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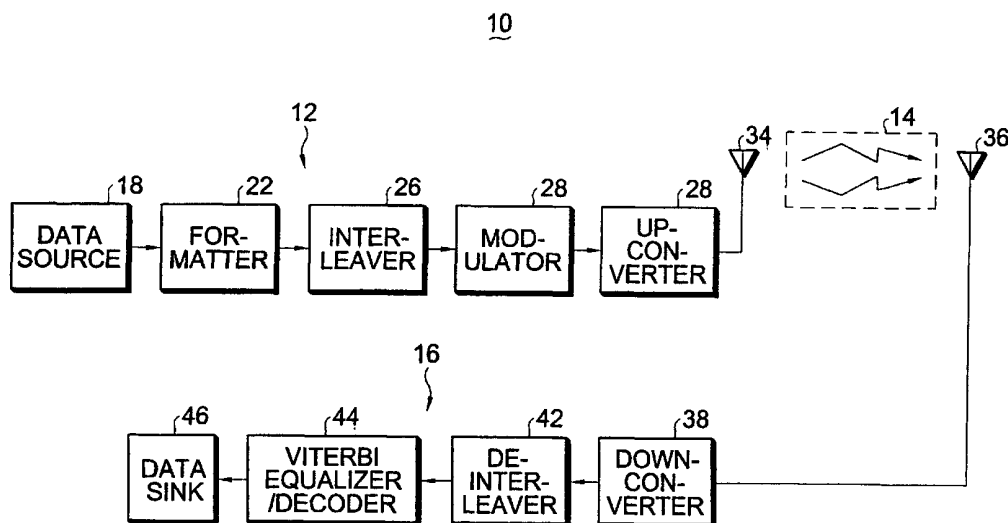
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(54) Title: HYBRID DIMENSIONAL, SPHERICAL SPACE-TIME CODING AND DECODING APPARATUS, AND ASSOCIATED METHOD, FOR A COMMUNICATION SYSTEM



(57) Abstract: Apparatus (28, 44), and an associated method, for encoding (28) and decoding (44) data in a communication system (10). A hybrid dimensional Spherical Space-Time Code (SSTC) scheme is provided. Data (18) to be transmitted upon a communication channel (14) is encoded, and when received at a receiving station (16), the encoded sequence is decoded (44).

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INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04L1/06

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)

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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, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	TAROKH V ET AL: "SPACE-TIME BLOCK CODING FOR WIRELESS COMMUNICATIONS: PERFORMANCE RESULTS" IEEE JOURNAL ON SELECTED AREAS IN COMMUNICATIONS, IEEE INC. NEW YORK, US, vol. 17, no. 3, March 1999 (1999-03), pages 451-460, XP000804974 ISSN: 0733-8716 abstract page 452, column 1, line 14 - line 40 --- -/--	1, 12, 15, 16

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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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

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	TAROKH V ET AL: "Space-time codes for high data rate wireless communication: performance criterion and code construction" IEEE TRANSACTIONS ON INFORMATION THEORY, IEEE INC. NEW YORK, US, vol. 44, no. 2, 1 March 1998 (1998-03-01), pages 744-765, XP002089112 ISSN: 0018-9448 abstract; figure 1	1,12,15, 16
A	SESHADRI N ET AL: "Space-time codes for wireless communication: code construction" VEHICULAR TECHNOLOGY CONFERENCE, 1997, IEEE 47TH PHOENIX, AZ, USA 4-7 MAY 1997, NEW YORK, NY, USA, IEEE, US, 4 May 1997 (1997-05-04), pages 637-641, XP010228920 ISBN: 0-7803-3659-3 abstract page 637, column 1, line 21 -column 2, line 14	1,12,15, 16
A	TAROKH V ET AL: "Space-time codes for high data rate wireless communication: performance criteria" COMMUNICATIONS, 1997. ICC '97 MONTREAL, TOWARDS THE KNOWLEDGE MILLENNIUM. 1997 IEEE INTERNATIONAL CONFERENCE ON MONTREAL, QUE., CANADA 8-12 JUNE 1997, NEW YORK, NY, USA, IEEE, US, 8 June 1997 (1997-06-08), pages 299-303, XP010227134 ISBN: 0-7803-3925-8 abstract	1,12,15, 16
A	WO 99 45657 A (AT & T CORP) 10 September 1999 (1999-09-10) page 5, line 1 -page 16, last line; figure 1	1,12,15, 16
A	WOLF J K ET AL: "P2 CODES: PRAGMATIC TRELLIS CODES UTILIZING PUNCTURED CONVOLUTIONAL CODES" IEEE COMMUNICATIONS MAGAZINE, IEEE SERVICE CENTER. PISCATAWAY, N.J, US, vol. 33, no. 2, 1 February 1995 (1995-02-01), pages 94-99, XP000505676 ISSN: 0163-6804 page 94, column 1, line 1 -page 99, column 2, last line; figure 2	1,12,15, 16
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INTERNATIONAL SEARCH REPORT

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	VARANASI M K ET AL: "Complex spherical modulation for noncoherent communications" 2000 IEEE INTERNATIONAL SYMPOSIUM ON INFORMATION THEORY (CAT. NO.00CH37060), 2000 IEEE INTERNATIONAL SYMPOSIUM ON INFORMATION THEORY, SORRENTO, ITALY, 25-30 JUNE 2000, page 163 XP002187442 2000, Piscataway, NJ, USA, IEEE, USA ISBN: 0-7803-5857-0 page 163, column 1, line 1 -column 2, last line ---	1,12,15, 16
A	WILSON S G ET AL: "FOUR-DIMENSIONAL MODULATION AND CODING: AN ALTERNATE TO FREQUENCY-REUSE" LINKS FOR THE FUTURE. AMSTERDAM, MAY 14 - 17, 1984, INTERNATIONAL CONFERENCE ON COMMUNICATIONS, AMSTERDAM, NORTH-HOLLAND, NL, vol. 2, May 1984 (1984-05), pages 919-923, XP000793854 abstract ---	1,12,15, 16
A	WANG F-Q ET AL: "NEW ROTATIONALLY INVARIANT FOUR-DIMENSIONAL TRELLIS CODES" IEEE TRANSACTIONS ON INFORMATION THEORY, IEEE INC. NEW YORK, US, vol. 42, no. 1, January 1996 (1996-01), pages 291-300, XP000823359 ISSN: 0018-9448 page 291, column 1, line 1 - line 17 -----	1,12,15, 16

INTERNATIONAL SEARCH REPORT

Information on patent family members

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9945657	A	10-09-1999	US 6088408 A 11-07-2000
			BR 9908389 A 31-10-2000
			CN 1292175 T 18-04-2001
			EP 1060575 A1 20-12-2000
			WO 9945657 A1 10-09-1999
