

- a set of available sides of neighboring pixels S , namely: left (s_L), right (s_R), top (s_T), lower-left (s_{LL}), lower-right (s_{LR}) and top-right (s_{TR}) one.

Different contexts could be specified for a probability model, for example low-reliable prediction (denoted as CTX_{LR}), medium-reliable prediction (denoted as CTX_{MR}) and highly-reliable prediction (denoted as CTX_{HR}) cases. Default context is medium-reliable context. The reliability of prediction affects the probability of BIP flag being equal 0, and could be estimated by how close I_{IPM} is to one of the ultimate modes listed above. These modes are determined according to the aspect ratio of a block which is calculated at the next step (block 1304). Such as, $R_A = \log_2(w) - \log_2(h)$. Aspect ratio is represented by a value that is positive if a block is aligned horizontally (i.e. width is greater than height) and negative if the block is aligned vertically. The next step (block 1306) is to select ultimate modes as specified by Table 2 and Table 3. For example, $\{I_{IPM_LL}, I_{IPM_TL}, I_{IPM_TR}\} = LUT(R_A)$.

Following decision making on context selection is performed depending on whether

- left and right sides are available,
- left side is available, and/or
- the rest cases

Depending on the availability of reference samples sides (S) different ranges are defined and context is selected on the fact of whether I_{IPM} belongs to this range or not. If left and right sides are available at block 1308, $\{s_L, s_R\} \supseteq S$, CTX_{LR} is selected at block 1328 when top side is not available and I_{IPM} belongs to the range as shown in **Error! Reference source not found.A** (block 1310). At block 1310, that whether top side is not available and whether I_{IPM} belongs to the range as shown in **Error! Reference source not found.A** is determined, for example,

$$(\{s_T\} \not\supseteq S) \text{ and } (I_{IPM_TR} < I_{IPM} < I_{IPM_LT} \text{ Or } I_{IPM_LL} < I_{IPM} < I_{IPM_LA}).$$

If left and right sides are available at block 1308, $\{s_L, s_R\} \supseteq S$, CTX_{MR} is selected at block 1326 when top side is available or I_{IPM} does not belong to the range as shown in **Error! Reference source not found.A** (block 1310).

If left and top sides are available, CTX_{HR} is selected if right side is not available and I_{IPM} belongs to the range as shown in **Error! Reference source not found.B**. In FIG. 14A and FIG. 14B, ~~for~~ for the rest cases additional calculations may be performed at block 1312, specifically:

or by the video encoder 200 as shown in FIG. 2. Process 1700 is an example for the encoder's processing. Encoder-side changes introduced by the present disclosure primarily relate to the selection of intra prediction mode using rate-distortion optimization (RDO) procedure. This procedure may notably comprise:

- 5 – preparing a list of candidate intra prediction modes L_{RC} using cost estimation based on estimation of intra prediction residual; and
- selecting a best intra prediction out of the L_{RC} list using cost estimation based on coding of intra prediction residual.

One of the possible implementation forms involves a particular way of preparing a list
10 of candidate intra prediction modes L_{RC} . Besides the numbers of intra prediction modes, The L_{RC} list would also contain the values of `bip_flag` associated with the corresponding intra prediction modes. FIG. ~~16-17~~ shows an exemplary flowchart for preparing a list of candidate intra prediction modes and corresponding values of `bip_flag` using cost estimation based on estimation of intra prediction residual.
15 According to the flowchart 1700, available intra prediction modes are scanned twice having the value of `bip_flag` equal 0 and 1, respectively. The flowchart 1700 also skips Rate-Distortion Optimization (RDO) cost estimations for the cases when `bip_flag` is incompliant with the intra prediction mode I_{IPM} being checked.

At block 1702, the encoder genereates `intra_pred_list()` for a current block. At
20 beginning, `bip_flag` is 0 as shown at block 1704, and the I_{IPM} is 0 as shown at block 1706.

