CLAIMS

1. An image encoding device comprising:

an image compressor that quantizes transform coefficients of a difference image between an image and a prediction image, and outputs the transform coefficients quantized as compressed data;

a filter that carries out a filtering process on a decoded image which is a result of addition of the difference image decoded from the compressed data and the prediction image; and

an encoder that encodes the compressed data and a filter parameter used when the filtering process is carried out by the filter, and generates a bitstream,

wherein the filter determines a classification method of a class on a coding block having a largest size, carries out a classification on each pixel within the coding block having a largest size by using the classification method, calculates an offset value for each class for the coding block having a largest size, and carries out a pixel adaptive offset process by which the offset value is added to a pixel value of a pixel belonging to a corresponding class,

the encoder variable-length-encodes a parameter associated with a quantization matrix for generating a quantization matrix used when the transform coefficients are quantized by the image compressor, the quantization matrix comprising a scaling value for one of transform coefficients, and an index indicating the classification method of a class on each coding block having the largest size, the classification method being determined by the filter, and variable-length-encodes a parameter of the offset value for each class on a basis of a binarization process using a truncated unary code, and

a maximum of the offset value is determined by a bit depth of decoded image.

2. An image decoding device comprising:

a decoder that decodes compressed data, a filter parameter and a quantization matrix parameter from coded data multiplexed into a bitstream, the quantization matrix parameter being used for generating a quantization

matrix and the quantization matrix comprising a scaling value for one of transform coefficients to be obtained from the compressed data;

a difference image generator that inverse-quantizes the transform coefficients by using the quantization matrix parameter decoded by the decoder, and inverse-transforms the transform coefficients inverse-quantized to generate a difference image; and

a filter that carries out a filtering process on a decoded image which is decoded from the compressed data by using the filter parameter,

wherein the decoder decodes, as the filter parameter, an index indicating a classification method of a class on a coding block having a largest size from the coded data, and decodes a parameter about an offset value for each class on which a binarization process using a truncated unary code is performed,

the filter specifies the classification method of a class on each coding block having the largest size by using the index, carries out a classification on each pixel by using the classification method, calculates a offset value from the parameter about an offset value for each class, and carries out a pixel adaptive offset process by which the offset value is added to a pixel value of a pixel belonging to a corresponding class, and

a maximum of the offset value is determined by a bit depth of decoded image.

CLAIMS

1. An image encoding device comprising:

a filter that carries out a filtering process on a decoded image which is a result of addition of a difference image decoded from compressed data and a prediction image;

an encoder that encodes said compressed data and a filter parameter used when the filtering process is carried out, and generates a bitstream;

a slice partitioner that partitions an inputted image into slices which are a plurality of part images;

a coding parameter determinator that determines the largest size of a coding block which is a unit to be processed when an encoding process is carried out and determines an upper limit on a number of hierarchies when a coding block having the largest size is partitioned hierarchically, and that assigns a coding mode to each of the coding blocks which are partitioned hierarchically;

a block partitioner that partitions a slice which is partitioned by said slice partitioner into coding blocks each having the largest size determined by said coding parameter determinator, and that can partition each of said coding blocks hierarchically into blocks until its number of hierarchies reaches the upper limit on the number of hierarchies which is determined by said coding parameter determinator;

a predictor that carries out a prediction process according to the coding mode assigned by said coding parameter determinator on each of the coding blocks which are partitioned by said block partitioner to generate a prediction image;

a difference image generator that generates a difference image between each of the coding blocks which are partitioned by said block partitioner and the prediction image generated by said predictor;

an image compressor that carries out a transformation process on the difference image generated by said difference image generator and quantizes transform coefficients of said difference image, and that outputs the transform coefficients quantized as compressed data; and

a decoded image generator that decodes the difference image from the compressed data outputted from said image compressor, and adds the difference image decoded and the prediction image generated by said predictor to generate a decoded image, wherein

said filter

determines a classification method of a class on a coding block having a largest size,

carries out a classification on each pixel within said coding block having a largest size by using said classification method,

calculates an offset value for each class for said coding block having largest size, and

carries out a pixel adaptive offset process by which said offset value is added to a pixel value of a pixel belonging to a corresponding class; and

said encoder

encodes an index indicating the classification method determined by said filter,

encodes a parameter about the offset value for each class on a basis of a binarization process using a truncated unary code, and

encodes header information of each slice including information about the partitioning into the slices by said slice partitioner, an index indicating an adaptation parameter set used by a corresponding slice, the compressed data outputted from said image compressor, the coding mode assigned by said coding parameter determinator, a quantization matrix parameter for generating a quantization matrix used when the transform coefficients are quantized by said image compressor, and the filter parameter used when the filtering process is carried out by said filter to generate a coded bitstream into which coded data about said header information, the coded data about said compressed data, coded data about said coding mode, coded data about said quantization matrix parameter, and the coded data about said filter parameter are multiplexed;

