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Published:
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(54) **Title**: INTER-VIEW MOTION PREDICTION IN 3D VIDEO CODING

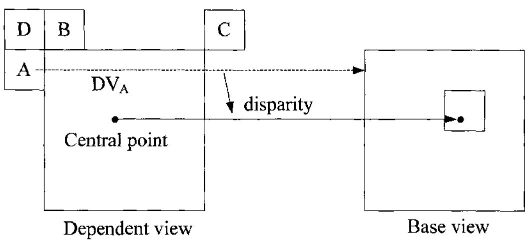

Fig. 3

(57) **Abstract**: In one embodiment, a close loop derivation concept of the inter-view motion vector is described, which uses both the forward disparity from the current view to the reference view and the backward disparity from the reference view to the current view to derive the inter-view motion information. In another embodiment, an inter-view motion derivation which uses the coded disparity vectors (DV) from spatial neighbors is described.

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INTER-VIEW MOTION PREDICTION IN 3D VIDEO CODING

FIELD OF INVENTION

The invention relates generally to video processing. In particular, the present invention relates to methods and apparatuses of motion prediction in 3D video coding.

BACKGROUND OF THE INVENTION

Three dimensional video coding (3DVC) is a popular topic in recent year. ISO/IEC moving picture experts group (MPEG) now is working on a new 3DVC standard, which aims to significantly improve the coding performance for 3D video. There are several tools which can exploit the correlations between neighboring views such as inter-view texture prediction and inter-view motion prediction. And the current 3DVC system is based on both H.264/AVC, i.e. ATM, and high efficiency video coding (HEVC), i.e. HTM.

SUMMARY OF THE INVENTION

In light of the previous description, the inter-view motion prediction in the current 3DVC system can be further improved.

In the first embodiment, a close loop derivation concept of the inter-view motion vector is described, which uses both the forward disparity from the current view to the reference view and the backward disparity from the reference view to the current view to derive the inter-view motion information. In the second embodiment, an inter-view motion derivation which uses the coded disparity vectors (DV) from spatial neighbors is described.

BRIEF DESCRIPTION OF THE DRAWINGS

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

Fig. 1 is a diagram illustrating the process of inter-view motion derivation in HTM;

Fig. 2 is a diagram illustrating an example of the close loop inter-view motion derivation;

Fig. 3 is a diagram illustrating the disparity derivation method for the current block by using its spatial neighbors.

DETAILED DESCRIPTION

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.

Usually, a 3D sequence consists of several sequences with the same scene but slightly different view angles. In coding process, one of the views is chosen as base view which is coded independently without referencing any other views. The views other than base view call dependent views which are coded dependently with referencing other views. For description convenience, we call the view being coded as current view and the view it references as reference view. In general, the base view is used as reference view.

In current 3DVC system, both texture and depth map are transmitted. The motion information from the reference views can be used as prediction of the current view. In specific, the block type, reference index, prediction direction and motion vector of the current block can be predicted by that from the corresponding block in the reference view. The corresponding block in the reference view is generally found by using the disparity between the two blocks. Fig. 1 shows an example which is in the current HTM version 0.3. In this example, the disparity of the central point in the current block is used to derive the corresponding block in the reference view. After that, the motion vector of the block in the reference view is used for the current block. The current method of inter-view motion vector prediction can be further improved.

In the first embodiment, a close loop derivation concept is used to further improve the derivation of the inter-view motion derivation. This concept is to use more information from in the reference view to help derive the motion information for the current view. In specific, both the forward disparity from the current view to the reference view and the backward disparity from the reference view to the current view are used to derive the inter-view motion information.

Fig. 2 shows an example of the close loop method. In this figure, the base view is reference view. And the dependent is the current view. The central point of the current block (time n) in dependent view and its forward disparity, disaprity0, is used to find its inter-view corresponding point in the base view. Then, the motion vector and reference index of the block which contains this point in the based view (time n) is used to find the corresponding position of this block in the temporal reference picture (time n-1). After that, the temporal corresponding block of the current block in dependent view (time n-1) can be found by using forward disparity, disaprity1. And the mv1 can be derived by using mv0, disparity0 and disparity1 as

$$mv1 = mv0 + disparity0 + disparity1.$$

mv0 and mv1 can be used individually or together. When used together, the two motion vectors are adaptively switched explicitly, e.g. sending signal flag as indication in block level or region level, or implicitly, e.g. using the difference between disparity0 and disparity1 to judge the precision of mv1. The mv0 and mv1 can also be switched according the existence of the picture n-1 in base view. In specific, if the picture is in the decoded frame buffer when coding the current picture (time n) in the dependent view, mv1 is used. Otherwise, mv0 is used.

