DESCRIPTION

Title of Invention

PREDICTIVE ENCODING METHOD, PREDICTIVE ENCODING DEVICE, AND PREDICTIVE ENCODING PROGRAM OF MOTION VECTOR, AND, PREDICTIVE DECODING METHOD, PREDICTIVE DECODING DEVICE, AND PREDICTIVE DECODING PROGRAM OF MOTION VECTOR

Technical Field

[0001] Embodiments of the present invention relate to a predictive encoding method, a predictive encoding device, and a predictive encoding program of motion vector and to a predictive decoding method, a predictive decoding device, and a predictive decoding program of motion vector.

Background Art

[0002] Motion compensated prediction technology is occasionally used in video encoding and video decoding. In the motion compensation technology, a frame of a processing target in a video sequence is divided into a plurality of partitions. These partitions are sequentially selected as a partition of a processing target (target partition). A motion vector is then determined for the target partition. In the motion compensated prediction technology, a motion vector predictor is determined using motion vectors of neighboring partitions to the target partition and the motion vector of the target partition is predictively encoded or predictively decoded in some cases.

[0003] Figs. 1A and 1B are drawings to illustrate rectangular

neighboring partitions used in the motion compensated prediction. In Fig. 1A, the shape of target partition BT is identical to the shape of neighboring partitions BL, BA, and BRA. The left-neighboring partition BL includes a neighboring pixel existing on the left side of the top left pixel in the target partition BT; the above-neighboring partition BA includes a neighboring pixel existing above the top left pixel in the target partition BT; the above-right-neighboring partition BRA includes a neighboring pixel existing above and on the right side of the top right pixel in the target partition BT. The conventional technology H.264/AVC employs a motion vector predictor having median values of horizontal components and vertical components of motion vectors of the left-neighboring partition BL, the above-neighboring partition BA, and the above-right-neighboring partition BRA.

[0004] On the other hand, Fig. 1B illustrates a case where there are a plurality of neighboring partitions having respective shapes different from the shape of the target partition BT. The plurality of neighboring partitions in Fig. 1B include neighboring partitions BL1, BL2, BA1, BA2, BD, and BE, in addition to the left-neighboring partition BL, the above-neighboring partition BA, and the above-right-neighboring partition BRA. According to the technology described in Patent Literature 1, the plurality of neighboring partitions are scanned in a predetermined spatial order to specify a neighboring partition with the best spatial similarity to a pixel signal of the target partition, and a motion vector of the neighboring partition thus specified is used as a motion vector predictor. In the technology of Patent Literature 1, the spatial similarity to be used is the sum of absolute differences (SAD)

between the pixel signal of the target partition and the pixel signal of the neighboring partition.

Citation List

Patent Literature

[0005] Patent Literature 1: Japanese Translation of PCT Application Laid-open No. 2010-515399

Summary of Invention

Technical Problem

[0006] Since the foregoing technology of Patent Literature 1 involves calculating the spatial similarity while scanning the plurality of neighboring partitions in the predetermined order, it requires a considerable number of calculations for determination of the motion vector predictor.

[0007] There are therefore demands for reduction in computational complexity necessary for the determination of the motion vector predictor in the technical fields concerned.

Solution to Problem

[0008] One aspect of the present invention relates to a predictive encoding technology of motion vectors.

[0009] A predictive encoding method of motion vectors according to one aspect of the present invention is a method for predictively encoding a motion vector used in motion compensated prediction of a video sequence consisting of a temporal sequence of frame pictures, comprising: (a) a step of determining a motion vector of a target partition in a frame picture of an encoding target in the video sequence; (b) a step of determining a first motion vector predictor candidate

satisfying a predetermined criterion used for determination of motion vector predictor candidates, from a motion vector or motion vectors of one or more partitions belonging to a left-neighboring region located on the left side of the target partition; (c) a step of determining a second motion vector predictor candidate satisfying a predetermined criterion used for determination of motion vector predictor candidates, from a motion vector or motion vectors of one or more partitions belonging to an above-neighboring region located above the target partition; (d) a step of selecting an optimum motion vector predictor and outputting motion vector predictor indication information to specify the selected optimum motion vector predictor, the optimum motion vector predictor selected based on comparison between one or more motion vector predictor candidates including the first motion vector predictor candidate and the second motion vector predictor candidate, and the motion vector of the target partition; and (e) a step of encoding the motion vector predictor indication information.

[0010] A predictive encoding device of motion vectors according to one aspect of the present invention is a device for predictively encoding a motion vector used in motion compensated prediction of a video sequence consisting of a temporal sequence of frame pictures comprising: motion detection means which determines a motion vector of a target partition in a frame picture of an encoding target in the video sequence; first motion vector predictor candidate determination means which determines a first motion vector predictor candidate satisfying a predetermined criterion used for determination of motion vector predictor candidates from a motion vector, or motion vectors, of one or

more partitions belonging to a left-neighboring region located on the left side of the target partition; second motion vector predictor candidate determination means which determines a second motion vector predictor candidate satisfying a predetermined criterion used for determination of motion vector predictor candidates from a motion vector, or motion vectors, of one or more partitions belonging to an above-neighboring region located above the target partition; motion vector predictor determination means, which selects an optimum motion vector predictor based on comparison between the motion vector of the target partition and one or more motion vector predictor candidates. The one or more motion vector predictor candidates including at least one of the first motion vector predictor candidate, or the second motion vector predictor candidate. The motion vector predictor determination means outputs motion vector predictor indication information to specify the optimum motion vector predictor selected; and encoding means which encodes the motion vector predictor indication information.

[0011] A predictive encoding program of motion vectors according to one aspect of the present invention is a program for causing a computer to operate as a device for predictively encoding a motion vector used in motion compensated prediction of a video sequence consisting of a temporal sequence of frame pictures, the program causing the computer to function as: the motion detection means, the first motion vector predictor candidate determination means, the second motion vector predictor candidate determination means, the motion vector predictor determination means, and the encoding means described above.

[0012] In the predictive encoding technology of motion vectors

according to one aspect of the present invention described above, the motion vector predictor candidates are narrowed down, and thereafter the motion vector predictor is determined based on the comparison between the motion vector of the target partition and the motion vector predictor candidates. Therefore, this technology may reduce the computational complexity necessary for the determination of the motion vector predictor.

[0013] In an embodiment, the predictive encoding technology may be configured as follows: a predicted signal of a pixel signal of a target partition is generated by referring to a reference frame with a frame number specified by a reference picture list identification and a reference picture identification; a first motion vector predictor candidate is determined from motion vectors of partitions in a left-neighboring region having a reference picture list identification and/or a reference picture identification coincident with the reference picture list identification and/or the reference picture identification for the target partition; the second motion vector predictor candidate is determined from motion vectors of partitions in an above-neighboring region having a reference picture list identification and/or a reference picture identification coincident with the reference picture list identification and/or the reference picture identification for the target partition.

[0014] In an embodiment, the motion vector predictor indication information may be encoded into encoded data of a bit count according to the number of motion vector predictor candidates. For example, the motion vector predictor indication information may be encoded into encoded data of a minimum bit count according to the number of

motion vector predictor candidates. This embodiment may reduce the bit count of encoded data of the motion vector predictor indication information.

[0015] In an embodiment, a left-neighboring region may include a neighboring partition located below and on the left side of a target partition. The below-left-neighboring partition is a partition including neighboring pixels existing below and on the left side of a bottom left pixel in the target partition. In this embodiment, the below-left-neighboring partition is included in the left-neighboring region, and the motion vector of the below-left-neighboring partition is not defined as an independent motion vector predictor candidate when the first motion vector predictor candidate is determined from the left-neighboring region. This embodiment may reduce the number of motion vector predictor candidates. As a result, a bit count of encoded data of the motion vector predictor indication information may be reduced.

[0016] In an embodiment, an above-neighboring region may include a neighboring partition located above and on the right side of a target partition. The above-right-neighboring partition is a partition that includes neighboring pixels existing above and on the right side of a top right pixel in the target partition. In this embodiment, the above-right-neighboring partition is included in the above-neighboring region, and a motion vector of the above-right-neighboring partition is not defined as an independent motion vector predictor candidate when the second motion vector predictor candidate is determined from the above-neighboring region. This embodiment may reduce the number

of motion vector predictor candidates. As a result, a bit count of encoded data of the motion vector predictor indication information may be reduced.

[0017] In an embodiment, either a left-neighboring region or an above-neighboring region may include a neighboring partition located above and on the left side of a target partition. The above-left-neighboring partition is a partition that includes neighboring pixels existing above and on the left side of a top left pixel in the target partition. In this embodiment, a motion vector of the above-left-neighboring partition is not defined as an independent motion vector predictor candidate, and a motion vector predictor candidate is determined while the above-left-neighboring partition is included in the left-neighboring region or in the above-neighboring region. This embodiment may reduce the number of motion vector predictor candidates. As a result, s bit count of encoded data of the motion vector predictor indication information may be reduced.

[0018] In an embodiment, a predictive encoding technology may be configured as follows: one or more partitions in a left-neighboring region are scanned in an upward direction from a bottom of the left-neighboring region, whereby a motion vector satisfying a predetermined criterion is determined as the first motion vector predictor candidate from motion vectors of the one or more partitions. The predetermined criterion is used in determination of motion vector predictor candidates. A subsequent scan in the left-neighboring region may be terminated upon detection of the motion vector satisfying the predetermined criterion used in determination of motion vector

predictor candidates. According to knowledge gained by the inventors based on research on a large number of video sequences, a partition, from among the partitions in the left-neighboring region, with a motion vector having a small difference from the motion vector of the target partition tends to exist on the lower side in the left-neighboring region. Therefore, the first motion vector predictor candidate with a small difference from the motion vector of the target partition can be efficiently determined by scanning the left-neighboring region in the foregoing scan order.

[0019] In an embodiment, the predictive encoding technology may be configured as follows: one or more partitions in an above-neighboring region are scanned in a leftward direction from right to left, whereby a motion vector satisfying a predetermined criterion used in determination of motion vector predictor candidates is determined as a second motion vector predictor candidate from motion vectors of the one or more partitions. The subsequent scan in the above-neighboring region may be terminated upon detection of the motion vector satisfying the predetermined criterion used in determination of motion vector predictor candidates. According to the knowledge gained by the inventors based on research on a large number of video sequences, a partition with a motion vector having a small difference from the motion vector of the target partition among the partitions in the above-neighboring region tends to exist on the right side in the above-neighboring region. Therefore, the second motion vector predictor candidate with a small difference from the motion vector of the target partition can be efficiently determined by scanning the

above-neighboring region in the foregoing scan order.

