TITLE

METHOD AND APPARATUS FOR SIGNALING OF MAPPING FUNCTION OF CHROMA QUANTIZATION PARAMETER

CROSS-REFERENCE TO RELATED APPLICATIONS

This patent application claims priority of U.S. Provisional Patent Application No. US 62/839,6076, filed April 26, 2019, as well as International Patent Application PCT/RU2019/000444, filed June 21, 2019, as well as U.S. Provisional Patent Application No. US 62/871,197, filed July 7, 2019, as well as U.S. Provisional Patent Application No. 62/872,238, filed July 9, 2019.

TECHNICAL FIELD

Embodiments of the present application (disclosure) generally relate to the field of image and/or video decoding and more particularly to apparatus and method for chroma quantization parameter signaling

BACKGROUND

Video coding (video encoding and decoding) is used in a wide range of digital video applications, for example broadcast digital TV, video transmission over internet and mobile networks, real-time conversational applications such as video chat, video conferencing, DVD and Blu-ray discs, video content acquisition and editing systems, and camcorders of security applications.

The amount of video data needed to depict even a relatively short video can be substantial, which may result in difficulties when the data is to be streamed or otherwise communicated across a communications network with limited bandwidth capacity. Thus, video data is generally compressed before being communicated across modern day telecommunications networks. The size of a video could also be an issue when the video is stored on a storage device because memory resources may be limited. Video compression devices often use software and/or hardware at the source to code the video data prior to transmission or storage, thereby decreasing the quantity of data needed to represent digital video images. The compressed data is then received at the destination by a video decompression device that

CLAIMS

1. A method of obtaining a chrominance quantization parameter (QP) for chrominance components based on a luminance QP for a luminance component, wherein the method is performed by a decoder, comprising:

receiving a bitstream;

parsing the bitstream to obtain a luminance QP and information on a chroma QP mapping table which associates a QP index (QPi) to a chrominance QP (QPc);

obtaining a QPi based at least in a part on the obtained luminance QP;

obtaining a chroma QP mapping table based on the obtained information;

obtaining a first QPc based on the obtained chroma QP mapping table and the obtained QPi; and

obtaining a second chrominance quantization parameter based on the first QPc.

2. The method of claim 1, wherein

qP_{Cb}, qP_{Cr} and qP_{CbCr} are derived as follows:

$qP_{Chroma} = Clip3(-QpBdOffset, 63, Qp_{Y})$;

$qP_{Cb} = ChromaQpTable[0][qP_{Chroma}]$;

$qP_{Cr} = ChromaQpTable[1][qP_{Chroma}]$;

$qP_{CbCr} = ChromaQpTable[2][qP_{Chroma}]$;

wherein the chroma quantization parameters for the Cb and Cr components, Qp'_{Cb} and Qp'_{Cr}, and joint Cb-Cr coding Qp'_{CbCr} are derived as follows:

$Qp'_{Cb} = Clip3(-QpBdOffset, 63, qP_{Cb} + pps_cb_qp_offset + slice_cb_qp_offset + CuQpOffset_{Cb}) + QpBdOffset$;

$Qp'_{Cr} = Clip3(-QpBdOffset, 63, qP_{Cr} + pps_cr_qp_offset + slice_cr_qp_offset + CuQpOffset_{Cr}) + QpBdOffset$;

$Qp'_{CbCr} = Clip3(-QpBdOffset, 63, qP_{CbCr} + pps_joint_cbcr_qp_offset_value + slice_joint_cbcr_qp_offset + CuQpOffset_{CbCr}) + QpBdOffset;$

wherein the ChromaQpTable is the chroma QP mapping table;

wherein the QPi corresponds to the qP_{Chroma};

wherein the first QPc corresponds to the qP_{Cb}, qP_{Cr} and qP_{CbCr};

wherein the QpBdOffset is the bit depth offset calculated based on the bit depth of the samples of the luma and chroma arrays using the formula:

