quality of the reconstructed video pictures is lower or worse compared to the quality of the original video pictures.

Several video coding standards belong to the group of “lossy hybrid video codecs” (e.g. combine spatial and temporal prediction in the sample domain and 2D transform coding for applying quantization in the transform domain). Each picture of a video sequence is typically partitioned into a set of non-overlapping blocks, and the coding is typically performed on a block level. In other words, at the encoder the video is typically processed, i.e. encoded, on a block (video block) level, e.g., by using spatial (intra picture) prediction and/or temporal (inter picture) prediction to generate a prediction block, subtracting the prediction block from the current block (block currently processed/to be processed) to obtain a residual block, transforming the residual block and quantizing the residual block in the transform domain to reduce the amount of data to be transmitted (compression), whereas at the decoder the inverse processing compared to the encoder is applied to the encoded or compressed block to reconstruct the current block for representation. Furthermore, the encoder duplicates the decoder processing loop such that both will generate identical predictions (e.g., intra- and inter predictions) and/or re-constructions for processing, e.g. coding, the subsequent blocks.

In the following embodiments of a video coding system 10, a video encoder 20 and a video decoder 30 are described based on FIGS. 1 to 3.

FIG. 1A is a schematic block diagram illustrating an example coding system 10, e.g., a video coding system 10 (or short coding system 10) that may utilize techniques of this present application. Video encoder 20 (or short encoder 20) and video decoder 30 (or short decoder 30) of video coding system 10 represent examples of devices that may be configured to perform techniques in accordance with various examples described in the present application.

As shown in FIG. 1A, the coding system 10 comprises a source device 12 configured to provide encoded picture data 21 e.g., to a destination device 14 for decoding the encoded picture data 21.

The source device 12 comprises an encoder 20, and may additionally, optionally, comprise a picture source 16, a pre-processor (or pre-processing unit) 18, e.g., a picture pre-processor 18, and a communication interface or communication unit 22.

as defined, for instance, in equation (1) is mandatory. However, the state-of-the-art PDPC implementation has a potential flaw, which is illustrated in the following example where the result of the clipping procedure could be out of the range determined by $\mathrm{BitDepth}_Y$ or $\mathrm{BitDepth}_C$:

Given $R_{-1,y} = 0,\ R_{x,-1} = 0, R_{-1,-1} = 100, P(x,y) = 0$, from equation (1) it follows that for the (0,0) position of a 4x4 predicted block $\hat{P}(x,y) = \mathrm{Clip1Cmp}\big(\big(wL \times R_{-1,y} + wT \times R_{x,-1} - wTL \times R_{-1,-1} + (64 - wl - wT + wTL) \times P(x,y) + 32)\big) \gg 6\big) = \mathrm{Clip1Cmp}\big(\big(-wTL \times R_{-1,-1} + 32\big) \gg 6\big) = \mathrm{Clip1Cmp}(\ (-4 \times 100 + 32) \gg 6)$,

with $wTL = 4$, as shown in FIG. 13.

As seen from the example above, a negative value "$-4 \times 100 + 32 = -368$" is being right-shifted using arithmetic bit shift. Depending on the implementation, arithmetic right bit shift of a negative value may lead to different output (e.g., in case of C/C++ programming language) and thus it could not be guaranteed that Clip1Cmp() output will always be 0, since the result of shifting a negative value to the right may have a positive sign and a non-zero magnitude in specific implementations.

Although the issue related to clipping performed in PDPC is described for planar intra-prediction, a similar situation may occur for PDPC using DC intra prediction.

For diagonal (denoted as 2 and 66 in FIG.10B and FIG. 10C) and adjacent modes (directional modes not less than 58 or not greater than 10 in FIG. 10B or FIG. 10C) processing is performed as described below using the same formula (1):

FIG. 14A illustrates the definition of reference samples $R_{x,-1}$, $R_{-1,y}$ and $R_{-1,-1}$ for the extension of PDPC to the top-right diagonal mode. The prediction sample *pred*(*x'*, *y'*) is located at (*x'*, *y'*) within the prediction block. The coordinate *x* of the reference sample $R_{x,-1}$ is given by: $x = x' + y' + 1$, and the coordinate *y* of the reference sample $R_{-1,y}$ is similarly given by: $y = x' + y' + 1$.

