(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
9 July 2015 (09.07.2015)

WIPO | PCT

(10) International Publication Number
WO 2015/100522 A1

(51) International Patent Classification:
H04N 19/00 (2014.01)

(21) International Application Number:
PCT/CN2013/090836

(22) International Filing Date:
30 December 2013 (30.12.2013)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicant *(for all designated States except IR, SA, US)*: **MEDIATEK SINGAPORE PTE. LTD.** [SG/SG]; #03-01 Solaris, No.1 Fusionopolis Walk, Singapore 138628 (SG).

(72) Inventors; and
(71) Applicants *(for US only)*: **ZHANG, Xianguo** [CN/CN]; Room 202, Unit 4, Building 45, Zuojiazhuang Beili, Chaoyang District, Beijing 100028 (CN). **ZHANG, Kai** [CN/CN]; A1101, Dongfang Yujinxiang Building, No. 216 Tangli Road, Chaoyang District, Beijing 100013 (CN). **AN, Jicheng** [CN/CN]; No. 44, Zhanlanguan Road, Xicheng District, Beijing 100037 (CN).

(74) Agent: **BEIJING SANYOU INTELLECTUAL PROPERTY AGENCY LTD.**; 16th Fl., Block A, Corporate Square, No. 35 Jinrong Street, Beijing 100033 (CN).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: METHODS FOR INTER-COMPONENT RESIDUAL PREDICTION

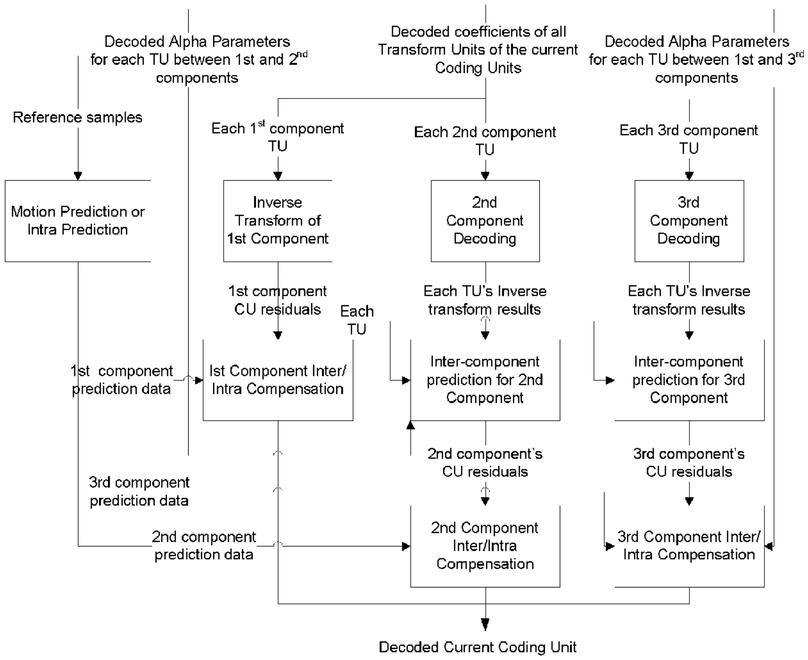

Fig. 1

(57) Abstract: Methods of Inter-component Residual Prediction (IRP) are disclosed. It is proposed to predict and transmit the alpha parameter values in more efficient ways, including methods utilizing shorter binary codes to signalize larger alpha values and methods without flags signalizing the sign of alpha parameter.

WO 2015/100522 A1

Published:

— *with international search report (Art. 21(3))*

METHODS FOR INTER-COMPONENT RESIDUAL PREDICTION

TECHNICAL FIELD

[0001] The invention relates generally to the processing of general videos. In particular, the present invention relates to optimized methods for Inter-component Residual Prediction (IRP) in HEVC Range Extension Video Coding Standard (Shortly as HEVC-REXT). IRP mainly focuses on encoding the videos which have the same resolution among different color components.

