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(54) **Title:** ADVANCED TEMPORAL MOTION VECTOR PREDICTION IN VIDEO CODING

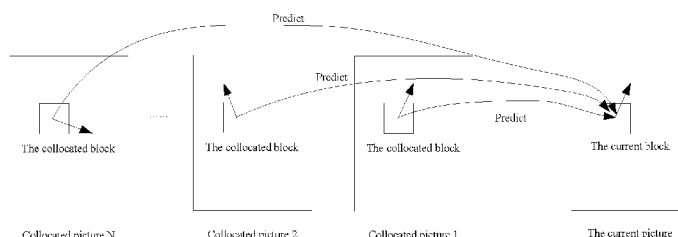


Fig. 3

(57) **Abstract:** An advanced temporal motion vector prediction (ATMVP) method is proposed. In ATMVP, more than one collocated pictures can be applied for the current picture. And TMVP can be fetched from one or more of these collocated pictures.

ADVANCED TEMPORAL MOTION VECTOR PREDICTION IN

VIDEO CODING

FIELD OF THE INVENTION

[0001] The invention relates generally to video coding. In particular, the presented
5 invention relates to temporal motion vector prediction.

BACKGROUND

[0002] In video coding standards such as H.264/AVC or H.265/HEVC, temporal motion vector prediction (TMVP) is applied as a kind of motion vector prediction. As shown in Fig. 1, TMVP is fetched from a collocated block in a collocated picture. The
10 collocated picture is one reference picture of the current picture. The collocated block is a block corresponding to the current block. Usually it is the block at the same relative position in the collocated picture as the current block in the current picture. When TMVP is used to predict the current motion vector (MV), it should be scaled based on the time distance between pictures as demonstrated in Fig. 2.

15 [0003] In H.264/AVC, the collocated picture is a fixed reference picture in the reference list. In H.265/HEVC, the encoder can choose any reference picture in the reference list as the collocated picture for the current picture. The information about which reference picture is chosen as the collocated picture is signaled from the encoder to the decoder in the slice header.

20 [0004] In the prior-arts, only one collocated picture is involved. However, only one collocated picture may not exploit the temporal correlation of MVs sufficiently.

SUMMARY

[0005] In light of the previously described problems, an advanced temporal motion vector prediction (ATMVP) method is proposed. In ATMVP, more than one collocated
25 pictures can be applied for the current picture. And TMVP can be fetched from one or more of these collocated pictures.

[0006] 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 THE DRAWINGS

- 5 The invention can be more fully understood by reading the subsequent detailed description and examples with references made to the accompanying drawings, wherein:
- [0007] Fig. 1 is a diagram illustrating temporal motion vector prediction;
- [0008] Fig. 2 is a diagram illustrating A TMVP example;
- [0009] Fig. 3 is a diagram illustrating the advanced TMVP method;
- 10 [0010] Fig. 4 is a diagram illustrating exemplary collocated blocks;
- [0011] Fig. 5 is a diagram illustrating Two Exemplary TMVP checking orders;
- [0012] Fig. 6 is a diagram illustrating Scaling the motion vectors in collocated pictures before storing.

DETAILED DESCRIPTION

- 15 [0013] 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.
- [0014] An advanced temporal motion vector prediction (ATMVP) method depicted in
- 20 Fig.3 is proposed. In ATMVP, two or more collocated pictures can be used by the current picture. TMVP can be fetched from one or more of those collocated pictures.
- [0015] In one embodiment, the number of collocated pictures is a fixed number, such as 2, 3, 4, and so on.
- [0016] In another embodiment, the number of collocated pictures can be determined
- 25 by the encoder and signalled from the encoder to the decoder. It can be signalled in video parameter set (VPS), sequence parameter set (SPS), picture parameter set (PPS), slice header, coding unit (CU), or picture unit (PU).
- [0017] In one embodiment, the collocated pictures can be at fixed positions in the reference picture list.
- 30 [0018] In another embodiment, the collocated pictures can be chosen by the encoder and their positions in the reference picture list can be signalled from the encoder to the

decoder. It can be signalled in video parameter set (VPS), sequence parameter set (SPS), picture parameter set (PPS), slice header, coding unit (CU), or picture unit (PU).

