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DESCRIPTION

BACKGROUND

1. Field

[0001] One or more embodiments of the present invention relate to a method and apparatus for determining a reference picture set (RPS) which is a set of reference pictures that are used in predictive decoding of a current picture that is to be decoded.

2. Description of the Related Art

[0002] Recently, with the development of digital display technology and the advent of high-quality digital televisions (TVs), a new codec for processing a large amount of video data has been proposed. Information of reference pictures which are used in predictive decoding of a current picture can be encoded and transferred to a decoding portion. The decoding portion can perform predictive decoding of the current picture by using the transferred information of the reference pictures.
The standards proposal documents TAN T K ET AL: "AHG21 : Inter reference picture set prediction syntax and semantics", 7. JCT-VC MEETING; M98. MPEG MEETING; 21-11-2011 - 30-11-2011; GENEVA; (JOINT COLLABORATIVE TEAM ON VIDEO CODING OF ISO/IEC JTC1/ SC29/WG11 AND ITU-T SG.16); URL: HTTP://WFTP3.ITU.INT/AV-ARCH/JCTV-SITE/, no JCTVC-G198, 8 November 2011 describes a proposal to reduce the amount of bits necessary for signaling the reference picture set by predicting the delta picture order count (ΔPOC) values using the ΔPOC values from a reference picture set already present in the picture parameter set (PPS). The number of additional PPS signaling bits needed for the random access and low delay common conditions are reduced.

SUMMARY

[0003] One or more exemplary embodiments include an apparatus for determining a reference picture set (RPS) which is a set of reference pictures that are used in predictive decoding of a current picture.

[0004] Additional aspects will be set forth in part in the description which follows and, in part, will be apparent from the description, or may be learned by practice of the presented embodiments.

[0005] The invention is set out in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] These and/or other aspects will become apparent and more readily appreciated from the following description of the embodiments, taken in conjunction with the accompanying drawings in which:

FIGS. 1A and 1B are block diagrams of an internal structure of a video encoding apparatus related to an exemplary embodiment;

FIGS. 2A and 2B are block diagrams of an internal structure of a video decoding apparatus related to an exemplary embodiment;

FIG. 3 is a block diagram of an internal structure of a picture encoding unit related to an exemplary embodiment;

FIG. 4 is a block diagram of an internal structure of a picture decoding unit related to an exemplary embodiment;

FIGS. 5 and 6 are flowcharts illustrating a method of signaling a reference picture set (RPS) for use with to an exemplary embodiment;

FIGS. 7 and 8 are flowcharts illustrating a method of determining an RPS for use with to an exemplary embodiment;

FIG. 9 is a view of an example of a sequence parameter set (SPS);

FIG. 10 is a view of an example of a slice headert;

FIG. 11 is a view of an example of a short term RPS; and

FIGS. 12A and 12B are views of an example of an RPS of pictures.

DETAILED DESCRIPTION

[0007] Hereinafter, the present invention will be described in detail by explaining preferred embodiments of the invention with reference to the attached drawings. Detailed descriptions of related well known functions or configurations will be omitted so as not to obscure the description of the present invention. Like reference numerals in the drawings denote like elements.

[0008] The terms and words which are used in the present specification and the appended claims should not be limited to their common or dictionary meanings, because an inventor can define the concept of the terms appropriately to describe his/her invention in the best manner. Therefore, they should be construed as having a meaning and concept fit to the technological concept and scope and of the present invention. Therefore, the embodiments and structures described in the drawings of the present specification are just exemplary embodiments of the present invention, and they do not represent the entire technological concept and scope of the present invention. Therefore, it should be understood that there can be many equivalents and modified embodiments that can substitute those described in this specification.

[0009] The principle of the present invention may be applied to an encoding standard based on an arbitrary intra frame and an inter frame. The term "picture" used throughout the present specification is an inclusive term to denote various forms of video image information that may be known in the related art, such as a "frame," a "field," and a "slice."