The PDPC weights for the top-right diagonal mode are:

$$wT = 16 >> ((y'<<1) >> shift),\ wL = 16 >> ((x'<<1) >> shift),\ wTL = 0.$$

Similarly, FIG. 14B illustrates the definition of reference samples $R_{x,-1}$, $R_{-1,y}$ and $R_{-1,-1}$ for the extension of PDPC to the bottom-left diagonal mode. The coordinate x of the reference sample $R_{x,-1}$ is given by: $x = x' + y' + 1$, and the coordinate y of the reference sample $R_{-1,y}$ is: $y = x' + y' + 1$. The PDPC weights for the bottom-left diagonal mode are: $wT = 16 >> ((y'<<1) >> shift)$, $wL = 16 >> ((x'<<1) >> shift)$, $wTL = 0$. The case of an adjacent top-right diagonal mode is illustrated in FIG. 14C. The PDPC weights for an adjacent top-right diagonal mode are: $wT = 32 >> ((y'<<1) >> shift)$, $wL = 0$, $wTL = 0$. Similarly, the case of an adjacent bottom-left diagonal mode is illustrated in FIG. 14D. The PDPC weights for an adjacent bottom-left diagonal mode are: $wL = 32 >> ((x'<<1) >> shift)$, $wT = 0$, $wTL = 0$. The reference sample coordinates for the last two cases are computed using the tables that are already used for angular mode intra prediction. Linear interpolation of the reference samples is used if fractional reference sample coordinates are calculated.

Simplified PDPC could be performed as specified in the VVC specification. Further, the following denotation are used:

invAngle = $\mathrm{Round}\left(\frac{256*32}{\mathrm{intraPredAngle}}\right)$, is the value of inverse angle,

Round(x) = Sign(x) * Floor(Abs(x) + 0.5),

$$\mathrm{Sign}(x) = \begin{cases} 1 & ; \quad x > 0 \\ 0 & ; \quad x == 0 \\ -1 & ; \quad x < 0 \end{cases}$$

Floor(x) is the largest integer less than or equal to x,

Log2(x) is the base-2 logarithm of x.

intraPredAngle is the angle parameter specified in Table 4,

A = C ? B : D is a ternary assignment operation, where A is set equal to B if condition C is true. Otherwise, if condition C is false, A is set equal to D.

INTRA_PLANAR is a planar intra prediction mode (),

INTRA_DC is a DC intra prediction mode,

normalize the non-normalized predicted sample value by an arithmetic right shift of an integer representation of the non-normalized predicted sample value.

The predictor, encoder or decoder device 1000 may, in an embodiment, further add a residual value to the normalized predicted sample values, resulting in reconstructed sample values.

In an embodiment of the described method, the horizontal weighting factor *wL* may be a factor, which is applied to a value of a left reference sample resulting in a weighted left reference sample value. Further, the vertical weighting factor *wT* may be a factor, which is applied to a value of a top reference sample resulting in a weighted top reference sample value.

Specifically, for example, the weighted left and top reference sample values may be obtained by multiplication of the left and top reference sample values, respectively, with corresponding horizontal and vertical weighting factors *wL* and w*T*.

Further, in an embodiment, the additional value may be obtained including a summation of the weighted top reference sample value and the weighted left reference sample values.

The functional components of the encoder or decoder device 1000 may be implemented by processing circuitry 1040 configured to perform any one of the above methods, as illustrated in FIG 16B.

In an embodiment, the processing circuitry may comprise one or more processors 1050 and a non-transitory computer-readable storage medium 1060, which is connected to the one or more processors 1050. The storage medium includes program code, which, when executed by a processor, causes the processor to perform any one of the above methods.

In a specific embodiment, the method may comprise the following step:

The normalized predicted sample $\hat{P}(x,y)$ located at (x, y) may be calculated as follows:

$$\hat{P}(x,y) = \left(wL \times R_{-1,y} + wT \times R_{x,-1} + (64 - wL - wT) \times P(x,y) + 32\right) \gg 6 \qquad (2)$$

where $R_{x,-1}$, $R_{-1,y}$ represents the reference samples located above (top) and to the left of the current sample (x, y), respectively. $P(x,y)$ denotes the value of the predicted sample, which is predicted using a DC intra prediction mode. In the above formula, the weighted predicted sample is represented by $(64 - wL - wT) \times P(x,y)$ and the additional value is represented by $wL \times R_{-1,y} + wT \times R_{x,-1} + 32$. The normalization is represented by the bitwise right-shift

CLAIMS

1. A method of intra predicting a block of a picture, comprising for a sample of the block:

obtaining a predicted sample value from one or more reference sample values by intra-prediction using a DC intra-prediction mode;

multiplying the predicted sample value by a sample weighting factor, resulting in a weighted predicted sample value;

adding an additional value to the weighted predicted sample value, resulting in a non-normalized predicted sample value; and

normalizing the non-normalized predicted sample value by an arithmetic right shift of an integer representation of the non-normalized predicted sample value, wherein

the sample weighting factor is $\left((2 \ll p) - wL - wT\right)$, wherein

p is a parameter of the sample weighting factor,

wL is a horizontal weighting factor, and

wT is a vertical weighting factor,

wherein the additional value is a sum of one or more summands, including a summand depending on one or more of the reference samples.

