak v HTC	Kecker & Van Nest LLP	HTC	Complete
Fujitsu v Belkin et al.	Covington LLP	Fujitsu	Complete

Case Name	Law Firm	Client	Status
VirneTX v Avaya	Fish and Richardson LLP	Avaya	Complete
Interdigital v Huawei et al.	Covington LLP;Fish and Richardson LLP; Brinks Hofer Gilson & Lione LLP; Alston & Bird LLP	Huawei; LG; ZTE; Nokia	Complete
SPH America v Acer Inc. et al	Nixon Peabody; K&L Gates; Altson and Bird; Greenberg Traurig; Spotts Fain; Winston & Strawn; Goodwin Proctor	Sierra Wireless; Novatel; Nokia; Hewlett Packard; UT Starcom; Motorola Solutions; Motorola Mobility.	Complete
MMI v Apple Inc.	Proskauer LLP	MMI	Complete
Motorola v Microsoft Inc.	Ropes and Grey LLP	Motorola	Complete

Case Name	Law Firm	Client	Status
Motorola v Apple Inc.	Quinn Emanuel LLP	Motorola	Complete
MOSAID v Cisco Inc.	Hogan Lovells LLP	MOSAID	Complete
HTC v Apple Inc.	Finnegan Henderson LLP Keker & Van Nest LLP	HTC	Complete
Samsung v Apple Inc.	Quinn Emanuel LLP	Samsung	Complete
Broadcom v Emulex	Gibson Dunn LLP	Emulex	Settled

Case Name	Law Firm	Client	Status
WiAV v Motorola	Howrey LLP	Motorola	Settled
WiAV v Sony	Quinn Emanuel	Sony	Settled
Minerva Inc. v Motorola Inc. et al.	Howrey LLP	Research in Motion	Settled
Telecommunications Systems Inc. v Sybase 365 Inc.	McDermott Will & Emery LLP	Sybase	Settled
AT&T v Airbiquity	Baker Botts LLP	AT&T	Settled

Case Name	Law Firm	Client	Status
SPH v Nokia	Foley and Lardner LLP	Nokia	Complete
ESN v Cisco	Quinn Emanuel LLP	Cisco	Settled
Data Treasury Corp. v. Wells Fargo. et al.	Baker & McKenzie LLP and Kilpatrick Stockton LLP	Wells Fargo and Wachovia.	Settled
Saxon Innovations LLC. v. Nokia Corp. et al.	Covington & Burling; Cooley; Howrey; DLA Piper	Samsung; Nintento; RIM; Palm	Settled
eBay Inc. v. IDT Corp. et al.	Irell & Manella LLP	eBay.	Settled

Case Name	Law Firm	Client	Status
SPH America LLC v. Kyocera Wireless Corp. et al.	Foley & Lardner LLP	Kyocera.	Settled
Paradox Ltd. v. ADT Ltd.	Banner & Witcoff	Paradox	Complete
Freedom Wireless Inc. v. Cricket Communications Inc et al.	Latham & Watkins LLP	Cricket Comm.	Settled
in re Katz Interactive Call Processing	Jones Day LLP	Citizens Communications	Settled
Intermec Tech. V. Palm Inc.	Heller Ehrman LLP and Covington & Burling LLP	Palm	Complete

Case Name	Law Firm	Client	Status
Verizon Corp. v. Cox Inc.	Kilpatrick Stockton LLP	Cox	Complete
Motorola Inc. v. Research in Motion Inc.	Ropes & Grey LLP	Motorola	Complete
Intel Corp. v. CSIRO Inc.	Keker & Van Nest LLP	Intel	Complete
Intel Corp. v. Wi-LAN Inc.	Kirkland and Ellis LLP	Intel	Complete
C2 Comm. Tech Inc. v. AT&T Inc.	Sidley Austin LLP	AT&T	Settled

Case Name	Law Firm	Client	Status
Commil USA LLC v. Cisco Systems Inc.	Simpson Thacher & Bartlett LLP	Cisco	Complete
in re Katz Patents	Howrey	General Electric	Settled
3Com Inc. v. D-Link/ Realtek Inc.	Simpson Thacher & Bartlett LLP	3Com	Complete
in re Katz Patents	Jones Day LLP	Experian	Settled
Qualcomm Inc. v. Broadcom Inc.	Cooley Godward Kronish LLP	Qualcomm	Complete

Case Name	Law Firm	Client	Status
Qualcomm Inc. v. Nokia Inc.	DLA Piper	Qualcomm	Complete
Microsoft Inc. v. Alcatel Inc.	Fish and Richardson	Microsoft	Settled
Foundry Networks v. Alcatel Inc.	Howrey	Foundry Networks	Settled
Ericsson Inc v. Samsung Inc.	McKool Smith	Ericsson	Settled
Qualcomm Inc v. Broadcom Inc.	Heller Ehrman White & McAuliffe	Qualcomm	Settled

Case Name	Law Firm	Client	Status
STS Networks v. Witness Systems	Fish and Richardson	Witness Systems	Complete
Foundry Networks v. Lucent Technologies Inc.	Howrey	Foundry Networks	Settled
GlobespanVirata v. Texas Instruments	Heller Ehrman White & McAuliffe	Texas Instruments; Stanford University	Complete
Agere Systems v. Broadcom Inc.	Weil Gotshal & Manges	Broadcom	Settled
Proxim v. 3Com	Morgan Miller and Blair	3Com.	Settled

Case Name	Law Firm	Client	Status
Broadcom Inc. v Qualcomm Inc.	Cooley Godward Kronish LLP	Qualcomm	Complete
Broadcom Inc. v Qualcomm Inc.	Cravath Swaine & Moore	Qualcomm	Complete
Broadcom Inc. v Qualcomm Inc.	Heller Ehrman White & McAuliffe	Qualcomm	Settled
Ericsson v Samsung	Fish and Richardson LLP	Samsung	Complete
Digitude v Motorola	Kilpatrick Townsend LLP	Motorola	Complete

Case Name	Law Firm	Client	Status
HTC v Apple Inc.	Finnegan Henderson LLP	HTC	Complete
Tekelec v Performance Technologies Inc.	Fish and Richardson LLP	Performance Technologies; Inc.	Settled
Adaptix v Motorola Mobility LLC et al.	Winston & Strawn LLP	Motorola Mobility	Ongoing
Cassidian Communications v. microData GIS Inc.; microData LLC; and TeleCommunications Systems Inc.	Bunsow De Mory Smith & Allison LLP	Cassidian Communications	Complete
Commonwealth Scientific and Industrial Research Organisation v. MediaTek Inc. et al.	OêMelveny & Myers LLP	Samsung Electronics Co.; Ltd.; Samsung Semiconductor Inc.; and Samsung Telecommunications America; LLC	onhold

Case Name	Law Firm	Client	Status
InterDigital Technology Corp.IPR Licensing Inc. and InterDigital Holdings Inc	Ropes & Gray LLP	Samsung Electronics Co.; LTD.; Samsung Electronics America; Inc.; and Samsung Telecommunications America; LLC	Ongoing
InterDigital Technology Corp.IPR Licensing Inc. and InterDigital Holdings Inc	Alston & Bird LLP	Nokia Corporation and Nokia Inc	Settled
InterDigital Technology Corp.IPR Licensing Inc. and InterDigital Holdings Inc	Brinks Hofer Gilson & Lione	ZTE Corporation and ZTE (USA) Inc.	Ongoing
InterDigital Technology Corp.IPR Licensing Inc. and InterDigital Holdings Inc	Covington & Burling LLP	Huawei	Ongoing
Intellectual Ventures I LLC and Intellectual Ventures II LLC v Canon Inc. Canon U.S.A. Inc. and Canon Solutions America Inc.	Tensegrity Law Group LLP	Intellectual Ventures I LLC and Intellectual Ventures II LLC	Ongoing

Case Name	Law Firm	Client	Status
Intellectual Ventures I LLC and Intellectual Ventures II LLC v Ricoh Company Ltd. Ricoh Americas Corporation and Ricoh Electronics Inc	Tensegrity Law Group LLP	Intellectual Ventures I LLC and Intellectual Ventures II LLC	Ongoing
SimpleAir Inc. v. Microsoft Corporation et al.	Kilpatrick Townsend & Stockton LLP	Google Inc.	Complete
SimpleAir Inc. v. Microsoft Corp. et al.	Kirkland & Ellis LLP	Samsung Electronics Co.; Ltd.; Samsung Electronics America; Inc.; and Samsung Telecommunications America LLC	Complete
WIAV Solutions v. ZTE Corporation. et at.	Goodwin Procter LLP	ZTE Corporation and ZTE (USA)	Complete
AT&T v. Intrado	Sidley Austin LLP	AT&T Mobility LLC (f/k/a Cingular Wireless LLC) (_AT&Tî);	Complete

Case Name	Law Firm	Client	Status
Intellectual Ventures v PNC Bank, Capital One, First National Bank of Omaha, JP Morgan Chase, Fifth Third Bank, Bank of America, BBVA Compass Bank, Commerce Bank, Suntrust, and M&T	Feinberg Day Alberti & Thompson LLP	Intellectual Ventures	Ongoing
Intellectual Ventures v PNC Bank, Capital One, First National Bank of Omaha, JP Morgan Chase, Fifth Third Bank, Bank of America, BBVA Compass Bank, Commerce Bank, Suntrust, and M&T	Feinberg Day Alberti & Thompson LLP	Intellectual Ventures	Ongoing
Adaptix v Motorola Mobility LLC et al.	Winston & Strawn LLP	Motorola Mobility	Ongoing
AIP Acquisition LLC v. Cablevision Systems Corporation, et al.	Gibson Dunn		Complete
Monec Holding AG v. Motorola Mobility LLC, et al.,	Kilpatrick Townsend & Stockton	Motorola Mobility LLC	Ongoing

Case Name	Law Firm	Client	Status
Monec Holding AG v. Motorola Mobility LLC, et al.,	Cooley LLP	HTC Corporation	Ongoing
Monec Holding AG v. Motorola Mobility LLC, et al.,	Cooley LLP	Exedea, Inc	Ongoing
Monec Holding AG v. Motorola Mobility LLC, et al.,	Fish & Richardson P.C.	Samsung Electronics America, Inc. and Samsung Electronics, Inc.	Ongoing
Sasken Communication Technologies Limited v. Spreadtrum Communications, Inc. and Spreadtrum Communications USA Inc	Covington & Burling LLP	Spreadtrum	Ongoing
Cellport v. ZTE et al.	Sheppard Mullin Richter & Hampton LLP	ZTE Corporation and ZTE (USA)	

Case Name	Law Firm	Client	Status
Cellport v. ZTE et al.	Dickstein Shapiro LLP, Lathrop & Gage, LLP	LG Electronics, Inc., et al	
Cellport v. ZTE et al.	FOX ROTHSCHILD LLP, KING & SPALDING LLP	Nokia Corp., et al.	
Cellport v. ZTE et al.	GREENBERG TRAURIG, LLP	Samsung Electronics Co., Ltd., et al	
Cellport v. ZTE et al.	FINNEGAN, HENDERSON, LLP and HOLLAND & HART LLP	HTC Corp., et al	
Cellport v. ZTE et al.	BAKER & McKENZIE LLP	Pantech Co. Ltd., et al	

EXHIBIT 10

CARLA S. MULHERN
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Ms. Mulhern specializes in the application of microeconomic principles to issues arising in complex business litigation. She has served as an expert witness on damages issues in commercial litigation matters, including intellectual property and breach of contract cases. Her intellectual property damages experience spans cases involving allegations of patent, copyright, and trademark infringement, as well as misappropriation of trade secrets. Ms. Mulhern has testified before the International Trade Commission on economic issues such as commercial success, domestic industry, remedy, bond, and public interest. In addition, she has worked with leading academic experts on commercial litigation matters including intellectual property, antitrust, and breach of contract cases.

Ms. Mulhern's project experience spans a variety of industries including automotive, computer hardware and software, consumer products, entertainment, medical devices, pharmaceuticals, semiconductors, and telecommunications. She has assisted clients in all aspects of litigation projects, including development and review of pretrial discovery, development of economic and financial models to analyze damages, critique of analyses propounded by opposing experts, and preparation of testimony.

In non-litigation matters, Ms. Mulhern has assisted clients in valuing intellectual property and other business assets in the context of strategic alliances involving licensing and joint ventures. In addition, she has consulted on matters involving the application of economic principles to issues arising in the pharmaceutical and health care fields.

EDUCATION

1988	M.Sc. in Economics, London School of Economics and Political Science, London, England
1987	Diploma with Merit in Economics, London School of Economics and Political Science, London, England
1986	B.S. in Mathematics, Bucknell University, Lewisburg, PA

PROFESSIONAL EXPERIENCE

1997–Present	Analysis Group, Inc., Washington, D.C.
1994–1997	Putnam, Hayes & Bartlett, Inc., Washington, D.C.
1989–1994	National Economic Research Associates, Inc., Washington, D.C.

EXPERT REPORTS/TESTIMONY

- **In the Matter of Certain Graphics Systems, Components Thereof, and Consumer Products Containing the Same, Investigation No. 337-TA-1044**
  U.S. International Trade Commission, Washington, D.C.
  Patent infringement: expert report (2017) and deposition testimony (2017) on behalf of complainants, Advanced Micro Devices, Inc. and ATI Technologies ULC, regarding economic issues related to domestic industry in case involving semiconductor components such as APUs and GPUs.