Disaprity0 can certainly be derived using the disparity of the central point or the average disparity of any subset of the pixels in the current block. And the disparity value can be derived using the corresponding depth map (coded depth or estimated depth) and camera parameters, as well as the coded disparity from the spatial or temporal neighbors of the current block. So does disparity1. The derived motion information can both be directly used as the motion information of the current block and be used as the prediction for the motion information of the current block.

Please note that the backward disparity is not limited to the disparity1 shown in Fig. 2. It can also be the disparity of the corresponding block in picture n in reference view. In this case, the forward disparity and the backward disparity can be used together to decide if the block found by forward disparity is good enough, e.g. judging by the difference of the two disparities.

In the second embodiments, the disparity vectors from the spatial neighbors are used for the current block together with the disparity derived by depth to improve the current inter-view motion derivation as shown in Fig. 3. The central point of the current block in the dependent view and its disparity are used to find the corresponding point in the base view. After that, the motion of the block which includes the corresponding point in the base view is used as the inter-view candidate of the current block. The disparity can be derived from both the neighboring blocks and the depth value of the central point. In specific, if one of the neighboring blocks has disparity vector (DV), e.g. DV_A in Figure 2, the DV is used as the disparity. Otherwise, the depth-based disparity is used, which is derived using the depth value of the central point and camera parameters. Compared to only using the depth-based disparity, DVs from spatial neighbours can partially avoid error propagation in case that the depth value of the central point is not available, e.g. the depth image is lost. The depth-based disparity can be totally replaced by the coded DVs from spatial neighbours to reduce the computational complexity and avoid the error propagation. In this case, if there is no DV in the spatial neighbours, no inter-view candidate is used for the current block.

The methods described above can be used in a video encoder as well as in a video decoder. Embodiments of the methods 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.

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 generating motion prediction of a dependent view from a base view comprising:

using both forward disparity from a current view to a reference view and backward disparity from the reference view to the current view to derive a corresponding block of the current block in the reference view; and

using motion information of the block in the reference view for the current block.

2. The method as claimed in claim 1, wherein the forward disparity and the backward disparity can be in the same or different time instant.

3. The method as claimed in claim1, wherein the motion information generated by the forward disparity and the backward disparity are used for the current block individually or collaboratively.

4. The method as claimed in claim 3, wherein switch between the two kinds of motion information is explicit by sending a signal flag at a region level.

5. The method as claimed in claim 3, wherein switch between the two kinds of motion information is implicit by using a difference between the forward disparity and backward disparity.

6. The method as claimed in claim 1, wherein the motion information generated by the forward disparity is adjusted according to the backward disparity.

7. method of generating motion prediction of a dependent view from a base view comprising:

using a coded disparity from the spatial neighbors of the current block as a forward disparity.

8. The method as claimed in claim 7, wherein the neighboring disparity is used together with the disparity derived from a depth map.

9. The method as claimed in claim 8, wherein if the neighboring disparity is not available, the disparity derived from the depth map is used as the forward disparity.

10. The method as claimed in claim 8, wherein if the neighboring disparity is not available, the disparity derived from the depth map is used as the backward disparity.

