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(54) **QUANTIZATION PARAMETER SELECTIONS FOR ENCODING OF CHROMA AND LUMA VIDEO BLOCKS**

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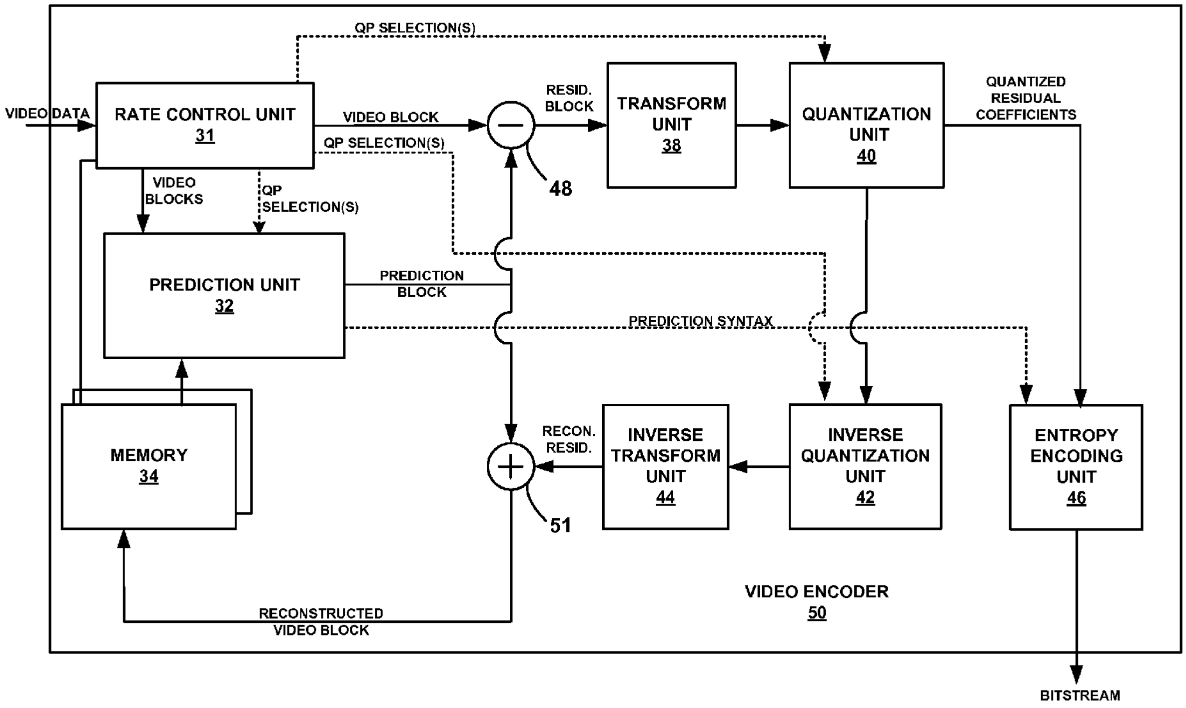
(57) **ABSTRACT**

This disclosure describes rules that may be applied during block-based video coding to ensure that quantization parameter selections for luma blocks will not adversely affect the quality of chroma blocks. In accordance with this disclosure, rate-controlled video encoding occurs in which quantization parameter changes in luma blocks are pre-evaluated to determine whether such quantization parameter changes in luma blocks will also cause quantization changes for chroma blocks. If quantization parameter changes in the luma blocks will also cause quantization changes for chroma blocks, then that quantization parameter change for luma blocks may be skipped and not evaluated. In this way, secondary effects of quantization parameter changes in the luma blocks (with respect to the chroma blocks) can be avoided.