- **In the Matter of Certain Carbon and Alloy Steel Products, Investigation No. 337-TA-1002**
  U.S. International Trade Commission, Washington, D.C.
  Unfair competition: expert report (2017) and deposition testimony (2017) on behalf of respondents Shanghai Baosteel Group Corporation; Baoshan Iron & Steel Co., Ltd.; Baosteel America, Inc.; Hebei Iron and Steel Group Co., Ltd.; Hebei Iron & Steel Group Hengshui Strip Rolling Co., Ltd.; Hebei Iron & Steel (Hong Kong) International Trade Co., Ltd.; Jiangsu Shagang Group; Jiangsu Shagang International Trade Co., Ltd.; Anshan Iron and Steel Group; Angang Group International Trade Corporation; Angang Group Hong Kong Co. Ltd.; Wuhan Iron and Steel Group Corp.; Wuhan Iron and Steel Co., Ltd.; WISCO America Co., Ltd.; Shougang Corporation; China Shougang International Trade & Engineering Corporation; Magang Group Holding Co. Ltd.; and Maanshan Iron and Steel Co. Ltd.; regarding economic issues related to domestic industry and injury in case involving the importation of steel by respondents with a false designation of origin.

- **EndoEvolution, LLC v. Ethicon Endo-Surgery, Inc.**
  American Arbitration Association, International Center for Dispute Resolution
  Breach of contract, fraud, and misappropriation of trade secrets: expert report (2017) and hearing testimony (2017) on behalf of defendant, Ethicon, regarding monetary compensation resulting from alleged misappropriation of trade secrets relating to medical device used for minimally invasive surgery.

- **In the Matter of Certain Passenger Vehicle Automotive Wheels, Investigation No. 337-TA-1006**
  U.S. International Trade Commission, Washington, D.C.
  Design patent and trademark infringement: expert report (2016) on behalf of complainant, Daimler AG, regarding economic issues related to domestic industry in case involving passenger vehicle automotive wheels.

- **Odyssey Wireless, Inc. v. Motorola Mobility LLC**
  U.S. District Court, Southern District of California, San Diego Division
  Patent infringement: expert report (2016) and deposition testimony (2016) on behalf of defendants regarding reasonable royalty damages for patents associated with technology related to the LTE telecommunications standard.

- **In the Matter of Certain Radio Frequency Identification ("RFID") Products and Components Thereof, Investigation No. 337-TA-979**
  U.S. International Trade Commission, Washington, D.C.
  Patent infringement: expert reports (2016), deposition testimony (2016), and trial testimony (2016) on behalf of respondents, Kapsch and Star, regarding economic issues related to public interest, bond and commercial success in case involving RFID technology used in electronic toll collection systems.

- **VideoShare, LLC v. Google, Inc. and YouTube, LLC**
  U.S. District Court, District of Delaware
  Patent infringement: expert report (2016) and deposition testimony (2016) on behalf of defendants regarding reasonable royalty damages in case involving technology related to video sharing, uploading and conversion.

- **Amgen, Inc. v. Sanofi, Sanofi-Aventis U.S., LLC, Aventisub, LLC, f/d/b/a/ Aventis Pharmaceuticals, Inc., and Regeneron Pharmaceuticals, Inc.**
  U.S. District Court, District of Delaware
  Patent infringement: expert report (2015) and deposition testimony (2016) on behalf of defendants regarding lost profits, price erosion, and reasonable royalty damages in case involving biologic product, PCSK9 inhibitor.

- **CardiAQ Valve Technologies, Inc. v. Neovasc, Inc. and Neovasc Tiara, Inc.**
  U.S. District Court, District of Massachusetts
  Breach of contract, fraud, and misappropriation of trade secrets: expert report (2015), deposition testimony (2016), and trial testimony (2016) on behalf of defendants in case involving mitral valve implants for the heart.

- **In the Matter of Certain Lithium Metal Oxide Cathode Materials, Lithium-Ion Batteries Containing Same, and Products with Lithium-Ion Batteries Containing Same, Investigation No. 337-TA-951**
  U.S. International Trade Commission, Washington, D.C.
  Patent infringement: expert reports (2015) and deposition testimony (2015) on behalf of complainants, BASF Corporation and UChicago Argonne LLC, regarding economic issues related to domestic industry, remedy, bond, and public interest in case involving cathode materials used in lithium-ion batteries.

- **In the Matter of Certain Graphics Processing Chips, Systems on a Chip, and Products Containing the Same, Investigation No. 337-TA-941**
  U.S. International Trade Commission, Washington, D.C.
  Patent infringement: expert report (2015), deposition testimony (2015), and trial testimony (2015) on behalf of complainant, Samsung, regarding domestic industry, remedy, bond, and public interest in case involving GPU and SOC semiconductor devices.

- **The Washington University v. Wisconsin Alumni Research Foundation**
  U.S. District Court, District of Delaware
  Breach of contract: expert report (2015) and deposition testimony (2015) on behalf of defendant regarding damages arising from alleged breach of contract involving pharmaceutical product, Zemplar.

- **In the Matter of Certain Windshield Wipers and Components Thereof, Investigation No. 337-TA-937**
  U.S. International Trade Commission, Washington, D.C.
  Patent infringement: expert report (2015), deposition testimony (2015), and trial testimony (2015) on behalf of complainants, Valeo North America, Inc. and Delmex de Juarez S. de R.L. de C.V., regarding domestic industry in case involving windshield wipers.

- **In the Matter of Certain Dental Implants, Investigation No. 337-TA-934**
  U.S. International Trade Commission, Washington, D.C.
  Patent infringement: expert report (2015), deposition testimony (2015), and trial testimony (2015) on behalf of respondent, Neodent, regarding domestic industry in case involving dental implants.

- **In the Matter of Certain Formatted Magnetic Data Storage Tapes and Cartridges Containing the Same, Investigation No. 337-TA-931**
  U.S. International Trade Commission, Washington, D.C.
  Patent infringement: expert reports (2015) and deposition testimony (2015) on behalf of respondents, IBM and Oracle, regarding public interest in case involving magnetic tape data storage systems.

- **In the Matter of Certain Sulfentrazone, Sulfentrazone Compositions, and Processes for Making Sulfentrazone, Investigation No. 337-TA-914**
  U.S. International Trade Commission, Washington, D.C.
  Patent infringement: expert reports and trial testimony (2014 and 2015) on behalf of complainant, FMC Corporation, regarding domestic industry in case involving agricultural herbicide products.

- **In the Matter of Certain Devices Containing Non-volatile Memory and Products Containing the Same, Investigation No. 337-TA-922**
  U.S. International Trade Commission, Washington, D.C.
  Patent infringement: expert report (2015) on behalf of respondent, Spansion Inc., regarding remedy, bond, and public interest in case involving non-volatile memory including NAND flash memory.

- **Comcast v. Sprint**
  U.S. District Court, District of Delaware
  Patent infringement: expert reports (2014), deposition testimony (2014) and trial testimony (2014) on behalf of plaintiff, Comcast regarding reasonable royalty damages in case involving telecommunications network technology.

- **In the Matter of Certain Antivenom Compositions and Products Containing the Same, Investigation No. 337-TA-903**
  U.S. International Trade Commission, Washington, D.C.
  Patent infringement: expert reports (2014) and deposition testimony (2014) on behalf of complainant, BTG, regarding domestic industry, remedy, bond and public interest in case involving antivenoms used in treating snake bites.

- **Louis Vuitton Malletier S.A., v. Sunny Merchandise Corp., et.al.**
  U.S. District Court, Southern District of New York
  Trademark infringement: expert report (2014) and deposition testimony (2014) on behalf of plaintiff, Louis Vuitton Malletier, S.A., regarding actual and unjust enrichment damages in case involving alleged use of Louis Vuitton trademarks on eyewear.

- **In the Matter of Certain Navigation Products, Including GPS Devices, Navigation and Display Systems, Radar Systems, Navigational Aids, Mapping Systems, and Related Software, Investigation No. 337-TA-900**
  U.S. International Trade Commission, Washington, D.C.
  Patent Infringement: expert report (2014) and deposition testimony (2014) on behalf of complainant Furuno Electric Co., regarding domestic industry, remedy, bond, and public interest in case involving marine navigation devices.

- **Mylan v. GlaxoSmithKline**
  U.S. District Court, District of New Jersey
  Breach of contract: expert reports (2011 and 2013), deposition testimony (2011 and 2014), and trial testimony (2014) responding to plaintiff's claims of damages resulting from breach of contract involving generic pharmaceutical product.

- **In the Matter of Certain Integrated Circuit Chips and Products Containing Same, Investigation No. 337-TA-859**
  U.S. International Trade Commission, Washington, D.C.
  Patent infringement: expert report (2013), deposition testimony (2013), and trial testimony (2014) on behalf of respondents, LSI Corporation and Seagate Technology, regarding domestic industry and bond in Section 337 case involving semiconductor technology.

- **Walker Digital, LLC v. Google, Inc.**
  U.S. District Court, District of Delaware
  Patent infringement: expert report (2013) and deposition testimony (2014) regarding reasonable royalty damages for patent infringement case involving patents related to anonymous communication technology used in social networks.

- **In the Matter of Certain TV Programs, Literary Works for TV Production and Episode Guides Pertaining to Same, Investigation No. 337-TA-886**
  U.S. International Trade Commission, Washington, D.C.
  Copyright infringement and unfair competition: expert report (2013) and deposition testimony (2014) on behalf of respondents, The Walt Disney Company and Thunderbird Films, Inc., regarding the existence of a domestic industry and injury to a domestic industry in Section 337 case involving literary works related to a pilot television series.

- **In the Matter of Certain Microelectromechanical Systems ("MEMS Devices") and Products Containing Same, Investigation No. 337-TA-876**
  U.S. International Trade Commission, Washington, D.C.
  Patent infringement: expert report (2013) and deposition testimony (2013) on behalf of complainant, STMicroelectronics, Inc., regarding domestic industry, remedy, cease and desist order, and bond in Section 337 case involving microelectromechanical (MEMS) devices.

- **In the Matter of Certain Wireless Communications Equipment and Articles Therein, Investigation No. 337-TA-866**
  U.S. International Trade Commission, Washington, D.C.
  Patent infringement: expert reports (2013), deposition testimony (2013) and trial testimony (2013) on behalf of complainants; Samsung Electronics Co., Ltd. and Samsung Telecommunications America, LLC; regarding domestic industry, remedy, cease and desist order, and bond in Section 337 case involving wireless communications equipment.

- **Organogenesis, Inc. v. Vincent Ronfard and Healthpoint, Ltd.**
  Commonwealth of Massachusetts Superior Court, Suffolk County
  Breach of contract, unfair competition, and misappropriation of trade secrets: expert report (2013) and deposition testimony (2013) on behalf of plaintiff, regarding damages arising from alleged violations relating to employment contract for companies in biopharmaceutical industry.

- **In the Matter of Certain Products Having Laminated Packaging, and Components Thereof, Investigation No. 337-TA-874**
  U.S. International Trade Commission, Washington, D.C.
  Patent infringement: expert report (2013), deposition testimony (2013) and trial testimony (2013) on behalf of respondents; Remy Cointreau USA, Inc., Pernod Ricard USA LLC, John Jameson Import Company, Moët Hennessy USA, Inc., Champagne Louis Roederer, Maisons Marques & Domaines USA Inc., Freixenet USA, Inc., L'Oreal USA, Inc., Hasbro, Inc., Cognac Ferrand USA Inc., Diageo North America, Inc., WJ Deutsch & Sons Ltd., and Beats Electronics LLC; regarding domestic industry in Section 337 case involving products having laminated packaging.

- **In the Matter of Certain Projectors with Controlled-Angle Retarders, Components Thereof, and Products Containing Same, Investigation No. 337-TA-815**
  U.S. International Trade Commission, Washington, D.C.
  Patent infringement: expert report (2012) and deposition testimony (2012) on behalf of respondents; Sony Corporation, Sony Corporation of America, and Sony Electronics Inc.; regarding domestic industry in Section 337 case involving projectors.

- **In the Matter of Certain Dynamic Random Access Memory and NAND Flash Memory Devices and Products Containing Same, Investigation No. 337-TA-803**
  U.S. International Trade Commission, Washington, D.C.
  Patent infringement: expert reports (2012) and deposition testimony (2012) on behalf of respondents; Elpida Memory, Inc., Elpida Memory (USA) Inc., Hynix Semiconductor Inc., Hynix Semiconductor America, Inc., Acer Inc., Acer America Corp., ADATA Technology Co., Ltd, ADATA Technology (U.S.A.) Co., Ltd., Asustek Computer Inc., Asus Computer International, Dell, Inc., Hewlett-Packard Company, Kingston Technology Co., Inc., Logitech International S.A., Logitech, Inc., Best Buy Co., Inc., and Wal-Mart Stores, Inc.; regarding domestic industry, remedy, bond, and public interest in Section 337 case involving DRAM and NAND flash memory devices.

- **Genentech, Inc. v. UCB Celltech**
  American Arbitration Association, International Center for Dispute Resolution
  Breach of contract: expert reports (2012) and hearing testimony (2012) on behalf of plaintiff, regarding damages arising from alleged breach of contract and fraud involving pharmaceutical products.

- **Apple Inc. and Next Software, Inc. (f/k/a Next Computer, Inc.) v. Motorola, Inc., and Motorola Mobility, Inc.**
  U.S. District Court, Northern District of Illinois
  Patent infringement: expert report (2012) and deposition testimony (2012) on behalf of Motorola Inc. and Motorola Mobility, Inc., regarding damages due Motorola associated with alleged infringement of patents directed to wireless communications functionality.

- **In the Matter of Certain Electronic Devices, Including Wireless Communication Devices, Portable Music and Data Processing Devices, and Tablet Computers, Investigation No. 337-TA-794**
  U.S. International Trade Commission, Washington, D.C.
  Patent infringement: expert report (2012), deposition testimony (2012), and trial testimony (2012) on behalf of complainants; Samsung Electronics Co., Ltd. and Samsung Telecommunications America, LLC; regarding domestic industry in Section 337 case involving certain electronic devices.