[0020] In an embodiment, the predictive encoding technology may be configured as follows: it comprises determining first scan direction indication information indicative of a direction of scanning one or more partitions included in a left-neighboring region, in order to determine a first motion vector predictor candidate; determining second scan direction indication information indicative of a direction of scanning one or more partitions included in an above-neighboring region, in order to determine a second motion vector predictor candidate; and further encoding the first scan direction indication information and the second scan direction indication information. In this embodiment, the scans are carried out in both the upward and downward directions in the left-neighboring region to select a motion vector satisfying the predetermined criterion used in determination of motion vector predictor candidates. An optimum motion vector from among the motion vectors selected in the upward and downward directions is defined as the first motion vector predictor candidate, and information indicative of the direction of the scan in which the first motion vector predictor candidate is acquired is defined as the first scan direction indication information. Furthermore, the scans are carried out in both the leftward and rightward directions in the above-neighboring region to select the motion vector satisfying the predetermined criterion used indetermination of motion vector predictor candidates. The optimum motion vector, from among the motion vectors selected in the leftward and rightward directions, is defined as the second motion vector predictor candidate and information indicative of the direction of the

scan in which the second motion vector predictor candidate is acquired is defined as the second scan direction indication information. This embodiment permits achievement of further improvement in encoding efficiency by determination of the first motion vector predictor candidate and the second motion vector predictor candidate.

[0021] In an embodiment, the number of one or more motion vector predictor candidates may be not more than 3. This embodiment may further reduce the bit count of encoded data of the motion vector predictor indication information.

[0022] In an embodiment, an optimum motion vector predictor may be used as a motion vector of a target partition, without encoding a residual signal between the motion vector of the target partition and the optimum motion vector predictor. This embodiment may further improve the encoding efficiency because the residual signal of the motion vector is not encoded.

[0023] Another aspect of the present invention relates to a predictive decoding technology of motion vectors.

[0024] A method for predictively decoding a motion vector according to one aspect of the present invention is a method for predictively decoding a motion vector used in motion compensated prediction to restore a video sequence consisting of a temporal sequence of frame pictures. The method comprises: (a) a step of determining a first motion vector predictor candidate that satisfies a predetermined criterion used in determination of motion vector predictor candidates, the first motion vector predictor candidate determined from a motion vector or motion vectors of one or more partitions included in a

left-neighboring region located on the left side of a target partition in a frame picture of a decoding target; (b) a step of determining a second motion vector predictor candidate that satisfies a predetermined criterion used in determination of motion vector predictor candidate, the second motion vector predictor candidate determined from a motion vector or motion vectors of one or more partitions included in an above-neighboring region located above the target partition; (c) a step of decoding encoded data to restore motion vector predictor indication information specifying an optimum motion vector predictor for the target partition; and (d) a step of selecting the optimum motion vector predictor specified by the motion vector predictor indication information, from one or more motion vector predictor candidates, the one or more motion vector predictor candidates including at least the first motion vector predictor candidate and the second motion vector predictor candidate.

[0025] A device for predictively decoding a motion vector according to one aspect of the present invention is a device for predictively decoding a motion vector used in motion compensated prediction to restore a video sequence consisting of a temporal sequence of frame pictures. The device comprises: first motion vector predictor candidate determination means, which determines a first motion vector predictor candidate that satisfies a predetermined criterion used in determination of motion vector predictor candidates from a motion vector or motion vectors of one or more partitions belonging to a left-neighboring region located on the left side of a target partition in a frame picture of a decoding target; second motion vector predictor candidate

determination means, which determines a second motion vector predictor candidate that satisfies a predetermined criterion used in determination of motion vector predictor candidates from a motion vector or motion vectors of one or more partitions belonging to an above-neighboring region located above the target partition; decoding means which decodes encoded data to restore motion vector predictor indication information to specify an optimum motion vector predictor for the target partition; and optimum motion vector predictor determination means which selects the optimum motion vector predictor specified by the motion vector predictor indication information. The optimum motion vector predictor is selected from one or more motion vector predictor candidates including at least the first motion vector predictor candidate and the second motion vector predictor candidate.

[0026] A program for predictively decoding a motion vector according to one aspect of the present invention is a program for causing a computer to operate as a device for predictively decoding a motion vector used in motion compensated prediction to restore a video sequence consisting of a temporal sequence of frame pictures. The program causes the computer to function as: the first motion vector predictor candidate determination means, the second motion vector predictor candidate determination means, the decoding means, and the optimum motion vector predictor determination means described above.

[0027] In the predictive decoding technology of motion vectors according to one aspect of the present invention described above, the motion vector predictor candidates are narrowed down and thereafter the motion vector predictor is determined based on the comparison

between the motion vector of the target partition and the motion vector predictor candidates. Therefore, it may reduce the computational complexity necessary for the determination of the motion vector predictor.

[0028] In an embodiment, the predictive decoding technology may be configured as follows: a predicted signal of a picture signal of a target partition is generated by referring to a reference frame with a frame number specified by a reference picture list identification and a reference picture identification; a first motion vector predictor candidate is determined from motion vectors of partitions in the left-neighboring region having a reference picture list identification and/or a reference picture identification identical to the reference picture list identification and/or the reference picture identification for the target partition; a second motion vector predictor candidate is determined from motion vectors of partitions in the above-neighboring region having a reference picture list identification and/or a reference picture identification identical to the reference picture list identification and/or the reference picture identification for the target partition.

[0029] In an embodiment, a bit count of encoded data of motion vector predictor indication information may be a bit count according to the number of motion vector predictor candidates. For example, the bit count of encoded data of the motion vector predictor indication information may be a minimum bit count according to the number of motion vector predictor candidates. This embodiment may reduce the bit count of the encoded data of the motion vector predictor indication information.

[0030] In an embodiment, a left-neighboring region may include a neighboring partition located below and on the left side of a target partition. In this embodiment, a motion vector of the below-left-neighboring partition is not defined as an independent motion vector predictor candidate and the below-left-neighboring partition is included in the left-neighboring region; then a first motion vector predictor candidate is determined from the left-neighboring region. This embodiment may reduce the number of motion vector predictor candidates. As a result, it may reduce the bit count of encoded data of the motion vector predictor indication information and reduce the computational complexity of the decoding process to restore the motion vector predictor indication information from the encoded data.

[0031] In an embodiment, an above-neighboring region may include a neighboring partition located above and on the right side of a target partition. In this embodiment, a motion vector of the above-right-neighboring partition is not defined as an independent motion vector predictor candidate and the above-right-neighboring partition is included in the above-neighboring region; then a second motion vector predictor candidate is determined from the above-neighboring region. This embodiment may reduce the number of motion vector predictor candidates. As a result, it may reduce the bit count of encoded data of the motion vector predictor indication information and reduce the computational complexity of the decoding process to restore the motion vector predictor indication information from the encoded data.

[0032] In an embodiment, either a left-neighboring region or a above-neighboring region may include a neighboring partition located above and on the left side of a target partition. In this embodiment, a motion vector of the above-left-neighboring partition is not defined as an independent motion vector predictor candidate and the above-left-neighboring partition is included in the left-neighboring region or in the above-neighboring region; then the motion vector predictor candidate is determined therefrom. This embodiment may reduce the number of motion vector predictor candidates. As a result, the bit count of encoded data of the motion vector predictor indication information may be reduced, and the computational complexity of the decoding process to restore the motion vector predictor indication information from the encoded data may also be reduced.

[0033] In an embodiment, the predictive decoding technology may be configured as follows: one or more partitions in a left-neighboring region are scanned in an upward direction from a bottom of the left-neighboring region, whereby a motion vector satisfying a predetermined criterion used in determination of motion vector predictor candidates is determined as the first motion vector predictor candidate from motion vectors of the one or more partitions. A subsequent scan in the left-neighboring region may be terminated upon detection of the motion vector satisfying the predetermined criterion of determination of motion vector predictor candidates. The first motion vector predictor candidate with a small error from the motion vector of the target partition can be efficiently determined by scanning the left-neighboring region in the foregoing scan order.

[0034] In an embodiment, the predictive decoding technology may be configured as follows: one or more partitions in the above-neighboring region are scanned in a direction from right to left, whereby a motion vector satisfying the predetermined criterion used in determination of motion vector predictor candidates is determined as a second motion vector predictor candidate from motion vectors of the one or more partitions. The subsequent scan in the above-neighboring region may be terminated upon detection of the motion vector satisfying the predetermined criterion used indetermination of motion vector predictor candidates. The second motion vector predictor candidate with a small error from the motion vector of the target partition can be efficiently determined by scanning the above-neighboring region in the foregoing scan order.

[0035] In an embodiment, the predictive decoding technology may be configured to include: decoding encoded data to restore first scan direction indication information to specify a direction of scanning of one or more partitions in a left-neighboring region and second scan direction indication information to specify a direction of scanning of one or more partitions in an above-neighboring region; scanning the one or more partitions in the left-neighboring region in the direction specified by the first scan direction indication information to determine the first motion vector predictor candidate; and scanning the one or more partitions in the above-neighboring region in the direction specified by the second scan direction indication information to determine the second motion vector predictor candidate. This embodiment may determine the first motion vector predictor candidate

and the second motion vector predictor candidate with smaller errors from the motion vector of the target partition.

[0036] In an embodiment, the number of one or more motion vector predictor candidates may not be more than 3. This embodiment may further reduce the bit count of the motion vector predictor indication information.

[0037] In an embodiment, the optimum motion vector predictor may be used as a motion vector of a target partition. This embodiment may reduce a data volume of encoded data because a residual signal of the motion vector is not encoded.

Advantageous Effects of Invention

[0038] As described above, the aspects and the embodiments of the present invention provide the predictive encoding method, predictive encoding device, and predictive encoding program of motion vectors and the predictive decoding method, predictive decoding device, and predictive decoding program of motion vectors capable of reducing the computational complexity necessary for the determination of motion vector predictors.

Brief Description of Drawings

[0039] Fig. 1A is a drawing illustrating rectangular neighboring partitions used in motion compensated prediction.

Fig. 1B is a drawing illustrating rectangular neighboring partitions used in motion compensated prediction.

Fig. 2 is a drawing showing a configuration of a video encoding device according to an embodiment.

Fig. 3 is a flowchart showing an embodiment of a predictive

encoding method of motion vectors.

Fig. 4 is a drawing illustrating rectangular neighboring partitions used in motion compensated prediction.

Fig. 5 is a flowchart showing a first embodiment of a process of step S302 in Fig. 3 in detail.

Fig. 6 is a flowchart showing a first embodiment of a process of step S303 in Fig. 3 in detail.

Fig. 7 is a drawing showing a configuration of a video decoding device according to one embodiment.

Fig. 8 is a flowchart showing an embodiment of a predictive decoding method of motion vector.

Fig. 9 is a flowchart showing a determination process of motion vector predictor candidates in a predictive encoding method of motion vector in a second embodiment.

Fig. 10 is a flowchart showing a predictive decoding method of motion vector in the second embodiment.

Fig. 11 is a drawing showing a configuration of a video encoding program according to one embodiment.

