(QShift)

[0006]

Here, LevelScale and QShift are controlled by the quantization parameter. Moreover, ScalingMatrix[i][j] represents quantization scaling matrix values.

[0007]

In a video coding scheme such as ISO/IES14496-10 (MPEG-4AVC), a quantization scaling matrix can be included and coded in a sequence header or a picture header. Conventionally, quantization scaling matrix values are rearranged in a predetermined order, differences between previous and next quantization scaling matrix values are calculated, and the difference values are included and coded in the sequence header or the picture header.

[Citation List]

[Patent Literature]

[0008]

[PTL 1]

Japanese Unexamined Patent Application Publication No. 2008-193410

[Summary of Invention]

[Technical Problem]

[0009]

One of problems of the conventional techniques is associated with the number of bits required to transmit quantization scaling matrix values in a picture header. In particular, transmitting a large number of quantization scaling matrices in a picture header to a decoder requires a lot of bits, which reduces coding efficiency.

[0010]

~~TheEmbodiments of the~~ present invention ~~has been conceived in view of the above problem, and an object of the present invention is to~~ provide an image coding method and an image decoding method which make it possible to code a quantization scaling matrix using a smaller number of bits and decode the coded quantization scaling matrix, respectively.

[Solution to Problem]

[0011]

~~An image decoding method according to an aspect of the present~~

~~invention is a method of decoding a coded image included in a coded stream. More specifically, the image decoding method includes: obtaining an old quantization scaling matrix which is a decoded quantization scaling matrix and is used for decoding a new quantization scaling matrix; obtaining, from the coded stream, an update parameter indicating an amount of change in the new quantization scaling matrix with respect to the old quantization scaling matrix; decoding the new quantization scaling matrix using the old quantization scaling matrix obtained in the obtaining of an old quantization scaling matrix and the update parameter obtained in the obtaining of an update parameter; and decoding the coded image using the new quantization scaling matrix decoded in the decoding of the new quantization scaling matrix.~~

According to a first aspect of the present invention, there is provided an image decoding method for decoding a coded image included in a coded stream, said image decoding method comprising: obtaining an old quantization scaling matrix which is a decoded quantization scaling matrix and is used for decoding a new quantization scaling matrix; obtaining, from the coded stream, an update parameter indicating an amount of change in the new quantization scaling matrix with respect to the old quantization scaling matrix; wherein said update parameter includes a first update parameter and a second update parameter obtained from the coded stream, the first update parameter indicating a scale factor of the new quantization scaling matrix with respect to the old quantization scaling matrix, and the second update parameter indicating a degree of variation in values constituting the new quantization scaling matrix; computing a prediction matrix by adding a result of scaling the old quantization matrix using a first coefficient based on the first update parameter and a result of scaling a difference between the old quantization matrix and a fixed value using a second coefficient based on the second update parameter, the prediction matrix resulting from predicting the new quantization scaling matrix; decoding the new quantization scaling matrix using the computed prediction matrix; and decoding the coded image using the new quantization scaling matrix.

[0012]

As in the above configuration, the new quantization scaling matrix is computed based on the old quantization scaling matrix, and thus it is possible to reduce a greater amount of information to be included in the coded stream

than the conventional methods. As a result, the coding efficiency is increased.

[0013]

Moreover, in the obtaining of an update parameter, a first update parameter and a second update parameter may be obtained from the coded stream, the first update parameter indicating a scale factor of the new quantization scaling matrix with respect to the old quantization scaling matrix, and the second update parameter indicating a degree of variation in values constituting the new quantization scaling matrix. In the decoding of the new quantization scaling matrix, a prediction matrix may be computed using the old quantization scaling matrix, the first update parameter, and the second update parameter, and the new quantization scaling matrix may be decoded using the computed prediction matrix, the prediction matrix resulting from predicting the new quantization scaling matrix.

[0014]

Moreover, in the obtaining of an update parameter, a delta matrix may be further obtained from the coded stream, the delta matrix being a difference between the new quantization scaling matrix and the prediction matrix. In the decoding of the new quantization scaling matrix, the new quantization scaling matrix may be decoded by adding the prediction matrix and the delta matrix.

of an old quantization scaling matrix, among decoded quantization scaling matrices, a quantization scaling matrix identified using the identification information may be obtained as the old quantization scaling matrix.

[0020]

~~An image coding method according to an aspect of the present invention is a method of coding an image. More specifically, the image coding method includes: obtaining an old quantization scaling matrix which is a coded quantization scaling matrix and is used for coding a new quantization scaling matrix; computing an update parameter indicating an amount of change in the new quantization scaling matrix with respect to the old quantization scaling matrix; and generating a coded stream including (i) an image coded using the new quantization scaling matrix and (ii) the update parameter computed in the computing.~~

According to a second aspect of the present invention, there is provided an image coding method for coding an image, said image coding method comprising: obtaining an old quantization scaling matrix which is a coded quantization scaling matrix and is used for coding a new quantization scaling matrix; computing an update parameter indicating an amount of change in the new quantization scaling matrix with respect to the old quantization scaling matrix; further computing a first update parameter and a second update parameter of the update parameter, the first update parameter indicating a scale factor of the new quantization scaling matrix with respect to the old quantization scaling matrix, and the second update parameter indicating a degree of variation in values constituting the new quantization scaling matrix; generating a coded stream including an image coded using the new quantization scaling matrix and the update parameter computed in said computing; and in said generating, the first update parameter and the second update parameter are included in the coded stream, wherein in said computing, a prediction matrix is computed by adding a result of scaling the old quantization matrix using a first coefficient based on the first update parameter and a result of scaling a difference between the old quantization matrix and a fixed value using a second coefficient based on the second update parameter, the prediction matrix resulting from predicting the new quantization scaling matrix.