- **Automated Merchandising Systems, Inc. v. Crane Co., and Seaga Manufacturing, Inc.**
  U.S. District Court, Northern District of West Virginia
  Patent infringement: expert report (2011) regarding lost profits and reasonable royalty damages for patent infringement involving vending machines.
- **In the Matter of Certain Mobile Devices and Related Software, Investigation No. 337-TA-750**
  U.S. International Trade Commission, Washington, D.C.
  Patent infringement: expert report (2011) and deposition testimony (2011) on behalf of respondents; Motorola Mobility, Inc. and Motorola Solutions, Inc.; regarding domestic industry and appropriate amount of bond in Section 337 case involving mobile devices.
- **In the Matter of Certain Liquid Crystal Display Devices, Including Monitors, Televisions, and Modules, and Components Thereof, Investigation No. 337-TA-749C**
  U.S. International Trade Commission, Washington, D.C.
  Patent infringement: expert report (2011) , deposition testimony (2011), and trial testimony (2011) on behalf of respondents; AU Optronics Corporation, BenQ Corporation, Chimei InnoLux Corporation, MStar Semiconductor, Inc. and Qisda Corporation; regarding domestic industry in Section 337 case involving LCD displays.
- **In the Matter of Certain Wireless Communication Devices, Portable Music and Data Processing Devices, Computers and Components Thereof, Investigation No. 337-TA-745**
  U.S. International Trade Commission, Washington, D.C.
  Patent infringement: expert reports (2011) and deposition testimony (2011) on behalf of complainant, Motorola Mobility Inc., regarding domestic industry and certain secondary considerations of non-obviousness in Section 337 case involving wireless communication devices.
- **Paone v. Microsoft Corp.**
  U.S. District Court, Eastern District of New York
  Patent infringement: expert reports (2008 and 2011) and deposition testimony (2009 and 2011) regarding reasonable royalty damages for patent infringement case involving patent related to encryption technology used in computer software.
- **Intex Recreation Corp. v. Team Worldwide Corp.**
  U.S. District Court, Washington, D.C.
  Patent infringement: expert reports (2006 and 2011) and deposition testimony (2006) in a patent infringement case involving inflatable air mattresses. Provided testimony on lost profits and reasonable royalty damages.
- **B. Braun Melsungen et al. v. Terumo Medical Corp. et al.**
  U.S. District Court, District of Delaware
  Patent infringement: expert report (2010), deposition testimony (2010), and trial testimony (2010) regarding commercial success of safety IV catheter and contribution of patented technology.
- **Touchcom v. Bereskin & Parr et al.**
  U.S. District Court, Eastern District of Virginia
  Professional negligence: expert report (2010) and deposition testimony (2010) regarding damages due to plaintiff as a result of defendant's alleged malpractice in preparing and prosecuting patent application directed to interactive fuel pump system.

- **In the Matter of Certain DC-DC Controllers and Products Containing Same, Investigation No. 337-TA-698**
  U.S. International Trade Commission, Washington, D.C.
  Patent infringement and misappropriation of trade secrets: expert report (2010) and deposition testimony (2010) on behalf of respondents, uPI Semiconductor Corp. and Sapphire Technology, regarding injury to domestic industry and scope of exclusion order in Section 337 case involving DC-DC controllers.

- **In the Matter of Certain MLC Flash Memory Devices and Products Containing Same, Investigation No. 337-TA-683**
  U.S. International Trade Commission, Washington, D.C.
  Patent infringement: expert reports (2010), deposition testimony (2010), and trial testimony (2010) on behalf of respondent, Samsung, regarding domestic industry, scope of exclusion order, and appropriate amount of bond in Section 337 case involving patents directed to multi-level cell flash memory technology.

- **In the Matter of Certain Semiconductor Integrated Circuits and Products Containing Same, Investigation No. 337-TA-665**
  U.S. International Trade Commission, Washington, D.C.
  Patent infringement: expert report (2009), deposition testimony (2009), and trial testimony (2009) on behalf of respondents, LSI and Seagate, regarding domestic industry and scope of exclusion order in Section 337 case involving patents directed to semiconductor design and manufacturing processes.

- **McKesson v. Epic**
  U.S. District Court, Northern District of Georgia
  Patent infringement: expert report (2009) and deposition testimony (2009) regarding reasonable royalty damages for patent infringement case involving patent related to health information software.

- **Samsung Electronics v. ON Semiconductor Corp.**
  U.S. District Court, District of Delaware
  Patent infringement: expert reports (2008) and deposition testimony (2008) regarding reasonable royalty damages for patent infringement case involving patents directed to semiconductor manufacturing processes and products.

- **In the Matter of Certain Semiconductor Chips with Minimized Chip Package Size and Products Containing Same, Investigation No. 337-TA-630**
  U.S. International Trade Commission, Washington, D.C.
  Patent infringement: expert report (2008), deposition testimony (2008), and trial testimony (2008) on behalf of respondents; Kingston, ProMOS, Elpida and Nanya; regarding scope of exclusion order and appropriate amount of bond in Section 337 case involving semiconductor packaging technology.

- **In the Matter of Certain Baseband Processor Chips and Chipsets, Transmitter and Receiver (Radio) Chips, Power Control Chips and Products Containing Same, Including Cellular Telephone Handsets, Investigation No. 337-TA-543 – Enforcement Proceeding**
  U.S. International Trade Commission, Washington, D.C.
  Patent infringement: expert report (2008), deposition testimony (2008), and trial testimony (2008) on behalf of complainant, Broadcom, regarding claim that respondent violated cease and desist order. Provided testimony related to maximum value of penalty associated with alleged violations.

- **adidas America v. Wal-Mart**
  U.S. District Court, District of Oregon
  Trademark infringement: expert report (2008) and deposition testimony (2008) regarding reasonable royalty damages for trademark infringement case involving striped footwear.

- **In the Matter of Certain Semiconductor Chips with Minimized Chip Package Size and Products Containing Same, Investigation No. 337-TA-605**
  U.S. International Trade Commission, Washington, D.C.
  Patent infringement: expert report (2008), deposition testimony (2008), and trial testimony (2008) on behalf of respondent, ST Microelectronics, regarding domestic industry, scope of exclusion order, and appropriate amount of bond to be set for products covered by exclusion order during Presidential review period in Section 337 case involving semiconductor packaging technology.

- **JDB Medical, Inc. and James D. Beeton, Flint Medical, Inc. and Keith Flint v. The Sorin Group, S.p.A. and ELA Medical, Inc.**
  U.S. District Court, District of Colorado
  Breach of contract damages: expert report (2007) and deposition testimony (2008) responding to plaintiff's claim of damages resulting from breach of a sales agreement involving cardiac rhythm management devices.

- **TruePosition v. Andrew Corp.**
  U.S. District Court, District of Delaware
  Patent infringement: expert report (2006), deposition testimony (2007), and trial testimony (2007) on behalf of plaintiff, True Position, in a patent infringement case involving cellular telephone location equipment. Provided testimony on lost profits damages.

- **In the Matter of Certain NOR and NAND Flash Memory Devices and Products Containing Same, Investigation No. 337-TA-560**
  U.S. International Trade Commission, Washington, D.C.
  Patent infringement: expert report (2006), deposition testimony (2006), and trial testimony (2006) on behalf of respondent, ST Microelectronics, regarding domestic industry, scope of exclusion order, and appropriate amount of bond to be set for products covered by exclusion order during Presidential review period in Section 337 case involving NAND and NOR flash memory products.

- **In the Matter of Certain Flash Memory Devices and Components Thereof, and Products Containing Such Devices and Components, Investigation No. 337-TA-552**
  U.S. International Trade Commission, Washington, D.C.
  Patent infringement: expert report (2006) and deposition testimony (2006) on behalf of respondent, Hynix, regarding certain secondary considerations, domestic industry, scope of exclusion order, and appropriate amount of bond to be set during Presidential review period in Section 337 case involving NAND flash memory products.

- **In the Matter of Certain Baseband Processor Chips and Chipsets, Transmitter and Receiver (Radio) Chips, Power Control Chips and Products Containing Same, Including Cellular Telephone Handsets, Investigation No. 337-TA-543**
  U.S. International Trade Commission, Washington, D.C.
  Patent infringement: expert reports (2005 and 2006), deposition testimony (2006) and trial testimony (2006) on behalf of complainant, Broadcom, regarding scope of exclusion order associated with baseband and radio chips used in cellular telephones and other handheld devices in Section 337 case.

- **In the Matter of Certain NAND Flash Memory Circuits and Products Containing the Same, Investigation No. 337-TA-526**
  U.S. International Trade Commission, Washington, D.C.
  Patent infringement: rebuttal expert report and deposition testimony (2005) on behalf of respondent, ST Microelectronics, regarding domestic industry, scope of exclusion order and appropriate amount of bond to be set for products covered by exclusion order during Presidential review period in Section 337 case involving NAND flash memory products.

- **PDI, Inc. v. Cellegy Pharmaceuticals, Inc.**
  U.S. District Court, Northern District of California, San Francisco
  Commercial damages: expert report and deposition testimony (2005) regarding analysis of damages arising from claims of fraud and breach of contract in case involving male testosterone hormone replacement therapy.

- **Minuteman Trucks, Inc. v. HN80 Corporation and Sterling Truck Corp.**
  Superior Court of Massachusetts, Suffolk County
  Commercial damages: rebuttal expert report and trial testimony (2004) regarding issues related to calculation of damages associated with alleged violation of Massachusetts statute regarding dealer pricing in case involving heavy trucks.

- **Miltope Corporation and IV Phoenix Group Inc, v. DRS Technologies et al.**
  U.S. District Court, Eastern District of New York
  Misappropriation of trade secrets: expert report and deposition testimony (2003) on reasonable royalty damages in case involving rugged personal computers.

- **John W. Evans, et al., v. General Motors Corp.**
  Superior Court of Connecticut, Judicial District of Waterbury at Waterbury
  Misappropriation of trade secrets: expert report and deposition testimony (2002) and trial testimony (2003) on reasonable royalty damages in a case involving automotive engine technology.

- **SRAM Corporation v. AD-II Engineering, Inc.**
  U.S. District Court, Northern District of Illinois
  Patent infringement: expert report and deposition testimony (2002) on reasonable royalty damages due patent holder and lost profits due alleged infringer arising from allegedly false accusations involving patents related to bicycle twist shifters.

- **Qwest Communications International et al. v. WorldQuest Networks, Inc.**
  U.S. District Court, Eastern District of Virginia
  Trademark infringement and unfair competition: expert report on damages in a case involving sales of prepaid calling cards.

- **The Quigley Corporation v. GumTech International, et al.**
  U.S. District Court, Eastern District of Pennsylvania
  Patent infringement: expert report and deposition testimony (2001) on damages in case involving patent related to the use of zinc gluconate to reduce the duration of the common cold.

- **Cytyc Corporation v. Autocyte, Inc.**
  U.S. District Court, District of Delaware
  Patent infringement: expert report and deposition testimony (2000) on damages in a case involving liquid based cervical cancer screening tests.

- **Hearthstone, Inc. v. Ronald M. Hawes, et al.**
  U.S. District Court, Eastern District of Virginia
  Copyright and trademark infringement, breach of contract, and unfair competition: expert report on damages involving architectural plans for log homes.

SELECTED LITIGATION CONSULTING ASSIGNMENTS

Commercial Damages/Intellectual Property

- **Cubist v. Teva**
  U.S. District Court, District of Delaware
  Hatch-Waxman: analysis of commercial success of patented pharmaceutical product and extent to which patented technology contributed to that success.
- **Nokia v. Apple**
  U.S. District Court, District of Delaware
  Patent infringement: analysis of issues associated with determination of FRAND royalty for patents incorporated in wireless telecommunications products on behalf of Nokia.
- **Novartis v. Teva**
  U.S. District Court, District of Delaware
  Hatch-Waxman: analysis of commercial success of patented pharmaceutical products and extent to which patented technology contributed to that success.
- **Nokia v. Qualcomm**
  Delaware Chancery Court
  Commercial litigation: analysis of issues associated with determination of FRAND royalty for patents incorporated in wireless communications products on behalf of Nokia.
- **O2 Micro v. Samsung Electronics**
  U.S. District Court, Eastern District of Texas
  Patent damages: analysis of plaintiff's claims with respect to reasonable royalty damages for patents directed to technology used in LCD screens.
- **GlaxoSmithKline v. Ranbaxy**
  U.S. District Court, District of New Jersey
  Hatch-Waxman: analysis of commercial success of patented pharmaceutical product and extent to which the patented technology contributed to that success
- **Medinol Ltd. v. Boston Scientific Corp.**
  U.S. District Court, Southern District of New York
  Breach of contract damages: analyze damages resulting from allegations of breach of contract and misappropriation of trade secrets in case involving coronary stents.
- **Burst.Com v. Microsoft Corp.**
  U.S. District Court, District of Maryland
  Patent and trade secrets damages: analysis of reasonable royalty damages in case involving software used for streaming media. Respond to plaintiff's claim of lost profits damages and unjust enrichment arising from the misappropriation of trade secrets.

