

SPECIFICATION

TITLE OF THE INVENTION

MOVING IMAGE ENCODING DEVICE, MOVING IMAGE DECODING DEVICE,
MOVING IMAGE ENCODING METHOD, ~~AND MOVING IMAGE DECODING METHOD,~~
5 AND IMAGE PREDICTION DEVICE

FIELD OF THE INVENTION

[0001]

The present invention relates to ~~a moving~~ an image
encoding device for and ~~a moving~~ an image encoding method of
10 encoding ~~a moving~~ an image with a high degree of efficiency,
~~and a moving~~ an image decoding device for and ~~a moving~~ an image
decoding method of decoding an encoded ~~moving~~ image with a high
degree of efficiency, and an image prediction device.

BACKGROUND OF THE INVENTION

15 [0002]

For example, in accordance with an international standard
video encoding method, such as MPEG (Moving Picture Experts
Group) or "ITU-T H.26x", an inputted video frame is divided into
rectangular blocks (coding blocks), a prediction process using
20 an already-encoded image signal is carried out on each coding
block to generate a prediction image, and orthogonal
transformation and a quantization process are carried out on
a prediction error signal which is the difference between the
coding block and the prediction image in units of a block in
25 order to compress the information about the inputted video
frame.

[0003]

For example, in the case of AVC/H.264 (ISO/IEC
14496-10|ITU-T H.264) which is an international standard method,
30 an intra prediction process from already-encoded adjacent
pixels or a motion-compensated prediction process between

as shown in Fig. 15 matches the prediction direction, and the signal value in the block is kept constant along the prediction direction.

Related art document

5 Nonpatent reference

[0007]

Nonpatent reference 1: MPEG-4 AVC (ISO/IEC 14496-10) / H. ITU-T 264 standards

SUMMARY OF THE INVENTION

10 PROBLEMS TO BE SOLVED BY THE INVENTION

[0008]

Because the conventional moving image encoding device is constructed as above, the conventional moving image encoding device can predict a frame image with a high degree of accuracy by using a directional prediction when the direction of a boundary (edge) of an object in the target block to be predicted matches the prediction direction, and the signal value in the target block to be predicted is kept constant along the prediction direction. A problem is, however, that when the signal value varies along the prediction direction, as shown in Fig. 16, even if the direction of a boundary (edge) of an object in the target block to be predicted matches the prediction direction, the prediction error becomes large.

[0009]

25 The present invention is made in order to solve the above-mentioned problem, and it is therefore an object of the present invention to provide ~~a moving an~~ an image encoding device, ~~a moving an~~ an image decoding device, ~~a moving an~~ an image encoding method, ~~and a moving an~~ an image decoding method, and an image
30 prediction device capable of implementing a high-accuracy prediction even when the signal value varies

along the prediction direction, thereby being able to improve the image quality.

MEANS FOR SOLVING THE PROBLEM

[0010]

5 In accordance with the present invention, there is provided a ~~moving~~ an image encoding device in which when an intra-frame prediction process ~~at a time of generating a prediction image is~~ parameter indicates a horizontal ~~one~~ prediction process, an intra prediction unit adds a value proportional to a change in a horizontal direction of the luminance values of pixels adjacent to the top of each ~~prediction~~ block, which is a unit for prediction process of a coding block, to the luminance value of a pixel adjacent to the left of the ~~prediction~~ block to ~~determine~~ set the result of the addition as a predicted value of ~~the~~ a prediction image, whereas when the intra-frame prediction process ~~at the time of~~ generating the prediction image is parameter indicates a vertical ~~one~~ prediction process, the intra prediction unit adds a value proportional to a change in a vertical direction of the luminance values of pixels adjacent to the left of the ~~prediction~~ block to the luminance value of the pixel adjacent to the top of the ~~prediction~~ block to ~~determine~~ set the result of the addition as a predicted value of the prediction image.

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ADVANTAGES OF THE INVENTION

[0011]

Because the ~~moving~~ image encoding device according to the present invention is constructed in such a way that, when the intra-frame prediction process ~~at the time of generating the prediction image is~~ parameter indicates a horizontal ~~one~~ prediction process, the intra prediction unit adds a value proportional to a change in the horizontal direction of the luminance values of the pixels adjacent to the top of each ~~prediction~~ block to the luminance value of the pixel

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adjacent to the left of the ~~prediction~~ block to ~~determine~~ set the result of the addition as a predicted value of the prediction image, whereas when the intra-frame prediction ~~process at the time of generating the prediction image is~~ parameter indicates a vertical ~~one~~ prediction process, the intra prediction unit adds a value proportional to a change in the vertical direction of the luminance values of pixels adjacent to the left of the ~~prediction~~ block to the luminance value of the pixel adjacent to the top of the ~~prediction~~ block to ~~determine~~ set the result of the addition as a predicted value of the prediction image, there is provided an advantage of being able to implement a high-accuracy prediction, thereby improving the image quality, even when the signal value varies along the prediction direction.

