

~~An~~Disclosed herein is an image coding method according to an aspect of the present invention is an image coding method for coding an image, the image coding method includes: coding (i) coefficient information indicating a plurality of coefficients of one or more blocks included in the image, (ii) a first flag indicating whether or not to quantize the one or more blocks using a plurality of quantization matrices each having coefficients respectively corresponding to the plurality of coefficients of the one or more blocks, (iii) a second flag indicating whether or not the plurality of quantization matrices are included in a sequence parameter set, and (iv) a third flag indicating whether or not the plurality of quantization matrices are included in a picture parameter set; and quantizing the plurality of coefficients, wherein when the one or more blocks are quantized in the quantizing using a plurality of default matrices as the plurality of quantization matrices, the following are coded in the coding: (i) the first flag indicating that the one or more blocks are quantized using the plurality of quantization matrices, (ii) the second flag indicating that the plurality of quantization matrices are not included in the sequence parameter set, and (iii) the third flag indicating that the plurality of quantization matrices are not included in the picture parameter set.

According to a first aspect of the present invention, there is provided an image decoding method for decoding an image, the method comprising: decoding coefficient information indicating a plurality of coefficients of blocks in the image and quantization information used in inverse quantization of the plurality of coefficients; and inverse-quantizing the plurality of coefficients, wherein the quantization information includes at least one of (i) a first flag indicating whether or not the blocks have been quantized using a plurality of quantization matrices each having coefficients respectively corresponding to the plurality of coefficients, (ii) a second flag indicating whether or not the plurality of quantization matrices are included in a sequence parameter set, and (iii) a third flag indicating whether or not the plurality of quantization matrices are included in a picture parameter set, and when only the following have been decoded as the quantization information in the decoding: (i) the first flag indicating that all of the blocks have been quantized using the plurality of quantization matrices, (ii) the second flag indicating that the plurality of quantization matrices are not included in the sequence parameter set, and (iii) the third flag indicating that the plurality of

quantization matrices are not included in the picture parameter set, all of the blocks are inverse-quantized in the inverse-quantizing using only the plurality of default matrices as the plurality of quantization matrices.

According to a second aspect of the present invention, there is provided an image decoding apparatus which decodes an image, the apparatus comprising: a decoder which decodes decoding coefficient information indicating a plurality of coefficients of blocks in the image and quantization information used in inverse quantization of the plurality of coefficients; and an inverse quantizing unit configured to perform inverse quantization on the plurality of coefficients, wherein the quantization information includes at least one of (i) a first flag indicating whether or not the blocks have been quantized using a plurality of quantization matrices each having coefficients respectively corresponding to the plurality of coefficients, (ii) a second flag indicating whether or not the plurality of quantization matrices are included in a sequence parameter set, and (iii) a third flag indicating whether or not the plurality of quantization matrices are included in a picture parameter set, and when only the following have been decoded as the quantization information in the decoding: (i) the first flag indicating all of that the blocks have been quantized using the plurality of quantization matrices, (ii) the second flag indicating that the plurality of quantization matrices are not included in the sequence parameter set, and (iii) the third flag indicating that the plurality of quantization matrices are not included in the picture parameter set, the inverse quantizing unit is configured to perform inverse quantization on all of the blocks using only the plurality of default matrices as the plurality of quantization matrices.

According to a third aspect of the present invention, there is provided an image decoding apparatus which decodes an image, the apparatus comprising: processing circuitry; and storage accessible from the processing circuitry, wherein the processing circuitry executes, using the storage, decoding coefficient information indicating a plurality of coefficients of blocks in the image and quantization information used in inverse quantization of the plurality of coefficients; and inverse-quantizing the plurality of coefficients, wherein the quantization information includes at least one of (i) a first flag indicating whether or not the blocks have been quantized using a plurality of quantization matrices each having coefficients respectively corresponding to the plurality of coefficients, (ii) a second flag indicating whether or not the

plurality of quantization matrices are included in a sequence parameter set, and (iii) a third flag indicating whether or not the plurality of quantization matrices are included in a picture parameter set, and when only the following have been decoded as the quantization information in the decoding: (i) the first flag indicating that all of the blocks have been quantized using the plurality of quantization matrices, (ii) the second flag indicating that the plurality of quantization matrices are not included in the sequence parameter set, and (iii) the third flag indicating that the plurality of quantization matrices are not included in the picture parameter set, all of the blocks are inverse-quantized in the inverse-quantizing using only the plurality of default matrices as the plurality of quantization matrices.