- **Medtronic AVE v. Advanced Cardiovascular Systems and Guidant Corp.**
  U.S. District Court, District of Delaware
  Patent and trade secrets damages: analysis of lost profits and reasonable royalty damages in case involving coronary stents. Respond to plaintiff's claim of damages arising from misappropriation of trade secrets.
- **Titan Sports, Inc., etc. v. Turner Broadcasting Systems, Inc. et al.**
  U.S. District Court, District of Connecticut
  Copyright and trademark damages: unjust enrichment due to misappropriation of intellectual property involving two popular wrestling characters.
- **Stairmaster Sports/Medical Products, a Limited Partnership v. Groupe Procycle, Inc. et al.**
  U.S. District Court, District of Delaware
  Patent damages: lost profits, reasonable royalty, and prejudgment interest involving patent directed to stair-climbing fitness equipment.
- **BTG v. Magellan Corp./BTG v. Trimble Navigation**
  U.S. District Court, Eastern District of Pennsylvania
  Patent damages/intervening rights: reasonable royalty, prejudgment interest, value of inventory on hand, preparation and investments made, and business commenced (as of patent reissue) involving a patent directed to secret or secure communications technology employed in global positioning system products.
- **Joint Medical Products Corp. v. DePuy Orthopaedics, Inc. et al.**
  U.S. District Court, District of Connecticut
  Patent damages: lost profits and reasonable royalty for patents directed to orthopedic implants.
- **Cordis Corp. v. SciMed Life Systems, Inc.**
  U.S. District Court, District of Minnesota
  Patent damages: lost profits, reasonable royalty, and prejudgment interest for patent directed to balloon catheters used in Percutaneous Transluminal Coronary Angioplasty (PTCA).
- **Nexstar Pharmaceuticals, Inc. v. The Liposome Company**
  U.S. District Court, District of Delaware
  Patent damages/intervening rights: Valuation of inventory on hand, preparations and investments made, and business commenced (as of patent reissuance) involving patents directed to lipid formulations of an anti-fungal pharmaceutical.
- **Autonation, Inc. v. Acme Commercial Corp., at al. (CarMax)**
  U.S. District Court, Southern District of Florida
  Trademark infringement/unfair competition: reasonable royalty associated with trademark infringement and unfair competition in the auto superstore business.
- **General Motors (GM) v. Lopez**
  U.S. District Court, Eastern District of Michigan
  Trade secrets: analysis of GM damages and Volkswagen unjust enrichment due to alleged theft of trade secrets by former GM employee.

Antitrust Litigation

- **Joe Comes et al. v. Microsoft Corp.**
  Iowa District Court for Polk County
  Analysis of economics of computer software industry and resulting implications for market structure and firm profitability.
- **Daniel Gordon et al. v. Microsoft Corp.**
  Minnesota District Court for Hennepin County
  Analysis of economics of computer software industry and resulting implications for market structure and firm profitability.
- **Burst.Com, Inc. v. Microsoft Corp.**
  U.S. District Court, District of Maryland
  Examination and evaluation of plaintiff's business strategy and likely implications with respect to plaintiff's claims of actual damages due to alleged antitrust violations.
- **In Re Microsoft Corp. Antitrust Litigation – All Purchaser Actions**
  U.S District Court, District of Maryland
  Analysis of economics of computer software industry and resulting implications for market structure and firm profitability.
- **Microsoft I-V Cases**
  Superior Court of The State of California, for The City and County of San Francisco
  Analysis of economics of computer software industry and resulting implications for market structure and firm profitability.
- **Vitamin Antitrust Litigation**
  U.S. District Court, District of Columbia
  Preliminary analysis of factors affecting supply and demand for Vitamin C.
- **Industrial Silicon Antitrust Litigation**
  U.S. District Court, Western District of Pennsylvania
  Analysis of issues related to likelihood of successful cartelization in production of industrial ferrosilicon, magnesium ferrosilicon, and silicon metal.
- **Independent Service Provider v. IBM**
  Texas State Court, Corpus Christi
  Analysis of issues related to liability and damages including definition of relevant market, assessment of market concentration and evaluation of antitrust damages.

SELECTED NON-LITIGATION CONSULTING ASSIGNMENTS

- **Intellectual Property Valuation**
  Assist clients with interpretation and/or negotiation of license terms for patented technology in a variety of fields including: consumer products, pharmaceuticals and semiconductors.
- **Corporate Committee of the American College of Nuclear Physicians**
  Analyses of the clinical and economic value of nuclear medicine in cardiology and oncology.
- **Lincoln General Hospital**
  Business valuation of two health care providers for use in determining relative shares of the parties in a joint venture.

- **Pharmaceutical Partners for Better Health Care**
  Comprehensive study of the Canadian health care system with particular emphasis on the effects of potential reforms on the pharmaceutical industry.

PUBLICATIONS

"Recently Released FDA Guidance and Biosimilar Development: Implications for the Litigation Environment," (with G. Long), *Update: Food and Law, Regulation and Education*, March 2012, pp. 19-21.

"The 25% Rule Lives On," (with John Jarosz and Michael Wagner), *IP Law 360,* September 8, 2010.

"Licensing in the Presence of Technological Standards," (with J. Browning), *The Licensing Journal*, Volume 29 No. 7, August 2009, pp. 18-29.

"Use of the 25 Per Cent Rule in Valuing IP," (with R. Goldscheider and J. Jarosz), *les Nouvelles*, Volume XXXVII No. 4, December 2002, pp. 123-133.

"Clinical and Economic Value of Cardiovascular Nuclear Medicine," monograph published by *Meniscus Health Care Communications*, (with K. Neels), 1996.

"The Health Care System in Canada," (with R. Rozek), Chapter 4, *Financing Health Care,* edited by U. Hoffmeyer and T. McCarthy, Kluwer Academic Publishers, 1994.

"Discounted Cash Flow Analysis in Patent Infringement Litigation," (with R. Rozek), *Licensing Economics Review*, Volume 1, August 1991, pp. 7-10.

PRESENTATIONS AND SPEAKING ENGAGEMENTS

"ITC Section 337 Litigation: Tips & Strategies for your Firm," The Knowledge Group Webinar, September 2017 (with Jordan Coyle, Edward Donovan, Eric Schweibenz, and Pallavi Seth).

"ITC Section 337 Investigations: Your Thorough Guide for 2017 and Beyond," The Knowledge Group Webinar, May 2017 (with Edward Donovan, Blaney Harper, and P.J. McCarthy).

"IP Valuation: Practical Guide on Effective Methods and Approaches for 2015 and Beyond," The Knowledge Group Webinar, October 2015 (with Chuck Faunce and Philip Green).

"Trolls, NPEs, and PAEs 'Oh My' – Sorting out Remedies in Patent Infringement Litigation," American Law Institute Continuing Legal Education, September 2013 (with Krish Gupta and Peter Strand).

"The Evolution of License Comparability in the Estimation of Reasonable Royalty Damages," West Legal Education Center Webinar, July 2013 (with John Jarosz).

"Taking and Defending Expert Depositions," Practicing Law Institute, Taking and Defending Depositions Seminar, March 2013 (with Kimo S. Peluso and Jack G. Stern).

"Taking and Defending Expert Depositions," Practicing Law Institute, Taking and Defending Depositions Seminar, May 2012 (with Kimo S. Peluso and Jack G. Stern).

"Calculating Reasonable Royalty Damages after *Uniloc v. Microsoft*: An Economic Perspective," Intellectual Property Law Section of the D.C. Bar, July 2011 (with Peter Strand).

"Patent Infringement: Calculating Royalty Damages in a Post-Uniloc World," Strafford Publications Webinar, March 2011 (with Paul Michel, George Pappas, and John Jarosz).

"Clearing the Way for Biosimilars: New Complexities Around Competition and Consumer Harm," ABA

Antitrust Section Teleseminar, February 2011 (Moderator, with Panelists: Seth Silber, Iain Cockburn, Julie McEvoy, and Matt Cantor)

"Damages Apportionment After Lucent," The 10th Anniversary Wilmer Hale Intellectual Property Conference, May 2010 (with Michael R. Heyison and Dominic E. Massa).

"Licensing in the Presence of Technological Standards," Licensing Executives Society, Annual Meeting, October 2008.

"Reasonable Royalty Determination in the Presence of Standards and University Licensing," Law Seminars International, Calculating and Providing Patent Damages Workshop, October 2006.

"Providing Effective Royalty Testimony," Licensing Executives Society/Association of University Technology Managers Spring Meeting (Workshop 4-H), May 2006 (with John Jarosz and Lisa Pirozzolo).

"Meeting the Standards for Price Erosion and Convoyed Sales," Law Seminars International, Calculating and Providing Patent Damages Workshop, February 2006.

"Intellectual Property Damages from an Economist's Perspective," DC Bar Association, Trade Secret Section, November 2005 (with John Jarosz and Abram Hoffman).

"Factors affecting Royalties," Licensing Executive Society Annual Meeting (Workshop 2-M), October 2005 (with Robert Vigil).

"Trade Secrets Damages: What Can A Successful Claimant Expect to Recover?" Trade Secrets Committee of the Intellectual Property Law Section of the D.C. Bar, February 2005.

"Economics of Price Erosion and Lost Convoyed Sales," Law Seminars International, Calculating and Proving Patent damages Workshop, March 2004.

"An Economist's Perspective on Reach-Through Royalties," Law Seminars International, Calculating and Proving Patent Damages: Recent Developments and New Tools for Success, June 2003.

"Trade Secrets Damages and Recent Developments," Trade Secrets Committee of the Intellectual Property Law Section of the D.C. Bar, May 2002.

"Industry Royalty Rates and Profitability: An Empirical Test of the 25% Rule," Licensing Executives Society Annual Meeting (Workshop 3-L), October 2001 (with John Jarosz and Robert Vigil).

"Estimating the Economic Value of Trade Secrets," U.S. Sentencing Commission (USSC) Symposium on Federal Sentencing Policy for Economic Crimes and New Technology Offenses, October 13, 2000.

"Estimating Economic Recovery in Trade Secrets Cases," Trade Secrets Committee of the Intellectual Property Law Section of the D.C. Bar, September 1999.

"Industry Royalty Rates and Profitability: An Empirical Test of the 25% Rule," Licensing Executives Society Annual Meeting, (Workshop 3-11), October 1998 (with John Jarosz).

"Royalty Rates and Awards in Patent Infringement Cases: 1916-1996," Licensing Executives Society Annual Meeting, November 1997 (with John Jarosz).

PROFESSIONAL AFFILIATIONS

American Economic Association (AEA)

Licensing Executives Society (LES)

IAM Patent 1000 (2014, 2015, 2016): The World's Leading Patent Practitioners - Economic Experts

EXHIBIT 11

Curriculum Vitae

WILLIAM OWEN KERR, PH.D.
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Dr. Kerr is an economic consultant and author, with more than 30 years experience. His practice involves application of economic, financial and statistical methods in areas such as: valuation of intellectual property and business assets, economic policy analysis and economic damages in litigation.

His areas of specialization in litigation include: intellectual property damages, antitrust and industrial organization, commercial damages and employment and discrimination matters. He has testified as an expert in federal and state courts, before mediation and arbitration panels and before government agencies and commissions.

Dr. Kerr was named ***"One of the World's Leading Patent Practitioners"*** by Intellectual Asset Management (IAM) in 2015 and 2016.

PROFESSIONAL EXPERIENCE

2010 to date	Berkeley Research Group
2005 to date	William O. Kerr & Company
2005-2010	LECG, LLC
1999-2005	Navigant Consulting, Inc.
1998-1999	PENTA Advisory Services, LLC
1997-1998	C.W. Amos & Company
1985-1997	Capital Economics
1983	President's Private Sector Survey on Cost Control
1979-1985	Arthur Young & Company
1978-1979	CONEG Policy Research Center
1975-1978	Department of Economics, C.W. Post College/Long Island University

INTELLECTUAL PROPERTY LITIGATION AND CONSULTING

Dr. Kerr has testified in IP litigation, on lost profits and reasonable royalty damages, commercial success, and infringer's profits. He also consults with clients on the value of intellectual property and evaluating licensing and pricing strategies for exploitation of intellectual property assets.

ANTITRUST LITIGATION AND INVESTIGATIONS

Dr. Kerr provides services to clients on economic issues related to liability and damages in antitrust and unfair competition matters. He has testified in litigation and made presentations to government agencies on market definition and competitive effects in mergers, intellectual property settlements, joint ventures and other commercial transactions.

COMMERCIAL LITIGATION

Dr. Kerr's experience in commercial litigation covers a range of industries and legal areas. He has testified on economic damages related to claims of breach of contract, fraud, and insurance claims, as well as environmental matters and construction delays.

EMPLOYMENT AND DISCRIMINATION

Dr. Kerr has testified in matters involving claimed violations of labor laws, wrongful termination and discrimination in employment and public accommodations. He has testified in collective bargaining disputes and advised both labor and management on labor market issues.

INTERNATIONAL TRADE AND INVESTMENT

Dr. Kerr has consulted for U.S. and foreign governments and for private sector clients on international trade and investment issues. He has testified before the U.S. International Trade Commission and other agencies in matters involving intellectual property and unfair trade practices, export controls and tariffs. He has consulted on export promotion programs, overseas private investment initiatives and trade preferences.

REGULATION AND POLICY ANALYSIS

Dr. Kerr has assisted public and private sector clients in the U.S. and abroad on the economic effects of public policy, taxes and regulation. Examples of his work include evaluation of: economic development programs; government regulations on interstate commerce; regulations of broadcasting and telecommunications; environmental regulations; government procurement programs; and federal and state tax policies.