[0010] A reference picture may be a picture that may be used for inter-prediction of a block in a current picture.

[0011] Generally, an encoding portion may identify reference pictures by using a picture order count (POC) value. The POC value represents a relative order of display of corresponding pictures. For example, a picture having a low POC value may be displayed earlier than a picture having a high POC value. The order of display and an order of decoding of pictures are different. The picture having the low POC value may not be decoded earlier than the picture having the high POC value. Also, the picture having the low POC value may be decoded earlier than the picture having the high POC value.

[0012] According to an exemplary embodiment, a description is made based on a High Efficiency Video Coding (HEVC) standard. However, it is not limited thereto, and may be applied to other video coding technologies. For example, a reference picture set (RPS) is described based on the HEVC standard, but the RPS may be applied to other standards.

[0013] Hereinafter, one or more embodiments of the present invention will be described more fully with reference to the accompanying drawings.

[0014] FIGS. 1A and 1B are block diagrams of an internal structure of a video encoding apparatus 100 according to an embodiment of the present invention.

[0015] Referring to FIG. 1A, the video encoding apparatus 100 may include an RPS determination unit 101 and a signaling method determination unit 102.

[0016] An RPS refers to a set of reference pictures which are capable of being used in predictive decoding of a current picture that is to be decoded. The RPS may be defined in a sequence parameter set (SPS) or a slice header. The SPS is header information including information regarding encoding of a sequence, such as a profile, a level, and the like. The SPS may include a plurality of RPSs that are capable of being identified as indexes. The slice header may include an additionally defined RPS in addition to the RPS defined in the SPS. The additionally defined RPS may be used in a picture corresponding to the slice header including the RPS.

[0017] The reference pictures included in the RPS may be indicated as a picture order count (POC) value based on the current picture. That is, when a POC value of the current picture for which the RPS may be used is set to 0, a POC value of the reference picture may be indicated. Although there may be a short term RPS and a long term RPS, the RPS hereinafter may be the short term RPS.

[0018] A method of defining the RPS in the slice header in the video encoding apparatus 100, that is, a method of signaling an RPS, includes an inter-RPS prediction method. According to the inter-RPS prediction method, the video encoding apparatus 100 may signal the RPS in the slice header to obtain an RPS to be used in predictive decoding of the current picture by referring to one of RPSs pre-defined in the SPS. In detail, the video encoding apparatus 100 may signal the RPS by adding a delta RPS of the RPS and an index of an RPS that may be referred to in determining the RPS to a bit stream. The RPS may be obtained in a decoding portion by adding the delta RPS, which is a difference between the reference RPS and the RPS to the reference RPS. That is, the RPS may be obtained by adding the delta RPS to each of POC values of reference pictures included in the reference RPS. The reference RPS is a value pre-defined in the SPS and may be identified as an index.

[0019] The delta RPS of the RPS that is to be used in predictive decoding of the current picture may be obtained by the fact that the delta RPS of the RPS that is to be used in predictive decoding of the current picture is the same as a difference between a POC value of the current picture and a POC value of a previous picture. Here, the previous picture may refer to a picture previous to the current picture, on a basis of an order of encoding. This is because the reference picture of the current picture should be a reference picture of a picture previously output or a reference picture of a picture previously decoded. Thus, according to the exemplary embodiment, the delta RPS of the RPS may be obtained by a POC difference between the previously decoded picture and the current picture. Accordingly, the video encoding apparatus 100 may signal the RPS used in predictive decoding of the current picture without adding the delta RPS and the index of the reference RPS to the bit stream. Here, the decoding portion may obtain the delta RPS of the RPS by the difference between the POC values of the current picture and the previous picture and obtain an RPS used in predictive decoding of the previous picture, in order to obtain the RPS to be used in predictive decoding of the current picture from the delta RPS and the RPS used in predictive decoding of the previous picture.