[0021]

As in the above configuration, the new quantization scaling matrix is computed based on the old quantization scaling matrix, and thus it is possible to reduce a greater amount of information to be included in the coded stream than the conventional methods. As a result, the coding efficiency is increased.

[0022]

Moreover, in the computing, a first update parameter and a second update parameter may be computed, the first update parameter indicating a scale factor of the new quantization scaling matrix with respect to the old quantization scaling matrix, and the second update parameter indicating a degree of variation in values constituting the new quantization scaling matrix. In the generating, the first update parameter and the second update parameter may be included in the coded stream.

[0023]

Moreover, in the computing, a prediction matrix may be computed using the old quantization scaling matrix, the first update parameter, and the second update parameter, and the first update parameter and the second update parameter may be computed so that values of a delta matrix become smallest, the prediction matrix resulting from predicting the new quantization scaling matrix, and the values being a difference between the new quantization scaling matrix and the prediction matrix. In the generating, the delta matrix may be

further included in the coded stream. With the above configuration, each value of the delta matrix is allowed to approach 0 as much as possible, and thus the coding efficiency is increased.

[0024]

Moreover, in the generating, identification information for identifying the old quantization scaling matrix obtained in the obtaining may be included in the coded stream. With this configuration, for instance, it is possible to select an old quantization scaling matrix having the highest correlation with the new quantization scaling matrix.

[0025]

~~An image decoding apparatus according to an aspect of the present invention decodes a coded image included in a coded stream. More specifically, the image decoding apparatus includes: a matrix obtaining unit configured to obtain an old quantization scaling matrix which is a decoded quantization scaling matrix and is used for decoding a new quantization scaling matrix; an update parameter obtaining unit configured to obtain, from the coded stream, an update parameter indicating an amount of change in the new quantization scaling matrix with respect to the old quantization scaling matrix; a matrix decoding unit configured to decode the new quantization scaling matrix using the old quantization scaling matrix obtained by the matrix obtaining unit and the update parameter obtained by the update parameter obtaining unit; and an image decoding unit configured to decode the coded image using the new quantization scaling matrix decoded by the matrix decoding unit.~~

According to a third aspect of the present invention, there is provided an image decoding apparatus which decodes a coded image included in a coded stream, said image decoding apparatus comprising: a processor; and a non-transitory computer-readable recording medium having stored thereon a computer program that, when executed by said processor, causes said image decoding apparatus to function as: a matrix obtaining unit configured to obtain an old quantization scaling matrix which is a decoded quantization scaling matrix and is used for decoding a new quantization scaling matrix; an update parameter obtaining unit configured to obtain, from the coded stream, an update parameter indicating an amount of change in the new quantization scaling matrix with respect to the old quantization scaling matrix; wherein said update parameter obtaining unit is further configured to obtain a first update

parameter and a second update parameter of the update parameter from the coded stream, the first update parameter indicating a scale factor of the new quantization scaling matrix with respect to the old quantization scaling matrix, and the second update parameter indicating a degree of variation in values constituting the new quantization scaling matrix; a matrix decoding unit configured to compute a prediction matrix by adding a result of scaling the old quantization matrix using a first coefficient based on the first update parameter and a result of scaling a difference between the old quantization matrix and a fixed value using a second coefficient based on the second update parameter, the prediction matrix resulting from predicting the new quantization scaling matrix; the matrix decoding unit further configured to decode the new quantization scaling matrix using the computed prediction matrix; and an image decoding unit configured to decode the coded image using the new quantization scaling matrix decoded by said matrix decoding unit.

[0026]

~~An image coding apparatus according to an aspect of the present invention codes an image. More specifically, the image coding apparatus includes: a matrix obtaining unit configured to obtain an old quantization scaling matrix which is a coded quantization scaling matrix and is used for coding a new quantization scaling matrix; an update parameter computation unit configured to compute an update parameter indicating an amount of change in the new quantization scaling matrix with respect to the old quantization scaling matrix; and a coding unit configured to generate a coded stream including (i) an image coded using the new quantization scaling matrix~~

~~and (ii) the update parameter computed by said update parameter computation unit.~~