[0019] The following table demonstrates an exemplary syntax table to signal the collocated pictures.

col_pic_num	ue(v)
for(col_pic_idx = 0; col_pic_idx < col_pic_num; col_pic_idx++){	
col_pic_list [col_pic_idx]	u(1)
col_pic_refidx [col_pic_idx]	ue(v)
}	

5 **[0020]** In one embodiment, there can be one or more collocated blocks in each collocated picture. TMVP can be fetched from any of those collocated blocks. Fig. 3 demonstrates exemplary collocated blocks. The ‘original collocated block’ represents the block at the same relative position in the collocated picture as the current block in the current picture.

10 **[0021]** In one embodiment, the encoder can choose the TMVP from any collocated block in any collocated picture.

[0022] In one embodiment, the encoder can choose the TMVP from any collocated block in any collocated picture. And the information of TMVP from which collocated block in which collocated picture is signalled from the encoder to the decoder. The
15 information can be signalled in slice header, coding unit (CU), or prediction unit (PU).

[0023] In one embodiment, N TMVPs from different collocated blocks in different collocated pictures can be inserted into the merging candidate list as N merging candidates.

[0024] In one embodiment, N TMVPs from different collocated blocks in different
20 collocated pictures can be inserted into the advanced motion vector prediction (AMVP) candidate list as N AMVP candidates.

[0025] In one embodiment, N TMVPs can be fetched by checking different collocated blocks in different collocated pictures in any order. Fig. 5 demonstrates some exemplary checking orders.

25 **[0026]** In one embodiment, there should be 1 TMVP at most in the merging candidate list or AMVP candidate list. Collocated blocks in a first collocated picture should be checked first. If motion vectors can be found in collocated blocks in the first collocated

picture, one or more of them will be chosen as the TMVP candidate. Otherwise, collocated blocks in a second collocated picture will be checked then.

[0027] In another embodiment, there should be 2 TMVPs at most in the merging candidate list or AMVP candidate list. Collocated blocks in a first collocated picture should be checked first in order. If one motion vector can be found in a collocated block in the first collocated picture, it will be chosen as the first TMVP candidate. The other collocated blocks in the first collocated picture will be skipped. Then, collocated blocks in a second collocated picture should be checked in order. If one motion vector can be found in a collocated block in the second collocated picture, it will be chosen as the second TMVP candidate.

[0028] In one embodiment, the motion vectors can be compressed in different collocated pictures with different compression ratio. For example, motion vectors in collocated picture 1 can be compressed by 1: 16. And motion vectors in collocated picture 2 can be compressed by 1:4. The encoder can signal the information of whether to compress MVs and the compression ratio for each collocated picture to the decoder. The information can be signalled in VPS, SPS, PPS, or slice header.

[0029] In one embodiment, different TMVPs from different collocated blocks in one or more collocated pictures can be combined to form a new TMVP.

[0030] In one embodiment, $TMVP1 = MV1$ and $TMVP2 = MV2$ can be combined as a new TMVP candidate TMVP 3 which utilizes bi-prediction. For TMVP3 with MV3 referred to a reference picture in reference list 0 and MV4 referred to a reference picture in reference list 1, MV3 can be obtained by scaling MV1 and MV4 can be obtained by scaling MV2.

[0031] In one embodiment, $TMVP1 = MV1$ and $TMVP2 = MV2$ can be combined as a new TMVP candidate $TMVP\ 3 = MV3$. $MV3 = (MV4 + MV5)/2$, where MV4 can be obtained by scaling MV1 and MV5 can be obtained by scaling MV2.

[0032] In one embodiment, $TMVP1 = MV1$, $TMVP2 = MV2$... and $TMVPN = MVN$ can be combined as a new TMVP candidate $TMVP\ 3 = MV3$. $MV3 = (MV1' + MV2' + \dots + MVN')/N$, where $MV1'$, $MV2'$, ... MVN' can be obtained by scaling MV1, MV2, ... MVN respectively.