BACKGROUND

[0002] HEVC-REXT is developed for encoding or decoding videos which have the more resolution in 2nd and 3rd color components or more input bit-depth for each color component. For cases when different color components have the same resolutions, there is probably redundancy among the color-component prediction residuals. To exploit the inter-component redundancy, additional tools such as Inter-component Residual Prediction (IRP) have been integrated to HEVC-REXT codec.

[0003] The basic decoding process the IRP in the current HEVC-REXT is illustrated in Fig. 1. According to the decoding process, the encoding process can be easily derived. The following decoding process analysis just takes videos in yuv format which contains 1 luma and 2 chroma components at the ratio of 4:4:4 for example. Videos with three components of R, G, and B can be easily extended, when the first encoded component is treated the same as luma component and the other two components are treated as two chroma components.

[0004]Table 1(a) and Table 1(b) show the IRP operating position and alpha parameter transmitted position in the current HEVC-REXT.

Table 1 (a)

transform_unit(x0, y0, xBase, yBase, log2TrafoSize, trafoDepth, blkIdx) {	Descriptor
…	
if(log2TrafoSize > 2 || ChromaArrayType = = 3) {	
for(tIdx = 0; tIdx < (ChromaArrayType = = 2 ? 2 : 1); tIdx++) {	

<table>
<tr><td>if(cbf_luma[x0][y0][trafoDepth] && (CuPredMode[x0][y0] != MODE_INTRA | | IntraPredModeC[x0][y0] = = 4 | | intra_bc_flag[x0][y0]) && inter_component_resi_pred_enabled_flag)</td><td></td></tr>
<tr><td>inter_ component_resi_pred(x0, y0, 1)</td><td></td></tr>
<tr><td>if(cbf_cb[x0][y0 + (tIdx << log2TrafoSizeC)][trafoDepth])</td><td></td></tr>
<tr><td>residual_coding(x0, y0 + (tIdx << log2TrafoSizeC), log2TrafoSizeC, 1)</td><td></td></tr>
<tr><td>}</td><td></td></tr>
<tr><td>for(tIdx = 0; tIdx < (ChromaArrayType = = 2 ? 2 : 1); tIdx++) {</td><td></td></tr>
<tr><td>if(cbf_luma[x0][y0][trafoDepth] && (CuPredMode[x0][y0] != MODE_INTRA | | IntraPredModeC[x0][y0] = = 4 | | intra_bc_flag[x0][y0]) && inter_color_prediction_enabled_flag)</td><td></td></tr>
<tr><td>inter_ component_resi_pred(x0, y0, 2)</td><td></td></tr>
<tr><td>if(cbf_cr[x0][y0 + (tIdx << log2TrafoSizeC)][trafoDepth])</td><td></td></tr>
<tr><td>residual_coding(x0, y0 + (tIdx << log2TrafoSizeC), log2TrafoSizeC, 2)</td><td></td></tr>
<tr><td></td><td></td></tr>
</table>

Table 1 (b)

inter_component_resi_pred(x0, y0, cIdx) {	**Descriptor**
res_scale_abs_val[cIdx][x0][y0]	ae(v)
if(scale_abs_val[cIdx][x0][y0] != 0)	
res_scale_sign_flag[cIdx][x0][y0]	ae(v)
}	

[0005] IRP firstly locates the collocated each luma transform block's (TB's) prediction residuals. These luma TB residuals are the reconstructed data from entropy decoding and inverse transforming. Then the luma TB residuals are utilized to predict the two groups of chroma TB residuals. And then, all TB residuals are compensated by inter or intra prediction data. At last, all TB data are decoded and construct the decoded CU data.

[0006] During each procedure of utilizing 1st component TB residuals to predict the current second or third TB residuals, an alpha parameter is transmitted in transform unit of the video stream and the luma TB residual multiplied by the alpha parameter and right shifted by 3 bits are utilized as the predicted residuals for the current component TB residuals. In the current IRP design, alpha values among -8, -4, -2, -1, 0, 1, 2, 4 and 8.