15 BRIEF DESCRIPTION OF THE FIGURES

[0012]

[Fig. 1] Fig. 1 is a block diagram showing a moving image encoding device in accordance with Embodiment 1 of the present invention;
 [Fig. 2] Fig. 2 is a flow chart showing a process (moving image coding method) carried out by the moving image encoding device in accordance with Embodiment 1 of the present invention;
 [Fig. 3] Fig. 3 is a block diagram showing a moving image decoding device in accordance with Embodiment 1 of the present invention;
 [Fig. 4] Fig. 4 is a flow chart showing a process (moving image decoding method) carried out by the moving image decoding device in accordance with Embodiment 1 of the present invention;
 [Fig. 5] Fig. 5 is an explanatory drawing showing an example in which each largest coding block is divided hierarchically into a plurality of coding blocks;
 [Fig. 6] Fig. 6(a) is an explanatory drawing showing a distribution of coding blocks and prediction blocks into which

CLAIMS

[1] A moving image decoding device comprising an intra prediction unit for, when an encoding mode associated with a variable-length-decoded coding block is an intra encoding mode, carrying out an intra-frame prediction process corresponding to an intra prediction parameter on each block, which is a unit for prediction process of the coding block shown by said intra encoding mode, said intra prediction parameter being used for said each block, to generate a prediction image, wherein when the intra-frame prediction process shown by said intra prediction parameter is a horizontal one, said intra prediction unit adds a value proportional to a change in a horizontal direction of luminance values of pixels adjacent to top of said each block to a luminance value of a pixel adjacent to left of said each block to determine a result of the addition as a predicted value of said prediction image.

[2] A moving image decoding device comprising an intra prediction unit for, when an encoding mode associated with a variable-length-decoded coding block is an intra encoding mode, carrying out an intra-frame prediction process corresponding to an intra prediction parameter on each block, which is a unit for prediction process of the coding block shown by said intra encoding mode, said intra prediction parameter being used for said each block, to generate a prediction image, wherein when the intra-frame prediction process shown by said intra prediction parameter is a vertical one, said intra prediction unit adds a value proportional to a change in a vertical direction of luminance values of pixels adjacent to left of said each block to a luminance value of a pixel adjacent to top of said each block to determine a result of the addition as a

predicted value of said prediction image.

[3] The moving image decoding device according to claim 1, wherein when the intra-frame prediction process shown by the intra prediction parameter is a horizontal one, the intra prediction unit adds a value calculated by multiplying the change in the horizontal direction of the luminance values of the pixels adjacent to the top of said each block by a scaling value set for each row of said each block to the luminance value of the pixel adjacent to the left of said each block to determine the result of the addition as the predicted value of said prediction image.

[4] The moving image decoding device according to claim 3, wherein the scaling value associated with each row which is used when the intra prediction unit carries out the horizontal prediction process is set to be a smaller value with distance from the pixels adjacent to the top of said each block.

[5] The moving image decoding device according to claim 3, wherein the variable length decoding unit variable-length-decodes information for defining the scaling value set for each row of said each block.

[6] The moving image decoding device according to claim 1, wherein when the intra-frame prediction process shown by the intra prediction parameter is a horizontal one, for each of a predetermined number of rows extending horizontally, the rows being numbered from the one at an upper end of said each block, the intra prediction unit adds the value proportional to the change in the horizontal direction of the luminance values of the pixels adjacent to the top of said each block to the luminance value of the pixel adjacent to the left of said each block to determine the result of the addition as the predicted value of

said prediction image, and, for each of remaining rows in said each block, the intra prediction unit determines the luminance value of the pixel adjacent to the left of said each block as the predicted value of said prediction image.

5 [7] The moving image decoding device according to claim 6, wherein the variable length decoding unit variable-length-decodes intra-block information for specifying the rows for each of which the result of the addition of the value proportional to the change in the horizontal
10 direction of the luminance values of the pixels adjacent to the top of said each block and the luminance value of the pixel adjacent to the left of said each block is determined as the predicted value.

