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(54) **MICROPHONE ARRAY SYSTEM**

(71) Applicant: **LI Creative Technologies, Inc.,**
 Florham Park, NJ (US)

(72) Inventors: **Manli Zhu**, Pearl River, NY (US); **Qi Li**, New Providence, NJ (US)

(73) Assignee: **LI Creative Technologies, Inc.,**
 Florham Park, NJ (US)

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Related U.S. Patent Documents

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(58) **Field of Classification Search**

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 USPC 381/300.57, 92, 94.1, 93
 See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,315,562 A * 5/1994 Bradley et al. 367/89
 7,039,199 B2 5/2006 Rui
 (Continued)

FOREIGN PATENT DOCUMENTS

WO WO2008041878 A2 4/2008
 WO WO 2010020162 A1 * 2/2010 H04R 1/403

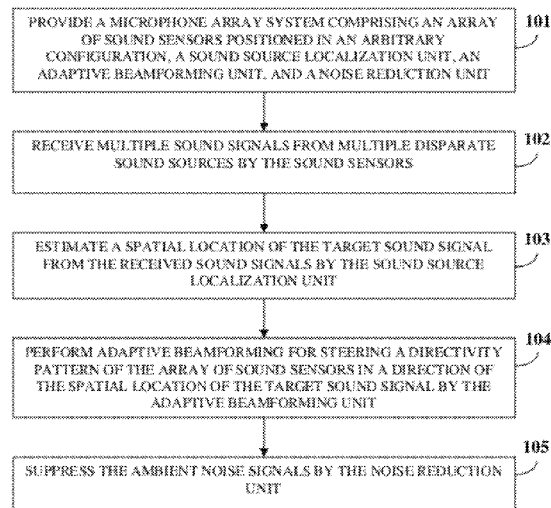
Primary Examiner — Ovidio Escalante

(74) *Attorney, Agent, or Firm* — Ash Tankha; Lipton, Weinberger & Husick

(57) **ABSTRACT**

A method and system for enhancing a target sound signal from multiple sound signals is provided. An array of an arbitrary number of sound sensors positioned in an arbitrary configuration receives the sound signals from multiple disparate sources. The sound signals comprise the target sound signal from a target sound source, and ambient noise signals. A sound source localization unit, an adaptive beamforming unit, and a noise reduction unit are in operative communication with the array of sound sensors. The sound source localization unit estimates a spatial location of the target sound signal from the received sound signals. The adaptive beamforming unit performs adaptive beamforming by steering a directivity pattern of the array of sound sensors in a direction of the spatial location of the target sound signal, thereby enhancing the target sound signal and partially suppressing the ambient noise signals, which are further suppressed by the noise reduction unit.

35 Claims, 34 Drawing Sheets



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(56) **References Cited**

U.S. PATENT DOCUMENTS

2003/0204397	A1 *	10/2003	Amiri et al.	704/231
2004/0161121	A1 *	8/2004	Choi et al.	381/92
2007/0076898	A1	4/2007	Sarroukh et al.	
2008/0232607	A1 *	9/2008	Tashev	G01S 3/86
				381/71.11
2009/0141907	A1 *	6/2009	Kim et al.	381/71.7
2009/0279714	A1	11/2009	Kim et al.	
2009/0304200	A1	12/2009	Kim et al.	
2010/0241426	A1 *	9/2010	Zhang	G10L 21/0208
				704/226
2011/0096915	A1 *	4/2011	Nemer	H04M 3/568
				379/158
2011/0135125	A1 *	6/2011	Zhan	H04R 1/403
				381/303
2011/0317522	A1 *	12/2011	Florencio	G01S 3/8006
				367/129