At block 1708, the encoder determines that `bip_flag` is 0 or `bip_flag` is 1. If the `bip_flag` is 0, the encoder determines whether the BIP is applied by default at block 1710. If the
| `bip_flag` is 1, the encoder determines whether the BIP is enabled at block 1712.

25 If the BIP is not applied by default, or the BIP is enabled, the encoder uses I_{IPM} as the intra_prediction modes of the current block at block 1714. The encoder performs RDO cost estimation at block 1716. Then, the encoder prepares a list of candidate intra prediction modes L_{RC} using RDO cost estimation based on estimation of intra prediction residual at block 1718, where the L_{RC} list may contain the values of `bip_flag`
30 associated with the corresponding intra prediction modes. Then at block 1718, a best

CLAIMS

1. A method of encoding a picture, the method comprising generating a bitstream for reconstructing the picture, wherein the method comprises:
- 5 generating a list of candidate intra prediction modes for a current coding block of the picture, wherein the list of candidate intra prediction modes comprises at least one BIP mode;
- determining whether a BIP flag is to be signaled in the bitstream according to prediction related information, wherein the BIP flag indicates a BIP mode selected for the current
- 10 coding block, and wherein the prediction related information comprises at least one of: numbers and positions of available primary reference samples, an intra prediction mode index, or a size of the current coding block; and
- when the BIP flag is to be signaled in the bitstream, deriving a probability model for encoding from the prediction related information, coding a value of the BIP flag to the
- 15 bitstream using the probability model; and
- when the BIP flag is not to be signaled in the bitstream, not coding a value of the BIP flag to the bitstream.
2. The method of claim 1, wherein the determining whether the BIP flag is to be
- 20 signaled comprises:
- determining that the BIP is enabled and the BIP flag is applied by default and is not to be signaled in the bitstream; or
- determining that the BIP is disabled and the BIP flag is not to be signaled in the
- 25 bitstream.
3. The method of claim 1 or claim 2, wherein the determining whether the BIP flag is to be signaled according to numbers and positions of available primary reference samples comprises:
- determining that the BIP is disabled and the BIP flag is not to be signaled in the
- 30 bitstream when a primary reference sample in a top side of the current coding block is not available, or
- determining that the BIP is disabled and the BIP flag is not to be signaled in the bitstream when primary reference samples in left and right sides of the current coding block are not available.

4. The method of any one of claims 1 to 3, wherein the determining whether a BIP flag is to be signaled according to the size of the current coding block comprises:
determining that the BIP is disabled, and the BIP flag is not to be signaled in the
5 bitstream when both a width and height of the current coding block equal a minimum size, or when the width of the current coding block is larger than a first maximum threshold, or when the height of the current coding block is larger than a second maximum threshold.
- 10 5. The method of any one of claims 1 to 4, wherein the determining whether the BIP flag is to be signaled according to numbers and positions of available primary reference samples, and intra prediction mode index:
determining that the BIP is disabled, and the BIP flag is not to be signaled in the
bitstream when the intra prediction mode index is less than a range start value or is
15 greater than a range end value, and when primary reference samples in left and right sides of the current coding block are available, wherein the range start value and the range end value is determined using a width and a height of the current coding block;
or
determining that the BIP is disabled, and a BIP flag is not to be signaled in the bitstream
20 when only a primary reference sample in left or right side of the current coding block is available, and one of the following is true:
a width of the current coding block is equal to a minimum size and the number of intra prediction mode differs from the number of horizontal one by a first threshold or less; or
25 a height of the current coding block is equal to a minimum size and the number of intra prediction mode differs from the number of vertical one by a second threshold or less.
- 30 6. The method of claim 1 or claim 2, wherein the determining whether a BIP flag is to be signaled according to the numbers and positions of available primary reference samples, and the intra prediction mode index comprises:
determining that the BIP is enabled, and the BIP flag is applied by default and is not to be signaled in the bitstream when the intra prediction mode index is greater than a range start value and is less than a range end value, and when a primary reference

sample in lower side or upper side of the current coding block is available, wherein the range start value and the range end value is determined using a width and a height of the current coding block.