[0007]

These general and specific aspects may be implemented using a system, an apparatus, an integrated circuit, a computer program, or a non-transitory computer-readable recording medium such as a CD-ROM, or any combination of systems, apparatuses, integrated circuits, computer programs, or recording media.

[Advantageous Effects of Invention]

[0008]

The image coding method and the image decoding method according to embodiments of the present invention make it possible to code and decode images efficiently.

[Brief Description of Drawings]

[0009]

CLAIMS

1. An image coding method for coding an image, comprising:
quantizing a plurality of coefficients of blocks in the image; and
5 coding coefficient information indicating the plurality of
coefficients and quantization information used in the quantizing,

wherein the quantization information includes at least one of (i)
a first flag indicating whether or not the blocks are quantized using a
plurality of quantization matrices each having coefficients
10 respectively corresponding to the plurality of coefficients, (ii) a
second flag indicating whether or not the plurality of quantization
matrices are included in a sequence parameter set, and (iii) a third
flag indicating whether or not the plurality of quantization matrices
are included in a picture parameter set, and

15 when all of the blocks are quantized in the quantizing using only
a plurality of default matrices as the plurality of quantization matrices,
the following are coded as the quantization information: (i) the first
flag indicating that the blocks are quantized using the plurality of
quantization matrices, (ii) the second flag indicating that the plurality
20 of quantization matrices are not included in the sequence parameter
set, and (iii) the third flag indicating that the plurality of quantization
matrices are not included in the picture parameter set.

2. The image coding method according to Claim 1,

25 wherein, when the blocks are quantized in the quantizing using
a plurality of flat matrices each having same coefficients instead of the
plurality of quantization matrices, the first flag indicating that the
plurality of quantization matrices are not quantized is coded in the
coding.

3. The image coding method according to Claim 1 or Claim 2,

30 wherein, when the blocks are quantized in the quantizing using
the plurality of quantization matrices,

in the coding:

35 the following are coded: (i) the first flag indicating that the

blocks are quantized using the plurality of quantization matrices, and
(ii) the second flag indicating that the plurality of quantization
matrices are included in the sequence parameter set, or the third flag
indicating that the plurality of quantization matrices are included in
5 the picture parameter set;

the plurality of quantization matrices are included in the
sequence parameter set when the second flag indicating that the
plurality of quantization matrices are included in the sequence
parameter set is coded; and

10 the plurality of quantization matrices are included in the picture
parameter set when the third flag indicating that the plurality of
quantization matrices are included in the picture parameter set is
coded.

15 4. The image coding method according to Claim 3,
wherein in the coding:

when the plurality of quantization matrices included in a
parameter set which is one of the sequence parameter set and the
picture parameter set includes a first quantization matrix and a
20 second quantization matrix, and the first quantization matrix is equal
to the second quantization matrix, an identifier indicating the second
quantization matrix is included, in the parameter set, as a copy matrix
identifier indicating a matrix whose copy is used as the first
quantization matrix; and

25 when the plurality of quantization matrices included in the
parameter set includes the first quantization matrix, and the first
quantization matrix is equal to one of the default matrices, an
identifier indicating the default matrix is included as the copy matrix
identifier in the parameter set.

30 5. The image coding method according to any one of Claim 1 to
Claim 4, comprising:

setting a plurality of sequence quantization matrices for a
sequence including a picture; and

35 setting a plurality of picture quantization matrices for the

picture,

wherein in the coding:

the first flag is coded which indicates that the blocks are quantized using the plurality of quantization matrices, when the blocks of the picture are quantized using, as the plurality of quantization matrices, the plurality of picture quantization matrices which have been set for the picture;

the second flag is coded which indicates that the plurality of quantization matrices are not included in the sequence parameter set, when the plurality of default matrices have been set for the sequence as the plurality of sequence quantization matrices, and

the third flag is coded which indicates that the plurality of quantization matrices are not included in the picture parameter set, when the plurality of sequence quantization matrices which have been set for the sequence are set for the picture as the plurality of picture quantization matrices.