EDUCATION

Ph.D. in economics, The Graduate Faculty of The New School (Major Fields: Industrial Organization, Labor Economics, International Economics), 1979

M.S. in economics, The Graduate Faculty of The New School, 1975

B.S. in social sciences, The New School for Social Research, 1974

PROFESSIONAL PUBLICATIONS AND PRESENTATIONS (2000-2015)

Assets and Finances: Calculating Intellectual Property Damages (with Richard B. Troxel), West Publishing, Thomson-Reuters, Rochester NY (12th Edition 2017; previous editions 2006-16)

The Iceberg Effect: Revisiting the Market Approach for IP Valuations (with David A. Kennedy and Cathy Lawton), Intellectual Asset Management, IAM Yearbook 2016: Building IP Value in the 21st Century, October 2015

The Economics of Licensing Standard Essential Patents, World Intellectual Property Forum: *IP as a Commercial Tool in Designing the Future,* Bangkok, Thailand, September 2015

Measuring Reverse Payments in the Wake of *Actavis* (with Cleve B. Tyler), Antitrust, Volume 28, Number 1, Fall 2013

Causal Nexus in Patent Remedies: *Apple v. Samsung*, Intellectual Property Owners Association's Webinars on Current Topics in IP, IP Chat Channel, December 2013

What's "Reasonable" in RAND Royalty Rates, Licensing Executives Society Annual Meeting, Philadelphia, PA, September 2013

Law & Economics in the Patent System; Giles Rich Inn of Court Program, Court of Appeals for the Federal Circuit, Washington, DC, January 2013

Investing in Intellectual Property Assets and Enforcement–Penn Club, Stroock, Stroock & Laven LLP, New York, NY, November 2012

New Rules for Patent Damages, Philadelphia Intellectual Property Law Association–Benjamin Franklin America Inns of Court (PIPLA/BFIOC), Patent Damages Panel, Philadelphia, PA, April 2011

Economic and Financial Issues in Antitrust Litigation, American Law Institute–American Bar Association (ALI-ABA), Washington, DC, 2001-2008

Patent Pools – a Practical Guide (with Mark Palim), Business Development & Licensing Journal for the Pharmaceutical Licensing Groups, Spring, 2007

Patent Damages - Economic Approaches to Quantifying Damages, The Intellectual Property Institute, Minneapolis MN, September 2005

Patent Infringement Damages, Statistics & Trends 1990 – 2004 (with Christopher Loza and Michele Riley), Intellectual Property Research Associates, Inc., Yardley PA, 2004

Federal Circuit Decisions Clarify Requirements for Lost Profits Damages (with R. Washington), Patent Strategy & Management, April 2004

Economic and Financial Trends in Intellectual Property Litigation (with Richard Troxel), Andrews' Intellectual Property Litigation Conference, Chicago IL, September 2004

Reducing the Asbestos penalty: An Economic Benefit of Asbestos Reform Litigation, FIAR, Washington DC, October 2003

Patent Damages: The Neglected Child, the American Intellectual Property Law Association (AIPLA), Washington DC, October 2003

Evaluating Economic and Financial Factors in an IP Licensing Program (with R. Parr and M. Riley), the Licensing Executives Society, San Diego CA, September 2003

Patent Damages and Royalty Awards: The Convergence of Economics and Law (with Gauri Prakash-Canjels), les Nouvelles, Vol. XXXVIII No.2, June 2003

Economic Issues: Tensions Between Antitrust Enforcement and Patent Protection, the Minnesota State Bar Association, Minneapolis MN, May 2003

Economic Trends in Patent Damage Awards, the Delaware Bar Association – Intellectual Property Section, Wilmington DE, December 2001

Pharmaceuticals Industry: Competitiveness, Innovation and Intellectual Property, presentation to the National Association for Business Economics, New York, September 2001

Federal Circuit Sets High Standards for Future Damages Claims, Patent Strategy & Management, July 2001

The Influence of Patent Law on Innovation and Technology, the National Association of Forensic Economists and the Southern Economic Association, Arlington VA, October 2000

Patent Damages and Innovation, Texas Intellectual Property Law Association, Austin TX, July 2000

Trends in Patent Infringement Lawsuits and Damage Awards, the Greater Richmond Intellectual Property Law Association, Richmond VA, March 2000 and The Patent Law Association, Washington DC, September 2000

EDITORIAL POSITIONS

Referee - Litigation Economics Digest (2000-03)

Editorial Board - Patent Strategy & Management (2001-06)

Editorial Board - The Patent Journal (2002)

TESTIMONY IN LITIGATION

LISCR, LLC v. Applied Information Sciences, Inc., American Arbitration Association, Case No. 01-15-0005-7786-1-JB (2017)

Lanard Toys Limited v. Toys "R" US – Delaware, Inc., Dolgencorp, LLC, and Ja-Ru, Inc., U.S. District Court, Middle District of Florida -- Jacksonville Division, Case No. 3:15-cv-849-J-34PDB (2017)

Evicam International, Inc. v. Enforcement Video, LLC d/b/a WatchGuard Video, U.S. District Court for the Eastern District of Texas, Tyler Division, Civil Action No. 6:15-cv-01043 (2017)

Johana Paola Beltran, et al.; and those similarly situated v. InterExchange, Inc., et al., U.S. District Court for the District of Colorado, Civil Case No. 14-cv-03074-CMA-KMT (2017)

Tyco Fire Products LP v. Victaulic Company, U.S. Patent and Trademark Office, Before the Patent Trial and Appeal Board, Cases IPR2016-00278 and IPR2016-00279 (2017)

Acacia Research Group, LLC, and Lifeport Sciences, LLC Claimants and Counter-Respondents, Against Boston Scientific Corporation, Respondent and Counter-Claimant, Before the Tribunal, American Arbitration Association, Case No. 02-15-0004-9460 (2016) (2017)

In the Matter of Certain Windscreen Wipers and Components Thereof, U.S. International Trade Commission, Inv. No. 337-TA-964 (2016)

Avnet, Inc. and BSP Software LLC v. Motio, Inc., U.S. District Court for the Northern District of Illinois, Eastern Division, Civil Action No. 1:12-cv-02100 (2016)

Prophase Labs, Inc., for itself and for the benefit of Phusion Laboratories, LLC v. Phosphagenics, Inc., Phosphagenics, LTD., and Phusion Laboratories, LLC and Phosphagenics, Inc., and Phosphagenics, LTD., for themselves and for the benefit of Phusion Laboratories, LLC v. Prophase Labs, Inc. and Phusion Laboratories, LLC, American Arbitration Association, Case No. 01-14-0001-7373 (2016)

Signal IP LLC v. BMW North America, LLC and BMW (US) Holding Corp., U.S. District Court, Central District of California, Western Division, Case No. 14-cv-3111 (2015)

In the Matter of Certain Recombinant Factor VIII Products, U.S. International Trade Commission, Inv. No. 337-TA-956 (2015)

Lifeport Sciences LLC v. Endologix, Inc., U.S. District Court, District of Delaware, Case No. 1:12-cv-01791-GMS (2015)

Liberty Global Logistics, LLC v. International Auto Logistics, LLC, American Arbitration Association, Case No. 01-14-0002-2715 (2015)

PPC Broadband, Inc. v. Corning Gilbert Inc., U.S. District Court, Northern District of New York, Civil Action No. 11-00761-GLS-DEP (2013) (2015)

In the Matter of Certain Hemostatic Products and Components Thereof, U.S. International Trade Commission, Inv. No. 337-TA-913 (2014) (2015)

Uniloc USA, Inc. and Uniloc Luxembourg S.A. v. Activision Blizzard, Inc., U.S. District Court, Eastern District of Texas, Civil Action Nos. 6:13-cv-00256 (2014)

MLR, LLC v. Dell Inc., U.S. District Court, Eastern District of Virginia, Civil Action No. 1:14-cv-135 GBL-TRJ (2014)

U.S. Nutraceuticals LLC d/b/a Valensa International; and The Board of Trustees of The University of Illinois v. Cyanotech Corporation and Nutrex Hawaii, Inc., U.S. District Court, Middle District of Florida, Ocala Division, Civil Action No. 5:12-cv-00366-WTH-TBS (2014)

Bell Helicopter Textron Inc. v. Eurocopter, U.S. District Court, District of Columbia, Case No. 1:10-cv-00789-RLW (2014)

In the Matter of Certain Non-Volatile Memory Devices and Products Containing Same, U.S. International Trade Commission, Inv. No. 337-TA-909 (2014)

Protostorm, LLC and Peter Faulisi v. Antonelli, Terry, Stout & Kraus, LLP, Dale Hogue and Frederick D. Bailey, U.S. District Court, Eastern District of New York, 08 Civ. 931 (NGG) (JO) (2010) (2012) (2014)

Corning Gilbert, Inc. d/b/a Corning Optical Communications RF, LLC v. John Mezzalingua Associates, Inc. d/b/a PPC, U.S. District Court, District of Arizona, Case No. 2:12-cv-02208-SRB (2014)

Barry C. Cosgrove v. Uniloc Corporation PTY., Ltd., et al.; and Uniloc Corporation PTY., Ltd., et al., Uniloc USA, Inc., and Uniloc Luxembourg S.A. v. Barry C. Cosgrove, Superior Court of California, Orange County, Central Justice Center, Case No. 30-2012-00586345 (2014)

John W. Von Holdt, Jr., Janice Anderson and Plas-Tool Co., v. A-1 Tool Corporation, Triangle Tool Corporation, Alfonso Arciniegas, Geoffrey Luther and Leroy Luther U.S. District Court, Northern District of Illinois, Eastern Division, Case No. 04 C 4123 (2007) (2014)

Campmor, Inc. v. Brulant, LLC, U.S. District Court, District of New Jersey, Civil Action No. 09-cv-5465 (WHW) (2011) (2013)

Uniloc Luxembourg SA. v. Compulink Business Systems, Inc., et al., U.S. District Court, Central District of California, Western Division, Civil Action No. 11-10122 MWF (PLAx) (2013)

In the Matter of Certain Audio/Visual Components and Products Containing the Same, U.S. International Trade Commission, Inv. No. 337-TA-837 (2013)

Life Technologies Corporation and Applied Biosystems, LLC v. AB Sciex PTE. Ltd. and DH Technologies Development PTE. Ltd., Judicial Arbitration and Mediation Services, Inc., JAMS Case No. 1400013323 (2012)

Starhome GmbH v. AT&T Mobility LLC, Roamware, Inc., and T-Mobile USA, Inc., U.S. District Court, District of Delaware, Civil Action No. 10-434 (GMS) (2012)

In the Matter of Certain Dynamic Random Access Memory and NAND Flash Memory Devices and Products Containing Same, U.S. International Trade Commission, Inv. No. 337-TA-803 (2011) (2012)

Avocent Redmond Corp. v. Rose Electronics, Peter Macourek, Darioush "David" Rahvar, ATEN Technology Inc., ATEN International Co., Ltd., Trippe Manufacturing Company, Belkin International, Inc., and Belkin, Inc., U.S. District Court, Western District of Washington at Seattle, Civil Action No. 06-1711 RSL (2012)

ITT Manufacturing Enterprises, Inc. v. Cellco Partnership (d/b/a Verizon Wireless), LG Electronics, Inc., and LG MobileComm U.S.A., Inc., Kyocera Corporation, Kyocera International, Inc., Kyocera Wireless Corp., and Kyocera Communications, Inc., and Qualcomm Inc., U.S. District Court, District of Delaware, Civil Action No. 09-190-LPS (2012)

Reporting Technologies, Inc. v. Emma, Inc., U.S. District Court, Eastern District of Virginia, Civil Action No. 1:11-CV-01203 (TSE/IDD) (2012)

Avocent Redmond Corp. v. Raritan Americas, Inc., U.S. District Court, Southern District of New York, Civil Action No. 10-CV-6100 (PKC)(JLC) (2012)

Maher Terminals, LLC v. The Port Authority of New York and New Jersey, Federal Maritime Commission, FMC Docket No. 08-03 (2011)

Hologic, Inc. v. IZI Medical Products, LLC, U.S. District Court, District of Massachusetts, Civil Action No. 1:11-cv-10619-WGY (2011)

U.S. Rubber Recycling, Inc. v. ECORE International Inc., U.S. District Court, Central District of California, Civil Action No.: 09-9516 SJO (OPx) (2011)

Waddington North America, Inc. v. Sabert Corporation, U.S. District Court, District of New Jersey, Civil Action No.: 2:09-cv-04883-GEB-MCA (2011)

In Re Qimonda AG Bankruptcy Litigation, U.S. District Court, Eastern District of Virginia, Alexandria Division, Case No. 09-14766 (RGM) (2011)

Thomas L. Logue, on behalf of himself and others similarly situated v. West-Penn Multi-List, Inc., et al., U.S. District Court, Western District of Pennsylvania, Case No.: 2:10-cv-0451 (2011)

Island Intellectual Property LLC and LIDs Capital LLC v. Deutsche Bank Trust Company Americas and Total Bank Solutions, LLC, U.S. District Court, Southern District of New York, Civil Action No. 09 Civ. 2675 (VM)(AJP) (2010)

MacroMavens, LLC v. Deutsche Bank Securities, Inc., U.S. District Court, Southern District of New York, Civil Action No. 09-CV 7819 (PKC)(RLE) ECF Case (2010)

Hubbell Incorporated v. Pass & Seymour, Inc., U.S. District Court, District of Connecticut, Case No. 3:08-cv01656 (2010)

Department of Financial and Professional Regulation v. Stroman Realty, Inc., State of Illinois, Civil Action No. E2005-92 (2010)

Callaway Golf Company v. Acushnet Company U.S. District Court, District of Delaware, Civil Action No. 06-91 (SLR) (2007) (2010)

MHL Tek v. Nissan Motor Co., *et al*., Case No. 2:07-cv 289, United States District Court for the Eastern District of Texas, Marshall Division (2009)

Certain Cast Steel Railway Wheels, Certain Processes for Manufacturing or Relating to Same and Certain Products Containing Same, United States International Trade Commission, Washington, DC, Investigation No. 337-TA-655 (2009)

Florida Department of Business and Professional Regulator, *et al.* v. Stroman Realty, Inc., Circuit Court of Leon County, Florida Civil Action No. 98-490 (1998) (2009)

Certain Semiconductor Integrated Circuits Using Tungsten Metallization and Products Containing Same, United States International Trade Commission, Washington, DC, Investigation No. 337-TA-648 (2009)

Commonwealth Scientific & Industrial Research Org. v. Toshiba America Information Systems, *et al.,* Case No. 6:06-CV-550 LED, United States District Court for the Eastern District of Texas, Tyler Division (2008)

Certain Semiconductor Chips with Minimized Chip Package Size and Products Containing Same (III), United States International Trade Commission, Washington, DC, Investigation No. 337-TA-630 (2008)

Corinthian Mortgage Corporation dba SouthBanc Mortgage v. ChoicePoint Precision Marketing United States District Court for the Eastern District of Virginia, Alexandria Division, Civil Action No. 1:07CV832 (JCC/TRJ) (2008)

Xerox Corporation v. Media Sciences, Inc. United States District Court for the Southern District of New York, Case No. 06-CV-4872 (RJH) (2008)

K-DUR Antitrust Litigation United States District Court, District of New Jersey, No. 01-CV-1652-JAG, MDL Docket No. 1419 (2008)