[0020] The video encoding apparatus 100 according to the exemplary embodiment may determine the RPS to be used in predictive decoding of the current picture and may add a flag to the bit stream based on the method of signaling the RPS. Also, the video encoding apparatus 100 may encode the current picture by using the determined RPS.

[0021] The RPS determination unit 101 may determine the RPS to be used in predictive decoding of the current picture. The determined RPS may be signaled according to a signaling method determined by the signaling method determination unit 102.

[0022] The signaling method determination unit 102 may determine whether to signal the RPS based on the delta RPS and may signal the RPS based on a result of the determination, in order to signal the RPS determined by the RPS determination unit 101.

[0023] Referring to FIG. 1B, the video encoding apparatus 100 according to the present embodiment may include an RPS determination unit 110, a signaling method determination unit 120, a flag adding unit 130, a picture encoding unit 140 and an output unit 150. The RPS determination unit 110 and the signaling method determination unit 120 of FIG. 1B respectively correspond to the RPS determination unit 101 and the signaling method determination unit 102 of FIG. 1A, and thus, their detailed descriptions will be omitted. The RPS determination unit 110 may determine the RPS to be used in predictive decoding of the current picture.

[0024] The signaling method determination unit 120 may determine the method of signaling the RPS to be used in predictive decoding of the current picture. The signaling method determination unit 120 may determine whether to determine the RPS based on the delta RPS and may determine the method of signaling the RPS based on a result of the determination. According to an exemplary embodiment, there are two methods of signaling the RPS based on the delta RPS. According to the first signaling method, in the video encoding apparatus 100, the decoding portion may determine the delta RPS based on POC values of the current picture and the previous picture and may signal the RPS to determine the RPS to be used in predictive decoding of the current picture, based on the determined delta RPS. Also, according to the second signaling method, in the video encoding apparatus 100, the decoding portion may signal the RPS to determine the RPS to be used in predictive decoding of the current picture based on the delta RPS and an index of the reference RPS used in predictive decoding of the current picture. The decoding portion may obtain the reference RPS by using the index of the reference RPS transferred from the video encoding apparatus 100, and may determine the RPS to be used in predictive decoding of the current picture based on the delta RPS and the reference RPS.

[0025] The flag adding unit 130 may add a flag to a bit stream according to a signaling method determined by the signaling method determination unit 120. In detail, the flag adding unit 130 may add flag values, which differ according to the first signaling method and the second signaling method, to the bit stream For example, the flag adding unit 130 may set the flag value to 1 in the case where the RPS to be used in predictive decoding of the current picture is signaled by the first signaling method. The flag adding unit 130 may set the flag value to 0 in the case where the RPS to be used in predictive decoding of the current picture is signaled by the second signaling method. Thus, the decoding portion may determine the signaling method based on the flag value and determine the RPS to be used in predictive decoding of the current picture based on the determined signaling method.

[0026] The picture encoding unit 140 may encode the current picture by using the RPS determined by the RPS determination unit 110. The encoded picture may be converted to a bit stream to be transferred to a video decoding apparatus 200 via the output unit 150.

[0027] The output unit 150 may output the encoded picture and a bit stream associated with information necessary for decoding the picture. The flag added to the bit stream by the flag adding unit 130 is the information necessary for decoding pictures and may be output by the output unit 150 by being added to the bit stream.

[0028] FIGS. 2A and 2B are block diagrams of an internal structure of the video decoding apparatus 200.

[0029] Referring to FIG. 2A, the video decoding apparatus 200 may include an RPS determination unit 201.

[0030] The RPS determination unit 201 may determine whether to determine an RPS based on a delta RPS and determine the RPS based on a result of the determination, in order to determine the RPS which is a set of reference pictures that are used in predictive decoding of a current picture.

[0031] Referring to FIG. 2B, the video decoding apparatus 200 may include a receiving unit 210, a flag obtaining unit 220, an RPS determination unit 230, and a picture decoding unit 240. The RPS determination unit 230 of FIG. 2B corresponds to the RPS determination unit 201 of FIG. 2A, and thus, its description will not be repeated here.