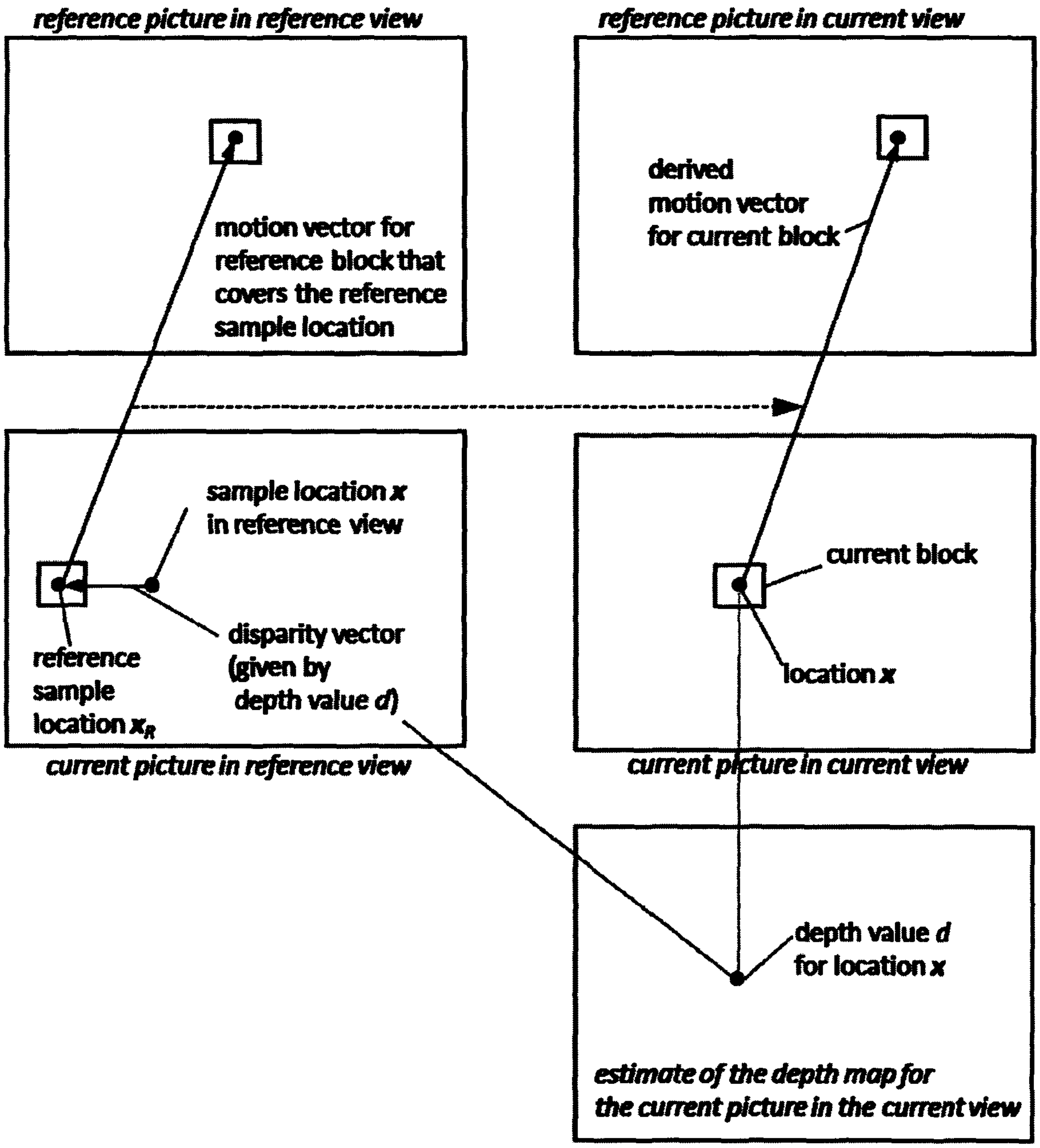
reference picture in reference view
motion vector for reference block that covers the reference sample location
reference picture in current view
derived motion vector for current block
sample location x in reference view
reference sample location x_R
disparity vector (given by depth value d)
current picture in reference view
current block
location x
current picture in current view
depth value d for location x
estimate of the depth map for the current picture in the current view

Fig. 1

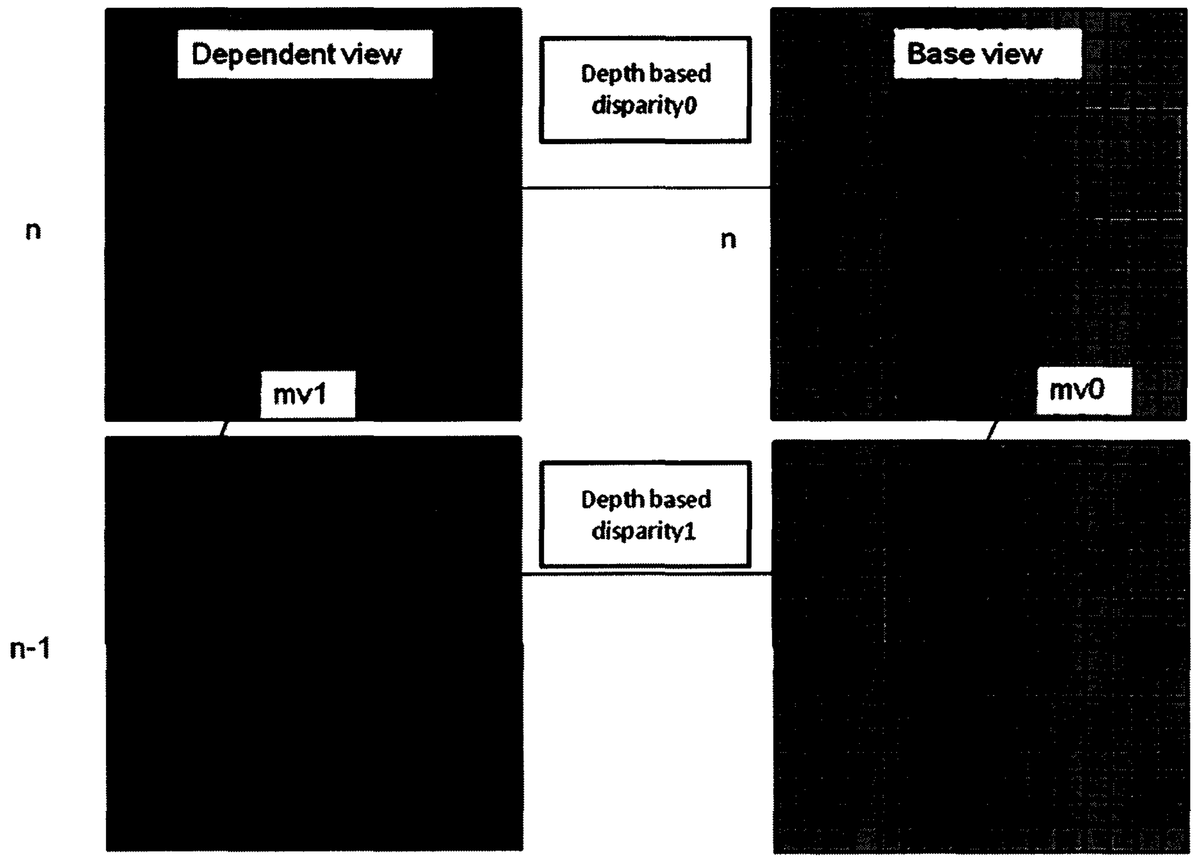
Dependent view
Depth based disparity0
Base view
n
n
mv1
mv0
Depth based disparity1
n-1

