PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 :		(11) International Publication Number:
H03M 7/00	A3	WO 96/37048
		(43) International Publication Date: 21 November 1996 (21.11.96)

(21) International Application Number: PCT/GB96/01164

(22) International Filing Date: 15 May 1996 (15.05.96)

(30) Priority Data:
9509831.5 15 May 1995 (15.05.95) GB

(71) Applicant *(for US only)*: GERZON, Peter, Herbert (legal representative of the deceased inventor) [GB/GB]; 12 Greatfield Drive, Charlton Kings, Cheltenham, Gloucestershire GL53 9BU (GB).

(71)(72) Applicant and Inventor: CRAVEN, Peter, Graham [GB/GB]; Old School House, Old School Lane, East Challow, Wantage, Oxon OX12 9SG (GB).

(72) Inventor: GERZON, Michael, Anthony (deceased).

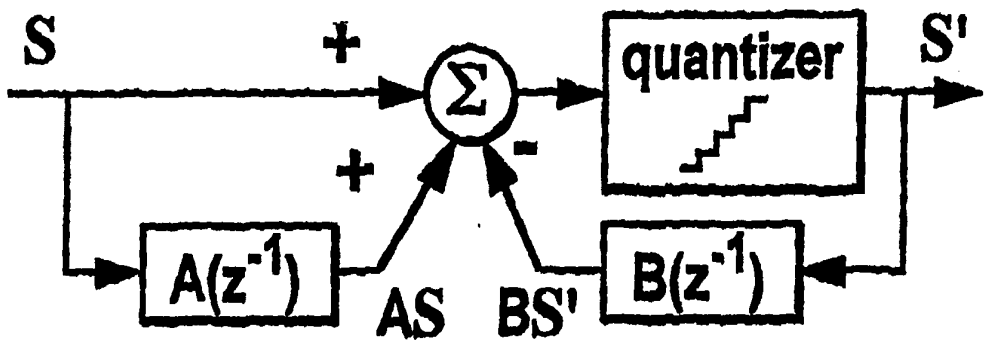
(74) Agent: GILL JENNINGS & EVERY; Broadgate House, 7 Eldon Street, London EC2M 7LH (GB).

(81) Designated States: AL, AM, AT, AU, AZ, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, 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 the receipt of amendments.

(88) Date of publication of the international search report:
9 January 1997 (09.01.97)

(54) Title: LOSSLESS CODING METHOD FOR WAVEFORM DATA



(57) Abstract

In a method of lossless processing of an integer value signal in a prediction filter which includes a quantiser, a numerator of the prediction filter is implemented prior to the quantiser and a denominator of the prediction filter is implemented recursively around the quantiser to reduce the peak data rate of an output signal. In the lossless processor, at each sample instant, an input to the quantiser is jointly responsive to a first sample value of a signal input to the prediction filter, a second sample value of a signal input to the prediction filter at a previous sample instant, and an output value of the quantiser at a previous sample incident. In a preferred embodiment, the prediction filter includes noise shaping for affecting the output of the quantiser.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AM	Armenia	**GB**	United Kingdom	**MW**	Malawi
AT	Austria	**GE**	Georgia	**MX**	Mexico
AU	Australia	**GN**	Guinea	**NE**	Niger
BB	Barbados	**GR**	Greece	**NL**	Netherlands
BE	Belgium	**HU**	Hungary	**NO**	Norway
BF	Burkina Faso	**IE**	Ireland	**NZ**	New Zealand
BG	Bulgaria	**IT**	Italy	**PL**	Poland
BJ	Benin	**JP**	Japan	**PT**	Portugal
BR	Brazil	**KE**	Kenya	**RO**	Romania
BY	Belarus	**KG**	Kyrgystan	**RU**	Russian Federation
CA	Canada	**KP**	Democratic People's Republic of Korea	**SD**	Sudan
CF	Central African Republic			**SE**	Sweden
CG	Congo	**KR**	Republic of Korea	**SG**	Singapore
CH	Switzerland	**KZ**	Kazakhstan	**SI**	Slovenia
CI	Côte d'Ivoire	**LI**	Liechtenstein	**SK**	Slovakia
CM	Cameroon	**LK**	Sri Lanka	**SN**	Senegal
CN	China	**LR**	Liberia	**SZ**	Swaziland
CS	Czechoslovakia	**LT**	Lithuania	**TD**	Chad
CZ	Czech Republic	**LU**	Luxembourg	**TG**	Togo
DE	Germany	**LV**	Latvia	**TJ**	Tajikistan
DK	Denmark	**MC**	Monaco	**TT**	Trinidad and Tobago
EE	Estonia	**MD**	Republic of Moldova	**UA**	Ukraine
ES	Spain	**MG**	Madagascar	**UG**	Uganda
FI	Finland	**ML**	Mali	**US**	United States of America
FR	France	**MN**	Mongolia	**UZ**	Uzbekistan
GA	Gabon	**MR**	Mauritania	**VN**	Viet Nam