[0032] The receiving unit 210 may receive a bit stream with respect to an encoded picture to perform parsing.

[0033] The flag obtaining unit 220 may obtain a flag to obtain an RPS in the bit stream for which the parsing is performed. According to a value of the flag, the RPS to be used in predictive decoding of the current picture is determined based on POC values of the current picture and a previous picture, according to the first signaling method. Alternatively, the RPS to be used in predictive decoding of the current picture is determined based on the delta RPS and an index of a reference RPS transferred from the video encoding apparatus 100, according to the second signaling method.

[0034] The RPS determination unit 230 may determine the RPS to be used in predictive decoding of the current picture according to the flag obtained by the flag obtaining unit 220. According to the first signaling method, the RPS determination unit 230 may determine the delta RPS of the RPS based on a difference value between the POC values of the current picture and the previous picture, and may determine an RPS used in predictive decoding of the previous picture. In addition, the RPS determination unit 230 may add the determined delta RPS to the RPS used in predictive decoding of the previous picture in order to determine the RPS to be used in predictive decoding of the current picture. That is, the RPS may be determined based on a value of the delta RPS added to each of POC values of reference pictures included in the RPS used in predictive decoding of the previous picture. Also, according to the second signaling method, the RPS determination unit 230 may obtain a reference RPS by using an index of the reference RPS transferred from the video encoding apparatus 100. Also, the RPS determination unit 230 may obtain the RPS to be used in predictive decoding of the current picture by adding the delta RPS transferred from the video encoding apparatus 100 to the reference RPS. That is, the RPS may be determined based on the value of the delta RPS added to each of the POC values of the reference pictures included in the reference RPS.

[0035] The picture decoding unit 240 may decode a picture by using the RPS determined by the RPS determination unit 230.

[0036] FIG. 3 is a block diagram of an internal structure of a picture encoding unit 300.

[0037] Referring to FIG. 3, the picture encoding unit 300 may include a movement estimation unit 301, a movement compensation unit 302, an intra-prediction unit 303, a converting unit 305, a quantization unit 306, an entropy encoding unit 307, a reverse quantization unit 308, a reverse converting unit 309, a deblocking unit 310, and a loop filtering unit 311. The picture encoding unit 300 of FIG. 3 may correspond to the picture encoding unit 140 of FIG. 1.

[0038] The movement estimation unit 301 may estimate the movement of the current picture by using reference pictures included in an RPS with respect to a current picture which is a picture currently input from the outside among pictures forming a video.

[0039] The movement compensation unit 302 may generate a predictive picture of the current picture by using the reference pictures included in the RPS with respect to the current picture. In more detail, the movement compensation unit 302 may generate the predictive picture of the current picture by using the movement of the current picture, which is estimated by the movement estimation unit 301.

[0040] The intra-prediction unit 303 may predict each of intra mode blocks among blocks forming the current picture to generate the predictive picture of the current picture.

[0041] The converting unit 305 may convert a residual picture, which is calculated by subtracting the predictive picture from the current picture, from a spatial domain to a frequency domain. For example, the converting unit 305 may convert the residual picture from the spatial domain to the frequency domain by using an integer transform of the discrete Hadamard transform (DHT) and discrete cosine transform (DCT).

[0042] The quantization unit 306 may quantize frequency coefficients of the residual picture converted by the converting unit 305.

[0043] The entropy encoding unit 307 may generate a bit stream by entropy-encoding results of quantization by the quantization unit 306. In particular, the entropy encoding unit 307 may entropy encode information for video decoding, for example, RPS information used in inter-prediction, movement vector information, location information of neighboring blocks used in intra-prediction, in addition to the results of quantization by the quantization unit 306.

[0044] The reverse quantization unit 308 may reverse-quantize the results of quantization by the quantization unit 306.

