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(54) Title: ADAPTIVE INTER PREDICTION

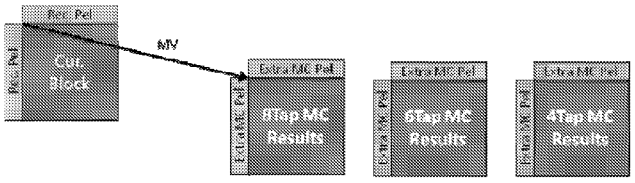

Fig.1

(57) Abstract: Adaptive inter prediction is proposed. The proposed method is to utilize the correlation between current block and neighboring reconstructed pixels to achieve the local adaptation of inter prediction.

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ADAPTIVE INTER PREDICTION

TECHNICAL FIELD

[0001] The invention relates generally to video coding.

BACKGROUND

[0002] Inter prediction is an important technology to improve the compression efficiency of video coding systems. In H.265/High Efficiency Video Coding standards, inter prediction can be uni-directional prediction or bi-directional prediction. For one block coded by inter prediction, there is only one predictor generated by integral or fractional motion compensation when uni-directional prediction is used. If bi-directional prediction is selected for this inter-predicted block, then there are two predictors generated by motion compensation and the final predictor is generated by averaging these two predictors. The fractional motion compensation is implemented by one pre-defined 8-Tap interpolation filter for luma component and one pre-defined 4-tap interpolation filter for chroma component, respectively. However, the process of inter prediction in HEVC is fixed, e.g. averaging in bi-directional prediction or filter coefficients in fractional motion compensation, so they cannot fit the characteristics of variant blocks well. Therefore, in order to further improve the compression efficiency of inter prediction, an adaptive inter prediction method is presented in the following.

SUMMARY

[0003] Methods of adaptive inter prediction offset are proposed. The proposed method is to utilize the correlation between current block and neighboring reconstructed pixels to achieve the local adaptation of inter prediction.

[0004] 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

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

[0005] Fig. 1 is a diagram illustrating an example of proposed method. Three interpolation filters can be used, and the selection is based on the distortion between neighboring reconstructed pixels and extra motion compensated pixels.

DETAILED DESCRIPTION

[0006] 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.

[0007] The proposed method is to utilize the correlation between current block and neighboring reconstructed pixels to achieve the local adaptation of inter prediction. The method is named as adaptive inter prediction.

[0008] In one embodiment, we use neighboring reconstructed pixels around current block to select which inter prediction method should be used for current block, when more than one inter prediction methods can be used. For example, three kinds of interpolation filters in fractional motion compensation can be used in one video coding system. In the beginning, we perform extra motion compensation with these three interpolation filters for neighboring reconstructed pixels around current block to generate extra motion compensated pixels, as shown in Fig. 1. Next, the distortions between neighboring reconstructed pixels and extra motion compensated pixels are calculated for these three kinds of interpolation filters, and the interpolation filter with the smallest distortion is used to generate the predictor of current block. For uni-directional prediction, adaptive inter prediction can be achieved by switching different interpolation filters.

[0009] In the other embodiment, for bi-directional prediction, adaptive inter

prediction can be implemented by supporting different weighting factors between two predictors, e.g. [0.5, 0.5], [0.25, 0.75], [0.75, 0.25], [0.375, 0.625], or [0.625, 0.375].

[0010] In another embodiment, different weighting factors of two predictors, different interpolation filters can also be used in bi-directional prediction.

[0011] In still another embodiment, different inter prediction methods can be combined to be another inter prediction method, e.g. different weighting factors with variant interpolation filters.

[0012] In still another embodiment, the distortion between neighboring reconstructed pixels and extra motion compensated pixels can be sum of absolute differences, sum of square errors, and so on.

[0013] In still another embodiment, for adaptive weighting factors for bi-directional prediction, the distortion can be calculated with only one extra motion compensation using the following steps, where X denote the neighboring reconstructed pixels:

1) Perform motion compensation and get predictor P0 and P1;
2) Q = (P0+P1)<<2;
3) R = P0-P1;
4) The distortion for weighting factor [0.5, 0.5] is calculated as D0 = (X<<3) – Q;
5) The distortion for weighting factor [0.625, 0.375] is calculated as D1 = D0 - R;
6) The distortion for weighting factor [0.375, 0.625] is calculated as D2 = D0 + R;
7) The distortion for weighting factor [0.75, 0.25] is calculated as D3 = D1 – R;
8) The distortion for weighting factor [0.25, 0.75] is calculated as D4 = D2 + R.

[0014] In still another embodiment, the supported adaptive inter prediction methods can be signaled at sequence level, picture level or slice level. And the supported adaptive inter prediction methods can be dependent on slice type, prediction mode, or motion information.

[0015] The methods described above can be used in a video encoder as well as in a video decoder. Embodiments of adaptive inter prediction 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.

[0016] 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 adaptive inter prediction:

- inter prediction using different interpolation filters;
- inter prediction using different weighting factors for bi-directional prediction.

2. The method as claimed in claim 1, wherein the difference among variant interpolation filters can be the number of filter taps or filter coefficients.

3. The method as claimed in claim 1, wherein the weighting factors for two predictors in bi-directional prediction can be [0.5, 0.5], [0.25, 0.75], [0.75, 0.25], [0.375, 0.625], or [0.625, 0.375].