2. The method according to claim 1, comprising predicting a first block and a second block of the picture,

wherein an intra-prediction mode used for obtaining the predicted sample value for the first block is the DC intra-prediction mode, and an intra-prediction mode used for obtaining a predicted sample value for the second block is a PLANAR intra-prediction mode.

3. The method according to claim 1 or 2, wherein,

a PLANAR intra prediction mechanism is used to calculate the additional value.

4. The method according to any one of claims 1 to 3, wherein, the sample weighting factor is $(64 - wL - wT)$.

5. The method according to any one of claims 1 to 4, wherein, the summand depending on one or more reference samples is $wL \times R_{-1,y} + wT \times R_{x,-1}$, and $R_{x,-1}$ and $R_{-1,y}$ represent values of the nearest reference samples located above and to the left of the predicted sample.

6. The method according to any one of claims 1 to 5, wherein, the horizontal weighting factor wL and/or the vertical weighting factor wT is a power of two.

7. The method according to any one of claims 1 to 6, wherein,

the horizontal weighting factor is $wL = \big(2 \ll (p-1)\big) \gg \big((x \ll 1) \gg nScale\big)$, wherein x is a horizontal coordinate of the sample,

the vertical weighting factor is $wT = \big(2 \ll (p-1)\big) \gg \big((y \ll 1) \gg nScale\big)$, wherein y is a vertical coordinate of the sample, and

$nScale$ is a scale parameter.

8. The method according to claim 7, wherein the scale parameter $nScale$ is derived from a size of the block.

9. The method according to claim 7, wherein the scale parameter $nScale$ is determined as $\big((\mathrm{Log2}(nTbW) + \mathrm{Log2}(nTbH) - 2) \gg 2\big)$ where $nTbW$ is a width of the block and $nTbH$ is a height of the block.

10. The method according to any one of claims 1 to 9, wherein a normalized predicted sample value is computed from the predicted sample value, including calculating

$$\big(wL \times R_{-1,y} + wT \times R_{x,-1} + (64 - wL - wT) \times P(x,y) + 32\big) \gg 6$$

where

$P(x,y)$ is the predicted sample value,

$R_{x,-1}$, $R_{-1,y}$ represent values of the nearest reference samples located above and to the left of the predicted sample,

wL is the horizontal weighting factor, and

wT is the vertical weighting factor.

11. A method of encoding or decoding a picture, comprising:

obtaining normalized predicted sample values by performing the steps of a method according to any one of claims 1 to 10; and

adding residual values to the normalized predicted sample values resulting in reconstructed sample values.

12. A device for encoding or decoding a picture, comprising processing circuitry configured to perform the method according to any one of claims 1 to 11.

13. The device according to claim 12, wherein the processing circuitry comprises one or more processors and a non-transitory computer-readable medium connected to the one or more processors, wherein the non-transitory computer-readable medium carries a program code which, when executed by the one or more processors, causes the device to perform the method of any one of claims 1 to 12.

14. A non-transitory computer-readable medium，carrying a program code which, when executed by a computer device, causes the computer device to perform the method of any one of claims 1 to 11.

15. A computer program, comprising a program code for performing the method according to any one of claims 1 to 11.

16. A predictor device for intra predicting a block of a picture, comprising:

an obtainer configured to obtain, for a sample of the block, a predicted sample value from one or more reference sample values by intra-prediction using a DC intra-prediction mode;

a multiplier configured to multiply the predicted sample value by a sample weighting factor, resulting in a weighted predicted sample value;

an adder configured to add an additional value to the weighted predicted sample value, resulting in a non-normalized predicted sample value; and

a normalizer configured to normalize the non-normalized predicted sample value by an arithmetic right shift of an integer representation of the non-normalized predicted sample value, wherein

the sample weighting factor is $\left((2 \ll p) - wL - wT\right)$, wherein

p is a parameter of the sample weighting factor,

wL is a horizontal weighting factor, and

wT is a vertical weighting factor,

wherein the additional value is a sum of one or more summands, including a summand depending on one or more of the reference samples.

17. The predictor device according to claim 16, further configured for predicting a first block and a second block of the picture,

wherein an intra-prediction mode used for obtaining the predicted sample value for the first block is the DC intra-prediction mode, and the intra prediction mode used for obtaining a predicted sample value for the second block is a planar intra prediction mode.

18. A method of encoding a picture, comprising

obtaining normalized predicted sample values by performing the steps of a method according to any one of claims 1 to 10; and

generating residual values by deducting original sample values with the normalized predicted sample values resulting in reconstructed sample values; and

encoding the generated residual values into a bit steam.

19. A non-transitory computer-readable medium, storing bit stream encoded by the method according to claim 18.

20. A bit stream, encoded by the method according to claim 18.