According to a fourth aspect of the present invention, there is provided an image coding apparatus which codes an image, said image coding apparatus comprising: a processor; and a non-transitory computer-readable recording medium having stored thereon a computer program that, when executed by said processor, causes said image coding apparatus to function as: a matrix obtaining unit configured to obtain an old quantization scaling matrix which is a coded quantization scaling matrix and is used for coding a new quantization scaling matrix; an update parameter computation unit configured to compute an update parameter indicating an amount of change in the new quantization scaling matrix with respect to the old quantization scaling matrix; wherein said update parameter computation unit is further configured to compute a first update parameter and a second update parameter of the update parameter, the first update parameter indicating a scale factor of the new quantization scaling matrix with respect to the old quantization scaling matrix, and the second update parameter indicating a degree of variation in values constituting the new quantization scaling matrix; a coding unit configured to generate a coded stream including an image coded using the new quantization scaling matrix and the update parameter computed by said update parameter computation unit; and said coding unit is further configured to include the first update parameter and the second update parameter in the coded stream, wherein said update parameter computation unit is configured to compute a prediction matrix by adding a result of scaling the old quantization matrix using a first coefficient based on the first update parameter and a result of scaling a difference between the old quantization matrix and a fixed value using a second coefficient based on the second update parameter, the prediction matrix resulting from predicting the new quantization scaling matrix.

[0027]

~~A computer program according to an aspect of the present invention causes a computer to decode a coded image included in a coded stream. More specifically, the computer program causes the computer to execute: obtaining an old quantization scaling matrix which is a decoded quantization scaling matrix and is used for decoding a new quantization scaling matrix; obtaining, from the coded stream, an update parameter indicating an amount of change in~~

~~the new quantization scaling matrix with respect to the old quantization scaling matrix; decoding the new quantization scaling matrix using the old quantization scaling matrix obtained in the obtaining of an old quantization scaling matrix and the update parameter obtained in the obtaining of an update parameter; and decoding the coded image using the new quantization scaling matrix decoded in the decoding of the new quantization scaling matrix.~~

According to a fifth aspect of the present invention, there is provided a non-transitory computer-readable recording medium for use in a computer, the recording medium having a computer program for causing the computer to decode a coded image included in a coded stream recorded thereon, the computer program causing the computer to execute: obtaining an old quantization scaling matrix which is a decoded quantization scaling matrix and is used for decoding a new quantization scaling matrix; obtaining, from the coded stream, an update parameter indicating an amount of change in the new quantization scaling matrix with respect to the old quantization scaling matrix; wherein in said obtaining of an update parameter, a first update parameter and a second update parameter of the update parameter are obtained from the coded stream, the first update parameter indicating a scale factor of the new quantization scaling matrix with respect to the old quantization scaling matrix, and the second update parameter indicating a degree of variation in values constituting the new quantization scaling matrix; computing a prediction matrix by adding a result of scaling the old quantization matrix using a first coefficient based on the first update parameter and a result of scaling a difference between the old quantization matrix and a fixed value using a second coefficient based on the second update parameter, the prediction matrix resulting from predicting the new quantization scaling matrix; decoding the new quantization scaling matrix using the computed prediction matrix; and decoding the coded image using the new quantization scaling matrix decoded in said decoding of the new quantization scaling matrix.

[0028]

~~A computer program according to another aspect of the present invention causes a computer to code an image. More specifically, the computer program causes the computer to execute: obtaining an old quantization scaling matrix which is a coded quantization scaling matrix and is used for coding a new quantization scaling matrix; computing an update parameter indicating an~~

~~amount of change in the new quantization scaling matrix with respect to the old quantization scaling matrix; and generating a coded stream including (i) an image coded using the new quantization scaling matrix and (ii) the update parameter computed in the computing.~~

According to a sixth aspect of the present invention, there is provided a non-transitory computer-readable recording medium for use in a computer, the recording medium having a computer program for causing the computer to code an image recorded thereon, the computer program causing the computer to execute: obtaining an old quantization scaling matrix which is a coded quantization scaling matrix and is used for coding a new quantization scaling matrix; computing an update parameter indicating an amount of change in the new quantization scaling matrix with respect to the old quantization scaling matrix; wherein in said computing, a first update parameter and a second update parameter of the update parameter are computed, the first update parameter indicating a scale factor of the new quantization scaling matrix with respect to the old quantization scaling matrix, and the second update parameter indicating a degree of variation in values constituting the new quantization scaling matrix; generating a coded stream including an image coded using the new quantization scaling matrix and the update parameter computed in said computing; and in said generating, the first update parameter and the second update parameter are included in the coded stream, wherein in said computing, a prediction matrix is computed by adding a result of scaling the old quantization matrix using a first coefficient based on the first update parameter and a result of scaling a difference between the old quantization matrix and a fixed value using a second coefficient based on the second update parameter, the prediction matrix resulting from predicting the new quantization scaling matrix.

[0029]

~~An integrated circuit according to an aspect of the present invention decodes a coded image included in a coded stream. More specifically, the integrated circuit includes: a matrix obtaining unit configured to obtain an old quantization scaling matrix which is a decoded quantization scaling matrix and is used for decoding a new quantization scaling matrix; an update parameter obtaining unit configured to obtain, from the coded stream, an update parameter indicating an amount of change in the new quantization scaling matrix with respect to the old quantization scaling matrix; a matrix decoding~~

~~unit configured to decode the new quantization scaling matrix using the old quantization scaling matrix obtained by the matrix obtaining unit and the update parameter obtained by the update parameter obtaining unit; and an image decoding unit configured to decode the coded image using the new quantization scaling matrix decoded by the matrix decoding unit.~~