* cited by examiner

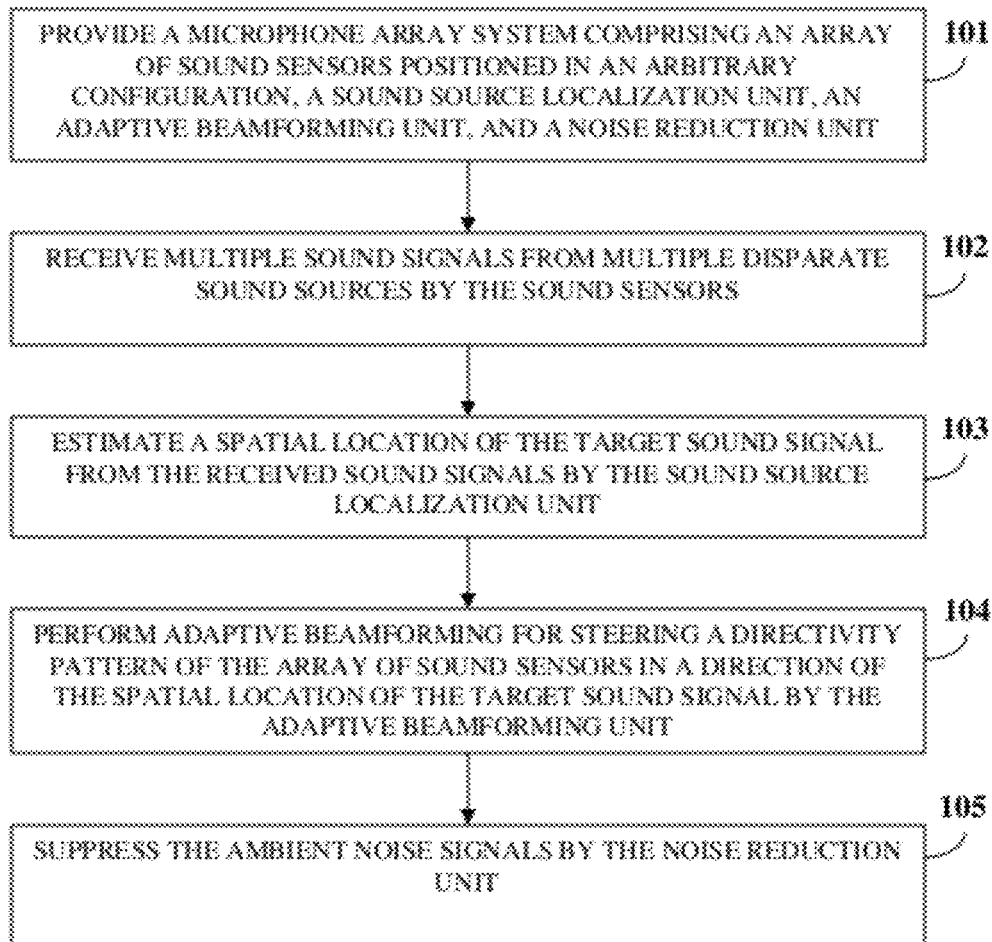


FIG. 1

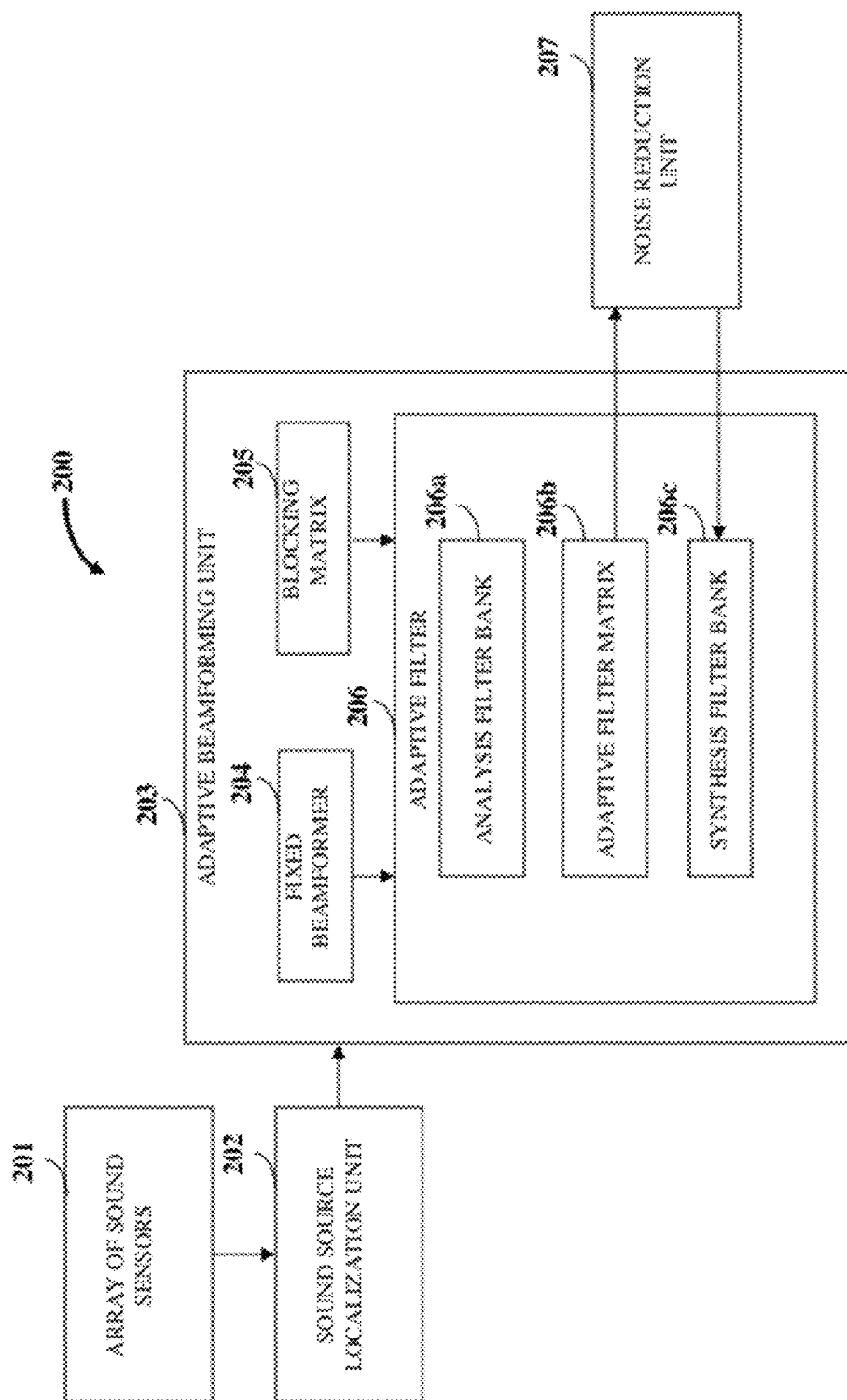