[0007] In video streams, the alpha values above are mapped into symbols valuing from 3, 2, 1 and 0 by right shifting 3 bits on its absolute value, and one sign flag showing it is positive or negative. In the binarization of absolute alpha value, Table 2 shows the binary code from shortest to longest and Table 3 presents the 3 context models for coding the symbols.

[0008] Table 2 shows the binarization for the absolute values of alpha parameter in the current IRP.

Table 2

abs(alpha)	binarization
0	0
1	10
2	110
4	1110
8	1111

[0009] Table 3 shows the context models for encoding absolute values of alpha parameter in the current IRP.

Table 3

Syntax element	ctxTable	InitType=0	InitType=1	InitType=2
res_scale_abs_val[ ][ ][ ]	Table 9-xx	0…2	3…5	6…8

[0010] Such existent method follows such rule for alpha coding: the smaller absolute values of alpha value, the lesser bits should be utilized; any two alpha values with the same absolute value have the same length of coding bits. This rule accords with the distributions of utilizing residuals of luma component to predict chroma components in YUV videos. However for RGB videos, such rule is not suitable, such as the proportion of alpha being equal to 8 or 4 is much larger than that being equal to 1.

SUMMARY

[0011] It is proposed to optimize the Inter-component Residual Prediction (IRP, residual prediction among residuals of different color components) in HEVC-REXT, especially the coding method for the alpha parameter utilized in IRP.

[0012] Two methods are proposed for the optimization, including one alpha-coding context model optimization approach and one input-format adaptive alpha coding method.

[0013] The alpha-coding context model optimization is proposed to encode the absolute values of alpha through 4 context models, instead of the 3 context models utilized in IRP for alpha coding currently. In such case, each bin of the alpha binary code corresponds to one independent context model and the alpha can be encoded more efficiently because the bins only used for absolute alpha values of 4 and 8 never share the same context model as before. Thus by using this method, alpha parameter can be encoded more efficiently than before with both YUV and RGB video input format, especially efficient when input video has a format of RGB.

[0014] Whether the input-format adaptive alpha coding method should be utilized is signalized in picture parameter set, just after the flag signalizing whether IRP should be enabled. While the input-format adaptive alpha coding method is carried out, the larger a non-zero alpha values, the shorter a non-zero alpha should be encoded in binary. Following this rule, one effective order of binarization length from shortest to longest can be 0, 8, 4, 2, 1, -1, -2, -4 and -8. Furthermore, several context models (e.g., 4) should be utilized in coding the binary codes for alpha parameter.

[0015] In practice, encoders can select to utilize the new method for RGB input videos; for YUV videos, the existent method or the existent method with alpha-coding context model optimization can be utilized. Whereas for decoders, the flag in the stream can be decoded to select which method should be utilized.

[0016] Other aspects and features of the invention will become apparent to those with ordinary skill in the art upon review of the following descriptions of specific embodiments.

BRIEF DESCRIPTION OF DRAWINGS

[0017] The invention can be more fully understood by reading the subsequent detailed description and examples with references made to the accompanying drawing, wherein:

[0018] Fig. 1 is a diagram illustrating the decoding process of IRP in the current HEVC-REXT.

DETAILED DESCRIPTION

[0019] The following description is of the best-contemplated mode of carrying out the invention. This description is made for the purpose of illustrating the general principles of the invention and should not be taken in a limiting sense. The scope of the invention is best determined by reference to the appended claims.

