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(54) Title: RICE PARAMETER UPDATE FOR COEFFICIENT LEVEL CODING IN VIDEO CODING PROCESS

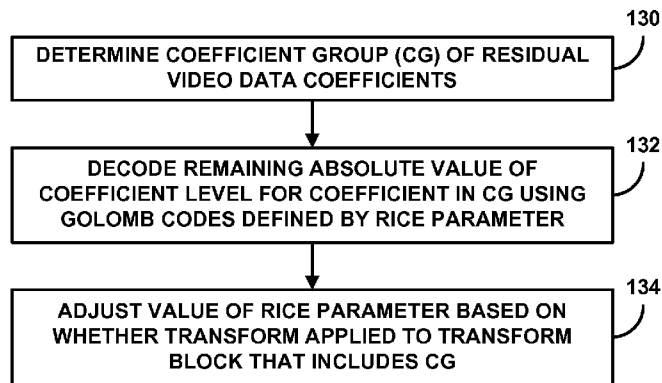


FIG. 10

(57) Abstract: Techniques are described for updating a value of a Rice parameter used to define Golomb codes for coefficient level coding. The Golomb codes defined by the Rice parameter may be used to code a remaining absolute value of a coefficient level for at least one coefficient in a coefficient group (CG). According to the techniques, the value of the Rice parameter is updated based on a selection of a minimum of either a maximum value of the Rice parameter or a variable increment of the value of the Rice parameter. The variable increment is determined based on the value of the Rice parameter and an absolute value of the coefficient level for the current coefficient being coded. Techniques are also described for adjusting the value of the Rice parameter used to define Golomb codes for coefficient level coding based on whether a transform is applied to a transform block.



INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER INV. H04N19/13 H04N19/91 H04N19/176 H04N19/156 ADD.		
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) H04N		
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 practicable, search terms used) EPO-Internal, WPI Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	MEMON N: "Adaptive coding of DCT coefficients by Golomb-Rice codes", IMAGE PROCESSING, 1998. ICIP 98. PROCEEDINGS. 1998 INTERNATIONAL CONFERENCE ON CHICAGO, IL, USA 4-7 OCT. 1998, LOS ALAMITOS, CA, USA, IEEE COMPUT. SOC, US, vol. 1, 4 October 1998 (1998-10-04), pages 516-520, XP010308805, DOI: 10.1109/ICIP.1998.723551 ISBN: 978-0-8186-8821-8 Section 2; Section 3 abstract <p style="text-align: center;">----- -/--</p>	1-3, 13-15, 25-29, 39,40
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family 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 application or patent 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 27 October 2014	Date of mailing of the international search report 03/11/2014	
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer <p style="text-align: center;">Morbee, Marleen</p>	

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International application No

PCT/US2014/033780

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	<p>NGUYEN T ET AL: "Reduced-complexity entropy coding of transform coefficient levels using a combination of VLC and PIPE", 4. JCT-VC MEETING; 95. MPEG MEETING; 20-1-2011 - 28-1-2011; DAEGU;(JOINT COLLABORATIVE TEAM ON VIDEO CODING OF ISO/IEC JTC1/SC29/WG11AND ITU-T SG.16); URL: HTTP://WFTP3.ITU.INT/AV-ARCH/JCTVC-SITE/,, no. JCTVC-D336, 16 January 2011 (2011-01-16), XP030008375, ISSN: 0000-0013 Section 2</p>	<p>1-3, 13-15, 25-29, 39,40</p>
X,P	<p align="center">-----</p> <p>SOLE J ET AL: "RCE2 Test A1: Simplified update of the coefficient level Rice parameter", 15. JCT-VC MEETING; 23-10-2013 - 1-11-2013; GENEVA; (JOINT COLLABORATIVE TEAM ON VIDEO CODING OF ISO/IEC JTC1/SC29/WG11 AND ITU-T SG.16); URL: HTTP://WFTP3.ITU.INT/AV-ARCH/JCTVC-SITE/,, no. JCTVC-00206, 15 October 2013 (2013-10-15), XP030115251, the whole document</p>	<p>1-3, 13-15, 25-29, 39,40</p>
X	<p align="center">-----</p> <p>US 6 987 468 B1 (MALVAR H S) 17 January 2006 (2006-01-17)</p> <p>paragraph [0107] - paragraph [0113] paragraph [0009] - paragraph [0031] paragraph [0083] figure 11</p>	<p>1-3, 13-15, 25-29, 39,40</p>
X	<p align="center">-----</p> <p>EP 1 653 746 A2 (MICROSOFT CORP [US]) 3 May 2006 (2006-05-03)</p> <p>paragraph [0098] - paragraph [0100] paragraph [0012] - paragraph [0031] figure 11</p> <p align="center">-----</p>	<p>1-3, 13-15, 25-29, 39,40</p>

INTERNATIONAL SEARCH REPORT

International application No.
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Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 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 No. III Observations where unity of invention is lacking (Continuation of item 3 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 fees, this Authority did not invite payment of additional fees.

