SPECIFICATION

TITLE OF THE INVENTION

~~VIDEO~~ IMAGE DECODING DEVICE, ~~VIDEO~~ IMAGE ENCODING DEVICE, ~~VIDEO~~ IMAGE DECODING METHOD, AND ~~VIDEO~~ IMAGE ENCODING METHOD

FIELD OF THE INVENTION

[0001]

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

BACKGROUND OF THE INVENTION

[0002]

Conventionally, in accordance with an international standard video encoding method, such as MPEG or ITU-T H.26x, after an inputted video frame is partitioned into macroblocks each of which consists of blocks of 16x16 pixels and a motion-compensated prediction is carried out on each of the macroblocks, information compression is carried out on the inputted video frame by carrying out orthogonal transformation and quantization on a prediction error signal on a per block basis. A problem is, however, that as the compression ratio becomes high, the compression efficiency is reduced because of degradation in the quality of a prediction reference image used when carrying out a motion-compensated prediction. To solve this problem, in accordance with an encoding method such as MPEG-4 AVC/H.264 (refer to nonpatent reference 1), by carrying out an in-loop blocking filtering process, a block distortion occurring in a prediction reference image and caused by quantization of orthogonal transformation coefficients is

264 standards

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0014]

Because the conventional ~~video~~ image encoding device is constructed as above, the high accuracy distortion compensation according to the locality of an image to be encoded can be implemented. A problem is, however, that because a class classification is carried out by using a method predetermined according to the motion information and the local signal characteristics of the image, the effect of the filtering process differs greatly depending upon the image to be encoded, and an image in which the distortion compensation effect caused by the filtering process is hardly exerted against distortions is generated.

[0015]

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 video~~an image decoding device, ~~a video~~an image encoding device, ~~a video~~an image decoding method, and ~~a video~~an image encoding method capable of improving the accuracy of improvement of image quality.

MEANS FOR SOLVING THE PROBLEM

[0016]

In accordance with the present invention, there is provided a video decoding device ~~in which a filter carries out a pixel adaptive offset process of performing a class classification of each pixel in a decoded image generated by a decoded image generator into one class for each coding block having a largest size by using a class classifying method, and~~

~~adding an offset of each class to the pixel value of each pixel belonging to the above-mentioned class~~including: a variable length decoder that variable-length-decodes compressed data associated with each of coding blocks hierarchically partitioned from encoded data multiplexed into a bitstream and also variable-length-decodes filter parameters for each coding block having a largest size from the encoded data; a predictor that carries out a prediction process on the coding block to generate a prediction image; a difference image generator that generates a difference image from the compressed data; a decoded image generator that adds the difference image and the prediction image to generate a decoded image; and a filter that carries out a filtering process using the filter parameters on the decoded image and outputs the decoded image filtering-processed thereby, in which the variable length decoder variable-length-decodes a flag disposed for each coding block having the largest size and indicating whether filter parameters for a coding block to be decoded having the largest size are the same as those for another coding block having the largest size and adjacent to top or left, and, when the flag indicates that the parameters are the same as those for the other coding block, sets the filter parameters of the other coding block having the largest size and adjacent to top or left as the filter parameters for the coding block to be decoded having the largest size.

ADVANTAGES OF THE INVENTION

[0017]

In accordance with the present invention, ~~the filter carries out the pixel adaptive offset process of performing a class classification of each pixel in the decoded image generated by the decoded image generator into one class for each coding block having the largest size by using a class classifying method, and adding the offset of each class to the pixel value of each pixel belonging to the above-mentioned class~~the video decoding device is constructed in such a way that the video decoding device includes: the variable length decoder that variable-length-decodes compressed data associated with each of coding blocks hierarchically partitioned from encoded data multiplexed into a bitstream and also variable-length-decodes filter parameters for each coding block having a largest size from the encoded data; the predictor that carries out a prediction process on the coding block to generate a prediction image; the difference image generator that generates a difference image from the compressed data; the decoded image generator that adds the difference image and the prediction image to generate a decoded image; and the filter that carries out a filtering process using the filter parameters on the decoded image and outputs the decoded image filtering-processed thereby, and the variable length decoder variable-length-decodes the flag disposed for each coding block having the largest size and indicating whether filter parameters for a coding block to be decoded having the largest size are the same as those for another coding block having the largest size and adjacent to top or left, and, when the flag indicates that the parameters are the same as those for the other coding block, sets the filter parameters of the other coding

block having the largest size and adjacent to top or left as the filter parameters for the coding block to be decoded having the largest size. Therefore, there is provided an advantage of being able to improve the accuracy of improvement of image quality.