[0045] The reverse converting unit 309 may convert results of quantization by the reverse quantization unit 308. That is, the reverse converting unit 309 may convert conversion coefficient values from a frequency domain to a spatial domain to restore the residual picture of the current picture and the predictive picture.

[0046] The deblocking unit 310 and the loop filtering unit 311 may adaptively perform filtering for the picture restored by the reverse quantization unit 308.

[0047] FIG. 4 is a block diagram of an internal structure of a picture decoding unit.

[0048] Referring to FIG. 4, the picture decoding unit 400 may include a parsing unit 401, an entropy decoding unit 403, a reverse quantization unit 405, a reverse converting unit 407, an intra-prediction unit 409, a movement compensation unit 415, a deblocking unit 411, and a loop filtering unit 413. The picture decoding unit 400 of FIG. 4 may correspond to the picture decoding unit 240 of FIG. 2.

[0049] The parsing unit 401 may perform parsing with respect to data of an encoded picture which is to be decoded and with respect to information related to decoding, which is necessary for encoding, from a bit stream.

[0050] The entropy decoding unit 403 may restore information for video decoding by entropy decoding the bit stream.

[0051] The reverse quantization unit 405 may restore conversion coefficient values by reverse quantizing values restored by the entropy decoding unit 403.

[0052] The reverse converting unit 407 may restore a residual picture of a current picture and a predictive picture by converting the conversion coefficient values restored by the reverse quantization unit 402 from a frequency domain to a spatial domain.

[0053] The intra-prediction unit 409 may generate the predictive picture of the current picture by predicting a value of a block of the current picture from a value of a restored block located neighboring a block of the current picture. The restored picture may be generated by adding the residual picture to the predictive picture.

[0054] The movement compensation unit 415 may generate the predictive picture of the current picture from reference pictures included in an RPS to be used in predictive decoding of the current picture. The restored picture may be generated by adding the residual picture to the predictive picture.

[0055] The deblocking unit 411 and the loop filtering unit 413 may adaptively perform filtering for the restored picture.

[0056] FIG. 5 is a flowchart illustrating a method of signaling an RPS.

[0057] Referring to FIG. 5, the picture encoding apparatus 100 may determine an RPS to be used in predictive decoding of a current picture in operation S501. That is, the picture encoding apparatus 100 may determine the RPS which is a set of pictures to be referred to in encoding the current picture. The picture encoding apparatus 100 may determine the RPS by referring to an index of one of RPSs defined in an SPS or may additionally define an RPS in a slice header in addition to the RPS defined in the SPS. According to an exemplary embodiment, in the case where an additional RPS is defined in the slice header in addition to the RPS defined in the SPS, the RPS may be defined by first and second signaling methods that will be described later.

[0058] The picture encoding apparatus 100 may determine whether the RPS is obtained based on a delta RPS in operation S503.

[0059] The picture encoding apparatus 100 may signal the RPS based on a result of the determination of operation S503, in operation S505.

[0060] FIG. 6 is a flowchart illustrating a method of signaling an RPS.

[0061] Referring to FIG. 6, the picture encoding apparatus 100 may signal an RPS to be used in predictive encoding of a current picture based on a delta RPS, in operation S601.

[0062] In the case where the picture encoding apparatus 100 signals the RPS based on the delta RPS, the picture encoding apparatus 100 may determine whether the RPS is obtained based on a difference value between POC values of a current picture and a previous picture in order to signal the RPS to be used in predictive decoding of the current picture according to the first method of signaling the RPS to be used in predictive decoding of the current picture, or whether the RPS is obtained based on the delta RPS of the RPS and an index of a reference RPS that may be referred to in determining the RPS in order to signal the RPS to be used in predictive decoding of the current picture according to the second method of signaling the RPS to be used in predictive decoding of the current picture, in operation S603. Here, the reference RPS may be one of RPSs pre-defined in an SPS and may be identified as an index of the reference RPS. The picture encoding apparatus 100 may determine one of the two signaling methods, which has better encoding efficiency. For example, the picture encoding apparatus 100 may determine the method of signaling the RPS based on a rate distortion cost. When the RPS is signaled by the first signaling method according to which the RPS is obtained based on the difference value between the POC values of the current picture and the previous picture in operation S605, a flag having a value of 1 may be added to a predetermined domain of a bit stream in operation S607. By this, the RPS to be used in predictive decoding of the current picture may be signaled.