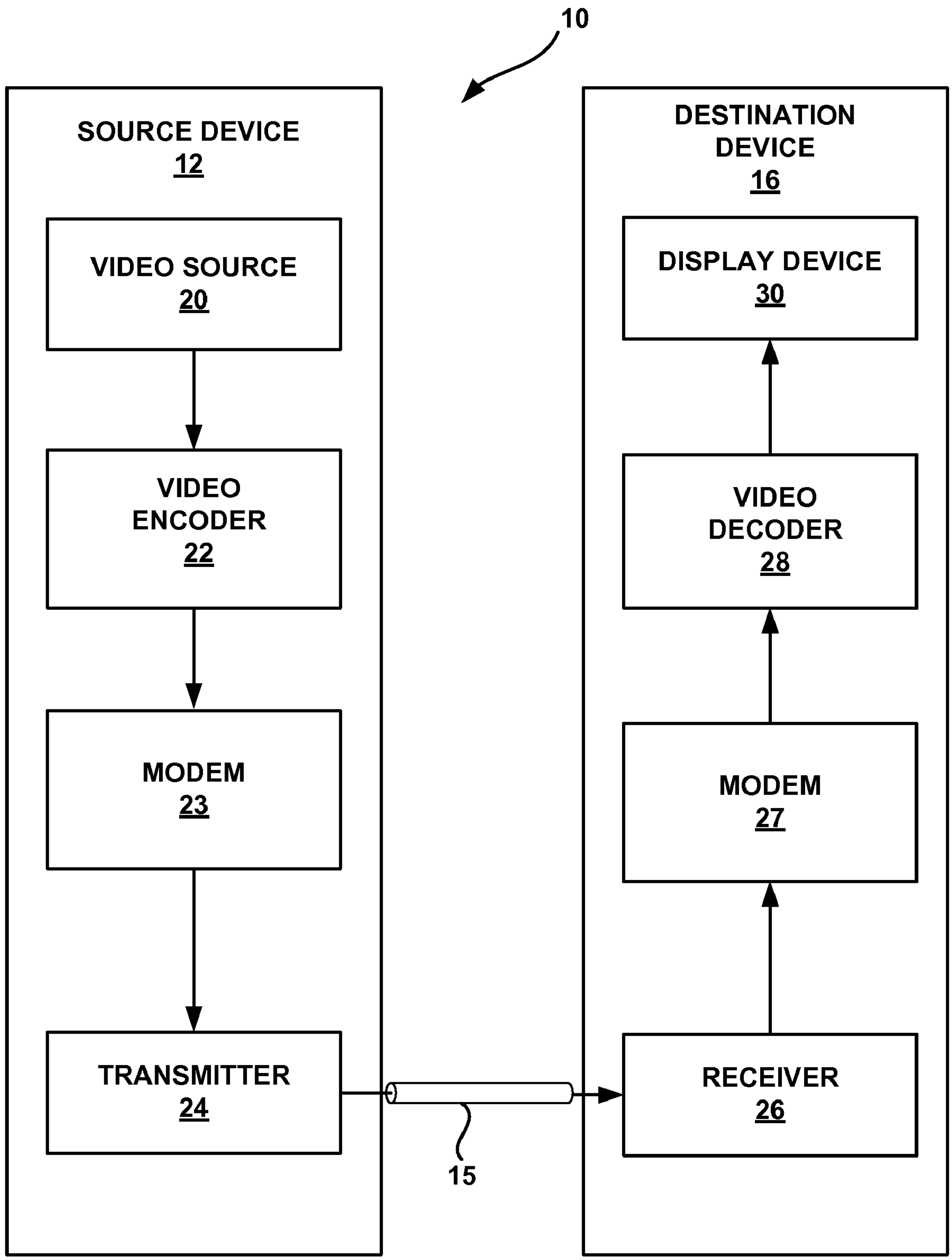

10
SOURCE DEVICE
12
VIDEO SOURCE
20
VIDEO
ENCODER
22
MODEM
23
TRANSMITTER
24
15
DESTINATION
DEVICE
16
DISPLAY DEVICE
30
VIDEO
DECODER
28
MODEM
27
RECEIVER
26