5 7. The method of claim 1, wherein the determining whether the BIP flag is to be signaled comprises:

determining a reliability of the BIP, where the reliability of the BIP includes low-reliable prediction (CTX_{LR}), medium-reliable prediction (CTX_{MR}) or highly-reliable prediction (CTX_{HR}).

10

8. The method of claim 7, wherein the determining the reliability of the BIP comprises: determining the reliability of the BIP as CTX_{LR} when primary reference samples in left and right sides of the current coding block are available, a primary reference sample in the top side of the current coding block is not available, and I_{IPM} belongs to a first predefined range.

15

9. The method of claim 7, wherein the determining the reliability of the BIP comprises: determining the reliability of the BIP as CTX_{HR} when primary reference samples in left and top sides of the current coding block are available, a primary reference sample in right side of the current coding block is not available, and I_{IPM} belongs to a second predefined range.

20

10. The method of claim 7, wherein the determining the reliability of the BIP comprises: determining the reliability of the BIP as CTX_{MR} when primary reference samples in left and right sides of the current coding block are available and one of the one of the following is true:

25

a primary reference sample in top side of the current coding block is available;

or

I_{IPM} does not belong to a first predefined range.

30

11. A method for intra prediction of a current coding block of a picture, the method comprising:

receiving a bitstream, wherein the bitstream comprises prediction related information, and wherein the prediction related information includes at least one of: numbers and

positions of available primary reference samples, an intra prediction mode index, or a size of the current coding block;

determining whether a bidirectional intra prediction (BIP) flag is signaled in the bitstream based on the prediction related information;

5 if the BIP flag is not signaled, deriving a value of the BIP flag from the prediction related information;

if the BIP flag is signaled, deriving a probability model from the prediction related information to restore a value of the BIP flag; and

reconstructing the picture based on the value of the BIP flag.

10

12. The method of claim 11, wherein the determining whether the BIP flag is signaled comprises:

determining that the BIP is enabled and the BIP flag is applied by default and is not signaled in the bitstream; or

15 determining that the BIP is disabled and the BIP flag is not signaled in the bitstream.

13. The method of claim 11 or claim 12, wherein the prediction related information comprises numbers and positions of available primary reference samples, and wherein the determining whether the BIP flag is signaled comprises:

20 determining that the BIP is disable and the BIP flag is not signaled in the bitstream when a primary reference sample in a top side of the current coding block is not available, or

determining that the BIP is disabled and the BIP flag is not signaled in the bitstream when primary reference samples in left and right sides of the current coding block are

25 not available.

14. The method of any one of claims 11 to 13, wherein the prediction related information comprises the size of the current coding block, and wherein the determining whether the BIP flag is signaled comprises:

30 determining that the BIP is disable and the BIP flag is not signaled in the bitstream when both a width and height of the current coding block equal to a minimum size, or when the width of the current coding block is larger than a first maximum threshold, or when the height of the current coding block is larger than a second maximum threshold.

15. The method of any one of claims 11 to 14, wherein the prediction related information comprises numbers and positions of available primary reference samples and intra prediction mode index, and wherein the determining whether the BIP flag is signaled comprises:

- 5 determining that the BIP is disable, and the BIP flag is not signaled in the bitstream when the intra prediction mode index is less than a range start value or is greater than a range end value, and when primary reference samples in left and right sides of the current coding block are available, wherein the range start value and the range end value is determined using a width and a height of the current coding block; or
- 10 determining that the BIP is disable, and a BIP flag is not signaled in the bitstream when only a primary reference sample in left or right side of the current coding block is available, and one of the one of the following is true:
- 15 a width of the current coding block is 4 and the number of intra prediction mode differs from the number of horizontal one by a first threshold or less; or
 - a height of the current coding block is 4 and the number of intra prediction mode differs from the number of vertical one by a second threshold or less.