According to a seventh aspect of the present invention, there is provided an integrated circuit which decodes a coded image included in a coded stream, said integrated circuit comprising: a processor; and a non-transitory computer-readable recording medium having stored thereon a computer program that, when executed by said processor, causes said integrated circuit to function as: a matrix obtaining unit configured to obtain an old quantization scaling matrix which is a decoded quantization scaling matrix and is used for decoding a new quantization scaling matrix; an update parameter obtaining unit configured to obtain, from the coded stream, an update parameter indicating an amount of change in the new quantization scaling matrix with respect to the old quantization scaling matrix; wherein said update parameter obtaining unit is further configured to obtain a first update parameter and a second update parameter of the update parameter from the coded stream, the first update parameter indicating a scale factor of the new quantization scaling matrix with respect to the old quantization scaling matrix, and the second update parameter indicating a degree of variation in values constituting the new quantization scaling matrix; a matrix decoding unit configured to compute a prediction matrix by adding a result of scaling the old quantization matrix using a first coefficient based on the first update parameter and a result of scaling a difference between the old quantization matrix and a fixed value using a second coefficient based on the second update parameter, the prediction matrix resulting from predicting the new quantization scaling matrix; the matrix decoding unit further configured to decode the new quantization scaling matrix using the computed prediction matrix; and an image decoding unit configured to decode the coded image using the new quantization scaling matrix decoded by said matrix decoding unit.

[0030]

~~An integrated circuit according to another aspect of the present invention codes an image. More specifically, the integrated circuit includes: a matrix obtaining unit configured to obtain an old quantization scaling matrix~~

~~which is a coded quantization scaling matrix and is used for coding a new quantization scaling matrix; an update parameter computation unit configured to compute an update parameter indicating an amount of change in the new quantization scaling matrix with respect to the old quantization scaling matrix; and a coding unit configured to generate a coded stream including (i) an image coded using the new quantization scaling matrix and (ii) the update parameter computed by said update parameter computation unit.~~

According to a eight aspect of the present invention, there is provided an integrated circuit which codes an image, said integrated circuit comprising: a processor; and a non-transitory computer-readable recording medium having stored thereon a computer program that, when executed by said processor, causes said integrated circuit to function as: a matrix obtaining unit configured to obtain an old quantization scaling matrix which is a coded quantization scaling matrix and is used for coding a new quantization scaling matrix; an update parameter computation unit configured to compute an update parameter indicating an amount of change in the new quantization scaling matrix with respect to the old quantization scaling matrix; wherein said update parameter computation unit is further configured to compute a first update parameter and a second update parameter of the update parameter, the first update parameter indicating a scale factor of the new quantization scaling matrix with respect to the old quantization scaling matrix, and the second update parameter indicating a degree of variation in values constituting the new quantization scaling matrix; a coding unit configured to generate a coded stream including an image coded using the new quantization scaling matrix and the update parameter computed by said update parameter computation unit; and said coding unit is further configured to include the first update parameter and the second update parameter in the coded stream, wherein said update parameter computation unit is configured to compute a prediction matrix by adding a result of scaling the old quantization matrix using a first coefficient based on the first update parameter and a result of scaling a difference between the old quantization matrix and a fixed value using a second coefficient based on the second update parameter, the prediction matrix resulting from predicting the new quantization scaling matrix.

[Advantageous Effects of Invention]

[0031]

~~The~~Embodiments of the present invention makes it possible to reduce the amount of coded data of quantization scaling matrix values, and thus the coding efficiency is increased.

[Brief Description of Drawings]

[0032]

[FIG. 1]

FIG. 1 is a functional block diagram showing an image decoding apparatus according to an embodiment of the present invention.

[FIG. 2]

FIG. 2 is a functional block diagram showing an image coding apparatus according to the embodiment of the present invention.

[FIG. 3]

FIG. 3 is a graph showing a relationship between a quantization scaling matrix value and an inverse quantized absolute value.

[FIG. 4A]

CLAIMS:

1. An image decoding method for decoding a coded image included in a coded stream, said image decoding method comprising:

obtaining an old quantization scaling matrix which is a decoded quantization scaling matrix and is used for decoding a new quantization scaling matrix;

obtaining, from the coded stream, an update parameter indicating an amount of change in the new quantization scaling matrix with respect to the old quantization scaling matrix;

wherein said update parameter includes a first update parameter and a second update parameter obtained from the coded stream, the first update parameter indicating a scale factor of the new quantization scaling matrix with respect to the old quantization scaling matrix, and the second update parameter indicating a degree of variation in values constituting the new quantization scaling matrix;

computing a prediction matrix by adding a result of scaling the old quantization matrix using a first coefficient based on the first update parameter and a result of scaling a difference between the old quantization matrix and a fixed value using a second coefficient based on the second update parameter, the prediction matrix resulting from predicting the new quantization scaling matrix;

decoding the new quantization scaling matrix using the computed prediction matrix; and

decoding the coded image using the new quantization scaling matrix.

2. The image decoding method according to Claim 1,

wherein said update parameter further includes a delta matrix further obtained from the coded stream, the delta matrix being a difference between the new quantization scaling matrix and the prediction matrix, and

in said decoding of the new quantization scaling matrix, the new quantization scaling matrix is decoded by adding the prediction matrix and the delta matrix.