Fig. 12 is a drawing showing a configuration of a video decoding program according to one embodiment.

Fig. 13 is a drawing showing a hardware configuration of a computer according to one embodiment.

Fig. 14 is a perspective view showing a computer according to one embodiment.

Description of Embodiments

[0040] Various embodiments will be described below in detail with

reference to the drawings. In the drawings identical or equivalent portions will be denoted by the same reference signs.

[0041] Fig. 2 is a drawing showing a configuration of a video encoding device according one embodiment. The video encoding device 20 shown in Fig. 2 is an example of a device that predictively encodes a motion vector according to one aspect of the present invention.

[0042] A video sequence input into the video encoding device 20 is composed of a temporal sequence of frame pictures. A frame picture signal targeted for encoding will be referred to hereinafter as "current frame." In the video encoding device 20, a current frame is divided into rectangular partitions of variable size and the processing described below is carried out in each of partition units.

[0043] The video encoding device 20 can use any one of an inter-frame prediction mode and a plurality of intra-frame prediction modes, switching the prediction mode for each partition among them. For example, the video encoding device 20 selects a prediction mode with a high encoding efficiency among the inter-frame prediction mode and the intra-frame prediction modes, for each partition. The "inter-frame prediction mode" herein is a mode in which a motion vector is detected with reference to a plurality of previously-encoded frame picture signals (reference frame picture signals) different in time from a frame picture signal, thereby to perform motion-compensated inter-frame prediction. The "intra-frame prediction mode" is a mode in which spatial prediction is carried out using pixel values of neighborhood regions previously encoded on the same frame. In the "inter-frame prediction mode," respective processes of motion detection, motion prediction, and motion

compensation are carried out for each of sub- partitions, for example, obtained by further dividing a partition of N×N pixels in an optional size (e.g., (N/2) pixels × N lines or (N/4) pixels × (N/4) lines).

[0044] As shown in Fig. 2, the video encoding device 20 can be provided with an input unit 201, a motion detection unit 202, a motion vector predictor candidate determination unit 203, a motion vector predictor determination unit 204, a motion vector difference unit 205, a motion compensation unit 206, a memory 207, a spatial prediction unit 208, a prediction method determination unit 209, a subtraction unit 210, a transform unit 211, a quantization unit 212, an entropy encoding unit 213, an inverse quantization unit 214, an inverse transform unit 215, and an addition unit 216.

[0045] The input unit 201 receives an input video signal as a video signal input from the outside and decomposes the video signal into frame picture signals. The input unit 201 outputs each frame picture signal through line L201a and through line L201b to the subtraction unit 210 and to the motion detection unit 202.

[0046] The memory 207 is a part that stores frame picture signals having been encoded in the past, information (motion vectors, reference picture list identifications, reference picture identifications) and other data used in the prediction thereof.

[0047] The motion detection unit 202 performs detection of motion vector. More specifically, the motion detection unit 202 searches a reference frame picture signal input via line L207a from the memory 207, for a picture signal pattern similar to a picture signal pattern of a target partition in the current frame input via line L201a. The motion

detection unit 202 searches in a predetermined search range in the reference frame. The motion detection unit 202 detects a motion vector representing a spatial displacement quantity between the target partition and the picture signal pattern obtained by the search, and a reference picture list identification and a reference picture identification for specifying a frame number of the reference frame used. The detected motion vector, reference picture list identification, and reference picture identification are output via line L202a to the motion compensation unit 206 and via line L202c to the motion vector difference unit 205. Furthermore, the motion detection unit 202 outputs the detected reference picture list identification and reference picture identification via line L202b to the motion vector predictor candidate determination unit 203. In the video encoding device 20, frame numbers to specify respective reference frame picture signals can be managed in the form of lists. A frame number is specified using a reference picture list identification (Reference Picture List) to specify a list, and, a reference picture identification (Reference Index) as an index of the frame number in the list. This technology is well-known technology in H.264/AVC and others.

[0048] The motion vector predictor candidate determination unit 203 determines motion vector predictor candidates using motion vectors of previously-encoded neighboring partitions input via line L207b. The details about the determination of motion vector predictor candidates will be described later. The motion vector predictor candidate determination unit 203 outputs the determined motion vector predictor candidates via line L203 to the motion vector predictor determination

unit 204.

[0049] The motion vector predictor determination unit 204 determines an optimum motion vector predictor (motion vector predictor values) from the motion vector predictor candidates input via line L203. More specifically, the motion vector predictor determination unit 204 determines a motion vector predictor candidate with the smallest difference from the motion vector of the target partition input via line L202c, as an optimum motion vector predictor PMVopt, out of the motion vector predictor candidates. The determined optimum motion vector predictor PMVopt is fed via line L204a to the motion vector difference unit 205. Furthermore, the number of motion vector predictor candidates and motion vector predictor indication information to specify the optimum motion vector predictor PMVopt out of the motion vector predictor candidates are fed via line L204b to the entropy encoding unit 213.

[0050] In the present embodiment the motion vector predictor candidate with the smallest difference from the motion vector of the target partition is selected as the optimum motion vector predictor PMVopt. Alternatively the motion vector predictor determination unit 204 may select as the optimum motion vector predictor PMVopt a motion vector predictor candidate with the smallest number of bits assigned to a calculated motion vector difference.

[0051] In the present embodiment the optimum motion vector predictor is determined after the motion detection of the target partition. Alternatively, the optimum motion vector predictor may be detected before the motion detection. Specifically, as indicated by the formula

(1) below, the optimum motion vector predictor may be calculated based on the sum of absolute differences (SADpmv) between the predicted picture signal in execution of the motion compensation using each of the actually-calculated motion vector predictor candidates, and the target picture signal and a cost function using the bit count Rpmv in encoding of the motion vector predictor candidate and λ as a weight for the bit count. In this case, the picture signal of the target partition is input through line L201a and each reference frame picture signal is input through line L207a to the motion vector predictor determination unit 204 in Fig. 2.

$$Cost_{pmv} = SAD_{pmv} + \lambda R_{pmv} \qquad (1)$$

[0052] The motion vector difference unit 205 calculates motion vector difference values which are difference information between the motion vector input via line L202c and the optimum motion vector predictor input via line L204a. The motion vector difference unit 205 transmits a signal including the calculated motion vector difference values, and the reference picture list identification and reference picture identification, as prediction information via line L205a to the entropy encoding unit 213. Furthermore, the motion vector difference unit 205 transmits a signal including the motion vector, and the reference picture list identification and reference picture identification, via line L205b to the memory 207.

[0053] The motion compensation unit 206 generates a predicted picture signal of the target partition, referring to the reference frame picture signal of the frame number specified by the reference picture list identification and the reference picture identification received from the

motion detection unit 202 and using the motion vector received from the motion detection unit 202. This predicted picture signal is output to the prediction method determination unit 209.

[0054] The spatial prediction unit 208 generates a predicted picture signal, referring to picture signals (reference frame picture signals) of previously-encoded neighboring regions input via line L207a. The spatial prediction unit 208 outputs the generated predicted picture signal to the prediction method determination unit 209.

[0055] The prediction method determination unit 209 compares the predicted picture signals received from the motion compensation unit 206 and the spatial prediction unit 208, to select either one of the predicted picture signals, and outputs the selected predicted picture signal to the subtraction unit 210. The prediction method determination unit 209 outputs prediction mode information indicative of a prediction method used for the generation of the selected predicted picture signal, via line L209b to the entropy encoding unit 213.

[0056] The subtraction unit 210 generates a difference value (prediction residual signal) between the frame picture signal input via line L201b and the predicted picture signal input via line L209a and outputs the prediction residual signal to the transform unit 211.

[0057] The transform unit 211 performs an orthogonal transform of the prediction residual signal input via line L210, to generate orthogonal transform coefficients, and outputs the orthogonal transform coefficients to the quantization unit 212. The quantization unit 212 quantizes the orthogonal transform coefficients input via line L211, to generate quantized orthogonal transform coefficients, and transmits the quantized

orthogonal transform coefficients to the entropy encoding unit 213 and the inverse quantization unit 212.

[0058] The entropy encoding unit 213 performs entropy encoding of the quantized orthogonal transform coefficients input via line L212, the prediction mode information received from the prediction method determination unit 209, the prediction information transmitted from the motion vector difference unit 205, and the motion vector predictor indication information output from the motion vector predictor determination unit 204, multiplexes generated encoded data into a compressed stream, and transmits the compressed stream to the outside.

[0059] The inverse quantization unit 214 performs inverse quantization of the quantized orthogonal transform coefficients input via line L212, to generate orthogonal transform coefficients, and transmits the orthogonal transform coefficients to the inverse orthogonal transform unit 215. Then the inverse orthogonal transform unit 215 applies an inverse orthogonal transform to the orthogonal transform coefficients input via line L214, to generate a prediction residual signal, and transmits the prediction residual signal to the addition unit 216.

[0060] The addition unit 216 performs addition of the prediction residual signal input via line L215 and the predicted picture signal input via line L209a, to generate a frame picture signal, and transmits the frame picture signal to the memory 207. This frame picture signal is stored in the memory 207 and is used as a reference frame picture signal in the subsequent encoding process. In the memory 207, the motion vector, the reference picture list identification, the reference picture identification, etc. input via line L205b are also stored in association

with the reference frame picture signal.

[0061] Next, one embodiment of a predictive encoding method of motion vector applicable in the video encoding device 20 will be described below.

[0062] First, partitions adjacent to a target partition will be described with reference to Fig. 1B. Partitions BL, BL1, and BL2 are partitions in contact with a left boundary of the target partition BT. Partition BD is a partition including neighboring pixels existing below and on the left side of the bottom left pixel in the target region BT. Partition BE is a partition including neighboring pixels existing above and on the left side of the top left pixel in the target partition BT. Partitions BA, BA1, and BA2 are partitions in contact with an upper boundary of the target partition BT. Partition BRA is a partition including neighboring pixels existing above and on the right side of the top right pixel in the target partition BT. The partitions neighboring the target partition may be partitions of the same size as the target partition BT, as shown in Fig. 1A.

[0063] Next, reference is made to Fig. 3. Fig. 3 is a flowchart showing one embodiment of the predictive encoding method of motion vector. As shown in Fig. 3, in the predictive encoding method of motion vector according to the embodiment, first, the reference picture list identification and reference picture identification are input into the motion vector predictor candidate determination unit 203 (step S301).

[0064] Next, the motion vector predictor candidate determination unit 203 determines a motion vector predictor candidate PMV1 from a motion vector or motion vectors of one or more partitions included in

the left-neighboring region located to the left of the target partition BT (step S302). The details about the determination method of the motion vector predictor candidate PMV1 will be described later.

[0065] Next, the motion vector predictor candidate determination unit 203 determines a motion vector predictor candidate PMV2 from a motion vector or motion vectors of one or more partitions included in the above-neighboring region located above the target partition BT (step S303). The details about the determination method of the motion vector predictor candidate PMV2 will be described later.