Parker-Hannifin Corporation and Parker Intangibles, LLC v. Wix Filtration Corporation United States District Court, Eastern District of California, CIV. F-06-00098-DFL (2008)

American Calcar, Inc. v. American Honda Motor Co., Inc., and Honda of America Manufacturing, Inc. United States District Court, Southern District of California, Civil Action No. 06-cv-2433-DMS (CAB), Judge Dana M. Sabraw; Magistrate Judge Cathy A. Bencivengo (2007) (2008)

Burrows Paper Corporation v. Northstar Pulp & Paper Co., Inc., United States District Court, Northern District of New York, Civil Action File No. 05-CV-1151 (DNH/GJD) (2007)

Eric Bischoff, Frank Brunckhorst Co., LLC v. Boar's Head Provisions Co., Inc., Frank Brunckhorst III and Robert S. Martin Supreme Court of the State of New York, County of New York, Index No. 604265-05, Justice Richard B. Lowe, III (2007)

Tele Atlas N.V. and Tele Atlas North America v. NavTeq Corporation U.S. District Court, Northern District of California, San Jose Division, Case No.C 05-1673 RMW (2007)

Alan Kahn v. Joseph J. Saker, et al. Superior Court of New Jersey, Chancery Division: Monmouth County, Civil Action No. C-214-06 (2007)

Derek Webb, et al. v. Mikohn Gaming Corporation and Progressive Games, Inc., U.S. District Court, Southern District of Mississippi, Jackson Division, Case No. 3:02-CV-1838 WS (2004) (2007)

Static Control Components, Inc. v. Lexmark International, Inc. v. Wazana Brothers International, Inc. d/b/a Micro Solutions Enterprises v. Pendl Companies, Inc. v. Ner Data Products, Inc. U.S. District Court, Eastern District of Kentucky at Lexington, Case No. 04-CV-84-GFVT (2006)

DBHL, Inc., and Dearborn HL, S.DE R.L. DE C.V. v. Moen, Incorporated and Moen Sonora S.A. DE. C.V. U.S. District Court of Harris County, Texas, 295th Judicial District, Case No. 2004-71621 (2006)

Leggett & Platt, Inc.; and L&P Property Management Co. v. Vutek, Inc. U.S. District Court for the Eastern District of Missouri, Eastern Division, Case No. 4:05-CV-788-CDP (2006)

W.P. Hickman Systems, Inc. v. The Garland Company, Inc., et al., U.S. District Court for the Northern District of Ohio, Civil Action No. 1:04CV2104 (2006)

Sensormatic Electronics Corporation v. WG Security Products, Inc. and EAS Sensorsense, Inc., U.S. District Court, Eastern District of Texas, Marshall Division, Civil No. 2-04CV-167-TJW (2006)

Commissariat A L'Energie Atomique v. Chi Mei Optoelectronics Corporation, AUO, Inc., et al., U.S. District Court, District of Delaware, Case No. 03-484 (KAJ) (2006)

Avocent Huntsville Corp., v. Clearcube Technology, Inc., U.S. District Court, Northern District of Alabama, Case No. CV-03-S-2875-NE (2004) (2006)

Fisher-Price, Inc. v. Safety 1st, Inc., U.S. District Court, District of Delaware, C. A. No. 01-051 (GMS) (2003) (2006)

ITT Manufacturing Enterprises, Inc. v. Samsung Electronics America, Inc. et al. and Sprint Corporation, U.S. District Court, District of Delaware, Case No. 03-CV-1086 (2005)

Cargill Incorporated v. Canbra Foods Ltd., Dow Agrosciences LLC and Dow Agrosciences Canada, Inc., U.S. District Court, District of Oregon, Civ. No. 03-01209-MO (2005)

Sierra Applied Sciences, Inc. v. Kurt J. Lesker Company, U.S. District Court, Western District of Pennsylvania, C.A. No. 01-628 (2005)

CFS Bakel, B.V. v. Stork Gamco, Inc. and Stork Titan B.V., U.S. District Court, District of Delaware, C.A. No. 09-901 GMS (2005)

NOS Communications, Inc. v. Sprint Corporation, Inc., Hi-Tech Gateway, Inc. and Does 1 through 100 Inclusive, Superior Court of the State of California for the County of Los Angeles, Case No. BC 282869 (2005)

Tenneco Automotive Operating Company, Inc. v. Visteon Corporation, U.S. District Court, District of Delaware, Case No. 03-103-SLR (2005)

Software AG and Software AG, Inc., v. BEA Systems, Inc., U.S. District Court, District of Delaware, C.A. No. 03-739 (GMS) (2005)

Apex, Inc. v. Raritan, Inc., U.S. District Court, Southern District of New York, Civ. No. 01CV-4435 (BSJ) (DFE) (2002) (2005)

Stroman Realty, Inc. v. Jim Antt, Jr., et al., U.S. District Court, Southern District of Texas, Houston Division, Civil Action No. H-98-0283 (1999) (2005)

Kathleen Cailloux, et al. v. Baker Botts, Wells Fargo, et al., 198th District Court of Kerr County, Texas, Cause No. 03-603-B (2004)

Anexsys Holdings of Missouri, Inc., v. Anexsys Holdings, Inc., Bank One, N.A., and Anexsys, LLC, American Arbitration Association, Case No. 51 180 01 109 03 (2004)

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Stanford University, J.D., 1981; A.M. (Economics), 1981; A.B. with honors and distinction (Economics), 1977. Associate Editor, *Stanford Law Review*. Myers Prize in Economics, 1977.

Current Employment

Criterion Economics, L.L.C., Washington, D.C.: Chairman, 2008–present. Founder, 1999–present.

Journal of Competition Law & Economics, published by the Oxford University Press, Oxford, United Kingdom: Founding Co-Editor, 2004–present.

Employment History

Tilburg University, Tilburg, The Netherlands: Ronald Coase Professor of Law and Economics, 2009–2014.

Georgetown University, Washington, D.C.: Visiting Professor of Law, 2005–2007.

American Enterprise Institute for Public Policy Research, Washington, D.C.: Resident Scholar and F.K. Weyerhaeuser Fellow in Law and Economics Emeritus, 2002–2005. Director, AEI Studies in Telecommunications Deregulation, 1992–1995. F.K. Weyerhaeuser Fellow in Law and Economics, 1995–2002. Resident Scholar, 1992–1995.

Yale University, New Haven, Connecticut: Senior Lecturer, Yale School of Management, 1993–2000.

Covington & Burling, Washington, D.C.: Associate, 1989–1992.

Federal Communications Commission, Washington, D.C.: Deputy General Counsel, 1987–1989.

Council of Economic Advisers, Executive Office of the President, Washington, D.C.: Senior Counsel and Economist, 1986–1987.

The Boston Consulting Group, Inc., Los Angeles: Management Consultant, 1984–1986.

O'Melveny & Myers, Los Angeles: Associate, 1982–1984.

U.S. Court of Appeals for the Seventh Circuit, Chicago: Law Clerk to Judge Richard A. Posner, 1981–1982.

Corporate Boards

NTT DoCoMo, Tokyo, Japan: Member, U.S. Advisory Board, 2002–2006.

Authored Books

Broadband in Europe: How Can Brussels Wire the Information Society, co-authored with Dan Maldoom, Richard Marsden, and Hal J. Singer (Springer 2005).

Deregulatory Takings and the Regulatory Contract: The Competitive Transformation of Network Industries in the United States (Cambridge University Press 1997), co-authored with Daniel F. Spulber (published in Chinese as 美国公用事业的竞争转型：放松管制与管制契约).

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Line Item Veto: The President's Constitutional Authority: Hearing before the Subcommittee on the Constitution of the Senate Judiciary Committee, 103d Congress, 2d Session (June 15, 1994).

Opinion of Law Concerning Legislation to Reform the Cost-Justification Defense to Discrimination in the Sale of Telecommunications Services, Letter to Ms. Deena Shiff, General Manager, Corporate Affairs, Telstra Corporation Limited, Sydney, New South Wales, Australia (Jan. 13, 1994) (distributed to the Australian Parliament).

Brief of *Amicus Curiae* J. Gregory Sidak, *Association of American Physicians and Surgeons, Inc. v. Hillary Rodham Clinton*, 997 F.2d 898 (D.C. Cir. 1993), filed Apr. 5, 1993.

Bar Admissions

California (1982); District of Columbia (1989); Supreme Court of the United States (1989).

Memberships

The American Law Institute

The London Court of International Arbitration, North American Users' Council

World Intellectual Property Organization, Neutral Expert

October 6, 2017

EXHIBIT 13

Curriculum Vitae of Earl W. McCune Jr.

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OVERVIEW

A "serial" entrepreneur since 1986 in wireless communications, with a long track record of visualizing business opportunities and heading leading-edge technology and product development. I have held business leadership roles since 1982, covering all of project, technology development, operations, business planning, and company leadership. Team building has been a key aspect of my responsibilities, resulting in arguably some of the strongest RF development teams assembled in recent times. My RF design experience spans more than 40 years. I have a long history as a team builder and player, though admittedly I do not tolerate mediocrity around me well. Yet, with any problems I affect diplomatic solutions in short order.

TECHNICAL INTERESTS

Low power consumption RF circuits and devices, general modulation with emphasis on angle modulation, polar signal processing, frequency synthesis and integrated modulators, spread spectrum, analog and digital signal processing. Specific interest in merging the technology bases of analog/RF and digital since 1975. Specialist in RF, particularly transmitter efficiency, modulation design, and metrology.

EDUCATION

- BSEE/CS (Cum Laude) **University of California**, Berkeley 1979
- MSEE (Radioscience) **Stanford University** 1983
  Thesis: Channelized IF Signal Processing
  Advisor: Prof. Alan Peterson
- Ph.D. EE **University of California**, Davis 1998
  Dissertation: Extended Phase-Shift Keying
  Research Advisor: Prof. William A. Gardner

Appointed an IEEE MTT Distinguished Microwave Lecturer for 2013-2015

AREAS OF TECHNICAL EXPERTISE

Communication system design and analysis	RF Instrumentation, Measurements, and Metrology
Multimode communications – low cost implementations	Cellular Radiotelephone, WLAN, PAN convergence
Conversion of RF to digital implementations	EMI/EMC radiation: causes and suppression
Spread Spectrum technology: Direct Sequence, Frequency Hopping, hybrid forms	General analog circuitry: IC and transistor level design
Modulation/Signal Design to system specifications	High-speed digital/baseband signal transmission
RF signal synthesis: PLL, DDS, DAS, and hybrid types	System simulation programming in 'C', MATLAB, and MathCAD
Radio receivers: all types, VLF - 40GHz	Commercial and Military product experience

POSITIONS HELD

RF Communications (Consulting) Owner/Principal Engineer 2009 on

Following retirement from Panasonic, my focus is now shifted to "giving back" to the industry I have served for so long. Updated my independent RF laboratory from 1993. Additional emphases, beyond yet including those from 1993 are

Academic visiting professor/scholar	Industrial training in wireless and modulation topics
Intellectual Property portfolio development	Business advice to entrepreneurs
Reference book / textbook author	

Panasonic Technology Fellow 2008-2009
Managing Director 2006-2008

PEARL (Panasonic Emerging Advanced RF Laboratory)
PEARL is a corporate R&D laboratory formed by the acquisition of Tropian by Panasonic in April 2006. Answering to the Corporate R&D operation in Japan, responsible for all aspects of the operation, technology, and the Intellectual Property developments at PEARL. I also work closely with Panasonic operating management to help improve their international RF business activities. Responsible for public communications at symposia and conferences, and standards development committee representation at MIPI.

Joined Panasonic through their acquisition of Tropian on 4-7-2006

Tropian Inc. Co-founder and Chief Technical Officer 1996-2006
Co-founder and President 1996-1999

Tropian is established to reduce costs of radio products by exploiting switches, rather than current sources, as the basic circuit design element. This leads directly polar signal processing, which also improves signal quality and energy efficiency for wireless products. Polar signal processing also has the desired cost effectiveness in achieving broad-capability multi-mode operation, and is very robust in manufacturing. Initial products are in support of cellular handsets and wireless modems. Other developments include base-station transmitters, where the energy efficiency of polar modulation is particularly valuable. Centrally involved in company business strategy.

Responsible for Tropian's entire Intellectual Property Rights portfolio strategy and development, including the selection and management of outside Counsel.

RF Communications (Consulting) Owner/Principal Engineer 1993 on

Provide my RF and Communications experience toward the successful development of products in wireless and other marketplaces. Established an independent RF laboratory and technical library. Projects have included:

Low cost Ku-band Synthesizer	Modulated clock to reduce digital system EMI
Microwave radio production cost reduction	Wireless network definitions
Cellular High-Speed measurement receiver	<10ps cycle-to-cycle jitter measurement method
Technical due-diligence analyses	Product Marketing analyses

Proxim, Inc. Vice President, Research and Development 1991-93

Led a team responsible for producing new high performance spread spectrum radio technology at both 900 MHz and 2400 MHz. Focused on low power consumption/small size for portable uses, and low cost for consumer marketing. These were full system designs, including choice of modulation types and frequency architectures. Worked closely with major customers to develop new business opportunities in these areas. Participation in early IEEE 802.11 committee work, focused on the FH PHY.

Additional ASICs: digital signal processor, mixed mode signal generator, GaAs front end

Joined Proxim through the merger with Digital RF Solutions on 5-1-91

Digital RF Solutions Corp. President/CEO 1986-88
Principal Founder Vice President, Engineering and Technology 1988-91

I started this company to apply digital technology and economics to the communications industry. I built the company team, led the business plan team, raised funding, developed the initial products, and established the sales network. Due to company growth, I brought in another person to be President after two years.