20 16. The method of claim 11 or claim 12, wherein the prediction related information comprises numbers and positions of available primary reference samples and intra prediction mode index, and wherein the determining whether the BIP flag is signaled comprises:

25 determining that the BIP is enabled, and the BIP flag is applied by default and is not signaled in the bitstream when the intra prediction mode index is greater than a range start value and is less than a range end value, and when a primary reference sample in lower side or upper side of the current coding block is available, wherein the range start value and the range end value is determined using a width and a height of the current coding block.

30 17. The method of claim 11, wherein the determining whether that BIP flag is signaled comprises:

determining a reliability of the BIP according to the prediction related information, where reliability of the BIP includes low-reliable prediction (CTX_{LR}), medium-reliable prediction (CTX_{MR}) or highly-reliable prediction (CTX_{HR}).

5 18. The method of claim 17, wherein the determining the reliability of the BIP comprises:

determining the reliability of the BIP as CTX_{LR} when primary reference samples in left and right sides of the current coding block are available, a primary reference sample in the top side of the current coding block is not available, and I_{IPM} belongs to a first
10 predefined range.

19. The method of claim 17, wherein the determining the reliability of the BIP comprises:

15 determining the reliability of the BIP as CTX_{HR} when primary reference samples in left and top sides of the current coding block are available, a primary reference sample in right side of the current coding block is not available, and I_{IPM} belongs to a second predefined range.

20. The method of claim 17, wherein the determining the reliability of the BIP
20 comprises:

determining the reliability of the BIP as CTX_{MR} when primary reference samples in left and right sides of the current coding block are available and one of the one of the following is true:

a primary reference sample in top side of the current coding block is available;

25 or

I_{IPM} does not belong to a first predefined range.

21. The method of any one of claims 11 to 20, wherein the BIP mode is a distance-weighted direction intra prediction (DWDIP) mode, and the BIP flag is a DWDIP flag.
30

22. An encoder (108; 200) comprising processing circuitry for carrying out the method according to any one of claims 1 to 10.

23. A decoder (116; 300) comprising processing circuitry for carrying out the method according to any one of claims 11 to 21.

5 24. A computer program product comprising a program code for performing the method according to any one of claims 1 to 10, or according to any one of claims 11 to 21, when the computer program runs on a computing device.

CLAIMS:

1. A method of encoding a picture, the method comprising generating a bitstream for reconstructing the picture, wherein the method comprises:

generating a list of candidate intra prediction modes for a current coding block of the picture, wherein the list of candidate intra prediction modes comprises at least one bidirectional intra prediction (BIP) mode;

determining whether a BIP flag is to be signaled in the bitstream according to prediction related information, wherein the BIP flag indicates for the current coding block whether or not a BIP mode selected, and wherein the prediction related information comprises at least one of: numbers and positions of available primary reference samples, an intra prediction mode index, or a size of the current coding block;
and

when the BIP flag is to be signaled in the bitstream, deriving a probability model for encoding from the prediction related information, coding a value of the BIP flag to the bitstream using the probability model; and

when the BIP flag is not to be signaled in the bitstream, not coding a value of the BIP flag to the bitstream.

2. The method of claim 1, wherein the determining whether the BIP flag is to be signaled comprises:

determining that the BIP is enabled and the BIP flag is applied by default and is not to be signaled in the bitstream; or

determining that the BIP is disabled and the BIP flag is not to be signaled in the bitstream.

3. The method of claim 1 or claim 2, wherein the determining whether the BIP flag is to be signaled according to numbers and positions of available primary reference samples comprises:

determining that the BIP is disabled and the BIP flag is not to be signaled in the bitstream when a primary reference sample in a top side of the current coding block is not available, or

determining that the BIP is disabled and the BIP flag is not to be signaled in the bitstream when primary reference samples in left and right sides of the current coding block are not available.