BRIEF DESCRIPTION OF THE FIGURES

[0018]

[Fig. 1] Fig. 1 is a block diagram showing a video encoding device in accordance with Embodiment 1 of the present invention;

[Fig. 2] Fig. 2 is a flow chart showing processing (video encoding method) carried out by the video encoding device in accordance with Embodiment 1 of the present invention;

[Fig. 3] Fig. 3 is a block diagram showing a video decoding device in accordance with Embodiment 1 of the present invention;

[Fig. 4] Fig. 4 is a flow chart showing processing (video decoding method) carried out by the video 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 partitioned 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 after

CLAIMS

[1] An image decoding device comprising:

a variable length decoder that variable-length-decodes compressed data associated with each of coding blocks hierarchically partitioned from encoded data multiplexed into a bitstream and also variable-length-decodes filter parameters for each coding block having a largest size from said encoded data;

a predictor that carries out a prediction process on said coding block to generate a prediction image;

a difference image generator that generates a ~~pre-compressed~~ difference image from ~~the~~ said compressed data ~~associated with the coding block variable-length-decoded by said variable length decoder~~;

a decoded image generator that adds ~~the~~ said difference image ~~generated by said difference image generator~~ and ~~the~~ said prediction image ~~generated by said predictor~~ to generate a decoded image; and

a filter that carries out a filtering process using said filter parameters on ~~the~~ said decoded image ~~generated by said decoded image generator~~ and outputs the decoded image filtering-processed thereby ~~as a reproduced image~~, wherein

said variable length decoder variable-length-decodes a flag disposed for each coding block having said largest size and indicating whether filter parameters for a coding block to be decoded having said largest size are same as those for another coding block having said largest size and adjacent to top or left ~~of the coding block having said largest size~~, and, when ~~the~~ said flag indicates that the parameters are the same as those for the other coding block, sets the ~~corresponding~~ filter parameters of the other coding block having said largest size and adjacent to top or left as the filter parameters for the coding block to be decoded

having said largest size.

[2] The image decoding device according to claim 1, wherein said variable length decoder variable-length-decodes the filter parameters for each coding block having said largest size, an index indicating a class classifying method, and an offset of each class, and said filter carries out a pixel adaptive offset process of performing a class classification of each pixel in the decoded image generated by said decoded image generator into one class for each coding block having the largest size by using the class classifying method specified by the index indicating said class classifying method, and adding the offset of said each class to a pixel value of each pixel belonging to the corresponding class.

[3] The image decoding device according to claim 2, wherein said variable length decoder variable-length-decodes a coding mode associated with each of the coding blocks hierarchically partitioned from the encoded data multiplexed into the bitstream, and wherein said video decoding device includes an intra predictor that, when said coding mode is an intra coding mode, carries out an intra-frame prediction process corresponding to said intra coding mode on each prediction block which is a unit for prediction process at a time of carrying out the prediction process on said coding block to generate a prediction image, and the said decoded image generator adds the difference image generated by said difference image generator and the prediction image generated by said intra predictor to generate the decoded image.

[4] The image decoding device according to claim 3, wherein said video decoding device includes a motion-compensated predictor that, when the coding mode

associated with the coding block variable-length-decoded by said variable length decoder is an inter coding mode, carries out a motion-compensated prediction process on each prediction block, which is a unit for prediction process at a time of carrying out the prediction process on the coding block, by using a reference image to generate a prediction image, and said decoded image generator adds the difference image generated by said difference image generator and the prediction image generated by said intra predictor or said motion-compensated predictor to generate the decoded image and said filter carries out the filtering process on the decoded image acquired by said decoded image generator and outputs the decoded image filtering-processed thereby to said motion-compensated predictor as a reference image.

[5] The image decoding device according to claim 4, wherein said variable length decoder variable-length-decodes block partitioning information from the encoded data multiplexed into the bitstream, and variable-length-decodes compressed data, a coding mode, a prediction parameter showing an intra prediction parameter or an inter prediction parameter, a quantization parameter, and a transformation block size which are associated with each coding block which is driven from said block partitioning information, and said difference image generator inverse-quantizes the compressed data associated with the coding block variable-length-decoded by said variable length decoder by using the quantization parameter associated with said coding block and carries out an inverse transformation process on the compressed data inverse-quantized thereby for each block having said transformation block size to generate the pre-compressed difference image.