All DRFS products are based on DDS (Direct Digital Synthesis) as proprietarily implemented in the patented NCMO™ (Number Controlled Modulated Oscillator™) ASIC. The DRFS-2250 was awarded Microwaves & RF Product of the Year for 1987. Representative products developed for different industry areas include:

Industrial/Commercial	Military/Government
VR1070 Decimal stepsize from decimal clock	Doppler Calibrator for AEGIS
DX2070 Low spurious, angle modulated	Clutter Simulator for AEGIS
DX4060 High agility, angle modulated	Doppler reference synthesizer for APG-69
DX4660 Quadrature output, angle modulated	I/Q chirp numeric synthesizer for SDIO
DRFS-2250, -3250, -4250 NCMO ASICs	Chirp IC for USN program
DRFS-9240 DDS (Decimal tuned NCMO)	Fast frequency hopping synthesizer for GBU-15
DRFS-3850 Numeric Chirp Synthesizer	

Cushman Electronics Chief Engineer 1983-86

Took over the engineering department following a management shake-up from the Board of Directors. Reviewed all active projects, and pruned the list to focus energies on highest probability of commercial success. The CE6000 product family remained in production for 10 years. Our new leadership team stopped losses at the company.

CE 60x0 Communications Monitor family
CE 7120 Communications Monitor
CE 4416 AMPS Cellular System Monitor/Tester
CE 415 Spectrum Analyzer plugin

Watkins Johnson Company MTS; Head, Analog Engineering 1979-83

Wideband demodulators: AM, FM, BPSK
YIG Wideband synthesizers (PLL): P, L, S, C, X, Ku bands
SAW channelized receiver – IF channel processor
Established phase noise measurement capability within the RECON Division

Hewlett-Packard Company Development Engineer 1978

ATE support equipment for HP-8903 Distortion Analyzer (new instrument development)
Phaselock synthesizer investigations

Siliconix Applications Engineering Technician 1976-77

FET circuit construction and characterization to support Applications Engineering

NASA Ames Research Center Technician, High Energy Laser Laboratory 1974-75
Mechanical Designer, Hypersonic 3.5' Wind Tunnel 1973-74

PROFESSIONAL AND FRATERNAL ASSOCIATIONS

IEEE	
Societies	Communications, Microwave Theory and Techniques, Solid-State Circuits, Vehicular Technology, Aerospace and Electronic Systems, Engineering Management, Circuits and Systems
Committees	CICC Technical Program Committee, Wireless subcommittee (2001-2013), Chair 2009-10 RAWCON (now RWS) Technical Program Committee, Power Amplifier subcommittee, PA Symposium Committee Appointed to IEEE Green Information and Communication Technology Initiative steering cmte JSSC reviewer from 2004; T-CAS reviewer since 2008; T-MTT reviewer since 2009
Awards	MTT Distinguished Microwave Lecturer (DML) 2013-2015, DML Emeritus 2016+
Honor Societies:	Phi Beta Kappa, Tau Beta Pi, Eta Kappa Nu
Universities	Board of Advisors, UC Davis Engineering Industrial Affiliates Visiting Associate Professor, Delft Technical University (TU Delft)
Amateur Radio	WA6SUH (Advanced class) since 1972 Amateur Radio Relay League, Amateur Radio Emergency Service, Silicon Valley Section
Standardization	DigRF Interface v3 (2004-2007) MIPI – multiple working groups (WG) (2007-2014) DigRF v4 WG: chair, BER, EMI, and PHY issues subgroup M-PHY WG: electrical subgroup RF-FE WG: founding member, EMI eTrack IEEE-SA: appointed WG chair for P1923.1 and P1924.1

PATENT RECORD

US Patents issued (as sole or contributing inventor) ***Additional applications submitted and pending - - -***

4,603,305 Apparatus and Method for Sweep Oscillator Calibration
4,746,880 Number Controlled Modulated Oscillator
5,053,982 Variable Modulus Digital Synthesizer
5,247,469 Digital Frequency Synthesizer and Method Using Vernier Interpolation
5,306,971 Binary Controlled Digital Tapped Delay Line
5,321,799 Signaling Transition Control in a Modulated Signal Communication System

5,491,458 Apparatus for Spreading the Spectrum of a Signal and Method Therefor
5,646,955 Apparatus for Measuring Cycle To Cycle Jitter Of a Digital Signal and Method Therefor
5,651,035 Apparatus for Reducing Jitter of A Spectrum Spread Clock Signal and Method Therefor
5,675,292 Phaselock Loop Enabling Smooth Loop Bandwidth Switching Over a Wide Range
5,731,773 Half-Order Hold for Direct Digital Frequency Synthesis
5,952,895 Direct Digital Synthesis of Precise, Stable Angle Modulated Signal
6,112,071 Quadrature-Free RF Receiver for Directly Receiving Angle Modulated Signal
6,198,347 Driving Circuits for Switch Mode RF Power Amplifiers
6,215,355 Constant Impedance for Switchable Amplifier with Power Control
6,323,731 Variable Bias Control for Switch Mode RF Amplifier
6,366,177 High Efficiency Power Modulators
6,377,784 High Efficiency Modulation RF Amplifier
6,567,491 High Efficiency Line Driver for high crest-factor signals such as DMT/ADSL signals
6,587,018 Notch Filter and Method
6,636,112 High Efficiency Modulating Amplifier
6,690,215 Sigma-Delta-Based Frequency Synthesis
6,724,830 High efficiency line driver for high crest-factor signals such as DMT/ADSL signals
6,751,265 Method and system of amplitude modulation using dual/split channel unequal amplification
6,781,452 Power supply processing for power amplifiers
6,816,016 High-efficiency modulating RF amplifier
6,850,736 Method and apparatus for reception quality indication in wireless communication
6,864,668 High-efficiency amplifier output level and burst control
6,924,695 Power supply processing for power amplifiers
6,969,984 Direct phase and frequency demodulation
7,010,276 Communications signal amplifiers having independent power control and amplitude modulation
7,012,984 PLL noise smoothing using dual-modulus interleaving
7,026,797 Extremely high-speed switchmode DC-DC converters
7,035,604 Communications signal amplifiers having independent power control and amplitude modulation
7,038,536 Power supply processing for power amplifiers
7,099,635 High-efficiency modulating RF amplifier
7,116,728 Quadrature alignment in communications receivers using dual delay lines
7,227,342 Extremely high-speed switchmode DC-DC converters
7,280.813 Variable Delay Radio Receiver
7,395,038 High-Efficiency modulating RF Amplifier
7,424,083 PLL Noise Smoothing using Dual-Modulus Interleaving
7,444,125 Communications signal amplifiers having independent power control and amplitude modulation
7,468,601 Direct Phase and Frequency Demodulation
7,515,885 Communications signal amplifiers having independent power control and amplitude modulation
7,518,461 Method of configuring a polar-based modulator using a parameter look-up table
7,558,334 Enhanced hybrid class-S modulator
7,627,057 Quadrature alignment in communications receivers
7,636,386 Method of continuously calibrating the gain for a multi-path angle modulator
7,642,847 Power supply processing for power amplifiers
7,702,300 Envelope modulator saturation detection using a DC-DC converter
7,755,443 Delay-based modulation of RF communications signals
7,859,459 Phased array receivers and methods employing phase shifting downconverters
7,906,944 Extremely high-speed switchmode DC-DC converters
7,929,644 Instant-acquisition clock and data recovery systems and methods for serial communications links
7,983,643 Frequency demodulation with threshold extension
8,064,855 Transmission Power Controller
8,126,409 Adaptive Delay in Polar Transmitters
8,145,147 Power amplifier edge evaluation-alternative envelope modulator
8,301,088 Polar Modulation Transmitter with Envelope Modulator Path Switch
8,331,882 VSWR normalizing envelope modulator
8,364,099 Methods and apparatus for controlling leakage and power dissipation in radio frequency power amplifiers
8,395,402 Frequency Extension Methods and Apparatus for low-frequency electronic instrumentation
8,405,465 Duty cycle translator methods and apparatus
8,446,099 Power Conversion and control systems and methods for solid-state lighting

8,508,309 Wideband Phase Modulation Methods and Apparatus
8,604,800 Frequency Extension Methods and Apparatus for low-frequency electronic instrumentation
8,750,421 Communications Transmitter having High-efficiency Combination Modulator
8,760,078 Power Conversion and control systems and methods for solid-state lighting
8,811,533 Communications Transmitter having High-efficiency Combination Modulator
8,899,921 Wind Turbine having flow-aligned blades
8,928,424 Duty cycle translator methods and apparatus
8,929,484 Communications Transmitter having High-efficiency Combination Modulator
8,981,655 Power conversion and control systems and methods for solid-state lighting
9,024,534 Power conversion and control systems and methods for solid-state lighting
9,041,602 Phased Array Transmission Methods and Apparatus
9,130,806 Wideband phase modulation methods and apparatus
9,178,734 Communications transmitter having high-efficiency combination modulator
9,179,508 Solid-state lighting dimming
9,263,967 AC/DC power conversion methods and apparatus
9,265,105 Power conversion and control systems and methods for solid-state lighting
9,397,621 Limiting driver for switch-mode power amplifier
9,397,713 Polar Modulation using product mode
9,420,647 Dimming and voltage protection method and apparatus for solid state lighting
9,444,501 Polar Modulation using Product Mode
9,456,481 High-efficiency, wide dynamic range dimming for solid state lighting
9,520,781 Rapid-transition DC-DC Converter

PUBLICATIONS

BOOKS (sole author)

E. McCune, *Practical Digital Wireless Signals*, Cambridge University Press, (2010) - *invited*
This book augments existing modulation texts by providing a physically oriented introduction to digital wireless signals, followed by mathematical descriptions as illustrations. Unlike traditional textbooks, mathematics is not the window through which modulation topics are presented. Targeted at advanced undergraduates, graduate students, plus practicing engineers new to digital wireless communication.

E. McCune, *Dynamic Power Supply Transmitters*, Cambridge University Press, (2015) - *invited*
This book is a clear and coherent exposition on what is envelope tracking, what is polar modulation, and their very dramatic differences in circuit operation. How the design of the dynamic power supply must differ between these two modes is also covered in detail. Covers principles, circuit implementation details, and testing considerations.

BOOK CHAPTERS

E. McCune, “Direct Sequence and Frequency Hopping Spread Spectrum,” *Handbook of RF & Wireless Technologies*, F. Dowla (ed.), Newnes/Elsevier, 2003 (Ch. 4)

E. McCune, “Multimode Transmitters: Easier with Strong Nonlinearity,” *Analog Circuit Design: Smart Data Converters, Filters on Chip, Multimode Transmitters*, A. van Roermund, H. Casier, M. Steyaert (Eds.), Springer, 2010 (Ch.13)

A. Ancora, I. Angelow, D. Brunel, C. Callender, H. Holma, P. Muszynski, E. McCune, L. Noel, “Performance Requirements,” *LTE for UMTS: OFDMA and SC-FDMA Based Radio Access*, Wiley, 2009 (Ch. 11 contributor)

E. McCune, “Oscillators and Synthesizers,” *ARRL Handbook for Radio Communications*, Ch. 9, 2014+

E. McCune, “Transmitter Linearity and Energy Efficiency,” *Linearization and Efficiency Enhancement Techniques for Silicon Power Amplifiers*, E. Kerherve, D. Belot (Eds.), Elsevier 2015 (Ch. 5)

E. McCune, “Nonlinear Applications at the Transmitter System Level,” *Nonlinear Design for Microwave Wireless Communications: from transistor to system-level*, A. Raffo, G. Cruppa (Eds.), Elsevier 2015 (Ch. 8)

TRADE PUBLICATIONS

E. McCune, "SAW Filters Improve Channelized Receivers", Microwaves & RF, Jan. 1984

E. McCune, "Cellular Radiotelephones: The Making of A Call", Mobile Communications Business, Jan. 1986

E. McCune, "Digital Communications Using Direct Digital Synthesis", RF Design (RF Featured Technology), Jan. 1990

E. McCune, "Create Signals Having Optimum Resolution, Response, and Noise", EDN, Mar. 14, 1991

E. McCune, "Ground-current control enhances dynamic range in high-speed circuits", EDN, Jan. 19, 1995

E. McCune, R. Bayruns, “EOIP – A Useful RF Transmitter Figure of Merit,” RF Design Dec 2000

E. McCune, "Gain for Compressed Amplifiers," Microwave Journal, vol. 45, no. 5, May 2002, pp. 300-304

E McCune, “High-Efficiency Multi-mode, Multi-band Terminal Power Amplifiers”, IEEE Microwave Magazine, vol. 6, No. 1, March 2005, pp. 44 - 55

E McCune, “Direct Polar Modulation has the Right Stuff”, EE Times, November 7, 2005

E. McCune, “Energy Efficient Transmitters: Easier with Strong Nonlinearity”, RF Technology International, Feb. 2012

E. McCune, “Envelope Tracking or Polar – Which is it?”, IEEE Microwave Magazine, vol. 13, No. 4, June 2012, pp. 34 - 56

E. McCune, D. Wyskiel, “Low EMI Printed Circuit Board Design for High Frequency Waveforms”, RF Technology International, August 2012

E. McCune, “This Emperor has No Clothes? (A treatise on OFDM)”, IEEE Microwave Magazine, June 2013, pp. 48-62

E. McCune, “Solving the Broken Sequence (A treatise on PSK),” IEEE Microwave Magazine, vol. 15, No. 4, June 2014, pp. 40-55

E. McCune, “A Technical Foundation for RF CMOS Power Amplifiers: Part 1,” IEEE Solid State Circuits Magazine, Vol. 7, No. 3, Summer 2015, pp. 81-85

E. McCune, “A Technical Foundation for RF CMOS Power Amplifiers: Part 2,” IEEE Solid State Circuits Magazine, Vol. 7, No. 4, Fall 2015, pp. 75-82

E. McCune, “A Technical Foundation for RF CMOS Power Amplifiers: Part 3,” IEEE Solid State Circuits Magazine, Vol. 8, No. 1, Winter 2016, pp. 44-50

E. McCune, “A Technical Foundation for RF CMOS Power Amplifiers: Part 4,” IEEE Solid State Circuits Magazine, Vol. 8, No. 2, Spring 2016, pp. 75-82

E. McCune, “A Technical Foundation for RF CMOS Power Amplifiers: Part 5,” IEEE Solid State Circuits Magazine, Vol. 8, No. 3, Summer 2016, pp. 57-62

E. McCune, “A Technical Foundation for RF CMOS Power Amplifiers: Part 6,” IEEE Solid State Circuits Magazine, Vol. 8, No. 4, Fall 2016, pp.