[0033] In one embodiment, MVs in a collocated picture can be scaled to a fixed time-distance before they are stored to the buffer. For example, MVs can all be scaled to a reference picture with time-distance=1. When the MVs are fetched from collocated

pictures as TMVP, they can be scaled as if they refer to a reference picture with time-distance=1. Fig. 6 depicts the process.

[0034] In this way, the original reference indices for the MVs in collocated pictures need not to be stored into the buffer.

5 **[0035]** The methods described above can be used in a video encoder as well as in a video decoder. Embodiments of disparity vector derivation 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
10 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
15 (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.
20 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.

[0036] 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
25 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. An advanced temporal motion vector prediction (ATMVP) method, comprising:
two or more collocated pictures can be used by the current picture, TMVP can be
5 fetched from one or more of those collocated pictures;
different TMVPs from different collocated blocks in one or more collocated pictures
can be combined to form a new TMVP; and

MVs in a collocated picture can be scaled to a fixed time-distance before they are
stored to the buffer.

10 2. The method as claimed in claim 1, wherein the number of collocated pictures is a
fixed number, such as 2, 3, 4, and so on.

3. The method as claimed in claim 1, wherein the number of collocated pictures can
be determined by the encoder and signalled from the encoder to the decoder, it can be
signalled in video parameter set (VPS), sequence parameter set (SPS), picture parameter
15 set (PPS), slice header, coding unit (CU), or picture unit (PU).

4. The method as claimed in claim 1, wherein the collocated pictures can be at fixed
positions in the reference picture list.

5. The method as claimed in claim 1, wherein the collocated pictures can be chosen
by the encoder and their positions in the reference picture list can be signalled from the
20 encoder to the decoder, it can be signalled in video parameter set (VPS), sequence
parameter set (SPS), picture parameter set (PPS), slice header, coding unit (CU), or
picture unit (PU).

6. The method as claimed in claim 1, wherein there can be one or more collocated
blocks in each collocated picture, TMVP can be fetched from any of those collocated
25 blocks.

7. The method as claimed in claim 6, wherein the encoder can choose the TMVP
from any collocated block in any collocated picture, and the information of TMVP from
which collocated block in which collocated picture is signalled from the encoder to the
decoder, the information can be signalled in slice header, coding unit (CU), or prediction
30 unit (PU).

8. The method as claimed in claim 1, wherein N TMVPs from different collocated
blocks in different collocated pictures can be inserted into the merging candidate list as N
merging candidates.

9. The method as claimed in claim 1, wherein N TMVPs from different collocated blocks in different collocated pictures can be inserted into the advanced motion vector prediction (AMVP) candidate list as N AMVP candidates.

10. The method as claimed in claim 8 and claim 9, wherein N TMVPs can be fetched
5 by checking different collocated blocks in different collocated pictures in any order.

11. The method as claimed in claim 10, wherein there should be 1 TMVP at most in the merging candidate list or AMVP candidate list, collocated blocks in a first collocated picture should be checked first, if motion vectors can be found in collocated blocks in the first collocated picture, one or more of them will be chosen as the TMVP candidate,
10 otherwise, collocated blocks in a second collocated picture will be checked then.

12. The method as claimed in claim 10, wherein there should be 2 TMVPs at most in the merging candidate list or AMVP candidate list, collocated blocks in a first collocated picture should be checked first in order, if one motion vector can be found in a collocated block in the first collocated picture, it will be chosen as the first TMVP candidate, the
15 other collocated blocks in the first collocated picture will be skipped, then, collocated blocks in a second collocated picture should be checked in order, if one motion vector can be found in a collocated block in the second collocated picture, it will be chosen as the second TMVP candidate.

13. The method as claimed in claim 1, wherein the motion vectors can be compressed
20 in different collocated pictures with different compression ratio.

14. The method as claimed in claim 13, wherein The encoder can signal the information of whether to compress MVs and the compression ratio for each collocated picture to the decoder, the information can be signalled in VPS, SPS, PPS, or slice header.

15. The method as claimed in claim 1, wherein $TMVP1 = MV1$ and $TMVP2 = MV2$
25 can be combined as a new TMVP candidate TMVP 3 which utilizes bi-prediction, for TMVP3 with MV3 referred to a reference picture in reference list 0 and MV4 referred to a reference picture in reference list 1, MV3 can be obtained by scaling MV1 and MV4 can be obtained by scaling MV2.