[0066] Next, the motion vector predictor candidate determination unit 203 determines a motion vector predictor candidate PMV3 (step S304). In the present embodiment, a motion vector of a partition existing in the reference frame and at a position spatially identical to the target partition is determined as the motion vector predictor candidate PMV3.

[0067] The motion vector predictor candidate PMV3 may be a motion vector of another partition spatially adjacent to the target partition, instead of the motion vector of the partition at the same position as the target partition in the reference frame. It is also possible to use average values or the like calculated based on the motion vector predictor candidate PMV1 and the motion vector predictor candidate PMV2, as the motion vector predictor candidate PMV3.

[0068] The number of motion vector predictor candidates may be three or more. In this case, a plurality of motion vector predictor candidates may be determined by different methods from each of the left-neighboring region and the above-neighboring region. More specifically, a plurality of motion vector predictor candidates may be

determined by searching partitions of each of the regions in a plurality of different scan directions, in each of the left-neighboring region and the above-neighboring region. It is also possible to use a motion vector of another neighboring region as a motion vector predictor candidate.

[0069] Referring back to Fig. 3, the motion vector predictor candidate determination unit 203 then determines only non-identical motion vector predictor candidates from among the motion vector predictor candidate PMV1, the motion vector predictor candidate PMV2, and the motion vector predictor candidate PMV3, as final motion vector predictor candidates (step S305). As a specific example, where the motion vector predictor candidate PMV1 is identical to the motion vector predictor candidate PMV3, only PMV1 and PMV2 are selected as motion vector predictor candidates. If there is no motion vector predictor candidates determined to satisfy the conditions in steps S302 to S304, a zero motion vector is defined as a motion vector predictor candidate.

[0070] Then the motion vector predictor determination unit 204 determines the optimum motion vector predictor, as described above, out of the motion vector predictor candidates determined by the motion vector predictor candidate determination unit 203 (step S306).

[0071] Then the encoding unit 213 encodes the motion vector predictor indication information to specify which motion vector predictor candidate is the optimum motion vector predictor (step S307).

[0072] In one embodiment, the motion vector predictor indication information can be encoded into encoded data of a bit count according

to the number of motion vector predictor candidates selected by the motion vector predictor determination unit 204. For example, when the number of motion vector predictor candidates is 0 or 1, the motion vector predictor indication information is neither encoded nor transmitted. When the number of motion vector predictor candidates is 2 or 3, the motion vector predictor indication information is encoded in two bits at most.

[0073] The motion vector predictor indication information may be encoded based on a fixed encoding table irrespective of the number of motion vector predictor candidates. In this case, the motion vector predictor indication information may be encoded using an encoding table below.

<Table 1. Encoding Table>

Bit value	Optimum motion vector predictor
0	motion vector predictor candidate 1 (PMV1)
10	motion vector predictor candidate 2 (PMV2)
11	motion vector predictor candidate 3 (PMV3)

[0074] In one embodiment, the order in which the motion vector predictor candidate PMV1, the motion vector predictor candidate PMV2, and the motion vector predictor candidate PMV3 are determined may be changed. For example, a process may be used in which the target partition is divided into a plurality of sub- partitions and the encoding process is carried out for each of the sub- partitions. Specifically, when the target partition is divided into upper and lower sub-partitions, and the lower sub-partition can be used as a target partition, or when the target partition is divided into left and right sub-partitions, and the left

sub-partition can be used as a target partition, -- the motion vector predictor candidates can be determined in an order of the left-neighboring region, the above-neighboring region, and another region (e.g., a partition in a reference frame at the same position as the target partition). On the other hand, when the target partition is divided into upper and lower sub-partitions, and the upper sub-partition can be used as a target partition, or the target partition is divided into left and right sub-partitions, and the right sub-partition can be used as a target partition, the motion vector predictor candidates can be determined in an order of the above-neighboring region, the left-neighboring region, and another region (e.g., a partition in a reference frame at the same position as the target partition), for these target partitions.

[0075] A first embodiment of the determination process of motion vector predictor candidate according to one embodiment will be described below in detail. First, the first embodiment of the process of step S302 in Fig. 3 will be described with reference to Figs. 1B, 4, and 5. It is assumed herein, as shown in Fig. 1B, that the left-neighboring region is composed of the below-left-neighboring partition BD to the target partition and the left-neighboring partitions BL, BL1, and BL2 to the target partition. It is also assumed that the partitions in the left-neighboring region are scanned in increasing order of index i shown in (a) of Fig. 4. Namely, the partitions in the left-neighboring region are assumed to be scanned in order from bottom to top.

[0076] The below-left-neighboring partition BD may be excluded from the left-neighboring region. Furthermore, a partition further below the

below left-neighboring partition BD may be included in the left-neighboring region. Furthermore, the partition BE or a partition located above the partition BE may be included in the left-neighboring region. Furthermore, a partition located on the left side of the target partition and at a predetermined distance from the target partition may be included in the left-neighboring region.

[0077] Referring back to (a) of Fig. 4 and Fig. 5, in the process of step S302, first, the motion vector predictor candidate determination unit 203 sets 0 in index i (step S501). The motion vector predictor candidate determination unit 203 increases the index i by an increment of 1 in the subsequent step S502.

[0078] Next, the motion vector predictor candidate determination unit 203 determines whether there is the i-th partition in the scan order in the left-neighboring region and whether the partition has a motion vector (step S503). If there is the i-th partition in the left-neighboring region and if the partition has a motion vector, the motion vector predictor candidate determination unit 203 determines, in the subsequent step S504, whether the i-th partition and the target partition have the same reference picture list identification and reference picture identification. When the determination condition in step S504 is satisfied, the motion vector predictor candidate determination unit 203 determines the motion vector of the i-th partition as motion vector predictor candidate PMV1 in the subsequent step S505 and then outputs the motion vector predictor candidate PMV1 in the subsequent step S506, followed by termination of processing.

[0079] On the other hand, when the determination condition in step

S503 is not satisfied or when the determination condition in step S504 is not satisfied, the processing transfers to step S507. In step S507, the motion vector predictor candidate determination unit 203 determines whether the index i is over the number N of partitions in the left-neighboring region. When the determination condition in step S507 is not satisfied, the motion vector predictor candidate determination unit 203 carries on the processing from step S502. On the other hand, when the determination condition in step S507 is satisfied, the motion vector predictor candidate determination unit 203 terminates the processing.

[0080] The partitions in the left-neighboring region are scanned in order from the bottom of the left-neighboring region in the embodiment shown in (a) of Fig. 4, but in one embodiment, as shown in (c) of Fig. 4, they may be scanned in order from the top of the left-neighboring region.

[0081] In another embodiment, either of the scan order shown in (a) of Fig. 4 and the scan order shown in (c) of Fig. 4 may be adaptively selected. For example, the scan order may be determined based on a relation of motion vectors of neighboring partitions. Specifically, it is possible to adopt a method of comparing an absolute difference α between the motion vector of the partition BL and the motion vector of the partition BA with an absolute difference β between the motion vector of the partition BRA and the motion vector of the partition BD in Fig. 1B, and selecting the scan order in (c) of Fig. 4 if the absolute difference α is smaller than the absolute difference β. In the opposite case, on the other hand, the scan order in (a) of Fig. 4 may be selected.

[0082] In an embodiment, step S502 may be configured to increase the index i by an increment of two or more, thereby decimating the partitions to be scanned.

[0083] The first embodiment of the process of step S303 in Fig. 3 will be described below in detail with reference to Figs. 1B, 4, and 6. It is assumed herein, as shown in Fig. 1B, that the above-neighboring region is composed of the above-left-neighboring partition BE to the target partition and the above-neighboring partition BA, BA1, and BA2 to the target partition. It is also assumed that the partitions in the above-neighboring region are scanned in increasing order of index j shown in (a) of Fig. 4. Namely, the partitions in the above-neighboring region are assumed to be scanned in order from right to left.

[0084] The above-left-neighboring partition BE may be excluded from the above-neighboring region. Furthermore, a partition further left to the above-left-neighboring partition BE may be included in the above-neighboring region. Furthermore, a partition located above the target partition and at a predetermined distance from the target partition may be included in the above-neighboring region.

[0085] Referring back to (a) of Fig. 4 and Fig. 6, in the process of step S303, first, the motion vector predictor candidate determination unit 203 sets 0 in the index j (step S601). The motion vector predictor candidate determination unit 203 increases the index j by an increment of 1 in the subsequent step S602.

[0086] Next, the motion vector predictor candidate determination unit 203 determines whether there is the j-th partition in the scan order in the

above-neighboring region and whether the partition has a motion vector (step S603). When there is the j-th partition in the above-neighboring region and when the partition has a motion vector, the motion vector predictor candidate determination unit 203 determines, in the subsequent step S604, whether the j-th partition and the target partition have the same reference picture list identification and reference picture identification. When the determination condition in step S604 is satisfied, the motion vector predictor candidate determination unit 203 determines, in the subsequent step S605, whether the motion vector of the j-th partition is identical to the motion vector predictor candidate PMV1. When the motion vector of the j-th partition is different from the motion vector predictor candidate PMV1, the motion vector predictor candidate determination unit 203 determines in the subsequent step S606 that the motion vector of the j-th partition is the motion vector predictor candidate PMV2, and then outputs the motion vector predictor candidate PMV2 in the subsequent step S607, followed by termination of processing.

[0087] On the other hand, when the determination condition in step S603 is not satisfied, when the determination condition in step S604 is not satisfied, or when the determination condition in step S605 is satisfied, the processing transfers to step S608.

[0088] In step S608, the motion vector predictor candidate determination unit 203 determines whether the index j is over the number M of partitions in the above-neighboring region. When the determination condition in step S608 is not satisfied, the motion vector predictor candidate determination unit 203 carries on the processing

from step S602. On the other hand, when the determination condition in step S608 is satisfied, the motion vector predictor candidate determination unit 203 terminates the processing.

[0089] The partitions in the above-neighboring region are scanned in order from right to left in the embodiment shown in (a) of Fig. 4, but the partitions may be scanned in order from left to right, as shown in (c) of Fig. 4, in one embodiment.

[0090] In another embodiment, either of the scan order shown in (a) of Fig. 4 or the scan order shown in (c) of Fig. 4 may be adaptively selected. For example, the scan order may be determined based on a relation of motion vectors of neighboring partitions. Specifically, it is possible to adopt a method of comparing an absolute difference α between the motion vector of the partition BL and the motion vector of the partition BA with an absolute difference β between the motion vector of the partition BRA and the motion vector of the partition BD in Fig. 1B, and selecting the scan order in (c) of Fig. 4 if the absolute difference α is smaller than the absolute difference β. In the opposite case, on the other hand, the scan order in (a) of Fig. 4 may be selected.