[8] The moving image decoding device according to claim 1,
15 wherein when the intra-frame prediction process shown by the intra prediction parameter is a horizontal one and said each block has a block size smaller than a predetermined block size, the intra prediction unit adds the value proportional to the change in the horizontal direction of the luminance values of
20 the pixels adjacent to the top of said each block to the luminance value of the pixel adjacent to the left of said each block to determine the result of the addition as a predicted value of said prediction image, whereas when the intra-frame prediction process shown by the intra prediction parameter indicates is
25 a horizontal one and said each block has a block size equal to or larger than the predetermined block size, determines the luminance value of the pixel adjacent to the left of said each block as a predicted value of said prediction image.

[9] The moving image decoding device according to claim 1,
30 wherein when the intra-frame prediction process shown by the

intra prediction parameter is a horizontal one, the intra prediction unit uses a value which is acquired by right shifting the change in the horizontal direction of the luminance values of the pixels adjacent to the top of said each block by one bit as the value proportional to the change in the horizontal direction of the luminance values of the pixels adjacent to the top of said each block.

[10] The moving image decoding device according to claim 1, wherein when the intra-frame prediction process shown by the intra prediction parameter is a horizontal one, and coordinates of a pixel at an upper left corner of said each block are set to be a point of origin (0, 0) and coordinates of each pixel for which a predicted value is calculated are expressed as (x, y), the intra prediction unit sets a luminance value of a pixel at coordinates (-1, y) as the luminance value of the pixel adjacent to the left of said each block, and sets a value which is acquired by subtracting a luminance value of a pixel at coordinates (-1, -1) from a luminance value of a pixel at coordinates (x, -1) as the change in the horizontal direction of the luminance values of the pixels adjacent to the top of said each block.

[11] A moving image encoding device comprising an intra prediction unit for, when an intra encoding mode is selected as an encoding mode corresponding to a coding block, carrying out an intra-frame prediction process corresponding to an intra prediction parameter on each block, which is a unit for prediction process of the coding block shown by said intra encoding mode, said intra prediction parameter being used for said each block, to generate a prediction image, wherein when the intra-frame prediction process shown by said intra

prediction parameter is a horizontal one, said intra prediction unit adds a value proportional to a change in a horizontal direction of luminance values of pixels adjacent to top of said each block to a luminance value of a pixel adjacent to left of said each block to determine a result of the addition as a predicted value of said prediction image.

[12] A moving image encoding device comprising an intra prediction unit for, when an intra encoding mode is selected as an encoding mode corresponding to a coding block, carrying out an intra-frame prediction process corresponding to an intra prediction parameter on each block, which is a unit for prediction process of the coding block shown by said intra encoding mode, said intra prediction parameter being used for said each block, to generate a prediction image, wherein when the intra-frame prediction process shown by said intra prediction parameter is a vertical one, said intra prediction unit adds a value proportional to a change in a vertical direction of luminance values of pixels adjacent to left of said each block to a luminance value of a pixel adjacent to top of said each block to determine a result of the addition as a predicted value of said prediction image.

[13] The moving image encoding device according to claim 11, wherein when the intra-frame prediction process shown by said intra prediction parameter is a horizontal one, the intra prediction unit adds a value calculated by multiplying the change in the horizontal direction of the luminance values of the pixels adjacent to the top of said each block by a scaling value set for each row of said each block to the luminance value of the pixel adjacent to the left of said each block to determine the result of the addition as the predicted value of said

prediction image.

[14] The moving image encoding device according to claim 13, wherein the scaling value associated with each row which is used when the intra prediction unit carries out the horizontal prediction process is set to be a smaller value with distance
5 from the pixels adjacent to the top of said each block.

[15] The moving image encoding device according to claim 13, wherein the variable length encoding unit variable-length-encodes information for defining the scaling value set for each row of said each block, and generates the
10 bitstream into which encoded data of said information for defining said scaling value, the encoded data of the compressed data, and the encoded data of the encoding mode are multiplexed.

[16] The moving image encoding device according to claim 11, wherein when the intra-frame prediction process shown by the
15 intra prediction parameter is a horizontal one, for each of a predetermined number of rows extending horizontally, the rows being numbered from the one at an upper end of said each block, the intra prediction unit adds the value proportional to the change in the horizontal direction of the luminance values of
20 the pixels adjacent to the top of said each block to the luminance value of the pixel adjacent to the left of said each block to determine the result of the addition as the predicted value of said prediction image, and, for each of remaining rows in said
25 each block, the intra prediction unit determines the luminance value of the pixel adjacent to the left of said each block as the predicted value of said prediction image.