FIG. 1

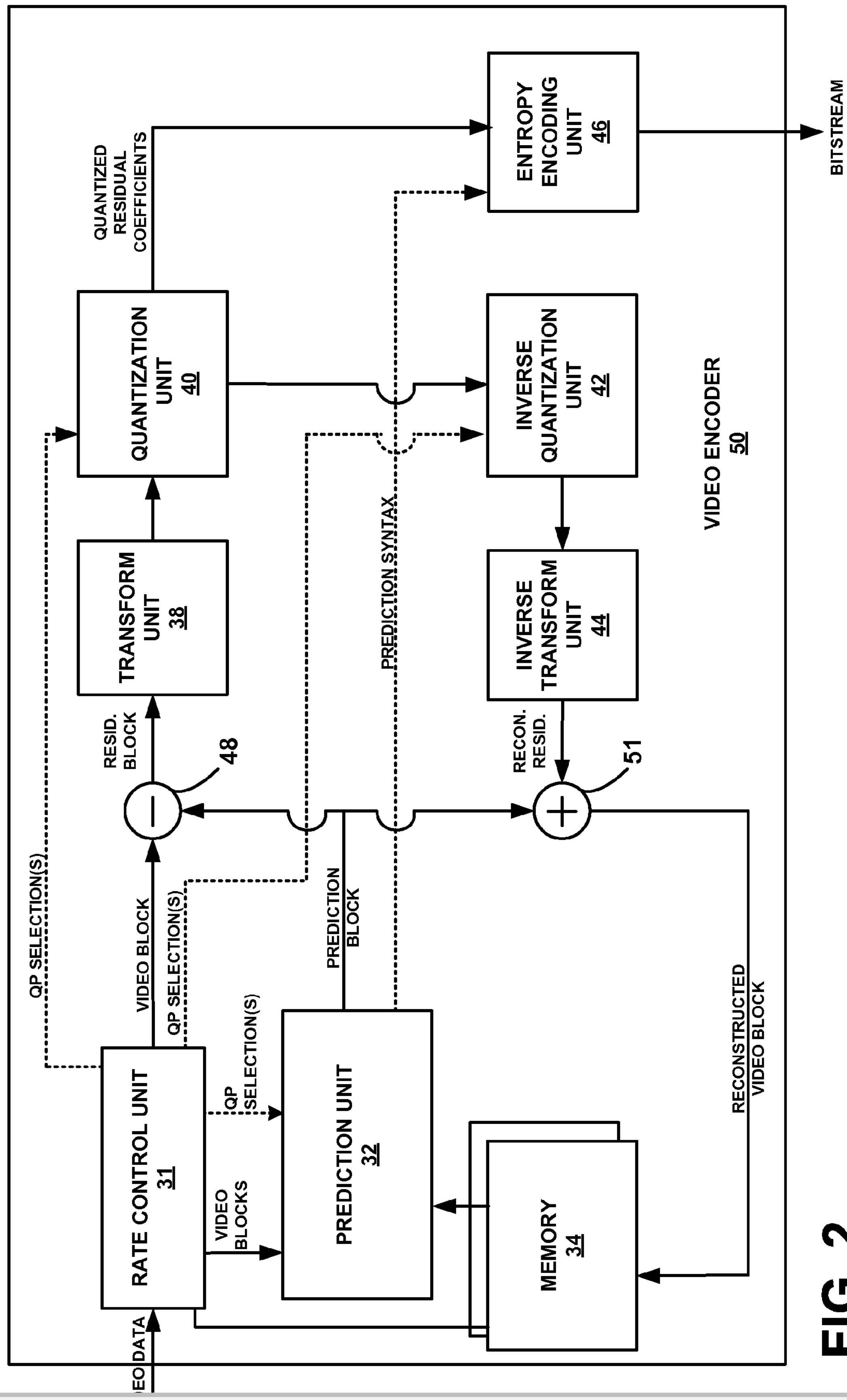

VIDEO ENCODER
50
RATE CONTROL UNIT
31
PREDICTION UNIT
32
MEMORY
34
TRANSFORM
UNIT
38
QUANTIZATION
UNIT
40
INVERSE
QUANTIZATION
UNIT
42
INVERSE
TRANSFORM
UNIT
44
ENTROPY
ENCODING
UNIT
46
48
51
VIDEO DATA
VIDEO BLOCK
VIDEO BLOCKS
QP SELECTION(S)
QP SELECTION(S)
QP SELECTION(S)
PREDICTION BLOCK
PREDICTION SYNTAX
RESID. BLOCK
RECON. RESID.
QUANTIZED RESIDUAL COEFFICIENTS
RECONSTRUCTED VIDEO BLOCK
BITSTREAM