6. The image coding method according to any one of Claim 1 to Claim 5,

wherein when a block not subject to transform is quantized using a flat matrix having same coefficients, and a block subject to transform is quantized using one of the default matrices,

the following are coded in the coding: (i) the first flag indicating that the blocks are quantized using the plurality of quantization matrices, (ii) the second flag indicating that the plurality of quantization matrices are not included in the sequence parameter set, and (iii) the third flag indicating that the plurality of quantization matrices are not included in the picture parameter set.

7. An image decoding method for decoding an image, the method comprising:

decoding coefficient information indicating a plurality of coefficients of blocks in the image and quantization information used in inverse quantization of the plurality of coefficients; and

inverse-quantizing the plurality of coefficients,

wherein the quantization information includes at least one of (i) a first flag indicating whether or not the blocks have been quantized using a plurality of quantization matrices each having coefficients respectively corresponding to the plurality of coefficients, (ii) a
5 second flag indicating whether or not the plurality of quantization matrices are included in a sequence parameter set, and (iii) a third flag indicating whether or not the plurality of quantization matrices are included in a picture parameter set, and

when the following have been decoded as the quantization
10 information in the decoding: (i) the first flag indicating that the blocks have been quantized using the plurality of quantization matrices, (ii) the second flag indicating that the plurality of quantization matrices are not included in the sequence parameter set, and (iii) the third flag indicating that the plurality of quantization matrices are not included
15 in the picture parameter set, all of the blocks are inverse-quantized in the inverse-quantizing using only the plurality of default matrices as the plurality of quantization matrices.

8. The image decoding method according to Claim 7,

20 wherein when the first flag has been decoded which indicates that the blocks have not been quantized using the plurality of quantization matrices, the blocks are inverse-quantized in the inverse-quantizing using the plurality of flat matrices each having same coefficients instead of the plurality of quantization matrices.

25 9. The image decoding method according to Claim 7 or Claim 8, wherein in the inverse-quantizing:

the blocks have been inverse-quantized using the plurality of quantization matrices included in the sequence parameter set, when
30 the following have been decoded: the first flag indicating that the blocks have been quantized using the plurality of quantization matrices and the second flag indicating that the plurality of quantization matrices are included in the sequence parameter set; and

35 the blocks are inverse-quantized using the plurality of

quantization matrices included in the picture parameter set, when the following have been decoded: the first flag indicating that the blocks have been quantized using the plurality of quantization matrices and the third flag indicating that the plurality of quantization matrices are included in the picture parameter set.

10. The image decoding method according to Claim 9,
wherein when a parameter set which is one of the sequence parameter set and the picture parameter set includes the plurality of quantization matrices including a first quantization matrix and a second quantization matrix, and the parameter set includes an identifier indicating the second quantization matrix as a copy matrix identifier indicating a matrix whose copy is used as the first quantization matrix, the blocks are inverse-quantized in the inverse-quantizing using the plurality of quantization matrices including the first quantization matrix as which a copy of the second quantization matrix is used; and

when the parameter set includes the plurality of quantization matrices including the first quantization matrix, and the parameter set includes an identifier indicating one of the default matrices as the copy matrix identifier, the blocks are inverse-quantized in the inverse-quantizing using the plurality of quantization matrices including the first quantization matrix as which a copy of the default matrix is used.

11. The image decoding method according to any one of Claim 7 to Claim 10, further comprising:

setting a plurality of sequence quantization matrices for a sequence including a picture; and

setting a plurality of picture quantization matrices for the picture,

wherein the blocks of the picture is inverse-quantized in the inverse-quantizing using, as the plurality of quantization matrices, the plurality of picture quantization matrices which have been set for the picture, when the first flag is has been decoded which indicates

that the blocks have been quantized using the plurality of quantization matrices, and

in the setting:

the plurality of default matrices for the sequence are set as the plurality of sequence quantization matrices, when the second flag has been decoded which indicates that the plurality of quantization matrices are not included in the sequence parameter set; and

the plurality of sequence quantization matrices which have been set for the sequence are set for the picture as the plurality of picture quantization matrices, when the third flag has been decoded which indicates that the plurality of quantization matrices are not included in the picture parameter set.