[17] The moving image encoding device according to claim 16, wherein the variable length encoding unit
30 variable-length-encodes intra-block information for

specifying the rows for each of which the result of the addition of the value proportional to the change in the horizontal direction of the luminance values of the pixels adjacent to the top of said each block and the luminance value of the pixel adjacent to the left of said each block is determined as the predicted value, and generates the bitstream into which encoded data of said intra-block information, the encoded data of the compressed data, and the encoded data of the encoding mode are multiplexed.

10 [18] The moving image encoding device according to claim 11, wherein when the intra-frame prediction process shown by the intra prediction parameter is a horizontal one and said each block has a block size smaller than a predetermined block size, the intra prediction unit adds the value proportional to the change in the horizontal direction of the luminance values of the pixels adjacent to the top of said each block to the luminance value of the pixel adjacent to the left of said each block to determine the result of the addition as a predicted value of said prediction image, whereas when the intra-frame prediction process shown by the intra prediction parameter indicates is
15 a horizontal one and said each block has a block size equal to or larger than the predetermined block size, determines the luminance value of the pixel adjacent to the left of said each block as a predicted value of said prediction image.

25 [19] The moving image encoding device according to claim 11, wherein when the intra-frame prediction process shown by the intra prediction parameter is a horizontal one, the intra prediction unit uses a value which is acquired by right shifting the change in the horizontal direction of the luminance values of the pixels adjacent to the top of said each block by one bit
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as the value proportional to the change in the horizontal direction of the luminance values of the pixels adjacent to the top of said each block.

[20] The moving image encoding device according to claim 11,
5 wherein when the intra-frame prediction process shown by the intra prediction parameter is a horizontal one, and coordinates of a pixel at an upper left corner of said each block are set to be a point of origin (0, 0) and coordinates of each pixel for which a predicted value is calculated are expressed as (x,
10 y), the intra prediction unit sets a luminance value of a pixel at coordinates (-1, y) as the luminance value of the pixel adjacent to the left of said each block, and sets a value which is acquired by subtracting a luminance value of a pixel at coordinates (-1, -1) from a luminance value of a pixel at
15 coordinates (x, -1) as the change in the horizontal direction of the luminance values of the pixels adjacent to the top of said each block.

[21] A moving image encoding method comprising an intra prediction processing step of, when an intra encoding mode is
20 selected as an encoding mode corresponding to a coding block, an intra prediction unit carrying out an intra-frame prediction process corresponding to an intra prediction parameter on each block, which is a unit for prediction process of the coding block shown by said intra encoding mode, to generate a
25 prediction image, wherein said intra prediction processing step includes a step of, when the intra-frame prediction process shown by said intra prediction parameter is a horizontal one, adding a value proportional to a change in a horizontal direction of luminance values of pixels adjacent to top of said
30 each block to a luminance value of a pixel adjacent to left

of said each block to determine a result of the addition as a predicted value of said prediction image.

[22] A moving image encoding method comprising an intra prediction processing step of, when an intra encoding mode is selected as an encoding mode corresponding to a coding block, an intra prediction unit carrying out an intra-frame prediction process corresponding to an intra prediction parameter on each block, which is a unit for prediction process of the coding block shown by said intra encoding mode, to generate a prediction image, wherein said intra prediction processing step includes a step of, when the intra-frame prediction process shown by said intra prediction parameter is a vertical one, adding a value proportional to a change in a vertical direction of luminance values of pixels adjacent to left of said each block to a luminance value of a pixel adjacent to top of said each block to determine a result of the addition as a predicted value of said prediction image.

[23] A moving image decoding method comprising an intra prediction processing step of, when an encoding mode associated with a variable-length-decoded coding block is an intra encoding mode, an intra prediction unit carrying out an intra-frame prediction process corresponding to an intra prediction parameter on each block, which is a unit for prediction process of the coding block shown by said intra encoding mode, to generate a prediction image, wherein said intra prediction processing step includes a step of, when the intra-frame prediction process shown by said intra prediction parameter is a horizontal one, adding a value proportional to a change in a horizontal direction of luminance values of pixels adjacent to top of said each block to a luminance value of a

pixel adjacent to left of said each block to determine a result of the addition as a predicted value of said prediction image.