16. The method as claimed in claim 1, wherein $TMVP1 = MV1$ and $TMVP2 = MV2$
30 can be combined as a new TMVP candidate $TMVP3 = MV3$, $MV3 = (MV4 + MV5)/2$, where MV4 can be obtained by scaling MV1 and MV5 can be obtained by scaling MV2.

17. The method as claimed in claim 1, wherein $TMVP1 = MV1$, $TMVP2 = MV2$... and $TMVPN = MVN$ can be combined as a new TMVP candidate $TMVP3 = MV3$, $MV3 = (MV1' + MV2' + \dots + MVN')/N$, where $MV1'$, $MV2'$, ... MVN' can be obtained by

scaling MV1, MV2,... MVN respectively.

18.The method as claimed in claim 1, wherein the original reference indices for the MVs in collocated pictures need not to be stored into the buffer.

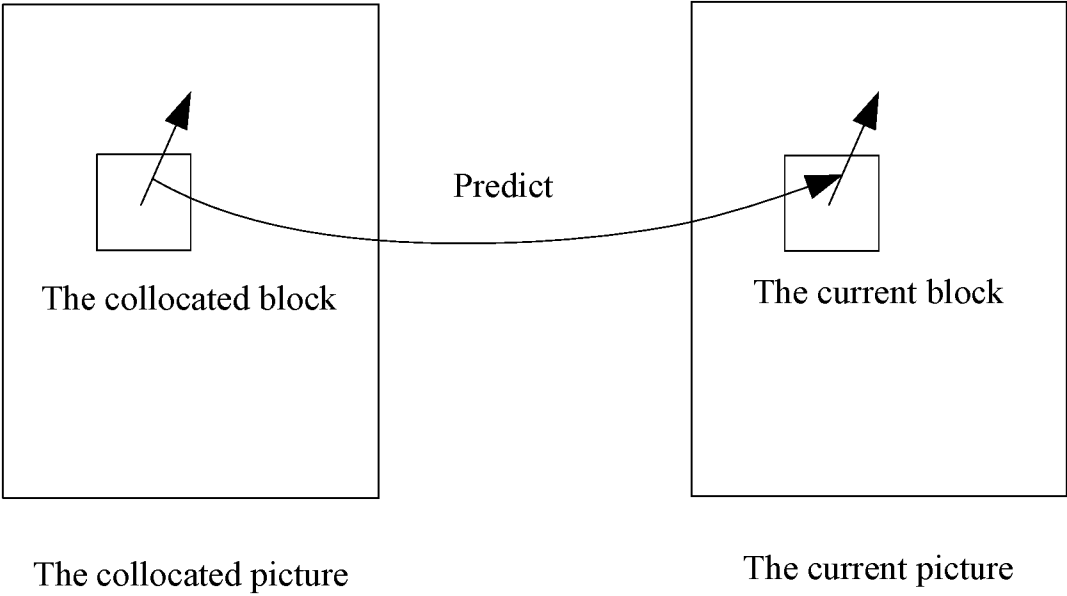


Fig. 1

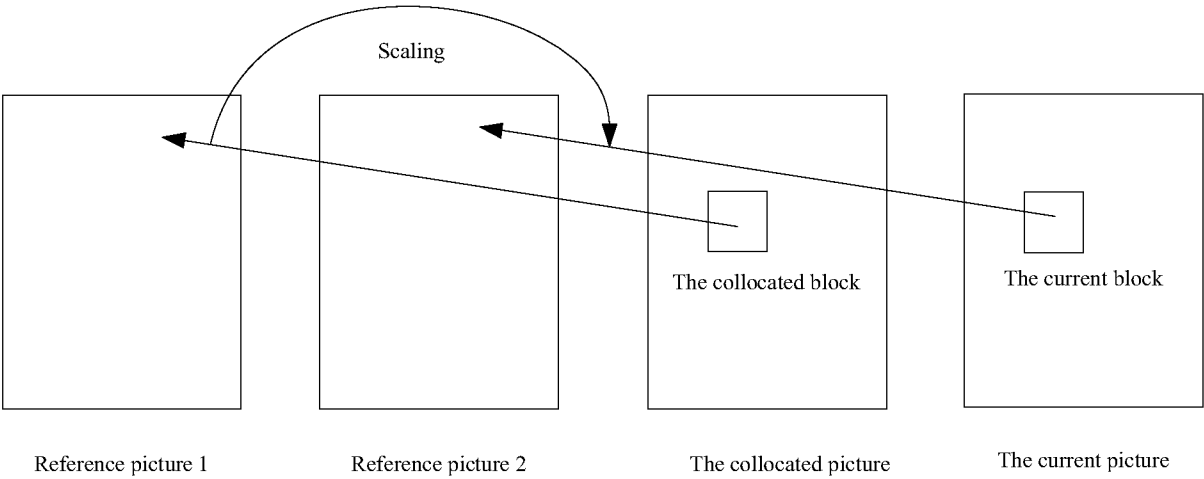


Fig. 2

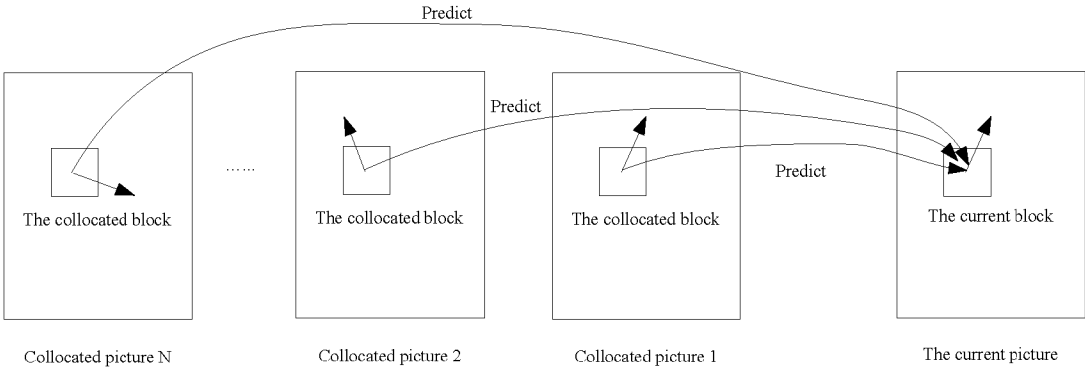
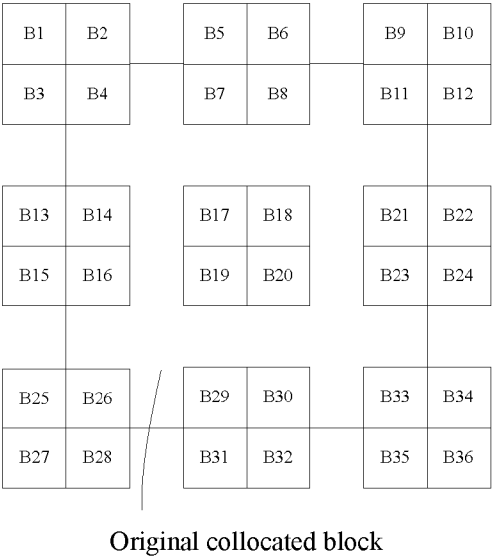