12. The image decoding method according to any one of Claim 7 to 11,

wherein when the following have been decoded: (i) the first flag indicating that the blocks have been quantized using the plurality of quantization matrices, (ii) the second flag indicating that the plurality of quantization matrices are not included in the sequence parameter set, and (iii) the third flag indicating that the plurality of quantization matrices are not included in the picture parameter set,

a block not subject to transform is inverse-quantized in the inverse-quantizing using a flat matrix having same coefficients, and a block subject to transform is inverse-quantized in the inverse-quantizing using one of the default matrices.

13. An image coding apparatus which codes an image, the apparatus comprising:

processing circuitry; and
storage accessible from the processing circuit,
wherein the processing circuitry executes, using the storage, quantizing a plurality of coefficients of blocks in the image, and coding coefficient information indicating the plurality of coefficients and quantization information used in the quantizing,
wherein the quantization information includes at least one of (i)

a first flag indicating whether or not the blocks are quantized using a plurality of quantization matrices each having coefficients respectively corresponding to the plurality of coefficients, (ii) a second flag indicating whether or not the plurality of quantization matrices are included in a sequence parameter set, and (iii) a third flag indicating whether or not the plurality of quantization matrices are included in a picture parameter set, and

when all of the blocks are quantized in the quantizing using only a plurality of default matrices as the plurality of quantization matrices, the following are coded as the quantization information: (i) the first flag indicating that the blocks are quantized using the plurality of quantization matrices, (ii) the second flag indicating that the plurality of quantization matrices are not included in the sequence parameter set, and (iii) the third flag indicating that the plurality of quantization matrices are not included in the picture parameter set.

14. An image decoding apparatus which decodes an image, the apparatus comprising:

processing circuitry; and

storage accessible from the processing circuitry, wherein the processing circuitry executes, using the storage, decoding coefficient information indicating a plurality of coefficients of blocks in the image and quantization information used in inverse quantization of the plurality of coefficients, and

inverse-quantizing the plurality of coefficients,

wherein the quantization information includes at least one of (i) a first flag indicating whether or not the blocks have been quantized using a plurality of quantization matrices each having coefficients respectively corresponding to the plurality of coefficients, (ii) a second flag indicating whether or not the plurality of quantization matrices are included in a sequence parameter set, and (iii) a third flag indicating whether or not the plurality of quantization matrices are included in a picture parameter set, and

when the following have been decoded as the quantization information in the decoding: (i) the first flag indicating that the blocks

have been quantized using the plurality of quantization matrices, (ii) the second flag indicating that the plurality of quantization matrices are not included in the sequence parameter set, and (iii) the third flag indicating that the plurality of quantization matrices are not included in the picture parameter set, all of the blocks are inverse-quantized in the inverse-quantizing using only the plurality of default matrices as the plurality of quantization matrices.

15. An image coding and decoding apparatus, comprising:

the image coding apparatus according to Claim 13; and
an image decoding apparatus which decodes an image, the image decoding apparatus including:

processing circuitry; and

storage accessible from the processing circuitry,

wherein the processing circuitry executes, using the storage, decoding coefficient information indicating a plurality of coefficients of blocks in the image and quantization information used in inverse quantization of the plurality of coefficients, and

inverse-quantizing the plurality of coefficients,

wherein the quantization information includes at least one of (i) a first flag indicating whether or not the blocks have been quantized using a plurality of quantization matrices each having coefficients respectively corresponding to the plurality of coefficients, (ii) a second flag indicating whether or not the plurality of quantization matrices are included in a sequence parameter set, and (iii) a third flag indicating whether or not the plurality of quantization matrices are included in a picture parameter set, and

when the following have been decoded as the quantization information in the decoding: (i) the first flag indicating that the blocks have been quantized using the plurality of quantization matrices, (ii) the second flag indicating that the plurality of quantization matrices are not included in the sequence parameter set, and (iii) the third flag indicating that the plurality of quantization matrices are not included in the picture parameter set, all of the blocks are inverse-quantized in the inverse-quantizing using only the plurality of default matrices as

the plurality of quantization matrices.