[0091] The partition BE is included in the above-neighboring region in the above-described embodiment, but the partition BE may be included in the left-neighboring region. It is also possible to define the partition BE as a region independent of the above-neighboring region and the left-neighboring region, and treat the motion vector of the partition BE as another motion vector predictor candidate.

[0092] The foregoing embodiment employs both of the reference picture list identification and the reference picture identification as a

determination condition for selecting the motion vector of the partition in the neighboring region as a motion vector predictor candidate, but the present invention is not limited to this. For example, either of the reference picture list identification or the reference picture identification may be used for the determination condition. When the reference picture identification is not used, scaling of motion vectors of partitions in the neighboring region may be implemented according to a distance between the reference frame and the target frame. It is also possible to use information of another intra-frame prediction. Specifically, the size of the target partition and the sizes of the neighboring partitions may be added as one in the aforementioned determination condition. Specifically, when the size of the target partition is N×N pixels, a determination condition may be that the size of a partition in the neighboring region is N×N pixels, or a determination condition may be that the size of a partition is from N/2×N/2 pixels to 2N×2N pixels.

[0093] In the foregoing embodiment the calculation of the motion vector predictor candidate PMV2 in the above-neighboring region is performed after the calculation of the motion vector predictor candidate PMV1 in the left-neighboring region, but the present invention is not limited to this. The motion vector predictor candidate PMV2 in the above-neighboring region may be determined prior to the determination of the motion vector predictor candidate PMV1 in the left-neighboring region. In this case, a process of determining whether a motion vector of a partition in the left-neighboring region is identical to the motion vector predictor candidate PMV2 in the above-neighboring region can be carried out in the process of determining the motion vector predictor

candidate PMV1 in the left-neighboring region.

[0094] In the above embodiment it is determined in step S605, whether the motion vector of the j-th partition in the above-neighboring region is identical to the motion vector predictor candidate PMV1 in the left-neighboring region, but this determination may be omitted. In this case, the process of step S606 can be directly performed when the determination condition in step S604 is satisfied.

[0095] In one embodiment, the step S602 may be configured to increase the index j by an increment of two or more, thereby decimating the partitions to be scanned.

[0096] The below will describe a video decoding device which decodes a compressed stream generated by the video encoding device 20, to restore a video sequence. Fig. 7 is a drawing showing a configuration of the video decoding device according to one embodiment. The video decoding device 30 shown in Fig. 7 is an example of a device that predictively decodes a motion vector according to one aspect of the present invention.

[0097] As shown in Fig. 7, the video decoding device 30 can be provided with an entropy decoding unit 301, a motion vector predictor candidate determination unit 302, a motion vector predictor determination unit 303, a motion vector addition unit 304, a motion compensation unit 305, a frame memory 306, a spatial prediction unit 307, a prediction method determination unit 308, an inverse quantization unit 309, an inverse orthogonal transform unit 310, and an addition unit 311.

[0098] The entropy decoding unit 301 receives a compressed stream,

then detects a synchronization word indicative of the beginning of each frame in the compressed stream, and thereafter restores the prediction mode information and the quantized orthogonal transform coefficients from encoded data in the compressed stream, in each of divided partition units. When the prediction mode specified by the prediction mode information is "inter-frame prediction mode," the entropy decoding unit 301 decodes the encoded data in the compressed stream to also restore the motion vector difference, reference picture list identification, and reference picture identification.

[0099] The entropy decoding unit 301 transmits the restored quantized orthogonal transform coefficients via line L301a to the inverse quantization unit 309. The entropy decoding unit 301 transmits the prediction mode information, the reference picture list identification, and the reference picture identification via line L301b to the motion vector predictor candidate determination unit 302. Furthermore, the entropy decoding unit 301 transmits the restored motion vector difference via line L301d to the motion vector addition unit 304. The entropy decoding unit 301 transmits the restored prediction mode information via line L301e to the prediction method determination unit 308.

[0100] When the prediction mode specified by the received prediction mode information is "inter-frame prediction mode," the motion vector predictor candidate determination unit 302 determines motion vector predictor candidates from motion vectors of previously-decoded neighboring partitions. Since the processing about the determination of motion vector predictor candidates carried out by the motion vector

predictor candidate determination unit 302 is the same as the processing described above as to the motion vector predictor candidate determination unit 203, the description thereof is omitted herein. This motion vector predictor candidate determination unit 302 outputs the determined motion vector predictor candidates via line L302b to the motion vector predictor determination unit 303. Furthermore, the motion vector predictor candidate determination unit 302 outputs the number of motion vector predictor candidates via line L302a to the entropy decoding unit 301.

[0101] The entropy decoding unit 301, when receiving the number of motion vector predictor candidates via line L302a, decodes the encoded data in the compressed stream according to the number of motion vector predictor candidates, to restore the motion vector predictor indication information. The entropy decoding unit 301 transmits the restored motion vector predictor indication information to the motion vector predictor determination unit 303. More specifically, when the number of motion vector predictor candidates is 0 or 1, no motion vector predictor indication information is transmitted and therefore the restoring process is not carried out. When the number of motion vector predictor candidates is 2 or 3, the encoded data of two bits at most is entropy-decoded to restore the motion vector predictor indication information.

[0102] The entropy decoding unit 301 is configured to restore the motion vector predictor indication information by decoding the encoded data according to the number of motion vector predictor candidates selected by the motion vector predictor candidate determination unit

302, but the present invention is not limited to this. For example, the motion vector predictor indication information may be restored using the fixed encoding table of Table 1 described above, independent of the number of motion vector predictor candidates. It should be noted that the setting of the fixed encoding table is not limited to this example. The motion vector predictor indication information may be restored prior to the calculation of motion vector predictor candidates.

[0103] The motion vector predictor determination unit 303 determines the optimum motion vector predictor PMVopt on the basis of the motion vector predictor indication information input via line L301c, out of the motion vector predictor candidates input via line L302b. The determined optimum motion vector predictor PMVopt is transmitted via line L303 to the motion vector addition unit 304.

[0104] The motion vector addition unit 304 performs addition of the motion vector difference transmitted from the entropy decoding unit 301 and the optimum motion vector predictor PMVopt transmitted from the motion vector predictor determination unit 303, to restore the motion vector. The motion vector addition unit 304 transmits a signal including the restored motion vector via line L304 to the motion compensation unit 305.

[0105] The motion compensation unit 305 selects the reference frame picture signal in the memory 306 on the basis of the motion vector transmitted from the motion vector addition unit 304 and the prediction mode information, the reference picture list identification, and the reference picture identification transmitted via line L301d from the entropy decoding unit 301, and generates a predicted picture signal,

using the selected reference frame picture signal. The motion compensation unit 305 transmits the predicted picture signal via line L305a to the prediction method determination unit 308. Furthermore, the motion compensation unit 305 outputs the prediction mode information, reference picture list identification, and reference picture identification used in generation of the predicted picture signal via line L305b to the frame memory 306. There are the previously-decoded frame picture signals, prediction mode information, reference picture list identifications, and reference picture identifications stored in the memory 306.

[0106] When the prediction mode specified by the prediction mode information input via line L301e is "intra-frame prediction mode," the spatial prediction unit 307 generates a predicted picture signal with reference to the picture signals (reference frame picture signals) of previously-decoded neighboring partitions and transmits the predicted picture signal to the prediction method determination unit 308.

[0107] The prediction method determination unit 308 selects either of the predicted picture signal generated by the inter-frame prediction or the predicted picture signal generated by the intra-frame prediction, based on the prediction mode transmitted from the entropy decoding unit 301, and transmits the selected predicted picture signal via line L308 to the addition unit 311.

[0108] The inverse quantization unit 309 performs inverse quantization of the quantized orthogonal transform coefficients transmitted from the entropy decoding unit 301, to restore orthogonal transform coefficients. The inverse quantization unit 309 transmits the restored orthogonal

transform coefficients via line L309 to the inverse orthogonal transform unit 310.

[0109] The inverse orthogonal transform unit 310 applies an inverse orthogonal transform to the received orthogonal transform coefficients to restore a prediction residual signal. The inverse orthogonal transform unit 310 transmits the restored prediction residual signal via line L310 to the addition unit 311.

[0110] The addition unit 311 performs addition of the predicted picture signal transmitted from the prediction method determination unit 308 and the prediction residual signal transmitted from the inverse orthogonal transform unit 310, to restore a frame picture signal.

[0111] The restored frame picture signal is output at predetermined display timing to a display device (not shown), whereby the input video signal (dynamic image signal) can be reproduced. Since the frame picture signal is used in the subsequent decoding process, it is stored as a reference frame picture signal into the memory 306. The frame picture signal herein can be the same value as the frame picture signal with the same number in the video encoding device 20. The information about the motion vector and the reference frame number is also simultaneously stored in association with the reference frame picture signal.

[0112] Next, one embodiment of a predictive decoding method of motion vectors used in the video decoding device 30 will be described below with reference to Fig. 8. Fig. 8 is a flowchart showing one embodiment of the predictive decoding method of motion vectors.

[0113] In the predictive decoding method of motion vector predictors

according to one embodiment, as shown in Fig. 8, the reference picture list identification and reference picture identification are first input into the motion vector predictor candidate determination unit 302 (step S801).

[0114] Next, the motion vector predictor candidate determination unit 302 determines a motion vector predictor candidate, PMV1, from a motion vector or motion vectors of one or more partitions included in a left-neighboring region located to the left of a target partition BT (step S302).

[0115] Next, the motion vector predictor candidate determination unit 302 determines a motion vector predictor candidate, PMV2, from a motion vector or motion vectors of one or more partitions included in the above-neighboring region located above the target partition BT (step S303).

[0116] Next, the motion vector predictor candidate determination unit 302 determines a motion vector predictor candidate PMV3 (step S304). The processes of steps S302 to S304 in Fig. 8 are the same as the processes of steps S302 to S304 in Fig. 3.

[0117] In step S805, the motion vector predictor candidate determination unit 302 then defines as motion vector predictor candidates only non-identical motion vector predictor candidates from among the motion vector predictor candidate PMV1, the motion vector predictor candidate PMV2, and the motion vector predictor candidate PMV3. As a specific example, where the motion vector predictor candidate PMV1 is identical to the motion vector predictor candidate PMV3, only the motion vector predictor candidate PMV1 and the

motion vector predictor candidate PMV2 are selected as motion vector predictor candidates. When the processing up to step S805 results in determining no effective motion vector predictor candidates, a zero motion vector is defined as a motion vector predictor candidate.

[0118] In step S806, as described above, the decoding unit 301 restores the motion vector predictor indication information on the basis of the number of motion vector predictor candidates. Next, in step S807, the motion vector predictor determination unit 303 selects the optimum motion vector predictor out of the motion vector predictor candidates, based on the motion vector predictor indication information.