[0020] Two methods are proposed for the optimization, including one alpha-coding context model optimization approach and one input-format adaptive alpha coding method. A best IRP procedure which combines the two alpha parameter coding methods works by (1) Whether the input-format adaptive alpha coding method should be utilized is signalized as adaptive_alpha_coding_flag in picture parameter set, just after the flag signalizing whether IRP should be enabled. adaptive_alpha_coding_flag being equal to 0 identifies to utilize the existent alpha coding method with or without the alpha-coding context model optimization approach. adaptive_alpha_coding_flag being equal to 1 identifies to utilize the input-format adaptive alpha coding method. (2) If adaptive_alpha_coding_flag equals to 0, the alpha-coding context model optimization is utilized to encode the absolute values of alpha (valuing among 0, 1, 2, 4, 8) through 4 context models as shown in Table 4, instead of the 3 context model utilized in IRP for alpha coding currently (the last two bins share the 3rd context model, as shown in Table 3). In such case, each bin of the binary alpha can correspond one independent context model and the alpha can be encoded more efficiently because the bins only used for absolute alpha values of 4 and 8 never share the same context model as before. Thus by using this method, alpha parameter can be encoded more efficiently than before with both YUV and RGB video input format, especially efficient when input video has a format of RGB. (3) If adaptive_alpha_coding_flag equals to 1, following the rule of “the larger a non-zero alpha values, the shorter a non-zero alpha should be encoded in binary”, the codec utilizes such effective binarization order: the binarization length for alpha parameter from shortest to longest should be 0, 8, 4, 2, 1, -1, -2, -4 and 8, as shown in Table 5. Furthermore, several context models (e.g., 4 context models as shown in Table 4) should be utilized in coding the binary codes for alpha parameter.

[0021]Table 4 shows the context models for encoding absolute values of alpha parameter in the proposed alpha-coding context model optimization approach for IRP.

Table 4

Syntax element	ctxTable	InitType=0	InitType=1	InitType=2
res_scale_abs_val[ ][ ][ ]	Table 9-xx	0…3	4…7	8…11

[0022]Table 5 shows the binarization for the absolute values of alpha parameter in the input-format adaptive alpha coding method for IRP.

Table 5

alpha	binarization
0	0
8	10
4	110
2	1110
1	11110
-1	111110
-2	1111110
-4	11111110
-8	11111111

[0023] A practical encoder should signalize adaptive_alpha_coding_flag by 1 for RGB videos and 0 for YUV videos.

[0024] The proposed method described above can be used in a video encoder as well as in a video decoder. Embodiments of the method according to the present invention as described above may be implemented in various hardware, software codes, or a combination of both. For example, an embodiment of the present invention can be a circuit integrated into a video compression chip or program codes integrated into video compression software to perform the processing described herein. An embodiment of the present invention may also be program codes to be executed on a Digital Signal Processor (DSP) to perform the processing described herein. The invention may also involve a number of functions to be performed by a computer processor, a digital signal processor, a microprocessor, or field programmable gate array (FPGA). These processors can be configured to perform particular tasks according to the invention, by executing machine-readable software code or firmware code that defines the particular methods embodied by the invention. The software code or firmware codes may be developed in different programming languages and different format or style. The software code may also be compiled for different target platform. However, different code formats, styles and languages of software codes and other means of configuring code to perform the tasks in accordance with the invention will not depart from the spirit and scope of the invention.

[0025] The invention may be embodied in other specific forms without departing from its spirit or essential characteristics. The described examples are to be considered in all respects only as illustrative and not restrictive. To the contrary, it is intended to cover various modifications and similar arrangements (as would be apparent to those skilled in the art). Therefore, the scope of the appended claims should be accorded the broadest interpretation so as to encompass all such modifications and similar arrangements.

CLAIMS

1. A method of Inter-component Residual Prediction (IRP) for general video coding, comprising encoding or decoding an alpha parameter for the Inter-component Residual Prediction.

2. The method as claimed in claim 1, wherein the alpha parameter is encoded and decoded in different ways, and a flag is signaled to determine which way is utilized.

3. The method as claimed in claim 2, wherein the flag is signalized in a sequence parameter set (SPS), picture parameter set (PPS) or coding tree unit (CTU) level.

4. The method as claimed in claim 1, wherein a number of utilized context models to encode and decode the alpha parameter is the same as a largest binarization length of existent absolute values of alpha.