$QpBdOffset = 6 * bit_depth_minus8,$

wherein bit_depth_minus8 is in the range of 0 to 8, inclusive;

wherein **pps_cb_qp_offset** and **pps_cr_qp_offset** specify the offsets to the luma quantization parameter Qp'_Y used for deriving Qp'_{Cb} and Qp'_{Cr}, respectively;

wherein **pps_joint_cbcr_qp_offset_value** specifies the offset to the luma quantization parameter Qp'_Y used for deriving Qp'_{CbCr};

wherein **slice_cr_qp_offset** specifies a difference to be added to the value of pps_cr_qp_offset when determining the value of the Qp'_{Cr} quantization parameter;

wherein **slice_cb_qp_offset** specifies a difference to be added to the value of pps_cb_qp_offset when determining the value of the Qp'_{Cb} quantization parameter;

wherein **slice_joint_cbcr_qp_offset** specifies a difference to be added to the value of pps_joint_cbcr_qp_offset_value when determining the value of the Qp'_{CbCr};

wherein variables $CuQpOffset_{Cb}$, $CuQpOffset_{Cr}$, and $CuQpOffset_{CbCr}$, specify values to be used for determining the respective values of the Qp'_{Cb}, Qp'_{Cr}, and Qp'_{CbCr} quantization parameters for the decoder.

3. The method of claim 1 or 2, wherein the chroma QP mapping table associates each element *x* of a set X, wherein the set X corresponds to QPis in an allowed QPi range supported by the

decoder, or any subset of the set X, to one element *y* of a set Y, wherein the set Y corresponds to QPcs in an allowed QPc range supported by the decoder.

4. The method of any one of claims 1 - 3, wherein the values of the chroma QP mapping table satisfy a mapping function.

5. The method of claim 4, wherein the mapping function is a piecewise mapping function, and information of the piecewise mapping function comprises breakpoints, or change points, or pivot points of the piecewise mapping function.

6. The method of claim 5, wherein the amount of the breakpoints, or the change points, or the pivot points and its respective x and y coordinates are signaled in the bitstream either directly or based on delta values between coordinates of a current pivot point and coordinates of a previous pivot point.

7. The method of any one of claims 4 to 6, wherein the mapping function is a piecewise function based on:

a linear equation;

an exponential equation;

a logarithmic equation; or

combinations of the equations above.

8. The method of claim 7, wherein parameters of pieces of the piecewise functions are obtained based on pivot points, using a linear equation given by:

y = *slope**x+*b*; with *slope* and *b* being parameters of the linear equation, wherein

slope = (Ey - Dy)/(Ex – Dx),

*b = Dy - slope*Dx;*

wherein D and E are pivot points with coordinates *Dx, Dy* and *Ex, Ey* correspondingly.

9. The method of any one of claims 1-8, wherein the information of the chroma QP mapping table is signaled jointly for all chrominance components.

10. The method of any one of claims 1-9, wherein the information of the chroma QP mapping table comprises an indicator indicating whether the mapping function is signaled for chrominance components separately or jointly.

11. The method of any one of claims 1-10, wherein the information of the chroma QP mapping table is signaled at:

sequence level in a sequence parameter set, or

picture level in a picture parameter set, or

tile group level in a tile group parameter set, or

in an adaptation parameter set, or

in a supplemental enhancement information (SEI) message.

12. A decoder (30) comprising processing circuitry for carrying out the method according to any one of claims 1 to 11.

13. A non-transitory storage medium comprising a bitstream decoded by the method of any one of claims 1 to 11.

14. A decoder, comprising:

one or more processors; and

a non-transitory computer-readable storage medium coupled to the processors and storing programming for execution by the processors, wherein the programming, when executed by the processors, configures the decoder to carry out the method according to any one of claims 1 to 11.

15. A decoder for obtaining a chrominance quantization parameter (QP) for chrominance components based on a luminance QP for a luminance component, comprising:

a receiving unit configured to receive a bitstream;

a parsing unit configured to parse the bitstream to obtain a luminance QP and information on a chroma QP mapping table which associates a QP index (QPi) to a chrominance QP (QPc);

a first obtaining unit configured to obtain a QPi based at least in a part on the obtained luminance QP;

a second obtaining unit configured to obtain a chroma QP mapping table based on the obtained information;

a third obtaining unit configured to obtain a first QPc based on the obtained chroma QP mapping table and the obtained QPi; and

a fourth obtaining unit configured to obtain a second chrominance quantization parameter based on the first QPc.