[0119] Next, a second embodiment of the predictive encoding method of motion vectors will be described below. Fig. 9 is a flowchart showing the determination process of motion vector predictor candidates in the predictive encoding method of motion vectors in the second embodiment. In the predictive encoding method of motion vectors according to the second embodiment, the flow shown in Fig. 9 is used instead of steps S302 to S304 in Fig. 3.

[0120] In the present embodiment, in step S901 the motion vector predictor candidate determination unit 203 first scans the partitions in the left-neighboring region located to the left of the target partition in a downward direction to determine a motion vector predictor candidate PMVa from the motion vectors of these partitions. In step S901, the motion vector predictor candidate determination unit 203 can detect the motion vector predictor candidate PMVa by carrying out the determination method of the motion vector predictor candidate PMV1 (step S302) described in the first embodiment, according to the scan

order of the left-neighboring region shown in (c) of Fig. 4. For determining the motion vector predictor candidate PMVa, the motion vector predictor candidate determination unit 203 can use the input reference picture list identification and reference picture identification, as in the first embodiment.

[0121] Next, in step S902 the motion vector predictor candidate determination unit 203 scans the partitions in a left-neighboring region located to the left of the target partition in an upward direction to determine a motion vector predictor candidate PMVb from the motion vectors of these partitions. In step S902, the motion vector predictor candidate determination unit 203 can detect the motion vector predictor candidate PMVb by carrying out the determination method of the motion vector predictor candidate PMV1 (step S302) described in the first embodiment, according to the scan order of the left-neighboring region shown in (a) of Fig. 4. For determining the motion vector predictor candidate PMVb, the motion vector predictor candidate determination unit 203 can use the reference picture list identification and reference picture identification.

[0122] Next, in step S903 the motion vector predictor candidate determination unit 203 selects a motion vector predictor candidate PMVX in the left-neighboring region from the motion vector predictor candidate PMVa and the motion vector predictor candidate PMVb. Furthermore, the motion vector predictor candidate determination unit 203 generates scan direction indication information indicative of the scan direction X used for determination of the selected motion vector predictor candidate. Specifically, the motion vector predictor

candidate determination unit 203 determines as the motion vector predictor candidate PMVX, a motion vector predictor candidate with the smallest error from the motion vector predictor of the target partition, out of motion vector predictor candidate PMVa and motion vector predictor candidate PMVb,. Furthermore, when the motion vector predictor candidate PMVa is selected as the motion vector predictor candidate PMVX, the motion vector predictor candidate determination unit 203 generates the scan direction indication information indicative of the downward direction; whereas when the motion vector predictor candidate PMVb is selected, it generates the scan direction indication information indicative of the upward direction.

[0123] Next, in step S904 the motion vector predictor candidate determination unit 203 scans the partitions in the above-neighboring region to the target partition in a rightward direction to determine a motion vector predictor candidate PMVc from the motion vectors of these partitions. In step S904 the motion vector predictor candidate determination unit 203 can detect the motion vector predictor candidate PMVc by carrying out the determination method of the motion vector predictor candidate PMV2 (step S303) described in the first embodiment, according to the scan order of the above-neighboring region shown in (c) of Fig. 4. For determining the motion vector predictor candidate PMVc, the motion vector predictor candidate determination unit 203 can use the input reference picture list identification and reference picture identification, as in the first embodiment.

[0124] Next, in step S905 the motion vector predictor candidate

determination unit 203 scans the partitions in the above-neighboring region to the target partition in a leftward direction to determine a motion vector predictor candidate PMVd from motion vectors of these partitions. In step S905, the motion vector predictor candidate determination unit 203 can detect the motion vector predictor candidate PMVd by carrying out the determination method (step S303) of the motion vector predictor candidate PMV2 described in the first embodiment, according to the scan order of the above-neighboring region shown in (a) of Fig. 4. For determining the motion vector predictor candidate PMVd, the motion vector predictor candidate determination unit 203 can also use the reference picture list identification and reference picture identification.

[0125] Next, in step S906 the motion vector predictor candidate determination unit 203 selects a motion vector predictor candidate PMVY in the above-neighboring region from the motion vector predictor candidate PMVc and the motion vector predictor candidate PMVd. The motion vector predictor candidate determination unit 203 generates the scan direction indication information indicative of the scan direction Y used for determination of the selected motion vector predictor candidate. Specifically, the motion vector predictor candidate determination unit 203 determines a motion vector predictor candidate with the smallest error from the motion vector predictor of the target partition, out of the motion vector predictor candidate PMVc and the motion vector predictor candidate PMVd, as the motion vector predictor candidate PMVY. When the motion vector predictor candidate PMVc is selected as the motion vector predictor candidate

PMVY, the motion vector predictor candidate determination unit 203 generates the scan direction indication information indicative of the rightward direction; when the motion vector predictor candidate PMVd is selected, it generates the scan direction indication information indicative of the leftward direction.

[0126] Next, in step S907 the motion vector predictor candidate determination unit 203 acquires a motion vector predictor candidate PMVZ of a partition in a reference frame at a position spatially identical to the target partition, in the same manner as the process of step S304. The process in this step S907 may be the same as the aforementioned modification form of the process of step S304 in the first embodiment.

[0127] Next, in step S908 the motion vector predictor candidate determination unit 203 defines only non-identical motion vector predictor candidates out of the motion vector predictor candidate PMVX, the motion vector predictor candidate PMVY, and the motion vector predictor candidate PMVZ, as motion vector predictor candidates. Then the motion vector predictor candidate determination unit 203 outputs the motion vector predictor candidates, the number of motion vector predictor candidates, and the scan direction indication information. As a specific example, where the motion vector predictor candidate PMVX is identical to the motion vector predictor candidate PMVZ, only the motion vector predictor candidate PMVX and the motion vector predictor candidate PMVY are selected as motion vector predictor candidates. If no effective motion vector predictor candidate is determined in steps S901 to S907, a zero motion vector is defined as a motion vector predictor candidate.

[0128] Thereafter, the same processing as in step S306 in the first embodiment is carried out in the second embodiment. Finally, in step S307 the encoding unit 213 encodes the motion vector predictor indication information to specify which motion vector predictor candidate is the optimum motion vector predictor. In the second embodiment the encoding unit 213 also encodes the scan direction indication information in step S307.

[0129] In the second embodiment, the partitions constituting the left-neighboring region and the partitions constituting the above-neighboring region may be modified as described above in the first embodiment. The number of motion vector predictors may also be changed as described above in the first embodiment. As described above in the first embodiment, the determination order of the motion vector predictor candidates PMVX, PMVY, and PMVZ may be changed based on the mode of division of the target partition into sub- partitions and the positions of the sub- partitions.

[0130] A predictive decoding method of motion vectors according to the second embodiment will be described below. Fig. 10 is a flowchart showing the predictive decoding method of motion vectors according to the second embodiment. The predictive decoding method shown in Fig. 10 is a method of predicting a motion vector from encoded data generated by the predictive encoding method of motion vectors according to the second embodiment.

[0131] In the present embodiment, as shown in Fig. 10, in step S1001 the motion vector predictor candidate determination unit 302 first receives input of the restored reference picture list identification,

reference picture identification, and scan direction indication information (scan direction X, scan direction Y).

[0132] Next, in step S1002 the motion vector predictor candidate determination unit 302 determines a motion vector predictor candidate PMVX in the left-neighboring region, according to the reference picture list identification, the reference picture identification, and the scan direction indication information to specify the scan direction X. The motion vector predictor candidate PMVX is determined by the same process as the determination of the motion vector predictor candidate PMV1 in the first embodiment, by sequentially scanning the partitions in the left-neighboring region in the scan direction X specified by the scan direction indication information.

[0133] Next, in step S1003, the motion vector predictor candidate determination unit 302 determines a motion vector predictor candidate PMVY in the above-neighboring region, according to the reference picture list identification, the reference picture identification, and the scan direction indication information to specify the scan direction Y. The motion vector predictor candidate PMVY is determined by the same process as the determination of the motion vector predictor candidate PMV2 in the first embodiment, by sequentially scanning the partitions in the above-neighboring region in the scan direction Y specified by the scan direction indication information.

[0134] Next, in step S1004 the motion vector predictor candidate determination unit 302 determines a motion vector predictor candidate PMVZ of a partition in a reference frame spatially identical to the target partition. The process of step S1004 is the same as the process of step

304.

[0135] Next, in step S1005 the motion vector predictor candidate determination unit 302 defines only non-identical motion vector predictor candidates, out of the motion vector predictor candidate PMVX, the motion vector predictor candidate PMVY, and the motion vector predictor candidate PMVZ, as motion vector predictor candidates. As a specific example, where the motion vector predictor candidate PMVX is identical to the motion vector predictor candidate PMVZ, only the motion vector predictor candidate PMVX and the motion vector predictor candidate PMVY are selected as motion vector predictor candidates. If no effective motion vector predictor candidates are determined by the processing up to step S1005, a zero motion vector is defined as a motion vector predictor candidate.

[0136] Next, in step S1006 the decoding unit 301 restores the motion vector predictor indication information on the basis of the number of motion vector predictor candidates. In step S1007, the motion vector predictor determination unit 303 then selects the optimum motion vector predictor from among the motion vector predictor candidates, based on the motion vector predictor indication information.

[0137] In the second embodiment, the determination order of the motion vector predictor candidates PMVX, PMVY, and PMVZ may also be changed based on the mode of division of the target partition into sub- partitions and the positions of the sub- partitions, as described above in the first embodiment.

[0138] The video encoding device 20 and video decoding device 30 described above are configured to narrow down candidates for a motion

vector predictor and then detect the optimum motion vector predictor from the resulting motion vector predictor candidates. Therefore, it is possible to reduce the computational complexity necessary for the determination of the optimum motion vector predictor. Furthermore, the motion vector predictor indication information to specify the optimum motion vector predictor can be encoded in a smaller bit count.

[0139] The video encoding device 20 and the video decoding device 30 using the predictive encoding and predictive decoding of the second embodiment are able to determine the motion vector predictor candidates with a smaller error from the motion vector of the target partition.

[0140] The below will describe a video encoding program 1000 for causing a computer to function as the video encoding device 20, and a video decoding program 1100 for causing a computer to function as the aforementioned video decoding device 30.

[0141] Fig. 11 is a drawing showing a configuration of the video encoding program according to one embodiment. Fig. 12 is a drawing showing a configuration of the video decoding program according to one embodiment. Fig. 13 is a drawing showing a hardware configuration of a computer according to one embodiment. Fig. 14 is a perspective view showing a computer according to one embodiment.

[0142] The video encoding program 1000 shown in Fig. 11 can be provided as stored in a recording medium SM. Furthermore, the video decoding program 1100 shown in Fig. 12 can also be provided as stored in a recording medium SM. Examples of such recording media SM applicable herein include recording media such as the floppy disk,

CD-ROM, DVD, or ROM, semiconductor memories, or the like.