[0063] When the RPS to be used in predictive decoding of the current picture is signaled by the second signaling method according to which the delta RPS and the index of the reference RPS are signaled in operation S605, a flag having a value of 0 may be added to a predetermined domain of the bit stream in operation S609.

[0064] According to the second signaling method, the picture decoding apparatus 200 needs the delta RPS of the current picture and the index of the reference RPS in order to obtain the RPS to be used in predictive decoding of the current picture by an inter-RPS method, and thus, the delta RPS of the current picture that is encoded and the index of the reference RPS need to be added to the bit stream.

[0065] The picture decoding apparatus 100 may determine the index of the reference RPS to be referred to in obtaining the RPS to be used in predictive decoding of the current picture in operation S611. Here, the picture decoding apparatus 100 may determine the index of the reference RPS based on encoding efficiency. The reference RPS is pre-defined in the SPS and may be identified as an index of each RPS.

[0066] The picture encoding apparatus 100 may obtain the delta RPS by using the index of the reference RPS determined in operation S611, in operation S613. The picture encoding apparatus 100 may obtain the reference RPS defined in the SPS by using the index of the reference RPS and may obtain the delta RPS by obtaining a difference between the obtained reference RPS and the RPS to be used in predictive decoding of the current picture.

[0067] In addition, a value indicating a reference picture of the reference RPS to which the delta RPS is applied may be defined in operation S613. For example, when the reference RPS is {-1, 1, 3, 5}, the RPS to be used in predictive decoding of the current picture and to be signaled is {-2, 0, 2}, and a value of the delta RPS is -1, the determined RPS may have the same value as the RPS of {-2, 0, 2} only when the delta RPS is not applied to a POC value of a fourth reference picture when applying the delta RPS to the reference RPS. Thus, {1, 1, 1, 0} in which a fourth value for the fourth reference picture is 0 may be defined as a value indicating the reference picture to which the delta RPS is applied. The value indicating the reference picture to which the delta RPS is applied may be defined and signaled by the first signaling method as well as the second signaling method.

[0068] The picture encoding apparatus 100 may signal the RPS to be used in prediction decoding of the current picture by encoding the index of the reference RPS and the delta RPS to add to the predetermined domain of the bit stream.

[0069] FIG. 7 is a flowchart illustrating a method of determining an RPS.

[0070] Referring to FIG. 7, the picture decoding apparatus 200 may determine whether to determine the RPS based on a delta RPS, in order to determine an RPS to be used in predictive decoding of a current picture, in operation S701.

[0071] In operation S703, the picture decoding apparatus 200 may determine the RPS based on a result of the determination of operation S701.

[0072] FIG. 8 is a flowchart illustrating a method of determining an RPS.

[0073] Referring to FIG. 8, when the picture decoding apparatus 200 determines the RPS based on the delta RPS, the picture decoding apparatus 200 may obtain a flag indicating whether a first signaling method or a second signaling method is used to determine the RPS to be used in predictive decoding of the current picture, in operation S801.

[0074] When the flag is 1 in operation S803, the picture decoding apparatus 200 may determine the RPS to be used in predictive decoding of the current picture by using the first signaling method.

[0075] The picture decoding apparatus 200 may obtain POC values of the current picture and a previous picture according to the first signaling method, in operation S805.

[0076] The picture decoding apparatus 200 may obtain the delta RPS of the current picture by using the obtained POC value in operation S807. That is, the picture decoding apparatus 200 may determine a difference value between the POC value of the current picture and the POC value of the previous picture as the delta RPS of the RPS to be used in predictive decoding of the current picture.