3. The image decoding method according to Claim 2,

wherein each of the new quantization scaling matrix, the old quantization scaling matrix, the prediction matrix, and the delta matrix is a matrix containing n values, where n is a natural number equal to or greater than 2, and

in said decoding of the new quantization scaling matrix, the new quantization scaling matrix is decoded according to Equation 1,

$$M_{new}(i) = (M_{old}(i) \times P_1) + \{(M_{old}(i) - F) \times P_2\} + \Delta M(i) \quad \text{(Equation 1)}$$

where $M_{new}(i)$ represents the n values constituting the new quantization scaling matrix, $M_{old}(i)$ represents the n values constituting the old quantization scaling matrix, $\Delta M(i)$ represents the n values constituting the delta matrix, P_1 represents a first coefficient obtained from the first update parameter, P_2 represents a second coefficient obtained from the second update parameter, F represents the fixed value determined for each new quantization scaling matrix, and i = any number from 1 to n.

4. The image decoding method according to Claim 3,

wherein the fixed value F corresponds to a direct-current component value of the old quantization scaling matrix.

5. The image decoding method according to Claim 3,

wherein the fixed value F corresponds to an average value of the n values constituting the old quantization scaling matrix.

6. The image decoding method according to Claim 1,

wherein the coded stream further includes an update flag indicating whether or not the coded stream includes the update parameter, and

in said image decoding method, when a value indicating that the coded stream includes the update parameter is set to the update flag, the new quantization scaling matrix is decoded.

7. The image decoding method according to Claim 1,

wherein the coded stream further includes an update type flag indicating a coding method for the new quantization scaling matrix, and

in said image decoding method, when a value indicating that the new quantization scaling matrix is coded using the old quantization scaling matrix is set to the update type flag, the new quantization scaling matrix is decoded using the old quantization scaling matrix and the update parameter.

8. The image decoding method according to Claim 1,

wherein the coded stream further includes identification information for identifying the old quantization scaling matrix, and

in said obtaining of an old quantization scaling matrix, among decoded quantization scaling matrices, a quantization scaling matrix identified using the identification information is obtained as the old quantization scaling matrix.

9. An image coding method for coding an image, said image coding method comprising:

obtaining an old quantization scaling matrix which is a coded quantization scaling matrix and is used for coding a new quantization scaling matrix;

computing an update parameter indicating an amount of change in the new quantization scaling matrix with respect to the old quantization scaling matrix;

further computing a first update parameter and a second update parameter of the update parameter, the first update parameter indicating a scale factor of the new quantization scaling matrix with respect to the old quantization scaling matrix, and the

second update parameter indicating a degree of variation in values constituting the new quantization scaling matrix;

generating a coded stream including (i) an image coded using the new quantization scaling matrix and (ii) the update parameter computed in said computing; and

in said generating, the first update parameter and the second update parameter are included in the coded stream,

wherein in said computing, a prediction matrix is computed by adding a result of scaling the old quantization matrix using a first coefficient based on the first update parameter and a result of scaling a difference between the old quantization matrix and a fixed value using a second coefficient based on the second update parameter, the prediction matrix resulting from predicting the new quantization scaling matrix.

10. The image coding method according to Claim 9,

wherein in said computing, the first update parameter and the second update parameter are computed so that values of a delta matrix become smallest, the prediction matrix resulting from predicting the new quantization scaling matrix, and the values being a difference between the new quantization scaling matrix and the prediction matrix, and

in said generating, the delta matrix is further included in the coded stream.

11. The image coding method according to Claim 9,

wherein in said generating, identification information for identifying the old quantization scaling matrix obtained in said obtaining is included in the coded stream.

12. An image decoding apparatus which decodes a coded image included in a coded stream, said image decoding apparatus comprising:

a processor; and

a non-transitory computer-readable recording medium having stored thereon a computer program that, when executed by said processor, causes said image decoding apparatus to function as:

a matrix obtaining unit configured to obtain an old quantization scaling matrix which is a decoded quantization scaling matrix and is used for decoding a new quantization scaling matrix;

an update parameter obtaining unit configured to obtain, from the coded stream, an update parameter indicating an amount of change in the new quantization scaling matrix with respect to the old quantization scaling matrix;

wherein said update parameter obtaining unit is further configured to obtain a first update parameter and a second update parameter of the update parameter from the coded stream, the first update parameter indicating a scale factor of the new quantization scaling matrix with respect to the old quantization scaling matrix, and the second update parameter indicating a degree of variation in values constituting the new quantization scaling matrix;

a matrix decoding unit configured to compute a prediction matrix by adding a result of scaling the old quantization matrix using a first coefficient based on the first update parameter and a result of scaling a difference between the old quantization matrix and a fixed value using a second coefficient based on the second update parameter, the prediction matrix resulting from predicting the new quantization scaling matrix;

the matrix decoding unit further configured to decode the new quantization scaling matrix using the computed prediction matrix; and

an image decoding unit configured to decode the coded image using the new quantization scaling matrix decoded by said matrix decoding unit.