FIG. 2

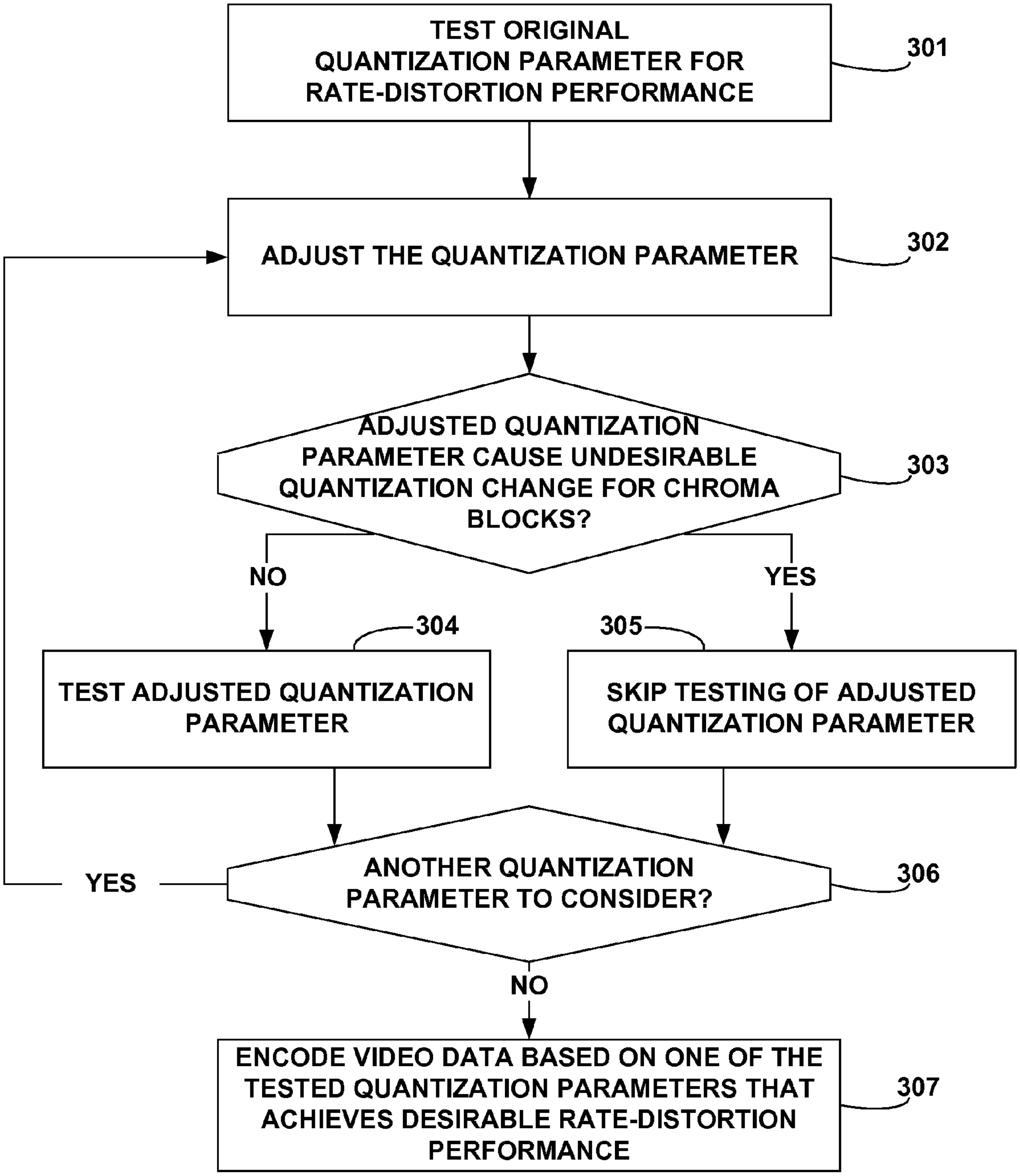

TEST ORIGINAL QUANTIZATION PARAMETER FOR RATE-DISTORTION PERFORMANCE
301
ADJUST THE QUANTIZATION PARAMETER
302
ADJUSTED QUANTIZATION PARAMETER CAUSE UNDESIRABLE QUANTIZATION CHANGE FOR CHROMA BLOCKS?
303
NO
YES
304
305
TEST ADJUSTED QUANTIZATION PARAMETER
SKIP TESTING OF ADJUSTED QUANTIZATION PARAMETER
YES
ANOTHER QUANTIZATION PARAMETER TO CONSIDER?
306
NO
ENCODE VIDEO DATA BASED ON ONE OF THE TESTED QUANTIZATION PARAMETERS THAT ACHIEVES DESIRABLE RATE-DISTORTION PERFORMANCE
307

FIG. 3

QUANTIZATION PARAMETER SELECTIONS FOR ENCODING OF CHROMA AND LUMA VIDEO BLOCKS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application 61/102,622 filed Oct. 3, 2008, the entire content of which is incorporated herein by reference.

TECHNICAL FIELD

[0002] This disclosure relates to block-based video encoding used to compress video data, and quantization techniques associated with block-based video encoding.