Fig. 2

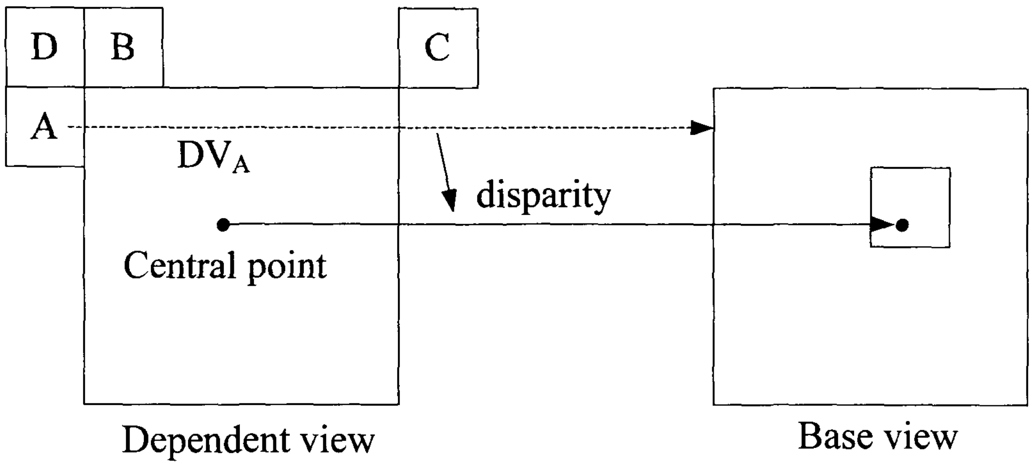

Fig. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2012/074807

A. CLASSIFICATION OF SUBJECT MATTER

H04N7/32(2006.01)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)

IPC: 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)

CPRSABS,VEN,CNKI: motion, predict+, cod+, forward, backward, disparity, depth, 3D

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN102045571A(UNIV BEIJING TECHNOLOGY) 04 May 2011(04.05.2011)	1-2, 6-7
	the description paragraphs 44-53, figures 2 and 4	
A	whole document	3-5,8-10
X	CN101600108A(UNIV BEIJING TECHNOLOGY) 09 Dec. 2009(09.12.2009) claim 1	1-2,6
A	CN101374242A(UNIV NINGBO) 25 Feb. 2009(25.02.2009) whole document	1-10

☐ Further documents are listed in the continuation of Box C. ☒ 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	Date of mailing of the international search report
20 Jan. 2013(20.01.2013)	**07 Feb. 2013 (07.02.2013)**
Name and mailing address of the ISA/CN The State Intellectual Property Office, the P.R.China 6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China 100088 Facsimile No. 86-10-62019451	Authorized officer GUO, Xiaoyu Telephone No. (86-10)62411453

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2012/074807

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:

There are 2 inventions covered by the claims indicated as follows: claims 1 and 7. Claims 1 and 7 direct to methods of generating motion prediction of a dependent view from a base view. Wherein the common technical feature among claims 1 and 7 is "the forward disparity", the feature is the common knowledge in the multiview video coding field, and their remainder features contents differ from each other, and are not linked by common and new inventive concept, thus do not form a single general inventive concept. The application, hence does not meet the requirements of unity of invention as defined in Rules 13.1 and 13.2 PCT.

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 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.:

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.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2012/074807

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN102045571A	04.05.2011	CN102045571B	05.09.2012
CN101600108A	09.12.2009	CN101600108B	02.02.2011
CN101374242A	25.02.2009	CN101374242B	02.06.2010