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

a processor; and

a non-transitory computer-readable recording medium having stored thereon a computer program that, when executed by said processor, causes said image coding apparatus to function as:

a matrix obtaining unit configured to obtain an old quantization scaling matrix which is a coded quantization scaling matrix and is used for coding a new quantization scaling matrix;

an update parameter computation unit configured to compute an update parameter indicating an amount of change in the new quantization scaling matrix with respect to the old quantization scaling matrix;

wherein said update parameter computation unit is further configured to compute a first update parameter and a second update parameter of the update parameter, the first update parameter indicating a scale factor of the new quantization scaling matrix with respect to the old quantization scaling matrix, and the second update parameter indicating a degree of variation in values constituting the new quantization scaling matrix;

a coding unit configured to generate a coded stream including (i) an image coded using the new quantization scaling matrix and (ii) the update parameter computed by said update parameter computation unit; and

said coding unit is further configured to include the first update parameter and the second update parameter in the coded stream,

wherein said update parameter computation unit is configured to compute a prediction matrix by adding a result of scaling the old quantization matrix using a first coefficient based on the first update parameter and a result of scaling a difference between the old quantization matrix and a fixed value using a second coefficient based on the second update parameter, the prediction matrix resulting from predicting the new quantization scaling matrix.

14. A non-transitory computer-readable recording medium for use in a computer, the recording medium having a computer program for causing the computer to decode a

coded image included in a coded stream recorded thereon, the computer program causing the computer to execute:

obtaining an old quantization scaling matrix which is a decoded quantization scaling matrix and is used for decoding a new quantization scaling matrix;

obtaining, from the coded stream, an update parameter indicating an amount of change in the new quantization scaling matrix with respect to the old quantization scaling matrix;

wherein in said obtaining of an update parameter, a first update parameter and a second update parameter of the update parameter are obtained from the coded stream, the first update parameter indicating a scale factor of the new quantization scaling matrix with respect to the old quantization scaling matrix, and the second update parameter indicating a degree of variation in values constituting the new quantization scaling matrix;

computing a prediction matrix by adding a result of scaling the old quantization matrix using a first coefficient based on the first update parameter and a result of scaling a difference between the old quantization matrix and a fixed value using a second coefficient based on the second update parameter, the prediction matrix resulting from predicting the new quantization scaling matrix;

decoding the new quantization scaling matrix using the computed prediction matrix; and

decoding the coded image using the new quantization scaling matrix decoded in said decoding of the new quantization scaling matrix.

15. A non-transitory computer-readable recording medium for use in a computer, the recording medium having a computer program for causing the computer to code an image recorded thereon, the computer program causing the computer to execute:

obtaining an old quantization scaling matrix which is a coded quantization scaling matrix and is used for coding a new quantization scaling matrix;

computing an update parameter indicating an amount of change in the new quantization scaling matrix with respect to the old quantization scaling matrix;

wherein in said computing, a first update parameter and a second update parameter of the update parameter are computed, the first update parameter indicating a scale factor of the new quantization scaling matrix with respect to the old quantization scaling matrix, and the second update parameter indicating a degree of variation in values constituting the new quantization scaling matrix;

generating a coded stream including (i) an image coded using the new quantization scaling matrix and (ii) the update parameter computed in said computing; and

in said generating, the first update parameter and the second update parameter are included in the coded stream,

wherein in said computing, a prediction matrix is computed by adding a result of scaling the old quantization matrix using a first coefficient based on the first update parameter and a result of scaling a difference between the old quantization matrix and a fixed value using a second coefficient based on the second update parameter, the prediction matrix resulting from predicting the new quantization scaling matrix.

16. An integrated circuit which decodes a coded image included in a coded stream, said integrated circuit comprising:

a processor; and

a non-transitory computer-readable recording medium having stored thereon a computer program that, when executed by said processor, causes said integrated circuit to function as:

a matrix obtaining unit configured to obtain an old quantization scaling matrix which is a decoded quantization scaling matrix and is used for decoding a new quantization scaling matrix;

an update parameter obtaining unit configured to obtain, from the coded stream, an update parameter indicating an amount of change in the new quantization scaling matrix with respect to the old quantization scaling matrix;

wherein said update parameter obtaining unit is further configured to obtain a first update parameter and a second update parameter of the update parameter from the coded stream, the first update parameter indicating a scale factor of the new quantization scaling matrix with respect to the old quantization scaling matrix, and the second update parameter indicating a degree of variation in values constituting the new quantization scaling matrix;

a matrix decoding unit configured to compute a prediction matrix by adding a result of scaling the old quantization matrix using a first coefficient based on the first update parameter and a result of scaling a difference between the old quantization matrix and a fixed value using a second coefficient based on the second update parameter, the prediction matrix resulting from predicting the new quantization scaling matrix;

the matrix decoding unit further configured to decode the new quantization scaling matrix using the computed prediction matrix; and

an image decoding unit configured to decode the coded image using the new quantization scaling matrix decoded by said matrix decoding unit.