CLAIMS

[Claim 1]

An image decoding method for decoding an image, the method
5 comprising:

decoding coefficient information indicating a plurality of
coefficients of blocks in the image and quantization information used
in inverse quantization of the plurality of coefficients; and

inverse-quantizing the plurality of coefficients,

10 wherein the quantization information includes at least one of (i)
a first flag indicating whether or not the blocks have been quantized
using a plurality of quantization matrices each having coefficients
respectively corresponding to the plurality of coefficients, (ii) a
second flag indicating whether or not the plurality of quantization
15 matrices are included in a sequence parameter set, and (iii) a third
flag indicating whether or not the plurality of quantization matrices
are included in a picture parameter set, and

when only the following have been decoded as the quantization
information in the decoding: (i) the first flag indicating that all of the
20 blocks have been quantized using the plurality of quantization
matrices, (ii) the second flag indicating that the plurality of
quantization matrices are not included in the sequence parameter set,
and (iii) the third flag indicating that the plurality of quantization
matrices are not included in the picture parameter set, all of the
25 blocks are inverse-quantized in the inverse-quantizing using only the
plurality of default matrices as the plurality of quantization matrices.

[Claim 2]

The image decoding method according to Claim 1,

30 wherein when the quantization information includes at least one
of (ii) the second flag indicating that the plurality of quantization
matrices are included in the sequence parameter set, and (iii) the third
flag indicating that the plurality of quantization matrices are included
in the picture parameter set, the quantization information further
35 includes (iv) specification information for specifying, in the plurality of

quantization matrices, the coefficients respectively corresponding to the plurality of coefficients.

[Claim 3]

5 An image decoding apparatus which decodes an image, the apparatus comprising:

 a decoder which decodes decoding coefficient information indicating a plurality of coefficients of blocks in the image and quantization information used in inverse quantization of the plurality
10 of coefficients; and

 an inverse quantizing unit configured to perform inverse quantization on the plurality of coefficients,

 wherein the quantization information includes at least one of (i) a first flag indicating whether or not the blocks have been quantized
15 using a plurality of quantization matrices each having coefficients respectively corresponding to the plurality of coefficients, (ii) a second flag indicating whether or not the plurality of quantization matrices are included in a sequence parameter set, and (iii) a third flag indicating whether or not the plurality of quantization matrices
20 are included in a picture parameter set, and

 when only the following have been decoded as the quantization information in the decoding: (i) the first flag indicating all of that the blocks have been quantized using the plurality of quantization matrices, (ii) the second flag indicating that the plurality of
25 quantization matrices are not included in the sequence parameter set, and (iii) the third flag indicating that the plurality of quantization matrices are not included in the picture parameter set, the inverse quantizing unit is configured to perform inverse quantization on all of the blocks using only the plurality of default matrices as the plurality
30 of quantization matrices.

[Claim 4]

 An image decoding apparatus which decodes an image, the apparatus comprising:

35 processing circuitry; and

storage accessible from the processing circuitry,
wherein the processing circuitry executes, using the storage,
decoding coefficient information indicating a plurality of
coefficients of blocks in the image and quantization information used
5 in inverse quantization of the plurality of coefficients; and
inverse-quantizing the plurality of coefficients,
wherein the quantization information includes at least one of (i)
a first flag indicating whether or not the blocks have been quantized
using a plurality of quantization matrices each having coefficients
10 respectively corresponding to the plurality of coefficients, (ii) a
second flag indicating whether or not the plurality of quantization
matrices are included in a sequence parameter set, and (iii) a third
flag indicating whether or not the plurality of quantization matrices
are included in a picture parameter set, and
15 when only the following have been decoded as the quantization
information in the decoding: (i) the first flag indicating that all of the
blocks have been quantized using the plurality of quantization
matrices, (ii) the second flag indicating that the plurality of
quantization matrices are not included in the sequence parameter set,
20 and (iii) the third flag indicating that the plurality of quantization
matrices are not included in the picture parameter set, all of the
blocks are inverse-quantized in the inverse-quantizing using only the
plurality of default matrices as the plurality of quantization matrices.