5. The method as claimed in claim 1, wherein before coding the alpha parameter, flags in coding tree unit (CTU), coding unit (CU) or transform tree or transform unit (TU) are utilized to signalize how a current alpha parameter is predicted from an alpha parameter of a neighboring unit and how the alpha parameter of a third component is predicted from alpha parameters of a second component and other neighboring units.

6. The method as claimed in claim 5, wherein if prediction of the alpha parameter is equal to a predicted alpha value, the alpha parameter is not transmitted or a 0 value is transmitted in a bitstream.

7. The method as claimed in claim 5, wherein if prediction of the alpha parameter is not equal to a predicted alpha value, a value of an alpha parameter prediction residual is transmitted or an actual alpha parameter is sub-sequentially transmitted.

8. The method as claimed in claim 1, wherein an alpha parameter of a third component is utilized to signalize how third component prediction residuals are predicted from second component prediction residuals.

9. The method as claimed in claim 3, wherein a second shortest binary code is selected to signalize an alpha value, which identifies directly utilizing a first component residual to predict a current component residual, under control of the transmitted flags.

10. The method as claimed in claim 3, wherein the 3rd shortest binary code can be selected to signalize the alpha value, which identifies utilizing half of the 1st component residual to predict the current component residual, under the control of the transmitted flag.

11. The method as claimed in claim 3, wherein an encoder and a decoder select no sign flag is utilized to signalize whether an alpha value is positive or negative.

12. The method as claimed in claim 11, wherein a binary code length of positive alpha values are longer than negative alpha values.

13. The method as claimed in claim 3, wherein the alpha parameter is selected to be transmitted as a largest alpha value corresponds to a shortest alpha binary code.

14. The method as claimed in claim 3, wherein a binary code length order from longest to shortest for positive alpha values is 0, 8, 4, 2 and 1, if a positive alpha ranges among 0, 1, 2, 4 and 8.

15. The method as claimed in claim 3, wherein binary bins utilized to signalize negative alpha values share same context model.