CONFERENCES and JOURNALS

E. McCune, "Direct Digital Synthesis and the Number Controlled Modulated Oscillator", Proceedings of the RF Technology Expo, February 1987

E. McCune, "Number Controlled Modulated Oscillator Theory and Applications", Proceedings of the RF Technology Expo, November 1987

E. McCune, "Control of Spurious Signals in Direct Digital Synthesizers", Proceedings of the RF Technology Expo, February 1988

E. McCune, "Low Spurious Techniques and Measurements for DDS Systems", Proceedings of the RF Technology Expo, November 1988

E. McCune, "Quantitative Prediction of DDS Spurs", Proceedings of the RF Technology Expo, February 1989

E. McCune, "Frequency Modulation Design for Direct Digital Synthesizers", Proceedings of the RF Technology Expo, October 1989

E. McCune, "Physical Mechanics and Synthesizer Switching Time", Proceedings of the RF Technology Expo, February 1991

E. McCune, "Field Strength Measurements for FCC Compliance", Proceedings of the RF Technology Expo, October 1992

E. McCune, "Ground Current Control in RF and High Speed Digital Circuits", Proceedings of the RF Technology Expo, March 1994

E. McCune, K. Feher, “CDMA and TDMA Standards Compatible Modem Developments Improve Power Efficiency and Performance of Wireless RFIC’s,” Proceedings of the Wireless Symposium, Feb. 1996

E. McCune, K. Feher, L Zuckerman, “An Impartial Comparison of DSSS and FHSS under Narrowband Interference for ISM Band Operation,” Proceedings of the Wireless Symposium, Feb. 1997

E. McCune, “Synthesis of a Superposition Based FIR Digital Baseband Filter,” Proceedings of the IEEE Midwest Symposium on Circuits and Systems, Aug. 1997

E. McCune, “Closed Form Propagation Model Combining One or More Propagation Constant Segments,” Proceedings of the IEEE Vehicular Technology Conference, May 1997

E. McCune, K. Feher, “Near-Far Interference Experiments Using Minimum Cost Hardware,” Proceedings of the IEEE Vehicular Technology Conference, May 1997

E. McCune, “Understanding Error Sources of the Quadrature Modulator and Demodulator,” Proceedings of the Wireless Symposium, Feb. 1998

E. McCune, “Taming the Quadrature Modulator,” Proceedings of the Wireless Symposium, Feb. 2000

E. McCune, “High Speed Wireless Data Transmitters without Heat Problems,” Proceedings of the IEEE Radio and Wireless Conference (RAWCON), Aug. 2000 (invited)

E. McCune, ”Solving the Heat Problems in Wireless Data Terminals,” Proceedings of the IBC Power for Mobile Devices Conference, London, Dec. 2000

E. McCune, “Taming Quadrature Modulation,” Proceedings of the IEEE SSCTC Workshop on RF Circuit Design, Feb 2001

E. McCune, “The Superposition Lowpass Filter,” Proceedings of the Wireless Symposium, Feb. 2001

E. McCune, “Heat Problems in Mobile Data Terminals,” Proceedings of the Communications Systems Design Conference, Oct. 2001

E. McCune, “Next Generation Silicon Design for Multimode RF Modems,” Proceedings of the UMTS Congress, Barcelona, Oct. 2001

E. McCune, “A Power Efficient Radio Platform for UMTS, GSM, EDGE, and TDMA,” Proceedings of the MobileSilicon Conference, Paris, Nov. 2001

E. McCune, “A Single, Multimode Common Radio Platform for WCDMA, CDMA, GSM, EDGE, and TDMA,” Proceedings of the Wireless Symposium, Feb. 2002

E. McCune, “Polar Modulation: An Alternative for Software Defined Radio,” Proceedings of the International Symposium for Advanced Radio Technology, Boulder CO, Mar. 2002 (invited)

E. McCune, “GSM/CDMA Multimode Terminals Using Polar Modulated Transmitters,” Proceedings of the MPRG Symposium, Virginia Tech, June 2002

E. McCune, “SDR Radio Subsystems Using Polar Modulation,” Proceedings of the Software Defined Radio Conference, San Diego, Nov. 2002

E. McCune, “Multi-mode and Multi-band Polar Transmitter for GSM, NADC, and EDGE,” Proceedings of the IEEE Wireless Communications and Networking Conference (WCNC), New Orleans, March 2003

E. McCune, W. Sander, “EDGE Transmitter Alternative using Nonlinear Polar Modulation,” Proceedings of the IEEE Int’l Symposium on Circuits and Systems (ISCAS), Bangkok, May 2003 (invited)

E. McCune, “Advanced Architectures for High-Efficiency Multi-mode, Multi-band Terminal Power Amplifiers,” Proceedings of the IEEE Radio and Wireless Conference (RAWCON), Atlanta, October 2004 (invited)

E. McCune, “Polar Modulation and Bipolar RF Power Devices,” Proceedings of the IEEE Bipolar Circuits and Technology Meeting (BCTM), Santa Barbara, Oct. 2005, pp. 1-5 (invited)

E. McCune, “Power Amplifiers and Multimode Requirements,” IEEE Topical Symposium on Power Amplifiers and Wireless Communications, Radio and Wireless Symposium (RWS), Jan 2007 (invited)

E. McCune, “Transmit Architectures and PA Requirements,” Proceedings of the IEEE GIRAFE Forum on Power Amplifiers and Transmitter Architectures, San Francisco, Feb 2007 (invited)

E. McCune, “Process- and technology-independent power switching transistor figures of merit,” Proceedings of the 2008 IEEE Radio and Wireless Symposium (RWS), Jan 2008, pp. 195-198

Osman, S., Lee, W., McCune, E., Hirano, S., Maeda, M., Ishida, K., “An RFIC within a direct open-loop polar multimode transmitter for UMTS/EDGE/GSM,” Radio Frequency Integrated Circuits Symposium 2008 (RFIC 2008) IEEE, June 2008, pp: 577-580

E. McCune, “Multimode Transmitters: Easier with Strong Nonlinearity,” 18th Advanced Analog Circuit Design Conference (AACD), 30 March – 1 April, 2009, Lund, Sweden (invited)

E. McCune, “Polar Modulation and Power Amplifiers,” Workshop WSC at the 2009 International Microwave Symposium, Boston, June 7-11, 2009 (invited)

E. McCune, “Direct Digital Frequency Synthesizer with Designable Stepsize,” Proceedings of the 2010 IEEE Radio and Wireless Symposium, New Orleans, January 10-15, 2010, pp. 356-359

E. McCune, “Time-Filtered Squarewave Output from Direct Digital Synthesis,” Proceedings of the 2010 International Microwave Symposium, Anaheim, May 23-28, 2010, pp. 996-999

E. McCune, “Modern Cellular Wireless Signals,” Proceedings of the 75th Automatic RF Techniques Group (ARFTG) Microwave Measurement Conference, Anaheim, May 28, 2010, pp.1-7 (invited)

E. McCune, “Spurious Mechanisms and Debugging in Direct Digital Synthesis,” Proceedings of the 2011 IEEE Radio and Wireless Symposium, Phoenix, January 16-19, 2011, pp. 235-238

E. McCune, “Begin at the Beginning for Transmitter Design,” Forum F1 at the 2011 International Solid State Circuits Conference (ISSCC 2011), San Francisco, February 20-23, 2011

E. McCune, “Digital Signals: How We Got Here, And Where We Could Get To,” Proceedings of the 12th annual Wireless and Microwave Conference (WAMICON), Clearwater Beach, Florida, April 18-19, 2011, pp,1-6 (invited)

E. McCune, “Physical Relationships along the Power Amplifier Continuum,” Workshop WSD at the 2011 International Microwave Symposium, Baltimore, MD, June 5-10, 2011

E. McCune, “Digital Signals: Shannon, Ohm, and PA Costs,” IEEE Topical Symposium on Power Amplifiers, Tempe, AZ, Nov. 29, 2011 (invited)

E. McCune, “Digital Wireless Communications Signals,” Advanced Short Course on RF Power Amplifier Systems Concepts, 78th ARFTG Microwave Measurements Conference, Tempe, AZ, Nov. 30, 2011 (invited)

E. McCune, “Embrace Circuit Nonlinearity to get Transmitter 'Linearity' and Energy Efficiency”, Workshop WSD at the 2012 International Microwave Symposium, Montreal, June 16-21 2012 (invited)

E. McCune, “Envelope Tracking and Polar Modulation: Similar Schematics with Extremely Different Operation”, Workshop WFD at the 2012 International Microwave Symposium, Montreal, June 16-21 2012 (invited)

E. McCune, “Wireless Figures of Merit and Wireless Standards,” Short Course presentation for the 80th ARFTG Microwave Measurement Symposium, San Diego, November 27, 2012 (invited)

E. McCune, “Gain: Changed Meanings for Compressed Amplifiers,” Proceedings of the 2013 Midwest Symposium on Circuits and Systems (MWSCAS), Columbus OH, August 2013, pp. 1232-1234

E. McCune, “pPSK for Bandwidth and Energy Efficiency,” Proceedings of the 43rd European Microwave Conference (EuMC), Nuremberg, October 2013, pp. 569-572

E. McCune, “Operating Modes of Dynamic-Power-Supply Transmitter Amplifiers,” Proceedings of the 2014 Integrated Nonlinear Microwave and Millimetre-wave Circuits Workshop (INMMIC), April 2014 (invited), pp. 1-3

E. McCune, “Concurrent Polar and Quadrature Modulator,” Proceedings of the 2014 Wireless and Microwave Technology Conference (WAMICON), Tampa FL, June 2014, pp.1-4

E. McCune, “Operating Modes of Dynamic-Power-Supply Transmitter Amplifiers,” *IEEE Trans. on Microwave Theory and Techniques*, vol. 62, no. 11, Nov. 2014, pp. 2511-2517

E. McCune, “A Technical Foundation for RF CMOS Power Amplifiers,” Forum E at the 2015 International Solid State Circuits Conference (ISSCC 2015), San Francisco, February 23-26, 2015 (invited)

E. McCune, “Operating Modes of Dynamic-Power-Supply Transmitter Amplifiers,” Workshop WSB at the 2015 International Microwave Symposium (IMS), Phoenix, May 17-22, 2015

E. McCune, “Dynamic Power Supply Transmitter Design,” Short Course SSA at the 2015 International Microwave Symposium (IMS), Phoenix, May 17, 2015

E. McCune, “Foundations of Green Communications,” Proceedings of the IEEE International Communications Conference (ICC), London, UK, 7-12 June 2015, pp. 2744-2749

E. McCune, D. Babić, R. Booth; D. Kirkpatrick, “Decade Bandwidth Agile GaN Power Amplifier Exceeding 50% Efficiency,” Proc. of MILCOM 2015, Tampa FL, October 2015, pp. 541-546

E. McCune, “Fundamentals of Switching RF Power Amplifiers,” *IEEE Microwave and Wireless Components Letters*, vol. 25, no. 12, Dec. 2015, pp.838-840

W. Godycki; Q. Diduck; E. McCune; D. Babić, “Class-D GaN 15MHz-bandwidth amplitude modulator with a direct CMOS interface,” Proc. 17th Annual IEEE Wireless and Microwave Technology Conference (WAMICON 2016), Florida, April 2016, pp.1-4

D. Babić; E. McCune; W. Godycki; Q. Diduck; D. Kirkpatrick, “Importance and measurement of phase-stiffness in RF switching amplifiers,” Proc. 87th ARFTG Microwave Measurement Conference (ARFTG), San Francisco, May 2016, pp. 1-4

E. McCune, R. Booth, D. Kirkpatrick, “Maximizing Wireless Communications Energy Efficiency,” Proc. of EDI-CON USA 2016, Boston, Sept. 19-23, 2016

E. McCune, “Applying Bipolar Transistors in Dynamic Power Supply Transmitters,” Proc. Of the 2016 Bipolar Circuits and Technologies Meeting (BCTM 2016), New Brunswick, New Jersey, Sept. 25-28 2016 (invited)

E. McCune, “Power Proportional Computing for “Green” Servers,” The International Workshop on Green ICT and Smart Networking (GISN 2016), Nov. 4, 2016 in Montreal, Quebec, Canada (invited)

E. McCune, “Signal Design and Figure of Merit for Green Communication Links,” Proc. of the 2017 Radio and Wireless Symposium (RWS2017), Jan 15-17 2017, Phoenix

E. McCune, “Fundamentals for Energy-Efficient Massive MIMO,” *Proc. of the 2017 Wireless Communications and Networking Conf.* (WCNC 2017), San Francisco

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E. McCune, “A Fully Polar Transmitter for Efficient Software-Defined Radios,” *Proc. of the 2017 Intl. Microwave Symposium* (IMS 2017), Honolulu, June 2017

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E. McCune, “Physics of Energy Efficient Communications,” *Proc. of the 2017 European Wireless Conference* (EW2017), Dresden, Germany, May 2017 (submitted)

E. McCune, “Polar Modulation Based Reduction of Communications Energy Consumption,” *Proc. of the 2017 International Conference on Communications* (ICC2017), Paris, France, May 2017 (submitted)

CERTAIN MOBILE ELECTRONIC DEVICES AND RADIO FREQUENCY AND PROCESSING COMPONENTS THEREOF

Inv. No. 337-TA-1065

CERTIFICATE OF SERVICE

I, K. Kevin Chu, hereby certify that on October 20, 2017, copies of the foregoing documents were served upon the following parties as indicated:

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