INTERNATIONAL SEARCH REPORT

Int onal Application No
PCT/GB 96/01164

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H03M7/00

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 6 H03M H03H

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)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	IEEE TRANSACTIONS ON CONSUMER ELECTRONICS, vol. 39, no. 3, 1 August 1993, pages 151-158, XP000396274 JAE JEONG HWANG ET AL: "TRANSMISSION NOISE ELIMINATIONS IN BDPCM IMAGE" see page 152, left-hand column, paragraph 3 - right-hand column, last paragraph; figure 1 ---	1,18
A	IEEE TRANSACTIONS ON ACOUSTICS,SPEECH AND SIGNAL PROCESSING, vol. ASSP-29, no. 5, October 1981, NEW YORK US, pages 1067-1071, XP002012564 R. BASTION: "Subjective Improvements in DPCM-AQ Performance Based on Adaptive Noise Shaping" see figure 1 ---	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
15 November 1996	29. 11. 96

Name and mailing address of the ISA	Authorized officer
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	Blaas, D-L

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

INTERNATIONAL SEARCH REPORT

Int onal Application No
PCT/GB 96/01164

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 520 491 A (RAULIN JEAN M ET AL) 28 May 1985 see abstract	1,18
A	US 5 070 515 A (IWAHASHI NAOTO ET AL) 3 December 1991 see abstract	1,18
A	US 3 909 721 A (BUSSGANG JULIAN J ET AL) 30 September 1975 see abstract	18
A	EP 0 596 663 A (SONY CORP) 11 May 1994 see abstract	22
A	US 4 821 119 A (GHARAVI HAMID) 11 April 1989 see abstract	22
A	EP 0 504 627 A (NIPPON ELECTRIC CO) 23 September 1992 see abstract see page 14, line 44 - line 50	30
A	EP 0 504 927 A (TOKYO SHIBAURA ELECTRIC CO) 23 September 1992 see abstract	30

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

INTERNATIONAL SEARCH REPORT

I national application No.

PCT/GB 96/01164

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 Annex

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 searches 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.:

1. Claims 1-21,33-35,38
2. Claims 22-29
3. Claims 30-32

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.:

Remark on Protest

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

☒ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International Application No. PCT/GB 96/ 01164

FURTHER INFORMATION CONTINUED FROM PCT/ISA/210

1. Claims 1-21,33-35,38: Lossless coding with prediction filter
2. Claims 22-29: Lossless encoders with adaptive rounding means
3. Claims 30-32: A lossless invertible matrix quantiser
4. Claims 36-37: Lossless pre-de-emphasiser
5. Claim 39: System for lossless gain control
6. Claim 40: A decoder for lossless gain control wtih an autodither generator
7. Claims 41-42: A decoder for transmission systems for multichannel signals
8. Claims 43-44: A mastering processor for multichannel signals
9. Claim 45: A lossless encoder for a multichannel signal comprising a matrix quantiser to encode for lowest data rates

INTERNATIONAL SEARCH REPORT

Information on patent family members

Int ional Application No
PCT/GB 96/01164

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
US-A-4520491	28-05-85	FR-A-	2515901	06-05-83
		CA-A-	1214278	18-11-86
		EP-A-	0078581	11-05-83
		JP-A-	58087936	25-05-83
US-A-5070515	03-12-91	JP-A-	1221021	04-09-89
		JP-A-	1233823	19-09-89
		EP-A-	0331405	06-09-89
US-A-3909721	30-09-75	NONE		
EP-A-0596663	11-05-94	JP-A-	6152542	31-05-94
		EP-A-	0677931	18-10-95
		US-A-	5563913	08-10-96
US-A-4821119	11-04-89	CA-A-	1312370	05-01-93
EP-A-0504627	23-09-92	JP-A-	4363000	15-12-92
		US-A-	5487128	23-01-96
		CA-A,C	2054849	03-05-92
		CA-A,C	2061832	27-08-92
		EP-A-	0483882	06-05-92
		US-A-	5271089	14-12-93
EP-A-0504927	23-09-92	JP-A-	4293096	16-10-92