the coding parameter determinator determines both a quantization parameter used when the difference image is compressed and a transformation block partitioning state for each of the coding blocks, and determines an intra prediction parameter or an inter prediction parameter used when the prediction process is carried out for each prediction block of said coding block;

the predictor carries out an intra-frame prediction process by using said intra prediction parameter when an intra coding mode is assigned by said coding parameter determinator and carries out a motion-compensated prediction process by using said inter prediction parameter when an inter coding mode is assigned by said coding parameter determinator; and

the image compressor carries out the transformation process on the difference image generated by the difference image generator for each transformation block determined by said coding parameter determinator, and quantizes the transform coefficients of said difference image by using the quantization parameter and the quantization matrix parameter which are determined by said coding parameter determinator and outputs the transform coefficients quantized as the compressed data about said difference image, and, when encoding said compressed data, the coding mode, said quantization matrix parameter, the filter parameter, and the header information of each slice, the encoder encodes the intra prediction parameter or the inter prediction parameter, which is determined by said coding parameter determinator, and transformation block partitioning information to generate the coded bitstream into which the coded data about said compressed data, the coded data about said coding mode, the coded data about said quantization matrix parameter, the coded data about said filter parameter, the coded data about said header information, coded data about said intra prediction parameter or said inter prediction parameter, and coded data about said transformation block partitioning information are multiplexed.

2. The image encoding device according to claim 1, wherein said adaption parameter set includes a flag showing whether or not a parameter associated with a deblocking filtering process exists, and

when said flag shows said parameter exists, said adaptation parameter set further includes said parameter associated with the deblocking filtering process.

3. An image decoding device comprising:

a decoder that decodes compressed data and a filter parameter from coded data multiplexed into a bitstream and decodes header information about each slice, a quantization matrix parameter, and a filter parameter from the coded data multiplexed into the coded bitstream, and that decodes compressed data and a coding mode associated with each of coding blocks which are hierarchically partitioned from said coded data;

a filter that carries out a filtering process on a decoded image decoded from the compressed data by using the filter parameter;

a predictor that carries out a prediction process according to the coding mode decoded by said decoder and associated with the coding block to generate a prediction image;

a difference image generator that inverse-quantizes transform coefficients which are compressed data decoded by said decoder and associated with the coding block by using a quantization parameter and said quantization matrix parameter which are decoded by said decoder, and that inverse-transforms the transform coefficients inverse-quantized to generate a difference image before compression; and

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, wherein

said decoder

decodes, as a filter parameter, an index indicating a classification method of a class on a coding block having a largest size, and

decodes a parameter about an offset value for each class on which a binarization process using a truncated unary code is performed;

said filter

specifies the classification method of a class on the coding block having the largest size by using the index,

carries out a classification on each pixel by using the classification method, and

carries out a pixel adaptive offset process by which said offset value is added to a pixel value of a pixel belonging to a corresponding class;

when decoding the compressed data, the coding mode, and an adaptation parameter set from the coded data multiplexed into the coded bitstream, the decoder decodes an intra

prediction parameter or an inter prediction parameter, and transformation block partitioning information,

when the coding mode decoded by said decoder and associated with the coding block is an intra coding mode, the predictor carries out the intra-frame prediction process by using said intra prediction parameter, and

when the coding mode decoded by said decoder and associated with the coding block is an inter coding mode, carries out the motion-compensated prediction process by using said inter prediction parameter, and the difference image generator inverse-transforms the transform coefficients inverse-quantized for each of transformation blocks acquired from the transformation block partitioning information decoded by said decoder to generate a difference image before compression.

4. The image decoding device according to claim 3, wherein said adaption parameter set includes a flag showing whether or not a parameter associated with a deblocking filtering process exists, and

when said flag shows said parameter exists, said adaptation parameter set further includes said parameter associated with the deblocking filtering process.

5. An image encoding method comprising:

carrying out a filtering process on a decoded image which is a result of addition of a difference image decoded from compressed data about an image and a prediction image;

carrying out an encoding process including encoding said compressed data and a filter parameter used when the filtering process is carried out to generate a bitstream;

partitioning an inputted image into slices which are a plurality of part images;

determining the largest size of a coding block which is a unit to be processed when an encoding process is carried out and determining an upper limit on a number of hierarchies when a coding block having the largest size is partitioned hierarchically, and assigning a coding mode to each of the coding blocks which are partitioned hierarchically;

partitioning a slice which is partitioned into coding blocks each having the largest size, and that can partition each of said coding blocks hierarchically into blocks until its number of hierarchies reaches the upper limit on the number of hierarchies;