[0143] As shown in Fig. 13, a computer C10 can be provided with a reading device C12 such as a floppy disk drive unit, a CD-ROM drive unit, or a DVD drive unit, a working memory (RAM) C14 on which an operating system is resident, a memory C16 storing a program stored in a recording medium SM, a monitor unit C18 such as a display, a mouse C20 and a keyboard C22 as input devices, a communication device C24 for transmission/reception of data and others, and a CPU C26 to control execution of the program.

[0144] When the recording medium SM is put into the reading device C12, the computer C10 becomes accessible to the video encoding program 1000 stored in the recording medium SM, through the reading device C12 and becomes able to operate as the video encoding device 20, based on the program 1000.

[0145] When the recording medium SM is put into the reading device C12, the computer C10 becomes accessible to the video decoding program 1100 stored in the recording medium SM, through the reading device C12 and becomes able to operate as the video decoding device 30, based on the program 1100.

[0146] As shown in Fig. 11, the video encoding program 1000 is provided with a main module 1001 to generally control the processing, an input module 1002, a motion detection module 1003, a motion vector predictor candidate determination module 1004, a motion vector predictor determination module 1005, a motion vector difference module 1006, a motion compensation module 1007, a spatial prediction module 1008, a prediction method determination module 1009, a

subtraction module 1010, an orthogonal transform module 1011, a quantization module 1012, an entropy encoding module 1013, an inverse quantization module 1014, an inverse orthogonal transform module 1015, and an addition module 1016. The functions that the input module 1002, the motion detection module 1003, the motion vector predictor candidate determination module 1004, the motion vector predictor determination module 1005, the motion vector difference module 1006, the motion compensation module 1007, the spatial prediction module 1008, the prediction method determination module 1009, the subtraction module 1010, the orthogonal transform module 1011, the quantization module 1012, the entropy encoding module 1013, the inverse quantization module 1014, the inverse orthogonal transform module 1015, and the addition module 1016 causes a computer to implement are the same as the functions of the aforementioned input unit 201, motion detection unit 202, motion vector predictor candidate determination unit 203, motion vector predictor determination unit 204, motion vector difference unit 205, motion compensation unit 206, spatial prediction unit 208, prediction method determination unit 209, subtraction unit 210, orthogonal transform unit 211, quantization unit 212, entropy encoding unit 213, inverse quantization unit 214, inverse orthogonal transform unit 215, and addition unit 216, respectively.

[0147] As shown in Fig. 12, the video decoding program 1100 is provided with a main module 1101 to generally control the processing, an entropy decoding module 1102, a motion vector predictor candidate determination module 1103, a motion vector predictor determination

module 1104, a motion vector addition module 1105, a motion compensation module 1106, a spatial prediction module 1107, a prediction method determination module 1108, an inverse quantization module 1109, an inverse orthogonal transform module 1110, and an addition module 1111. The functions that the entropy decoding module 1102, motion vector predictor candidate determination module 1103, motion vector predictor determination module 1104, motion vector addition module 1105, motion compensation module 1106, spatial prediction module 1107, prediction method determination module 1108, inverse quantization module 1109, inverse orthogonal transform module 1110, and addition module 1111 causes a computer to implement are the same as the functions of the aforementioned entropy decoding unit 301, motion vector predictor candidate determination unit 302, motion vector predictor determination unit 303, motion vector addition unit 304, motion compensation unit 305, spatial prediction unit 307, prediction method determination unit 308, inverse quantization unit 309, inverse orthogonal transform unit 310, and addition unit 311, respectively.

[0148] The above describes various embodiments, but the present invention can be modified in many ways without being limited to the above embodiments. For example, in the above embodiments the encoded data of the motion vector difference being the difference between the motion vector of the target partition and the motion vector predictor (optimum motion vector predictor) is transmitted from the encoding device to the decoding device, but the optimum motion vector predictor may be adopted as the motion vector of the target partition,

without transmitting the encoded data of the motion vector difference from the encoding device to the decoding device.

[0149] The motion vector predictor candidate PMVX may be determined as follows: predicted picture signals are created using the motion vector predictor candidates PMVa and PMVb and the motion vector predictor candidate PMVX to be adopted is a motion vector predictor candidate to make smaller the sum of absolute differences (SAD) between the predicted picture signal and the picture signal of the target partition, out of the motion vector predictor candidates PMVa and PMVb. The motion vector predictor candidate PMVY may be determined as follows: predicted picture signals are created using the motion vector predictor candidates PMVc and PMVd and the motion vector predictor candidate PMVY to be adopted is a motion vector predictor candidate to make smaller the sum of absolute differences (SAD) between the predicted picture signal and the picture signal of the target partition, out of the motion vector predictor candidates PMVc and PMCd. Furthermore, the sum of absolute transformed differences (SATD) or the sum of square differences (SSD) may be used instead of SAD.

Reference Signs List

[0150] 20 video encoding device; 30 video decoding device; 201 input unit; 202 detection unit; 203 motion vector predictor candidate determination unit; 204 motion vector predictor determination unit; 205 motion vector difference unit; 206 motion compensation unit; 207 memory; 208 spatial prediction unit; 209 prediction method determination unit; 210 subtraction unit; 211 transform unit; 212

quantization unit; 213 entropy encoding unit; 214 inverse quantization unit; 215 inverse transform unit; 216 addition unit; 301 entropy decoding unit; 302 motion vector predictor candidate determination unit; 303 motion vector predictor determination unit; 304 motion vector addition unit; 305 motion compensation unit; 306 frame memory; 307 spatial prediction unit; 308 prediction method determination unit; 309 inverse quantization unit; 310 inverse orthogonal transform unit; 311 addition unit.

CLAIMS

1. A method for predictively encoding a motion vector used in motion compensated prediction of a video sequence consisting of a temporal sequence of frame pictures, comprising:

a step of determining a motion vector of a target partition in a frame picture of an encoding target in the video sequence;

a step of determining a first motion vector predictor candidate that satisfies a predetermined criterion used in determination of motion vector predictor candidates, the first motion vector predictor candidate determined from a motion vector or motion vectors of one or more partitions belonging to a left-neighboring region located on the left side of the target partition;

a step of determining a second motion vector predictor candidate that satisfies a predetermined criterion used for determination of motion vector predictor candidates, the second motion vector predictor candidate determined from a motion vector or motion vectors of one or more partitions belonging to an above-neighboring region located above the target partition;

a step of selecting an optimum motion vector predictor and outputting motion vector predictor indication information to specify the selected optimum motion vector predictor, wherein the optimum motion vector predictor is selected based on comparison between one or more motion vector predictor candidates including the first motion vector predictor candidate and the second motion vector predictor candidate, and the motion vector of the target partition; and

a step of encoding the motion vector predictor indication information,

wherein the left-neighboring region includes a neighboring partition located below and on the left side of the target partition,

wherein the above-neighboring region includes a neighboring partition located above and on the right side of the target partition,

wherein the above-neighboring region includes a neighboring partition located above and on the left side of the target partition,

wherein the step of determining the first motion vector predictor candidate comprises scanning one or more partitions included in the left-neighboring region, in an upward direction from a bottom of the

left-neighboring region, and thereby determining, as the first motion vector predictor candidate, a motion vector satisfying the predetermined criterion used for determination of motion vector predictor candidates, from the motion vector or motion vectors of the one or more partitions belonging to the left-neighboring region, and

wherein the step of determining the second motion vector predictor candidate comprises scanning one or more partitions included in the above-neighboring region, in a direction from right to left, and thereby determining, as the second motion vector predictor candidate, a motion vector satisfying the predetermined criterion used for determination of motion vector predictor candidate, from the motion vector or motion vectors of the one or more partitions belonging to the above-neighboring region.

2. The method according to claim 1, wherein the step of encoding comprises encoding the motion vector predictor indication information into encoded data of a bit count according to the number of the motion vector predictor candidates.

3. The method according to claim 2, wherein the step of encoding comprises encoding the motion vector predictor indication information into encoded data of a minimum bit count according to the number of the motion vector predictor candidates.

4. The method according to any one of claims 1 to 3, wherein the step of determining the first motion vector predictor candidate comprises determining first scan direction indication information indicative of a direction of scanning of one or more partitions included in the left-neighboring region in order to determine the first motion vector predictor candidate,

wherein the step of determining the second motion vector predictor candidate comprises determining second scan direction indication information indicative of a direction of scanning of one or more partitions included in the above-neighboring region in order to determine the second motion vector predictor candidate, and

wherein the step of encoding comprises further encoding the first

scan direction indication information and the second scan direction indication information.

5. The method according to any one of claims 1 to 4, wherein the number of the one or more motion vector predictor candidates is not more than 3.

6. The method according to any one of claims 1 to 5, wherein, without encoding a residual signal between the motion vector of the target partition and the optimum motion vector predictor, the optimum motion vector predictor is used as the motion vector of the target partition.

7. The method according to any one of claims 1 to 6, wherein a predicted signal of the target partition is generated by referring to a reference frame with a frame number specified by a reference picture list identification and a reference picture identification,

wherein the step of determining the first motion vector predictor candidate comprises determining the first motion vector predictor candidate from motion vectors of partitions in the left-neighboring region having a reference picture list identification and/or a reference picture identification coincident with the reference picture list identification and/or the reference picture identification for the target partition, and

wherein the step of determining the second motion vector predictor candidate comprises determining the second motion vector predictor candidate from motion vectors of partitions in the above-neighboring region having a reference picture list identification and/or a reference picture identification coincident with the reference picture list identification and/or the reference picture identification for the target partition.

8. A device for predictively encoding a motion vector used in motion compensated prediction of a video sequence consisting of a temporal sequence of frame pictures, comprising:

motion detection means adapted to determine a motion vector of a target partition in a frame picture of an encoding target in the video sequence;

first motion vector predictor candidate determination means adapted

to determine a first motion vector predictor candidate satisfying a predetermined criterion used in determination of motion vector predictor candidates, the first motion vector predictor candidate determined from a motion vector or motion vectors of one or more partitions belonging to a left-neighboring region located on the left side of the target partition;

second motion vector predictor candidate determination means adapted to determine a second motion vector predictor candidate that satisfies a predetermined criterion used in determination of motion vector predictor candidates, the second motion vector predictor candidate determined from a motion vector or motion vectors of one or more partitions belonging to an above-neighboring region located above the target partition;

motion vector predictor determination means adapted to select an optimum motion vector predictor and output motion vector predictor indication information to specify the selected optimum motion vector predictor, wherein the optimum motion vector predictor is selected based on comparison between one or more motion vector predictor candidates including the first motion vector predictor candidate and the second motion vector predictor candidate; and

encoding means adapted to encode the motion vector predictor indication information,

wherein the left-neighboring region includes a neighboring partition located below and on the left side of the target partition,

wherein the above-neighboring region includes a neighboring partition located above and on the right side of the target partition,

wherein the above-neighboring region includes a neighboring partition located above and on the left side of the target partition,

wherein the step of determining the first motion vector predictor candidate comprises scanning one or more partitions included in the left-neighboring region, in an upward direction from a bottom of the left-neighboring region, and thereby determining, as the first motion vector predictor candidate, a motion vector satisfying the predetermined criterion used for determination of motion vector predictor candidates, from the motion vector or motion vectors of the one or more partitions belonging to the left-neighboring region, and

wherein the step of determining the second motion vector predictor

candidate comprises scanning one or more partitions included in the above-neighboring region, in a direction from right to left, and thereby determining, as the second motion vector predictor candidate, a motion vector satisfying the predetermined criterion used for determination of motion vector predictor candidate, from the motion vector or motion vectors of the one or more partitions belonging to the above-neighboring region.