Fig. 3



Original collocated block

Fig. 4

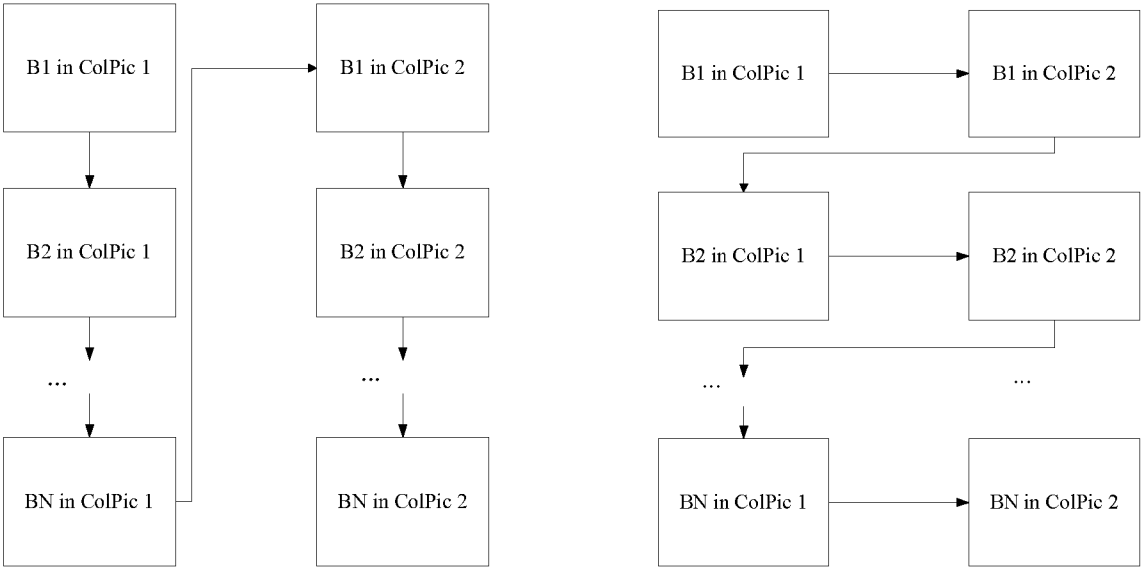


Fig. 5

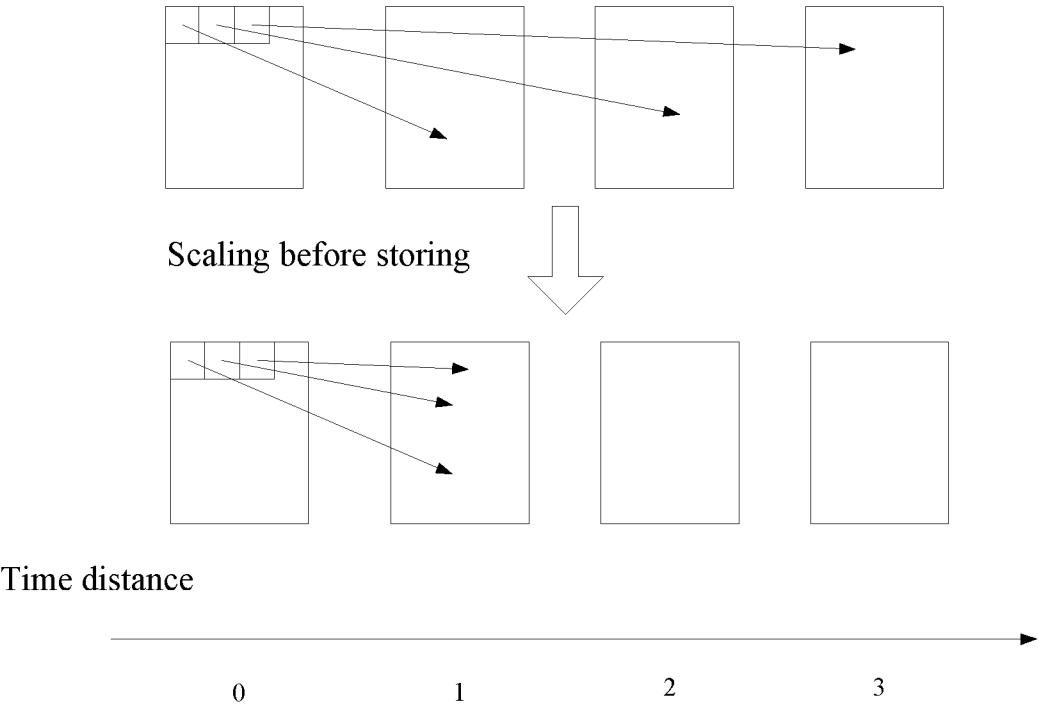


Fig. 6

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2015/076542

A. CLASSIFICATION OF SUBJECT MATTER

H04N 19/31(2014.01)i; H04N 19/52(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)

CNPAT,CNKI,EPODOC,WPI,IEEE: two, more, many, several, picture?, imag+, mov+, vector, co?locat+, +TMVP, temporal, frame?, predict+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of Box C.



See patent family annex.

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

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