

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
7 July 2005 (07.07.2005)

PCT

(10) International Publication Number
WO 2005/060574 A3

- (51) International Patent Classification:
H04B 7/08 (2006.01) H04B 17/02 (2006.01)
- (21) International Application Number:
PCT/US2004/040716
- (22) International Filing Date:
6 December 2004 (06.12.2004)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
10/732,003 10 December 2003 (10.12.2003) US
- (71) Applicant (for all designated States except US): **MOTIA, INC.** [US/US]; 2700 East Foothill Blvd., Suite 201, Pasadena, CA 91107 (US).
- (72) Inventors: **WANG, James, June-Ming**; 1473 Waverly Road, San Marino, CA 91108 (US). **WINTERS, Jack**; 103 Old Wagon Road, Middletown, NJ 07748 (US). **DOONG, Meng, Chang**; 1001 N. Stoneman Avenue, #D, Alhambra, CA 91801 (US). **YANG, Chau, Chin**; 1841 South Westgate Avenue, Los Angeles, CA 90025 (US).
- (74) Agent: **DUNN MCKAY, Diane**; Mathews, Collins, Shepherd & McKay, P.A., 100 Thanet Circle., Suite 306, Princeton, NJ 08540 (US).

- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.
- (84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

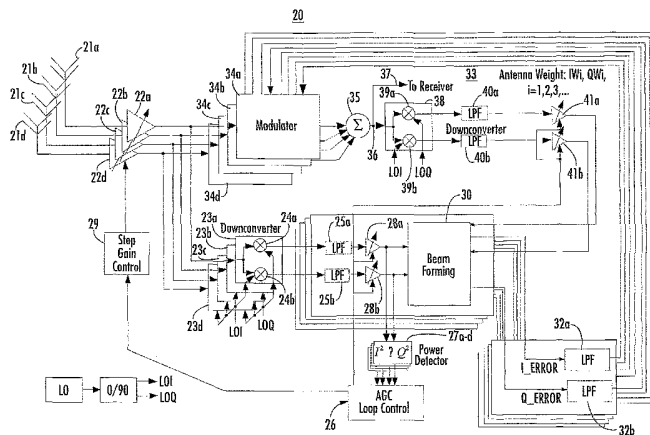
Published:

- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

(88) Date of publication of the international search report:
10 August 2006

[Continued on next page]

(54) Title: WIRELESS COMMUNICATION SYSTEM USING A PLURALITY OF ANTENNA ELEMENTS WITH ADAPTIVE WEIGHTING AND COMBINING TECHNIQUES



(57) Abstract: The present invention provides a method and system for operating a wireless communication system (Fig.2) in which received signals from a plurality of antennas (21) are weighted and combined with a beam forming operation (30) to form an output signal. The beam forming operation determines weights adjusted to increase a desired signal power in the output signal while reducing the power in the output signal of out-of-band components. In an embodiment of the present invention, beam forming operations are performed with maximal ratio combining (MRC). Alternatively, a constant modulus algorithm (CMA) can be used for beam forming operations. In an alternate embodiment, improved interference suppression is performed with a novel algorithm referred to as an interference nulling algorithm (INA). The INA receives an error signal which is 180 degrees out of phase with a combination of the Channels for individual antennas, referred to as the SUM channel. The error signal is determined by complex conjugate multiplication of the individual signals and a reference complex signal. It is desirable to simultaneously achieve diversity and combining gain and suppress the adjacent channel by combining the weight generation for MRC and that for WA, as described above, to generate antenna weights similar to those of MMSE combining.

WO 2005/060574 A3



For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US04/40716

A. CLASSIFICATION OF SUBJECT MATTER

IPC: **H04B 7/08,17/02**

USPC: 455/132,134,135

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 455/132,134,135

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Please See Continuation Sheet

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 6,161,001 A (IINUMA) 12 DECEMBER 2000 (12.121978) SEE ENTIRE DOCUMENT	1,5,16,26,30,41 ----- 7,10,32,35,49,50
X Y P	US 6,680,699 B2 (VOYER) 20 JANUARY 2004 (20.01.2004), SEE ENTIRE DOCUMENT US 2003/0162566 A1 (SHAPIRA et al.) 28 August 2003 (28.08.2003) SEE ENTIRE DOCUMENT US 6,990,137 B2 (SMEE et al.) 24 January 2006 (24.01.2006), SEE ENTIRE DOCUMENT	19-21,24,44,45 7,32 10,35

Further documents are listed in the continuation of Box C.

See patent family annex.

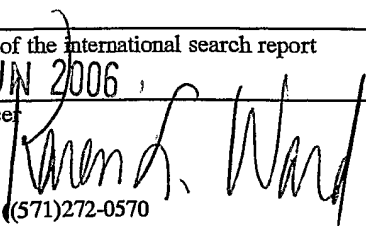
* Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"B" earlier application or patent published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means		
"P" document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search
08 May 2006 (08.05.2006)

Date of mailing of the international search report
22 JUN 2006

Name and mailing address of the ISA/US
Mail Stop PCT, Attn: ISA/US
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
Facsimile No. (571) 273-3201

Authorized officer
Richard Chan
Telephone No. (571)272-0570



INTERNATIONAL SEARCH REPORT

International application No.
PCT/US04/40716

C. (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	<p>TREICHLER. JOHN.R. A new approach to Multipath COrrrection of Constant Modulus Signals IEEE Transactions of Acoustics, Speech, and Signal Processing Vol. ASSP-31, NO.2, April 1983 pages 459-471</p>	49,50

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US04/40716

Continuation of B. FIELDS SEARCHED Item 2:

JOHN TREICHLER, IBEE TRANSACTIONS ON ACOUSTICS, SPEECH, AND SIGNAL PROCESSING, VOL. ASSP-31, NO.2,
APRIL 1983