[0077] The picture decoding apparatus 200 may obtain an RPS used in predictive decoding of the previous picture, where the RPS is capable of being used as a reference RPS to obtain the RPS, in operation S809.

[0078] The picture decoding apparatus 200 may obtain the RPS by using the delta RPS and the RPS used in predictive decoding of the previous picture, in operation S811. That is, the picture decoding apparatus 200 may obtain the RPS by adding the delta RPS to POC values of reference pictures included in the RPS used in predictive decoding of the previous picture. Here, the RPS may be obtained by further using a value indicating the reference picture to which the delta RPS is applied.

[0079] Meanwhile, when the flag is 0 in operation S803, the picture decoding apparatus 200 may determine the RPS to be used in predictive decoding of the current picture by using the second signaling method.

[0080] The picture decoding apparatus 200 may obtain an index of the reference RPS and the delta RPS from a predetermined domain of a bit stream, in operation S813.

[0081] The picture decoding apparatus 200 may obtain the reference RPS by using the index of the reference RPS obtained in operation S813, in operation S815. The reference RPS may be a value pre-defined in an SPS, which may be identified as an index.

[0082] The picture decoding apparatus 200 may determine the RPS to be used in predictive decoding of the current picture based on the reference RPS and the delta RPS in operation S817. That is, the picture decoding apparatus 200 may obtain the RPS to be used in predictive decoding of the current picture by adding the delta RPS to POC values of reference pictures of the reference RPS. Here, the RPS to be used in predictive decoding of the current picture may be determined based on a value indicating the reference picture of the reference RPS to which the delta RPS may be applied.

[0083] FIG. 9 is a view of an example of an SPS.

[0084] Referring to FIG. 9, num_short_term_ref_pic_sets (1) may be defined in the SPS as the number of a short term RPS, and short_term_ref_pic_set (i) (3) may be defined in the SPS as much as a value of num_short_term_ref_pic_sets (1). As described earlier, an RPS which is a set of reference pictures that are used in predictive decoding of a picture may be defined in the SPS, and each RPS may be identified as an index.

[0085] FIG. 10 is a view of an example of a slice header.

[0086] Referring to FIG. 10, when the short term RPS is defined in the slice header, 0 may be added to a value of short_term_ref_pic_set_flag (5). When the value of short_term_ref_pic_set_sps_flag (5) is 0, the short term RPS may be defined in short_term_ref_pic_set (num_short_term_ref_pic_sets) (7) of the slice header. The RPS defined in the slice header may be a value other than the RPS defined in the SPS.

[0087] FIG. 11 is a view of an example of a short term RPS.

[0088] Referring to FIG. 11, the short term RPS that may be defined in the slice header illustrated in FIG. 10 may be defined in short_term_ref_pic_set (idx).

[0089] A value of inter_ref_pic_set_prediction_flag (9) may be determined based on whether or not the RPS is defined by an inter RPS method.

[0090] In the case where, if the value of inter_ref_pic_set_prediction_flag is 1 in if(inter_ref_pic_set_prediction_flag) (11), idx is num_short_term_ref_pic_sets (13), that is, in the case where an index of the RPS is the same as the number of the short RPSs defined in the SPS, a value of derived_delta_rps_flag (15) may be determined.

[0091] The index of the short term RPS defined in the SPS may have a value in a range of 0 to num_short_term_ref_pic_sets-1. Thus, the case where the index of the RPS is the same as the number of the short term RPSs defined in the SPS is the case where an RPS which is not defined in the SPS is defined in the slice header. That is, the value of derived_delta_rps_flag (15) may be determined in the case where the RPS which is not defined in the SPS is defined in the slice header.

[0092] The value of derived_delta_rps_flag (15) may correspond to the flag that may be obtained by being added to the bit stream according to an exemplary embodiment. Also, the RPS may be signaled based on the value of derived_delta_rps_flag (15).