16. The decoder of claim 15, wherein

qP_{Cb}, qP_{Cr} and qP_{CbCr} are derived as follows:

$qP_{Chroma} = Clip3(-QpBdOffset, 63, Qp_{Y})$;

qP_{Cb} = ChromaQpTable[0][qP_{Chroma}];

qP_{Cr} = ChromaQpTable[1][qP_{Chroma}];

qP_{CbCr} = ChromaQpTable[2][qP_{Chroma}];

wherein the chroma quantization parameters for the Cb and Cr components, Qp'_{Cb} and Qp'_{Cr}, and joint Cb-Cr coding Qp'_{CbCr} are derived as follows:

Qp'_{Cb} = Clip3(−QpBdOffset, 63, qP_{Cb} + pps_cb_qp_offset + slice_cb_qp_offset + CuQpOffset$_{Cb}$) + QpBdOffset;

Qp'_{Cr} = Clip3(−QpBdOffset, 63, qP_{Cr} + pps_cr_qp_offset + slice_cr_qp_offset + CuQpOffset$_{Cr}$) + QpBdOffset;

Qp'_{CbCr} = Clip3(−QpBdOffset, 63, qP_{CbCr} + pps_joint_cbcr_qp_offset_value + slice_joint_cbcr_qp_offset +CuQpOffset$_{CbCr}$) + QpBdOffset;

wherein the ChromaQpTable is the chroma QP mapping table;

wherein the QPi corresponds to the qP_{Chroma};

wherein the first QPc corresponds to the qP_{Cb}, qP_{Cr} and qP_{CbCr};

wherein the QpBdOffset is the bit depth offset calculated based on the bit depth of the samples of the luma and chroma arrays using the formula:

QpBdOffset = 6 * bit_depth_minus8,

wherein bit_depth_minus8 is in the range of 0 to 8, inclusive;

wherein **pps_cb_qp_offset** and **pps_cr_qp_offset** specify the offsets to the luma quantization parameter Qp'_{Y} used for deriving Qp'_{Cb} and Qp'_{Cr}, respectively;

wherein **pps_joint_cbcr_qp_offset_value** specifies the offset to the luma quantization parameter Qp'_{Y} used for deriving Qp'_{CbCr};

wherein **slice_cr_qp_offset** specifies a difference to be added to the value of pps_cr_qp_offset when determining the value of the Qp'_{Cr} quantization parameter;

wherein **slice_cb_qp_offset** specifies a difference to be added to the value of

pps_cb_qp_offset when determining the value of the Qp'_{Cb} quantization parameter;

wherein **slice_joint_cbcr_qp_offset** specifies a difference to be added to the value of pps_joint_cbcr_qp_offset_value when determining the value of the Qp'_{CbCr};

wherein variables $CuQpOffset_{Cb}$, $CuQpOffset_{Cr}$, and $CuQpOffset_{CbCr}$, specify values to be used for determining the respective values of the Qp'_{Cb}, Qp'_{Cr}, and Qp'_{CbCr} quantization parameters for the decoder.

17. The decoder of claim 15 or 16, wherein the chroma QP mapping table associates each element *x* of a set X, wherein the set X corresponds to QPis in an allowed QPi range supported by the decoder, or any subset of the set X, to one element *y* of a set Y, wherein the set Y corresponds to QPcs in an allowed QPc range supported by the decoder.

18. The decoder of any one of claims 15 - 17, wherein the values of the chroma QP mapping table satisfy a mapping function.

19. The decoder of claim 18, wherein the mapping function is a piecewise mapping function, and information of the piecewise mapping function comprises breakpoints, or change points, or pivot points of the piecewise mapping function.

20. The decoder of claim 19, wherein the amount of the breakpoints, or the change points, or the pivot points and its respective x and y coordinates are signaled in the bitstream either directly or based on delta values between coordinates of a current pivot point and coordinates of a previous pivot point.

21. The decoder of any one of claims 18 to 20, wherein the mapping function is a

piecewise function based on:

a linear equation;

an exponential equation;

a logarithmic equation; or

combinations of the equations above.

22. The decoder of claim 21, wherein parameters of pieces of the piecewise functions are obtained based on pivot points, using a linear equation given by:

y = *slope**x+*b*; with *slope* and *b* being parameters of the linear equation, where

slope = (Ey - Dy)/(Ex – Dx),

*b = Dy - slope*Dx;*

wherein D and E are pivot points with coordinates *Dx*, *Dy* and *Ex*, *Ey* correspondingly.

23. The decoder of any one of claims 15-22, wherein the information of the chroma QP mapping table is signaled jointly for all chrominance components.

24. The decoder of any one of claims 15-23, wherein the information of the chroma QP mapping table comprises an indicator indicating whether the chroma QP mapping table is signaled for chrominance components separately or jointly.

25. The decoder of any one of claims 15-24, wherein the information of the chroma QP mapping table is signaled at:

sequence level in a sequence parameter set, or

picture level in a picture parameter set, or

tile group level in a tile group parameter set, or

in an adaptation parameter set, or

in a supplemental enhancement information (SEI) message.