FIG. 2

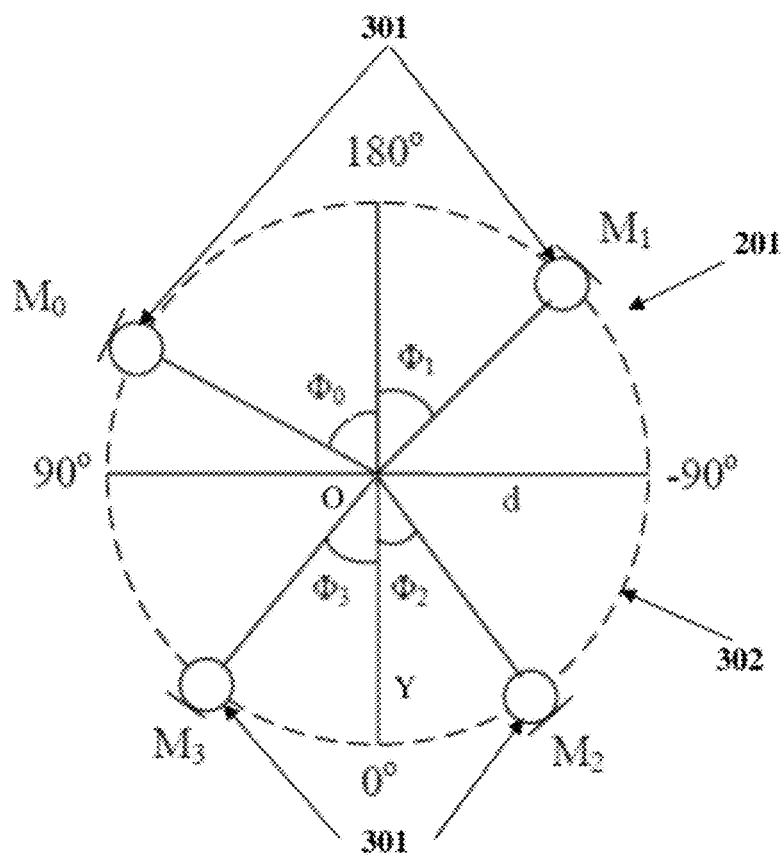


FIG. 3

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