carrying out a prediction process according to the assigned coding mode on each of the partitioned coding blocks to generate a prediction image;

generating a difference image between each of the partitioned coding blocks and the generated prediction image;

carrying out a transformation process on the generated difference image and quantizing transform coefficients of said difference image, and outputting the quantizing transform coefficients as compressed data; and

decoding the difference image from the outputted compressed data, and adding the decoded difference image and the generated prediction image to generate a decoded image, wherein

said filtering process includes

determining a classification method of a class on a coding block having a largest size,

carrying out a classification on each pixel within the coding block having the largest size by using said classification method,

calculating an offset value for each class, and

carrying out a pixel adaptive offset process by which said offset value is added to a pixel value of a pixel belonging to a corresponding class,

said encoding process includes

encoding an index indicating the classification method of carrying out a class classification on each coding block having the largest size, the classification method being determined by said filtering process,

encoding a parameter about the offset value for each class on a basis of a binarization process using a truncated unary code,

encoding header information of each slice including information about the partitioning into the slices, an index indicating an adaptation parameter set used by a corresponding slice, the compressed data outputted from said image compressor, the assigned coding mode, a quantization matrix parameter for generating a quantization matrix used when the transform coefficients are quantized by said image compressor, and the filter parameter used when the filtering process is carried out to generate a coded bitstream into which coded data about said header information, the coded data about said compressed data, coded data about said coding mode, coded data about said quantization matrix parameter, and the coded data about said filter parameter are multiplexed;

determining both a quantization parameter used when the difference image is compressed and a transformation block partitioning state for each of the coding blocks, and determining an intra prediction parameter or an inter prediction parameter used when the prediction process is carried out for each prediction block of said coding block; and

carrying out an intra-frame prediction process using said intra prediction parameter when an intra coding mode is assigned and carrying out a motion-compensated prediction process using said inter prediction parameter when an inter coding mode is assigned; and

said transformation process includes using the quantization parameter and the quantization matrix parameter which are determined and outputting the transform coefficients quantized as the compressed data about said difference image, and

when encoding said compressed data, the coding mode, said quantization matrix parameter, the filter parameter, and the header information of each slice, the encoder encodes

the intra prediction parameter or the inter prediction parameter, and transformation block partitioning information to generate the coded bitstream into which the coded data about said compressed data, the coded data about said coding mode, the coded data about said quantization matrix parameter, the coded data about said filter parameter, the coded data about said header information, coded data about said intra prediction parameter or said inter prediction parameter, and coded data about said transformation block partitioning information are multiplexed.

6. An image decoding method comprising:

decoding compressed data and a filter parameter from coded data multiplexed into a bitstream;

decoding header information about each slice, a quantization matrix parameter, and a filter parameter from the coded data multiplexed into the coded bitstream;

decoding compressed data and a coding mode associated with each of coding blocks which are hierarchically partitioned from said coded data;

carrying out a filtering process on a decoded image decoded from the compressed data decoded in said decoding process by using the filter parameter decoded in said decoding process,

decoding, as a filter parameter, an index indicating a classification method of a class on a coding block having a largest size;

decoding a parameter about an offset value for each class on which a binarization process using a truncated unary code is performed;

carrying out a prediction process according to the coding mode decoded by said decoder and associated with the coding block to generate a prediction image;

inverse-quantizing transform coefficients which are compressed data decoded by said decoder and associated with the coding block by using a quantization parameter and said quantization matrix parameter which are decoded by said decoder, and inverse-transforming the transform coefficients inverse-quantized to generate a difference image before compression; and

adding the generated difference image and the generated prediction image to generate a decoded image, wherein said filtering process includes

specifying the classification method of a class on the coding block having the largest size by using the index,

carrying out a class classification on each pixel by using the classification method specified for each coding block having said largest size, and

carrying out a pixel adaptive offset process by which said offset value is added to a pixel value of a pixel belonging to a corresponding class,

when decoding the compressed data, the coding mode, and an adaptation parameter set from the coded data multiplexed into the coded bitstream, an intra prediction parameter or an inter prediction parameter, and transformation block partitioning information are decoded,

when the decoded coding mode associated with the coding block is an intra coding mode, carrying out the intra-frame prediction process using said intra prediction parameter, and

when the decoded coding mode associated with the coding block is an inter coding mode, carrying out the motion-compensated prediction process using said inter prediction parameter, and inverse-transforming the transform coefficients inverse-quantized for each of transformation blocks acquired from the decoded transformation block partitioning information to generate a difference image before compression.

7. The image decoding method according to claim 6, wherein said adaption parameter set includes a flag showing whether or not a parameter associated with a deblocking filtering process exists, and

when said flag shows said parameter exists, said adaptation parameter set further includes said parameter associated with the deblocking filtering process.