[6] An image encoding device comprising:

a coding parameter determinator that determines a largest size of a coding block which is a unit to be processed at a time when an encoding process is carried out;

a block partitioner that partitions an inputted image into coding blocks each having the largest size determined by said coding parameter determinator, and also partitions each of said coding blocks hierarchically;

a predictor that carries out a prediction process on said coding block to generate a prediction image;

a difference image generator that generates a difference image between an inputted image of said ~~the~~ coding block ~~partitioned by said block partitioner~~ and ~~the~~ said prediction image ~~generated by said predictor~~;

an image compressor that compresses ~~the~~ said difference image ~~generated by said difference image generator~~ and outputs compressed data about said difference image;

a local decoded image generator that decodes ~~the~~ said compressed data ~~generated by said image compressor~~ and adds the difference image decoded and ~~the~~ said prediction image ~~generated by said predictor~~ to generate a local decoded image;

a filter that carries out a filtering process on ~~the~~ said local decoded image ~~generated by said local decoded image generator~~; and

a variable length encoder that variable-length-encodes said compressed data and filter parameters for each coding block having the largest size, and that generates a bitstream into which encoded data of said compressed data and encoded data of said filter parameters are multiplexed, wherein

said variable length encoder variable-length-encodes a flag disposed for each coding block having said largest size and indicating whether filter parameters for a coding block to be encoded having said largest size are same as those for another coding block having said largest size and adjacent to top or left ~~of the coding block having said largest size~~.

[7] The image encoding device according to claim 6, wherein said filter carries out a pixel adaptive offset process of determining a class classifying method for each coding block having the largest size determined by said coding parameter determinator, performing a class classification of each pixel of the local decoded image in the coding block having the largest size into one class by using said class classifying method, and adding an offset of each class to a pixel value of each pixel belonging to said class, and wherein said variable length encoder encodes, as filter parameters, the index indicating the class classifying method which is determined for each coding block having the largest size by said filter and the offset of each class for each coding block having the largest size.

[8] The image encoding device according to claim 7, wherein said video encoding device includes an intra predictor that, when an intra coding mode is assigned by said coding parameter determinator as the coding mode corresponding to the coding block partitioned by said block partitioner, carries out an intra-frame prediction process corresponding to said intra coding mode on each prediction block which is a unit for prediction process at a time of carrying out the prediction process on said coding block to generate a prediction image, and wherein said difference image generator generates a difference image between the coding block partitioned by said block partitioner and the prediction image generated by said

intra predictor, and said local decoded image generator adds the difference image decoded and the prediction image generated by said intra predictor to generate the local decoded image.

[9] The image encoding device according to claim 8, wherein said image encoding device includes a motion-compensated predictor that, when an inter coding mode is determined by said coding parameter determinator as the coding mode corresponding to the coding block partitioned by said block partitioner, carries out a motion-compensated prediction process on each prediction block which is a unit for prediction process at a time of carrying out the prediction process on said coding block by using a reference image to generate a prediction image, and wherein ~~a~~ said difference image generator generates a difference image between the coding block partitioned by said block partitioner and the prediction image generated by said motion-compensated predictor, said local decoded image generator adds the difference image decoded and the prediction image generated by said motion-compensated predictor to generate the local decoded image, and said filter that carries out the filtering process on the local decoded image generated by said local decoded image generator, and outputs the local decoded image filtering-processed thereby to said motion-compensated predictor as a reference image.

[10] The image encoding device according to claim 9, wherein said coding parameter determinator determines a quantization parameter and a transformation block partitioning state, which are used when the difference image is compressed, for each coding block, and also determines an intra prediction parameter or an inter prediction parameter, which is used when the prediction process is carried out, for each prediction block

of said coding block, said image compressor carries out the transformation process on the difference image generated by said difference image generator for each transformation block determined by said coding parameter determinator and also quantizes transform coefficients on which said transformation process is carried out by using the quantization parameter determined by said coding parameter determinator and outputs the transform coefficients quantized thereby as the compressed data about said difference image, and said variable length encoder variable-length-encodes the compressed data outputted from said image compressor, the coding mode selected by said coding parameter determinator, a prediction parameter showing the intra prediction parameter or the inter prediction parameter, the quantization parameter and transformation block partitioning information, and the filter parameters used when the filtering process is carried out by said filter to generate the bitstream into which the encoded data of said compressed data, the encoded data of said coding mode, encoded data of said prediction parameter, encoded data of said quantization parameter, encoded data of said transformation block partitioning information, and the encoded data of said filter parameters are multiplexed.

