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Published:
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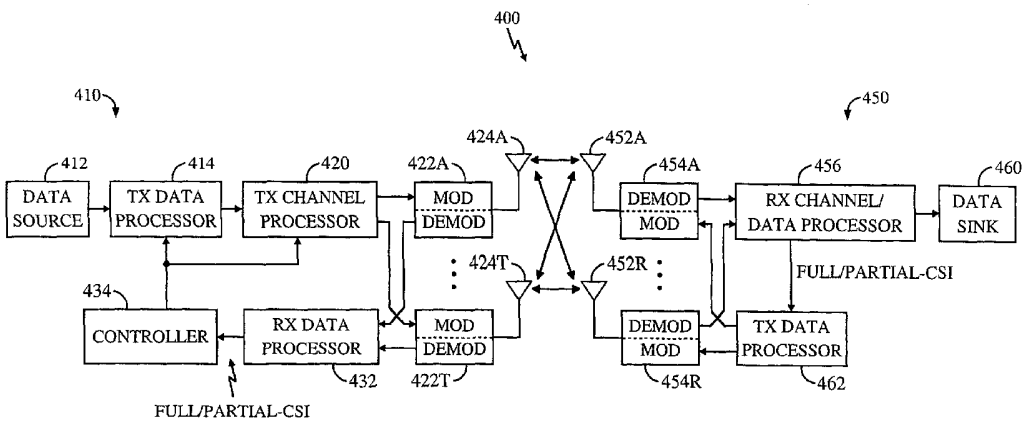
10 July 2003

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.

(54) Title: METHOD AND APPARATUS FOR DETERMINING POWER ALLOCATION IN A MIMO COMMUNICATION SYSTEM



(57) Abstract: In a MIMO communication system (100) with limited power for each antenna, a method, apparatus and a processor (420) provide for determining bin energy level allocation to each OFDM frequency bin at each transmit antenna. An estimate of a solution vector including elements of the allocation bin energy level to each OFDM frequency bin at each antenna is determined. An error function based on the determined solution vector is also determined. An error magnitude is determined based on the determined error function. The error magnitude is compared to an error threshold. The processor (420) accepts the estimate of the solution vector with the elements of the allocation bin energy level when the error magnitude is less than the error threshold.

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INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04B7/005 H04B7/06 H04L27/26

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)
IPC 7 H04B H04L

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

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ, INSPEC, COMPENDEX

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
2 A	US 6 144 711 A (POLLACK MICHAEL A ET AL) 7 November 2000 (2000-11-07) column 1, line 66 -column 2, line 63 column 24, line 14 -column 25, line 61; figure 23 ---	1
16 A	DEMIRKOL M F ET AL: "POWER-CONTROLLED CAPACITY FOR INTERFERING MIMO LINKS" VTC FALL 2001. IEEE 54TH. VEHICULAR TECHNOLOGY CONFERENCE. PROCEEDINGS. ATLANTIC CITY, NJ, OCT. 7 - 11, 2001, IEEE VEHICULAR TECHNOLGY CONFERENCE, NEW YORK, NY: IEEE, US, vol. 1 OF 4. CONF. 54, 7 October 2001 (2001-10-07), pages 187-191, XP001113775 ISBN: 0-7803-7005-8 paragraphs [000I]-[0III] --- -/--	1

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"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)

"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

"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

"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

"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.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
28 January 2003	11-04-2003
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Authorized officer Burghardt, G

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Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 02/32565

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	LI Y: "OPTIMUM TRAINING SEQUENCES FOR OFDM SYSTEMS WITH MULTIPLE TRANSMIT ANTENNAS" GLOBECOM'00. 2000 IEEE GLOBAL TELECOMMUNICATIONS CONFERENCE. SAN FRANCICO, CA, NOV. 27 - DEC. 1, 2000, IEEE GLOBAL TELECOMMUNICATIONS CONFERENCE, NEW YORK, NY: IEEE, US, vol. 3 OF 3, 27 November 2000 (2000-11-27), pages 1478-1482, XP002908063 ISBN: 0-7803-6452-X paragraphs [000I],[00II]; figure 1 ---	1
A	CHIURTU N ET AL: "ON THE CAPACITY OF MULTI-ANTENNA GAUSSIAN CHANNELS" PROCEEDINGS OF THE 2001 IEEE INTERNATIONAL SYMPOSIUM ON INFORMATION THEORY. ISIT 2001. WASHINGTON, WA, JUNE 24 - JUNE 29, 2001, IEEE INTERNATIONAL SYMPOSIUM ON INFORMATION THEORY, NEW YORK, NY: IEEE, US, 24 June 2001 (2001-06-24), page 53 XP001071683 ISBN: 0-7803-7123-2 the whole document -----	1

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 02/32565

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-2

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1,2

   A method for transmitting data from a transmitter to a receiver in a multiple-input multiple-output (MIMO) communication system

2. Claims: 3-23

   In a MIMO communication system with limited power for each transmit antenna, a method, an apparatus and a processor for determining bin energy level allocation to each OFDM frequency at each antenna.

Information on patent family members

International Application No
PCT/US 02/32565

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6144711 A	07-11-2000	US 6377631 B1	23-04-2002
		US 6452981 B1	17-09-2002
		AU 4238697 A	19-03-1998
		CA 2302289 A1	05-03-1998
		EP 0920738 A1	09-06-1999
		EP 0931388 A2	28-07-1999
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		WO 9809381 A1	05-03-1998
		WO 9809395 A1	05-03-1998