9. A program for causing a computer to operate as a device for predictively encoding a motion vector used in motion compensated prediction of a video sequence consisting of a temporal sequence of frame pictures, the program causing the computer to function as:

motion detection means adapted to determine a motion vector of a target partition in a frame picture of an encoding target in the video sequence;

first motion vector predictor candidate determination means adapted to determine a first motion vector predictor candidate that satisfies a predetermined criterion used in determination of motion vector predictor candidates, the first motion vector predictor candidate determined from a motion vector or motion vectors of one or more partitions belonging to a left-neighboring region located on the left side of the target partition;

second motion vector predictor candidate determination means adapted to determine a second motion vector predictor candidate satisfying a predetermined criterion used in determination of motion vector predictor candidates, the second motion vector predictor candidate determined from a motion vector or motion vectors of one or more partitions belonging to an above-neighboring region located above the target partition;

motion vector predictor determination means adapted to select an optimum motion vector predictor and output motion vector predictor indication information to specify the selected optimum motion vector predictor, wherein the optimum motion vector predictor is selected based on comparison between one or more motion vector predictor candidates including at least the first motion vector predictor candidate and the second motion vector predictor candidate, and the motion vector of the target partition; and

encoding means adapted to encode the motion vector predictor

indication information,

wherein the left-neighboring region includes a neighboring partition located below and on the left side of the target partition,

wherein the above-neighboring region includes a neighboring partition located above and on the right side of the target partition,

wherein the above-neighboring region includes a neighboring partition located above and on the left side of the target partition,

wherein the step of determining the first motion vector predictor candidate comprises scanning one or more partitions included in the left-neighboring region, in an upward direction from a bottom of the left-neighboring region, and thereby determining, as the first motion vector predictor candidate, a motion vector satisfying the predetermined criterion used for determination of motion vector predictor candidates, from the motion vector or motion vectors of the one or more partitions belonging to the left-neighboring region, and

wherein the step of determining the second motion vector predictor candidate comprises scanning one or more partitions included in the above-neighboring region, in a direction from right to left, and thereby determining, as the second motion vector predictor candidate, a motion vector satisfying the predetermined criterion used for determination of motion vector predictor candidate, from the motion vector or motion vectors of the one or more partitions belonging to the above-neighboring region.

10. A method for predictively decoding a motion vector used in motion compensated prediction to restore a video sequence consisting of a temporal sequence of frame pictures, comprising:

a step of determining a first motion vector predictor candidate that satisfies a predetermined criterion used in determination of motion vector predictor candidates, from a motion vector or motion vectors of one or more partitions belonging to a left-neighboring region located on the left side of a target partition in a frame picture of a decoding target;

a step of determining a second motion vector predictor candidate satisfying a predetermined criterion used in determination of motion vector predictor candidates, from a motion vector or motion vectors of one or more partitions belonging to an above-neighboring region located above

the target partition;

a step of decoding encoded data to restore motion vector predictor indication information specifying an optimum motion vector predictor for the target partition; and

a step of selecting the optimum motion vector predictor specified by the motion vector predictor indication information, from one or more motion vector predictor candidates including at least the first motion vector predictor candidate and the second motion vector predictor candidate,

wherein the left-neighboring region includes a neighboring partition located below and on the left side of the target partition,

wherein the above-neighboring region includes a neighboring partition located above and on the right side of the target partition,

wherein the above-neighboring region includes a neighboring partition located above and on the left side of the target partition,

wherein the step of determining the first motion vector predictor candidate comprises scanning one or more partitions included in the left-neighboring region, in an upward direction from a bottom of the left-neighboring region, and thereby determining, as the first motion vector predictor candidate, a motion vector satisfying the predetermined criterion used for determination of motion vector predictor candidates, from the motion vector or motion vectors of the one or more partitions belonging to the left-neighboring region, and

wherein the step of determining the second motion vector predictor candidate comprises scanning one or more partitions included in the above-neighboring region, in a direction from right to left, and thereby determining, as the second motion vector predictor candidate, a motion vector satisfying the predetermined criterion used for determination of motion vector predictor candidate, from the motion vector or motion vectors of the one or more partitions belonging to the above-neighboring region.

11. The method according to claim 10, wherein a bit count of the encoded data of the motion vector predictor indication information is a bit count according to the number of the motion vector predictor candidates.

12. The method according to claim 11, wherein the bit count of

the encoded data of the motion vector predictor indication information is a minimum bit count according to the number of the motion vector predictor candidates.

13. The method according to any one of claims 10 to 12, further comprising:

wherein the step of determining the first motion vector predictor candidate comprises a step of decoding encoded data to restore first scan direction indication information to specify a direction of scanning of one or more partitions included in the left-neighboring region,

wherein the step of determining the second motion vector predictor candidate comprises decoding encoded data to restore second scan direction indication information to specify a direction of scanning of one or more partitions included in the above-neighboring region,

wherein the step of determining the first motion vector predictor candidate comprises: scanning one or more partitions included in the left-neighboring region, in the direction specified by the first scan direction indication information, to determine the first motion vector predictor candidate, and

wherein the step of determining the second motion vector predictor candidate comprises scanning one or more partitions included in the above-neighboring region, in the direction specified by the second scan direction indication information, to determine the second motion vector predictor candidate.

14. The method according to any one of claims 10 to 13, wherein the number of the one or more motion vector predictor candidates is not more than 3.

15. The method according to any one of claims 10 to 14, wherein the optimum motion vector predictor is used as a motion vector of the target partition.

16. The method according to any one of claims 10 to 15, wherein a predicted signal of the target partition is generated by referring to a reference frame with a frame number specified by a reference picture list

identification and a reference picture identification,

wherein the step of determining the first motion vector predictor candidate comprises determining the first motion vector predictor candidate from motion vectors of partitions in the left-neighboring region having a reference picture list identification and/or a reference picture identification coincident with the reference picture list identification and/or the reference picture identification for the target partition, and

wherein the step of determining the second motion vector predictor candidate comprises determining the second motion vector predictor candidate from motion vectors of partitions in the above-neighboring region having a reference picture list identification and/or a reference picture identification coincident with the reference picture list identification and/or the reference picture identification for the target partition.

17. A device for predictively decoding a motion vector used in motion compensated prediction to restore a video sequence consisting of a temporal sequence of frame pictures, comprising:

first motion vector predictor candidate determination means adapted to determine a first motion vector predictor candidate satisfying a predetermined criterion used in determination of motion vector predictor candidates from a motion vector or motion vectors of one or more partitions belonging to a left-neighboring region located on the left side of a target partition in a frame picture of a decoding target;

second motion vector predictor candidate determination means adapted to determine a second motion vector predictor candidate satisfying a predetermined criterion used in determination of motion vector predictor candidates from a motion vector or motion vectors of one or more partitions belonging to an above-neighboring region located above the target partition;

decoding means adapted to decode encoded data to restore motion vector predictor indication information specifying an optimum motion vector predictor for the target partition; and

optimum motion vector predictor determination means adapted to select the optimum motion vector predictor specified by the motion vector predictor indication information, from one or more motion vector predictor candidates including at least the first motion vector predictor candidate and

the second motion vector predictor candidate,

wherein the left-neighboring region includes a neighboring partition located below and on the left side of the target partition,

wherein the above-neighboring region includes a neighboring partition located above and on the right side of the target partition,

wherein the above-neighboring region includes a neighboring partition located above and on the left side of the target partition,

wherein the step of determining the first motion vector predictor candidate comprises scanning one or more partitions included in the left-neighboring region, in an upward direction from a bottom of the left-neighboring region, and thereby determining, as the first motion vector predictor candidate, a motion vector satisfying the predetermined criterion used for determination of motion vector predictor candidates, from the motion vector or motion vectors of the one or more partitions belonging to the left-neighboring region, and

wherein the step of determining the second motion vector predictor candidate comprises scanning one or more partitions included in the above-neighboring region, in a direction from right to left, and thereby determining, as the second motion vector predictor candidate, a motion vector satisfying the predetermined criterion used for determination of motion vector predictor candidate, from the motion vector or motion vectors of the one or more partitions belonging to the above-neighboring region.

18. A program for causing a computer to operate as a device for predictively decoding a motion vector used in motion compensated prediction to restore a video sequence consisting of a temporal sequence of frame pictures, the program causing the computer to function as:

first motion vector predictor candidate determination means adapted to determine a first motion vector predictor candidate satisfying a predetermined criterion used in determination of motion vector predictor candidates from a motion vector or motion vectors of one or more partitions belonging to a left-neighboring region located on the left side of a target partition in a frame picture of a decoding target;

second motion vector predictor candidate determination means adapted to determine a second motion vector predictor candidate satisfying

a predetermined criterion used in determination of motion vector predictor candidates from a motion vector or motion vectors of one or more partitions belonging to an above-neighboring region located above the target partition;

decoding means adapted to decode encoded data to restore motion vector predictor indication information specifying an optimum motion vector predictor for the target partition; and

optimum motion vector predictor determination means adapted to select the optimum motion vector predictor specified by the motion vector predictor indication information, from one or more motion vector predictor candidates including at least the first motion vector predictor candidate and the second motion vector predictor candidate,

wherein the left-neighboring region includes a neighboring partition located below and on the left side of the target partition,

wherein the above-neighboring region includes a neighboring partition located above and on the right side of the target partition,

wherein the above-neighboring region includes a neighboring partition located above and on the left side of the target partition,

wherein the step of determining the first motion vector predictor candidate comprises scanning one or more partitions included in the left-neighboring region, in an upward direction from a bottom of the left-neighboring region, and thereby determining, as the first motion vector predictor candidate, a motion vector satisfying the predetermined criterion used for determination of motion vector predictor candidates, from the motion vector or motion vectors of the one or more partitions belonging to the left-neighboring region, and

wherein the step of determining the second motion vector predictor candidate comprises scanning one or more partitions included in the above-neighboring region, in a direction from right to left, and thereby determining, as the second motion vector predictor candidate, a motion vector satisfying the predetermined criterion used for determination of motion vector predictor candidate, from the motion vector or motion vectors of the one or more partitions belonging to the above-neighboring region.