4. The method of any one of claims 1 to 3, wherein the determining whether a BIP flag is to be signaled according to the size of the current coding block comprises:
determining that the BIP is disabled, and the BIP flag is not to be signaled in the bitstream when both a width and height of the current coding block equal a minimum size, or when the width of the current coding block is larger than a first maximum threshold, or when the height of the current coding block is larger than a second maximum threshold.

5. The method of any one of claims 1 to 4, wherein the determining whether the BIP flag is to be signaled according to numbers and positions of available primary reference samples, and intra prediction mode index:

determining that the BIP is disabled, and the BIP flag is not to be signaled in the bitstream when the intra prediction mode index is less than a range start value or is greater than a range end value, and when primary reference samples in left and right sides of the current coding block are available, wherein the range start value and the range end value is determined using a width and a height of the current coding block; or
determining that the BIP is disabled, and a BIP flag is not to be signaled in the bitstream when only a primary reference sample in left or right side of the current coding block is available, and one of the following is true:

a width of the current coding block is equal to a minimum size and the number of intra prediction mode differs from the number of horizontal one by a

first threshold or less; or

a height of the current coding block is equal to a minimum size and the number of intra prediction mode differs from the number of vertical one by a second threshold or less.

6. The method of claim 1 or claim 2, wherein the determining whether a BIP flag is to be signaled according to the numbers and positions of available primary reference samples, and the intra prediction mode index comprises:

determining that the BIP is enabled, and the BIP flag is applied by default and is not to be signaled in the bitstream when the intra prediction mode index is greater than a range start value and is less than a range end value, and when a primary reference sample in lower side or upper side of the current coding block is available, wherein the range start value and the range end value is determined using a width and a height of the current coding block.

7. The method of claim 1, wherein the determining whether the BIP flag is to be signaled comprises:

determining a reliability of the BIP, where the reliability of the BIP includes low-reliable prediction (CTX_{LR}), medium-reliable prediction (CTX_{MR}) or highly-reliable prediction (CTX_{HR}).

8. The method of claim 7, wherein the determining the reliability of the BIP comprises:

determining the reliability of the BIP as CTX_{LR} when primary reference samples in left and right sides of the current coding block are available, a primary reference sample in the top side of the current coding block is not available, and an intra prediction mode (I_{IPM}) belongs to a first predefined range.

9. The method of claim 7, wherein the determining the reliability of the BIP comprises:

determining the reliability of the BIP as CTX_{HR} when primary reference samples in left and top sides of the current coding block are available, a primary reference sample in right side of the current coding block is not available, and I_{IPM} belongs to a second predefined range.

10. The method of claim 7, wherein the determining the reliability of the BIP comprises:

determining the reliability of the BIP as CTX_{MR} when primary reference samples in left and right sides of the current coding block are available and one of the following is true:

a primary reference sample in top side of the current coding block is available;

or

I_{IPM} does not belong to a first predefined range.

11. A method for intra prediction of a current coding block of a picture, the method comprising:

receiving a bitstream, wherein the bitstream comprises prediction related information, and wherein the prediction related information includes at least one of: numbers and positions of available primary reference samples, an intra prediction mode index, or a size of the current coding block;

determining whether a bidirectional intra prediction (BIP) flag is signaled in the bitstream based on the prediction related information, wherein the BIP flag indicates for the current coding block whether or not a BIP mode selected;

if the BIP flag is not signaled, deriving a value of the BIP flag from the prediction related information;

if the BIP flag is signaled, deriving a probability model from the prediction

related information to restore a value of the BIP flag; and
reconstructing the picture based on the value of the BIP flag.

12. The method of claim 11, wherein the determining whether the BIP flag is
signaled comprises:

determining that the BIP is enabled and the BIP flag is applied by default and is
not signaled in the bitstream; or

determining that the BIP is disabled and the BIP flag is not signaled in the
bitstream.