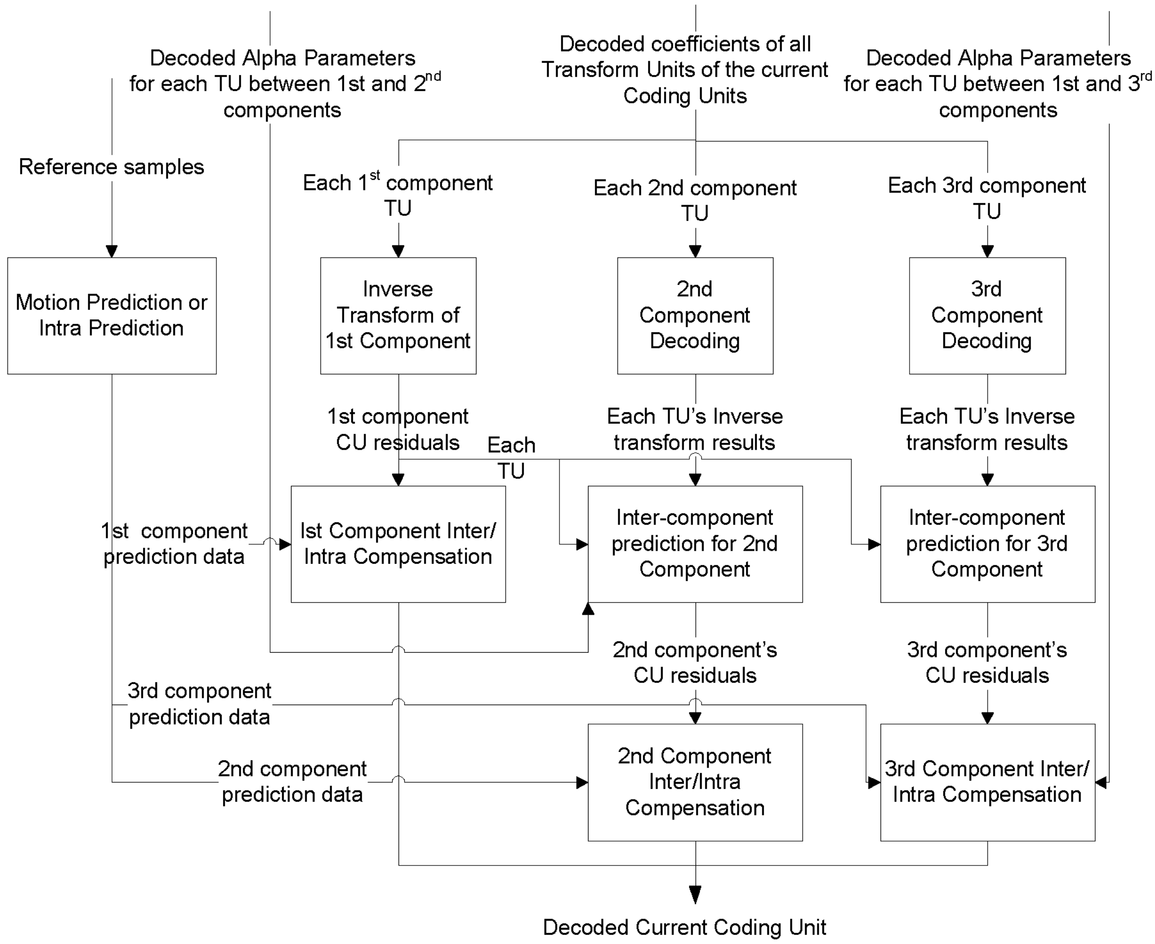
Decoded Alpha Parameters for each TU between 1st and 2nd components
Decoded coefficients of all Transform Units of the current Coding Units
Decoded Alpha Parameters for each TU between 1st and 3rd components
Reference samples
Each 1st component TU
Each 2nd component TU
Each 3rd component TU
Motion Prediction or Intra Prediction
Inverse Transform of 1st Component
2nd Component Decoding
3rd Component Decoding
1st component CU residuals
Each TU
Each TU's Inverse transform results
Each TU's Inverse transform results
1st component prediction data
Ist Component Inter/ Intra Compensation
Inter-component prediction for 2nd Component
Inter-component prediction for 3rd Component
2nd component's CU residuals
3rd component's CU residuals
3rd component prediction data
2nd component prediction data
2nd Component Inter/Intra Compensation
3rd Component Inter/ Intra Compensation
Decoded Current Coding Unit

Fig. 1

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2013/090836

A. CLASSIFICATION OF SUBJECT MATTER

H04N 19/00 (2014.01)i

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)

CNABS;CNTXT;VEN;USTXT;EPTXT:alpha， α， HEVC,residual, predict+, parameter, cod+, encod+, decod+,inter+,binary

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 103210647 A (MEDIA TEK) 17 July 2013 (2013-07-17) the description paragraphs [0031]-[0044]	1-3
A	CN 103139565 A (OH SOO MI) 05 June 2013 (2013-06-05) the whole document	1-15
A	CN 101459847 A (LIANFA SCI&TECHNOLOGY CO LTD) 17 June 2009 (2009-06-17) the whole document	1-15
A	EP 2428042 A1 (ERICSSON TELEFON AB L M) 14 March 2012 (2012-03-14) the whole document	1-15
A	CN 101521013 A (UNIV WUHAN) 02 September 2009 (2009-09-02) the whole document	1-15

☐ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

* Special categories of cited documents:

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 September 2014	**26 September 2014**

Name and mailing address of the ISA/	Authorized officer
STATE INTELLECTUAL PROPERTY OFFICE OF THE P.R.CHINA(ISA/CN) **6,Xitucheng Rd., Jimen Bridge, Haidian District, Beijing 100088 China**	**LV,Wei**
Facsimile No. **(86-10)62019451**	Telephone No. **(86-10)62411478**

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2013/090836

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
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