

The Scientist and Engineer's Guide to

# Digital Signal Processing

Second Edition

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by  
Steven W. Smith

California Technical Publishing  
San Diego, California

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## Digital Signal Processors

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Digital Signal Processing is carried out by mathematical operations. In comparison, word processing and similar programs merely rearrange stored data. This means that computers designed for business and other general applications are not optimized for algorithms such as digital filtering and Fourier analysis. *Digital Signal Processors* are microprocessors specifically designed to handle Digital Signal Processing tasks. These devices have seen tremendous growth in the last decade, finding use in everything from cellular telephones to advanced scientific instruments. In fact, hardware engineers use "DSP" to mean *Digital Signal Processor*, just as algorithm developers use "DSP" to mean *Digital Signal Processing*. This chapter looks at how DSPs are different from other types of microprocessors, how to decide if a DSP is right for your application, and how to get started in this exciting new field. In the next chapter we will take a more detailed look at one of these sophisticated products: the Analog Devices SHARC® family.

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### How DSPs are Different from Other Microprocessors

In the 1960s it was predicted that artificial intelligence would revolutionize the way humans interact with computers and other machines. It was believed that by the end of the century we would have robots cleaning our houses, computers driving our cars, and voice interfaces controlling the storage and retrieval of information. This hasn't happened; these abstract tasks are far more complicated than expected, and very difficult to carry out with the step-by-step logic provided by digital computers.

However, the last forty years have shown that computers are extremely capable in two broad areas, (1) **data manipulation**, such as word processing and database management, and (2) **mathematical calculation**, used in science, engineering, and Digital Signal Processing. All microprocessors can perform both tasks; however, it is difficult (expensive) to make a device that is *optimized* for both. There are technical tradeoffs in the hardware design, such as the size of the instruction set and how interrupts are handled. Even

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