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.:

1-3, 13-15, 25-29, 39, 40

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 and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- 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, 13, 14, 25-27, 39, 40

coding method which determines a block of coefficients of residual video data and which codes a remaining absolute value of a coefficient level of these coefficients using Golomb codes defined by a Rice parameter. The value of the Rice parameter is adjusted. This adjustment is done based on whether a transform is applied to the transform block that includes the block of coefficients. The block of coefficients comprises a coefficient group. In order to adapt to local changes of the coefficient levels within the coefficient group, an update of the value of the Rice parameter is performed after coding a coefficient. This updated Rice parameter value is then used when coding a subsequent coefficient in the coefficient group.

2. claims: 3, 15, 28, 29

coding method which determines a block of coefficients of residual video data and which codes a remaining absolute value of a coefficient level of these coefficients using Golomb codes defined by a Rice parameter. The value of the Rice parameter is adjusted. This adjustment is done based on whether a transform is applied to the transform block that includes the block of coefficients. The block of coefficients comprises a coefficient group. In order to adapt to changes of coefficient levels between different coefficient groups, an initialization of the value of the Rice parameter is performed. This initialized Rice parameter value is then used for coding coefficients of a subsequent coefficient group.

3. claims: 4-8, 16-20, 30-34

coding method which determines a block of coefficients of residual video data and which codes a remaining absolute value of a coefficient level of these coefficients using Golomb codes defined by a Rice parameter. The value of the Rice parameter is adjusted. This adjustment is done based on whether a transform is applied to the transform block that includes the block of coefficients. In order to implement the adjustment of the Rice parameter for the specific case that no transform is applied to the transform block that includes the block of coefficients, an update of the value of the Rice parameter is performed based on a selection of a minimum of either a maximum value of the Rice parameter or a variable increment of the value of the Rice parameter.

4. claims: 9, 21, 35

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

coding method which determines a block of coefficients of residual video data and which codes a remaining absolute value of a coefficient level of these coefficients using Golomb codes defined by a Rice parameter. The value of the Rice parameter is adjusted. This adjustment is done based on whether a transform is applied to the transform block that includes the block of coefficients. In order to determine the starting value for the Rice parameter for a subsequent block of coefficients for the specific case that no transform is applied to the transform block that includes the block of coefficients, the value of the Rice parameter for a subsequent block of coefficients in the transform block is initialized based on the value of the Rice parameter after decoding the remaining absolute value of the coefficient level for at least one coefficient in the current block of coefficients.

5. claims: 10, 11, 22, 23, 36, 37

coding method which determines a block of coefficients of residual video data and which codes a remaining absolute value of a coefficient level of these coefficients using Golomb codes defined by a Rice parameter. The value of the Rice parameter is adjusted. This adjustment is done based on whether a transform is applied to the transform block that includes the block of coefficients. In order to implement the adjustment of the Rice parameter for the specific case that a transform is applied to the transform block that includes the block of coefficients, an update of the value of the Rice parameter according to a HEVC Rice parameter update scheme is performed.

6. claims: 12, 24, 38

coding method which determines a block of coefficients of residual video data and which codes a remaining absolute value of a coefficient level of these coefficients using Golomb codes defined by a Rice parameter. The value of the Rice parameter is adjusted. This adjustment is done based on whether a transform is applied to the transform block that includes the block of coefficients. In order to determine whether or not the transform is applied to the transform block, one of a lossless coding status, a transform bypass status, a transform skip status or a profile set in a parameter set for the transform block is analysed.

7. claims: 41-68

coding method which determines a block of coefficients of residual video data and which codes a remaining absolute value of a coefficient level of these coefficients using

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Golomb codes defined by a Rice parameter. The value of the Rice parameter is adjusted. In order to obtain a fast and efficient adjustment of the value of the Rice parameter, an update of the value of the Rice parameter is performed based on a selection of a minimum of either a maximum value of the Rice parameter or a variable increment of the value of the Rice parameter, wherein the variable increment is determined based on the value of the Rice parameter and an absolute value of the coefficient level for the coefficient being coded.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date	
US 6987468	B1	17-01-2006	CN 1767395 A	03-05-2006
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