4. The method as claimed in claim 1, wherein the selection among different inter prediction methods can dependent on the neighboring reconstructed pixels.

5. The method as claimed in claim 1, wherein the selection among different inter prediction methods can dependent on the extra motion compensated pixels for neighboring reconstructed pixels around current block.

6. The method as claimed in claim 4, neighboring reconstructed pixels can be selected base on motion information of current block and neighboring pixels.

7. The method as claimed in claim 4, wherein the neighboring reconstructed pixels can be at least one row at top boundary of current block.

8. The method as claimed in claim 4, wherein the neighboring reconstructed pixels can be at least one column at left boundary of current block.

9. The method as claimed in claim 7 and claim 8, wherein subsample can be used to select the neighboring reconstructed pixels.

10. The method as claimed in claim 4 and claim 5, wherein the selection among different inter prediction methods can dependent on the distortion between neighboring reconstructed pixels and extra motion compensated pixels.

11. The method as claimed in claim 10, wherein the distortion can be calculated by using sum of absolute differences.

12. The method as claimed in claim 10, wherein the distortion can be calculated by using sum of square differences.

13. The method as claimed in claim 10, wherein, for adaptive weighting factors for bi-directional prediction, the distortion can be calculated with only one extra motion compensation using the following steps, where X denote the neighboring

reconstructed pixels:

1) Perform motion compensation and get predictor P0 and P1;
2) Q = (P0+P1)<<2;
3) R = P0-P1;
4) The distortion for weighting factor [0.5, 0.5] is calculated as D0 = (X<<3) – Q;
5) The distortion for weighting factor [0.625, 0.375] is calculated as D1 = D0 – R;
6) The distortion for weighting factor [0.375, 0.625] is calculated as D2 = D0 + R;
7) The distortion for weighting factor [0.75, 0.25] is calculated as D3 = D1 – R;
8) The distortion for weighting factor [0.25, 0.75] is calculated as D4 = D2 + R.

14. The method as claimed in claim 1, wherein the supported adaptive inter prediction methods can be signaled at sequence level, picture level, or slice level.

15. The method as claimed in claim 1, wherein the supported adaptive inter prediction methods can be dependent on slice type, prediction mode, or motion information.

16. The method as claimed in claim 1, the selection of adaptive inter prediction can be explicitly signaled to the decoder.

17. The method as claimed in claim 1, enabling or disabling adaptive inter prediction can be signaled at sequence level, picture level, slice level, coding unit level, or prediction unit level.

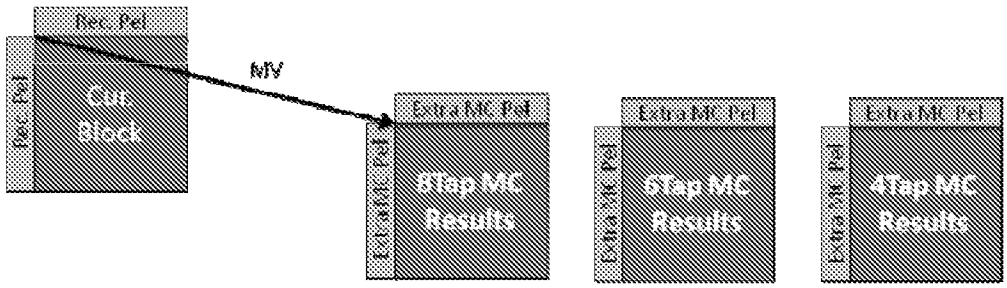
Ref. Pel
Ref. Pel
Cur. Block
MV
Extra MC Pel
Extra MC Pel
8Tap MC Results
Extra MC Pel
Extra MC Pel
6Tap MC Results
Extra MC Pel
Extra MC Pel
4Tap MC Results

Fig.1

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2015/088952

A. CLASSIFICATION OF SUBJECT MATTER

H04N 19/159(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; G06T

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)

WPI EPODOC CNKI CNPAT: filt+, adaptive, interpolat+, inter+, predit+, weight+, factor?, tap?, bi?direction+, forward, backward, coefficient?, frame?, select+, determin+, neighbor+, left, top, adjacent+, pixel?, block?, macroblock?, mode, sequence, slice, picture

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2011103478 A1 (DOLBY LABORATORIES LICENSING CORPORATION) 05 May 2011 (2011-05-05) description, paragraphs [0075], [0146] and figure 2	1, 3-4, 7-9, 14-17
Y	US 2011103478 A1 (DOLBY LABORATORIES LICENSING CORPORATION) 05 May 2011 (2011-05-05) description, paragraphs [0075], [0146] and figure 2	2
Y	CN 103747269 A (PEKING UNIVERSITY SHENZHEN GRADUATE SCHOOL) 23 April 2014 (2014-04-23) description, paragraphs [0034]-[0060]	2
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A	CN 101953167 A (INTEGRATED DEVICE TECHNOLOGY INC.) 19 January 2011 (2011-01-19) the whole document	1-17

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

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"A" document defining the general state of the art which is not considered to be of particular relevance

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"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
05 April 2016	**04 May 2016**

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	US 2009245694 A1 (SONY CORPORATION) 01 October 2009 (2009-10-01) the whole document	1-17

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
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