13. The method of claim 11 or claim 12, wherein the prediction related
information comprises numbers and positions of available primary reference samples,
and wherein the determining whether the BIP flag is signaled comprises:

determining that the BIP is disable and the BIP flag is not signaled in the
bitstream when a primary reference sample in a top side of the current coding block is
not available, or

determining that the BIP is disabled and the BIP flag is not signaled in the
bitstream when primary reference samples in left and right sides of the current coding
block are not available.

14. The method of any one of claims 11 to 13, wherein the prediction related
information comprises the size of the current coding block, and wherein the determining
whether the BIP flag is signaled comprises:

determining that the BIP is disable and the BIP flag is not signaled in the
bitstream when both a width and height of the current coding block equal to a minimum
size, or when the width of the current coding block is larger than a first maximum
threshold, or when the height of the current coding block is larger than a second
maximum threshold.

15. The method of any one of claims 11 to 14, wherein the prediction related information comprises numbers and positions of available primary reference samples and intra prediction mode index, and wherein the determining whether the BIP flag is signaled comprises:

determining that the BIP is disable, and the BIP flag is not signaled in the bitstream when the intra prediction mode index is less than a range start value or is greater than a range end value, and when primary reference samples in left and right sides of the current coding block are available, wherein the range start value and the range end value is determined using a width and a height of the current coding block; or

determining that the BIP is disable, and a BIP flag is not signaled in the bitstream when only a primary reference sample in left or right side of the current coding block is available, and one of the following is true:

a width of the current coding block is 4 and the number of intra prediction mode differs from the number of horizontal one by a first threshold or less; or

a height of the current coding block is 4 and the number of intra prediction mode differs from the number of vertical one by a second threshold or less.

16. The method of claim 11 or claim 12, wherein the prediction related information comprises numbers and positions of available primary reference samples and intra prediction mode index, and wherein the determining whether the BIP flag is signaled comprises:

determining that the BIP is enabled, and the BIP flag is applied by default and is not signaled in the bitstream when the intra prediction mode index is greater than a range start value and is less than a range end value, and when a primary reference sample in lower side or upper side of the current coding block is available, wherein the

range start value and the range end value is determined using a width and a height of the current coding block.

17. The method of claim 11, wherein the determining whether that BIP flag is signaled comprises:

determining a reliability of the BIP according to the prediction related information, where reliability of the BIP includes low-reliable prediction (CTX_{LR}), medium-reliable prediction (CTX_{MR}) or highly-reliable prediction (CTX_{HR}).

18. The method of claim 17, wherein the determining the reliability of the BIP comprises:

determining the reliability of the BIP as CTX_{LR} when primary reference samples in left and right sides of the current coding block are available, a primary reference sample in the top side of the current coding block is not available, and an intra prediction mode (I_{IPM}) belongs to a first predefined range.

19. The method of claim 17, wherein the determining the reliability of the BIP comprises:

determining the reliability of the BIP as CTX_{HR} when primary reference samples in left and top sides of the current coding block are available, a primary reference sample in right side of the current coding block is not available, and I_{IPM} belongs to a second predefined range.

20. The method of claim 17, wherein the determining the reliability of the BIP comprises:

determining the reliability of the BIP as CTX_{MR} when primary reference samples in left and right sides of the current coding block are available and one of the following is true:

a primary reference sample in top side of the current coding block is available; or

I_{IPM} does not belong to a first predefined range.

21. The method of any one of claims 11 to 20, wherein the BIP mode is a distance-weighted direction intra prediction (DWDIP) mode, and the BIP flag is a DWDIP flag.

22. An encoder (108; 200) comprising processing circuitry for carrying out the method according to any one of claims 1 to 10.

23. A decoder (116; 300) comprising processing circuitry for carrying out the method according to any one of claims 11 to 21.

24. A computer program comprising a program code for performing the method according to any one of claims 1 to 10, or according to any one of claims 11 to 21, when the computer program runs on a computing device.