17. An integrated circuit which codes an image, said integrated circuit comprising:

a processor; and

a non-transitory computer-readable recording medium having stored thereon a computer program that, when executed by said processor, causes said integrated circuit to function as:

a matrix obtaining unit configured to obtain an old quantization scaling matrix which is a coded quantization scaling matrix and is used for coding a new quantization scaling matrix;

an update parameter computation unit configured to compute an update parameter indicating an amount of change in the new quantization scaling matrix with respect to the old quantization scaling matrix;

wherein said update parameter computation unit is further configured to compute a first update parameter and a second update parameter of the update parameter, the first

update parameter indicating a scale factor of the new quantization scaling matrix with respect to the old quantization scaling matrix, and the second update parameter indicating a degree of variation in values constituting the new quantization scaling matrix;

a coding unit configured to generate a coded stream including (i) an image coded using the new quantization scaling matrix and (ii) the update parameter computed by said update parameter computation unit; and

said coding unit is further configured to include the first update parameter and the second update parameter in the coded stream,

wherein said update parameter computation unit is configured to compute a prediction matrix by adding a result of scaling the old quantization matrix using a first coefficient based on the first update parameter and a result of scaling a difference between the old quantization matrix and a fixed value using a second coefficient based on the second update parameter, the prediction matrix resulting from predicting the new quantization scaling matrix.

18. The image decoding method according to Claim 8,

wherein in said obtaining of an old quantization scaling matrix, among decoded quantization scaling matrices, a quantization scaling matrix having a highest correlation with the new quantization scaling matrix is obtained as the old quantization scaling matrix based on the identification information.

19. The image coding method according to Claim 9,

wherein in said obtaining of an old quantization scaling matrix, among coded quantization scaling matrices, a quantization scaling matrix having a highest correlation with the new quantization scaling matrix is obtained as the old quantization scaling matrix.

[CLAIMS]

[Claim 1] An image decoding method for decoding a coded image included in a coded stream, said image decoding method comprising:

obtaining an old quantization scaling matrix which is a decoded quantization scaling matrix and is used for decoding a new quantization scaling matrix;

obtaining, from the coded stream, an update parameter indicating an amount of change in the new quantization scaling matrix with respect to the old quantization scaling matrix;

decoding the new quantization scaling matrix using the old quantization scaling matrix obtained in said obtaining of an old quantization scaling matrix and the update parameter obtained in said obtaining of an update parameter; and

decoding the coded image using the new quantization scaling matrix decoded in said decoding of the new quantization scaling matrix.

[Claim 2] The image decoding method according to Claim 1,

wherein in said obtaining of an update parameter, a first update parameter and a second update parameter are obtained from the coded stream, the first update parameter indicating a scale factor of the new quantization scaling matrix with respect to the old quantization scaling matrix, and the second update parameter indicating a degree of variation in values constituting the new quantization scaling matrix, and

in said decoding of the new quantization scaling matrix, a prediction matrix is computed using the old quantization scaling matrix, the first update parameter, and the second update parameter, and the new quantization scaling matrix is decoded using the computed prediction matrix, the prediction matrix resulting from predicting the new quantization scaling matrix.

[Claim 3] The image decoding method according to Claim 2,

wherein in said obtaining of an update parameter, a delta matrix is further obtained from the coded stream, the delta matrix being a difference between the new quantization scaling matrix and the prediction matrix, and

in said decoding of the new quantization scaling matrix, the new

quantization scaling matrix is decoded by adding the prediction matrix and the delta matrix.

[Claim 4] The image decoding method according to Claim 3,

wherein each of the new quantization scaling matrix, the old quantization scaling matrix, the prediction matrix, and the delta matrix is a matrix containing n values, where n is a natural number equal to or greater than 2, and

in said decoding of the new quantization scaling matrix, the new quantization scaling matrix is decoded according to Equation 1,

[Math. 1]

$$M_{new}(i) = (M_{old}(i) \times P_1) + \{(M_{old}(i) - F) \times P_2\} + \Delta M(i) \quad \text{(Equation 1)}$$

where $M_{new}(i)$ represents the n values constituting the new quantization scaling matrix, $M_{old}(i)$ represents the n values constituting the old quantization scaling matrix, $\Delta M(i)$ represents the n values constituting the delta matrix, P_1 represents a first coefficient obtained from the first update parameter, P_2 represents a second coefficient obtained from the second update parameter, F represents a coefficient determined for each new quantization scaling matrix, and i = any number from 1 to n.

[Claim 5] The image decoding method according to Claim 4,

wherein the coefficient F corresponds to a direct-current component value of the old quantization scaling matrix.

[Claim 6] The image decoding method according to Claim 4,

wherein the coefficient F corresponds to an average value of the n values constituting the old quantization scaling matrix.

[Claim 7] The image decoding method according to any one of Claims 1 to 6,

wherein the coded stream further includes an update flag indicating whether or not the coded stream includes the update parameter, and

in said image decoding method, when a value indicating that the coded

stream includes the update parameter is set to the update flag, the new quantization scaling matrix is decoded.

[Claim 8] The image decoding method according to any one of Claims 1 to 7,

wherein the coded stream further includes an update type flag indicating a coding method for the new quantization scaling matrix, and

in said image decoding method, when a value indicating that the new quantization scaling matrix is coded using the old quantization scaling matrix is set to the update type flag, the new quantization scaling matrix is decoded using the old quantization scaling matrix and the update parameter.