[24] A moving image decoding method comprising an intra prediction processing step of, when an encoding mode associated with a variable-length-decoded coding block is an intra encoding mode, an intra prediction unit carrying out an intra-frame prediction process corresponding to an intra prediction parameter on each block, which is a unit for prediction process of the coding block shown by said intra encoding mode, to generate a prediction image, wherein said intra prediction processing step includes a step of, when the intra-frame prediction process shown by said intra prediction parameter is a vertical one, adding a value proportional to a change in a vertical direction of luminance values of pixels adjacent to left of said each block to a luminance value of a pixel adjacent to top of said each block to determine a result of the addition as a predicted value of said prediction image.

[25] A moving image decoding device comprising an intra prediction unit for, when an encoding mode associated with a variable-length-decoded coding block is an intra encoding mode, carrying out an intra-frame prediction process to generate a prediction image.

CLAIMS

[1] An image decoding device comprising an intra prediction unit for, when an encoding mode associated with a coding block is an intra encoding mode, carrying out an intra-frame prediction process on each block to generate a prediction image, said block being a unit for prediction process of said coding block, said intra prediction unit, when an intra prediction parameter indicates a horizontal prediction process, adding a value to a luminance value of a pixel adjacent to left of said each block and setting a result of the addition as a predicted value of said prediction image, the value being proportional to a change in a horizontal direction of luminance value of pixels adjacent to top of said each block.

[2] The image decoding device according to claim 1, wherein when said intra prediction parameter indicates a horizontal ~~one~~ prediction process, and coordinates of a pixel at an upper left corner of said each block are set to be a point of origin (0, 0) and coordinates of each pixel for which a predicted value is calculated are expressed as (x, y), said intra prediction unit sets a luminance value of a pixel at coordinates (-1, y) as the luminance value of the pixel adjacent to the left of said each block, and sets a value which is acquired by subtracting a luminance value of a pixel at coordinates (-1, -1) from a luminance value of a pixel at coordinates (x, -1) as the change in the horizontal direction of the luminance values of the pixels adjacent to the top of said each block.

[3] An image encoding device comprising an intra prediction unit for, when an encoding mode corresponding to a coding block is an intra encoding mode, carrying out an intra-frame prediction process on each block to generate a prediction image, said block

being a unit for prediction process of said coding block, said intra prediction unit, when an intra prediction parameter indicates a horizontal prediction process, adding a value to a luminance value of a pixel adjacent to left of said each block and setting a result of the addition as a predicted value of
5 said prediction image, the value being proportional to a change in a horizontal direction of luminance value of pixels adjacent to top of said each block.

[4] The image encoding device according to claim 11, wherein
10 when said intra prediction parameter indicates a horizontal prediction process, and coordinates of a pixel at an upper left corner of said each block are set to be a point of origin (0, 0) and coordinates of each pixel for which a predicted value is calculated are expressed as (x, y), said intra prediction
15 unit sets a luminance value of a pixel at coordinates (-1, y) as the luminance value of the pixel adjacent to the left of said each block, and sets a value which is acquired by subtracting a luminance value of a pixel at coordinates (-1, -1) from a luminance value of a pixel at coordinates (x, -1) as the change
20 in the horizontal direction of the luminance values of the pixels adjacent to the top of said each block.

[5] An image encoding method comprising an intra prediction processing step of, when an encoding mode—associated with a coding block is an intra encoding mode, an intra prediction unit
25 carrying out an intra-frame prediction process on each block to generate a prediction image, said block being a unit for prediction process of said coding block, when an intra prediction parameter indicates a horizontal prediction process, adding a value to a luminance value of a pixel adjacent
30 to left of said each block and setting a result of the addition

as a predicted value of said prediction image, the value being proportional to a change in a horizontal direction of luminance values of pixels adjacent to top of said each block.

[6] An image decoding method comprising an intra prediction processing step of, when an encoding mode associated with a variable-length-decoded coding block is an intra encoding mode, an intra prediction unit carrying out an intra-frame prediction process on each block to generate a prediction image, said block being a unit for prediction process of said coding block when an intra prediction parameter indicates a horizontal prediction process, adding a value to a luminance value of a pixel adjacent to left of said each block and setting a result of the addition as a predicted value of said prediction image, the value being proportional to a change in a horizontal direction of luminance values of pixels adjacent to top of said each block.

[7] An image decoding device comprising an intra prediction unit for carrying out an intra-frame prediction process to generate a prediction image.