[11] An image decoding method comprising:

a variable length decoding processing step of ~~a variable length decoder~~ variable-length-decoding block partitioning information from encoded data multiplexed into a bitstream and also variable-length-decoding filter parameters for each coding block unit having a largest size from said encoded data;

a prediction processing step of ~~a predictor~~ carrying out a prediction process on said coding block to generate a

prediction image;

a difference image generation processing step of ~~a difference image generator~~ generating a ~~pre-compressed~~ difference image from ~~the~~ said compressed data ~~associated with the coding block variable-length-decoded in said variable length decoding processing step~~;

a decoded image generation processing step of ~~a decoded image generator~~ adding ~~the~~ said difference image ~~generated in said difference image generation processing step~~ and ~~the~~ said prediction image ~~generated in said prediction processing step~~ to generate a decoded image; and

a filtering processing step of ~~a filter~~ carrying out a filtering process on ~~the~~ said decoded image ~~generated in said decoded image generation processing step~~ and outputting the decoded image filtering-processed thereby ~~as a reproduced image~~,

wherein in said variable length decoding processing step, a flag disposed for each coding block having said largest size and indicating whether filter parameters for a coding block to be decoded having said largest size are same as those for another coding block having said largest size and adjacent to top or left ~~of the coding block having said largest size~~ is variable-length-decoded, and, when ~~the~~ said flag indicates that the parameters are the same as those for the other coding block, the ~~corresponding~~ filter parameters of the other coding block having said largest size and adjacent to top or left are set as the filter parameters for the coding block to be decoded having said largest size.

[12] An image encoding method comprising:

a coding parameter determination processing step of ~~a coding parameter determinator~~ determining a largest size of a coding block which is a unit to be processed at a time when an encoding process is carried out;

a block partitioning processing step of a ~~block partitioner~~ partitioning an inputted image into coding blocks each having the largest size determined in said coding parameter determination processing step, and also partitioning each of said coding blocks hierarchically;

a prediction processing step of ~~a prediction~~ process to generate a prediction image;

a difference image generation processing step of ~~a difference image generator~~ generating a difference image between an inputted image of said ~~the~~ coding block ~~partitioned in said block partitioning processing step~~ and ~~the~~ said prediction image ~~generated in said prediction processing step~~;

an image compression processing step of ~~an image compressor~~ compressing ~~the~~ said difference image ~~generated in said difference image generation processing step~~ and outputting compressed data about said difference image;

a local decoded image generation processing step of ~~a local decoded image generator~~ decoding ~~the coding block partitioned in said block partitioning processing step and the~~ said compressed data ~~generated in said image compression processing step~~, and adding the difference image decoded and ~~the~~ said prediction image ~~generated in said prediction processing step~~ to generate a local decoded image;

a filtering processing step of ~~a filter~~ carrying out a filtering process on ~~the~~ said local decoded image ~~generated in said local decoded image generation processing step~~; and

a variable length encoding processing step of ~~a variable length encoder~~ variable-length-encoding said compressed data and filter parameters for each coding block having the largest size which are used when the filtering process is carried out

in said filtering processing step, and generating a bitstream into which encoded data of said compressed data and encoded data of said filter parameters are multiplexed,

wherein in said variable length encoding processing step, a flag disposed for each coding block having said largest size and indicating whether filter parameters for a coding block to be encoded having said largest size are same as those for another coding block having said largest size and adjacent to top or left ~~of the coding block having said largest size~~ are variable-length-encoded.

[13] An image decoding device comprising:

a variable length decoder that variable-length-decodes compressed data associated with each of coding blocks hierarchically partitioned from encoded data multiplexed into a bitstream and also variable-length-decodes, as filter parameters, an index indicating a class classifying method for each coding block having a largest size and an offset of each class for each coding block having the largest size from said encoded data;

a predictor that carries out a prediction process on said coding block to generate a prediction image;

a difference image generator that generates a pre-compressed difference image from the compressed data associated with the coding block variable-length-decoded by said variable length decoder;

a decoded image generator that adds the difference image generated by said difference image generator and the prediction image generated by said predictor to generate a decoded image; and

a filter that carries out a filtering process using said

filter parameters on the decoded image generated by said decoded image generator and outputs the decoded image filtering-processed thereby as a reproduced image, wherein

said filter carries out a pixel adaptive offset process of performing a class classification of each pixel in the decoded image generated by said decoded image generator into one class for each coding block having the largest size by using the class classifying method specified by the index indicating said class classifying method, and adding the offset of each class to a pixel value of each pixel belonging to said class.