[Claim 9] The image decoding method according to any one of Claims 1 to 8,

wherein the coded stream further includes identification information for identifying the old quantization scaling matrix, and

in said obtaining of an old quantization scaling matrix, among decoded quantization scaling matrices, a quantization scaling matrix identified using the identification information is obtained as the old quantization scaling matrix.

[Claim 10] An image coding method for coding an image, said image coding method comprising:

obtaining an old quantization scaling matrix which is a coded quantization scaling matrix and is used for coding a new quantization scaling matrix;

computing an update parameter indicating an amount of change in the new quantization scaling matrix with respect to the old quantization scaling matrix; and

generating a coded stream including (i) an image coded using the new quantization scaling matrix and (ii) the update parameter computed in said computing.

[Claim 11] The image coding method according to Claim 10,

wherein in said computing, a first update parameter and a second

update parameter are computed, the first update parameter indicating a scale factor of the new quantization scaling matrix with respect to the old quantization scaling matrix, and the second update parameter indicating a degree of variation in values constituting the new quantization scaling matrix, and

in said generating, the first update parameter and the second update parameter are included in the coded stream.

[Claim 12] The image coding method according to Claim 11,

wherein in said computing, a prediction matrix is computed using the old quantization scaling matrix, the first update parameter, and the second update parameter, and the first update parameter and the second update parameter are computed so that values of a delta matrix become smallest, the prediction matrix resulting from predicting the new quantization scaling matrix, and the values being a difference between the new quantization scaling matrix and the prediction matrix, and

in said generating, the delta matrix is further included in the coded stream.

[Claim 13] The image coding method according to any one of Claims 10 to 12,

wherein in said generating, identification information for identifying the old quantization scaling matrix obtained in said obtaining is included in the coded stream.

[Claim 14] An image decoding apparatus which decodes a coded image included in a coded stream, said image decoding apparatus comprising:

a matrix obtaining unit configured to obtain an old quantization scaling matrix which is a decoded quantization scaling matrix and is used for decoding a new quantization scaling matrix;

an update parameter obtaining unit configured to obtain, from the coded stream, an update parameter indicating an amount of change in the new quantization scaling matrix with respect to the old quantization scaling matrix;

a matrix decoding unit configured to decode the new quantization

scaling matrix using the old quantization scaling matrix obtained by said matrix obtaining unit and the update parameter obtained by said update parameter obtaining unit; and

an image decoding unit configured to decode the coded image using the new quantization scaling matrix decoded by said matrix decoding unit.

[Claim 15] An image coding apparatus which codes an image, said image coding apparatus comprising:

a matrix obtaining unit configured to obtain an old quantization scaling matrix which is a coded quantization scaling matrix and is used for coding a new quantization scaling matrix;

an update parameter computation unit configured to compute an update parameter indicating an amount of change in the new quantization scaling matrix with respect to the old quantization scaling matrix; and

a coding unit configured to generate a coded stream including (i) an image coded using the new quantization scaling matrix and (ii) the update parameter computed by said update parameter computation unit.

[Claim 16] A computer program for causing a computer to decode a coded image included in a coded stream, said computer program causing the computer to execute:

obtaining an old quantization scaling matrix which is a decoded quantization scaling matrix and is used for decoding a new quantization scaling matrix;

obtaining, from the coded stream, an update parameter indicating an amount of change in the new quantization scaling matrix with respect to the old quantization scaling matrix;

decoding the new quantization scaling matrix using the old quantization scaling matrix obtained in said obtaining of an old quantization scaling matrix and the update parameter obtained in said obtaining of an update parameter; and

decoding the coded image using the new quantization scaling matrix decoded in said decoding of the new quantization scaling matrix.

[Claim 17] A computer program for causing a computer to code an image, said computer program causing the computer to execute:

obtaining an old quantization scaling matrix which is a coded quantization scaling matrix and is used for coding a new quantization scaling matrix;

computing an update parameter indicating an amount of change in the new quantization scaling matrix with respect to the old quantization scaling matrix; and

generating a coded stream including (i) an image coded using the new quantization scaling matrix and (ii) the update parameter computed in said computing.

[Claim 18] An integrated circuit which decodes a coded image included in a coded stream, said integrated circuit comprising:

a matrix obtaining unit configured to obtain an old quantization scaling matrix which is a decoded quantization scaling matrix and is used for decoding a new quantization scaling matrix;

an update parameter obtaining unit configured to obtain, from the coded stream, an update parameter indicating an amount of change in the new quantization scaling matrix with respect to the old quantization scaling matrix;

a matrix decoding unit configured to decode the new quantization scaling matrix using the old quantization scaling matrix obtained by said matrix obtaining unit and the update parameter obtained by said update parameter obtaining unit; and

an image decoding unit configured to decode the coded image using the new quantization scaling matrix decoded by said matrix decoding unit.

[Claim 19] An integrated circuit which codes an image, said integrated circuit comprising:

a matrix obtaining unit configured to obtain an old quantization scaling matrix which is a coded quantization scaling matrix and is used for coding a new quantization scaling matrix;

an update parameter computation unit configured to compute an update parameter indicating an amount of change in the new quantization scaling matrix with respect to the old quantization scaling matrix; and

a coding unit configured to generate a coded stream including (i) an image coded using the new quantization scaling matrix and (ii) the update parameter computed by said update parameter computation unit.