BACKGROUND

[0003] Digital video capabilities can be incorporated into a wide range of devices, including digital televisions, digital direct broadcast systems, wireless communication devices such as radio telephone handsets, wireless broadcast systems, personal digital assistants (PDAs), laptop or desktop computers, digital cameras, digital recording devices, video gaming devices, video game consoles, and the like. Digital video devices implement video compression techniques, such as MPEG-2, MPEG-4, or H.264/MPEG-4, Part 10, Advanced Video Coding (AVC), to transmit and receive digital video more efficiently. Video compression techniques perform spatial and temporal prediction to reduce or remove redundancy inherent in video sequences.

[0004] Block-based video compression techniques may perform spatial prediction and/or temporal prediction. Intra-coding relies on spatial prediction to reduce or remove spatial redundancy between video blocks within a given coded unit, which may comprise a video frame, a slice of a video frame, or the like. In contrast, inter-coding relies on temporal prediction to reduce or remove temporal redundancy between video blocks of successive coded units of a video sequence. For intra-coding, a video encoder performs spatial prediction to compress data based on other data within the same coded unit. For inter-coding, the video encoder performs motion estimation and motion compensation to encode video information based the movement of corresponding video blocks of two or more adjacent coded units.

[0005] Video blocks may include luminance (luma) blocks and chrominance (chroma) blocks. A 16-by-16 block of pixels, for example, may be represented by four 8-by-8 luma blocks and two sub-sampled 8-by-8 chroma blocks. Block-based coding may occur with respect to each of these different video blocks. In video coding, the YCbCr color space is commonly used, in which Y represents the luma component and Cb and Cr represent two different chroma components of a block of pixels. Given a 16-by-16 block of pixels, four 8-by-8 Y blocks, one sub-sampled 8-by 8-Cb block, and one sub-sampled 8-by-8 Cr block may be used to represent the 16-by-16 block of pixels, and block based coding may occur for each of these video blocks. The term "macroblock" is sometimes used to refer to a set of four 8-by 8-Y blocks, one sub-sampled 8-by-8 Cb block, and one sub-sampled 8-by-8 Cr block that collectively define a 16-by-16 block of pixels. In partitions such as 2-by-2 blocks, 2-by-4 blocks, 4-by-2 blocks, 4-by-4 blocks, 4-by-8 blocks, 8-by-4 blocks, and so forth.

[0006] A coded video block may be represented by prediction information that can be used to create or identify a predictive block, and a residual block of data indicative of differences between the block being coded and the predictive block. In the case of inter-coding, one or more motion vectors are used to identify the predictive block of data (typically from a previous or subsequent video frame of a video sequence), while in the case of intra-coding, the prediction mode may define how the predictive block is generated based on data within the same frame or other coded unit. Both intra-coding and inter-coding may define several different prediction modes, which may define different block sizes and/or prediction techniques used in the coding. Additional types of syntax elements may also be included as part of encoded video data in order to control or define the coding techniques or parameters used in the coding process.

[0007] After block-based prediction, the video encoder may apply transform, quantization and entropy coding processes to further reduce the bit rate associated with communication of a residual block. Transform techniques may comprise discrete cosine transforms or conceptually similar processes, wavelet transforms, integer transforms, or other types of transforms. In a discrete cosine transform (DCT) process, as an example, the transform process converts a set of pixel values into transform coefficients, which may represent the energy of the pixel values in the frequency domain. Quantization is applied to the transform coefficients, and generally involves a process that limits the number of bits associated with any given transform coefficient. Entropy coding comprises one or more processes that collectively compress a sequence of quantized transform coefficients.

SUMMARY

[0008] In general, this disclosure describes quantization parameter selection techniques that may be used during block-based video encoding. This disclosure recognizes and accounts for secondary effects that quantization parameter selections for luma blocks can have on the quantization of chroma blocks. This disclosure proposes rules that may be applied during block-based video encoding to ensure that quantization parameter selections for luma blocks will not adversely affect the quality of chroma blocks.

[0009] In one example, this disclosure describes a method of encoding video data. The method comprises testing a first quantization parameter with respect to a set of video blocks for rate-distortion performance in video encoding, wherein the set of video blocks include luma blocks and chroma blocks, adjusting the first quantization parameter to a second quantization parameter, and determining whether the second quantization parameter causes an undesirable quantization change for the chroma blocks relative to the first quantization parameter. The method also comprises testing the second quantization parameter with respect to the set of video blocks for rate-distortion performance in the video encoding if the second quantization parameter does not cause the undesirable quantization change for the chroma blocks. In addition, the method comprises skipping testing of the second quantization parameter with respect to the set of video blocks for rate-distortion performance in the video encoding if the second

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