[0093] In the case where derived_delta_rps_flag (15) is 0, the video decoding apparatus 200 may obtain the RPS to be used in predictive decoding of the current picture by using the delta RPS and the index of the reference RPS.

[0094] In the case where derived_delta_rps_flag (15) is 1, the delta RPS and the index of the reference RPS may be obtained from delta_idx_minus1 (19), delta_rps_sign (21), and abs_delta_rps_minus1 (23) by Equations 1 and 2 below.

[Equation 1]

$$\text{DeltaRPS} = (1-2*\text{delta\_rps\_sign})*(\text{abs\_delta\_rps\_minus1}+1)$$

[Equation 2]

$$\text{RIdx} = \text{idx}-(\text{delta\_idx\_minus1}+1)$$

[0095] In Equations 1 and 2, DeltaRPS denotes the delta RPS and RIdx denotes the index of the reference RPS.

[0096] delta_rps_sign (21) may have a value of 0 or 1, and each value may denote a negative number or a positive number. abs_delta_rps_minus1 (23) is a value in which 1 is subtracted from the delta RPS.

[0097] idx denotes an index of the short term RPS defined in the slice header, and delta_idx_minus1 (19) is a delta index value, which is a value obtained by subtracting 1 from a difference value between the RPS and the index of the reference RPS.

[0098] FIGS. 12A and 12B are views of an example of an RPS of pictures. FIG. 12A illustrates a frame decoded by a random access in which a decoding order and a POC are not the same, and FIG. 12B illustrates a frame decoded by a low delay in which the decoding order and the POC are the same.

[0099] Referring to FIGS. 12A and 12B, the POC 25 and 31, reference pictures 27 and 33, and delta RPSs 29 and 35 are indicated for each frame. Frame numbers are in accordance with the decoding order.

[0100] The delta RPSs 29 and 35 are each a difference value between POC values of reference pictures included in a reference RPS and reference pictures included in an RPS to be used in predictive decoding of a current picture. Here, the POC values of the reference pictures are on the basis of the current picture of 0. The reference RPS for each frame illustrated in FIG. 12A is an RPS used in predictive decoding of a frame previously decoded. Thus, referring to the reference pictures 27 and 33, the RPS used in predictive decoding of a previous picture and the RPS used in predictive decoding of the current picture has a difference that is the same as the delta RPS 29.

[0101] For example, the RPS of frame 4 is {-1, 1, 3, 7} and the RPS of frame 5 is {-1, -3, 1, 5} in FIG. 12A. Also, the delta RPS of frame 5 is -2. Thus, the RPS of frame 5 may be obtained by adding the delta RPS to RPS of FIG. 4. That is, the RPS of frame 5 may be {-1-2=-3, 1-2=-1, 3-2=1, 7-2=5}. However, the case where the delta RPS is added to the POC value of the RPS may be restricted by a value of reference ides 30. That is, the RPS to be used in predictive decoding of the current picture may be obtained by adding the delta RPS only to the POC value in which the value of the reference ides 30 is 1. The value of the reference ides 30 and 36 may correspond to a value indicating a reference picture of the RPS to which the delta RPS may be applied.

[0102] Meanwhile, when comparing the delta RPSs 29 and 35 and the POC 25 and 31, a difference value between the current picture and the previous picture is the same as the delta RPSs 29 and 35 for each frame. This is because a reference picture of the current picture should be a reference picture of a picture previously output or a reference picture of a picture previously decoded. Thus, according to the one or more of the above exemplary embodiments, the video decoding apparatus 200 may obtain the delta RPS of the RPS to be used in predictive decoding of the current picture by using a POC difference value between the picture previously decoded and the current picture, without the need of the delta RPS being explicitly encoded and transferred.

[0103] As described above, according to the one or more of the above exemplary embodiments, the video decoding apparatus 200 may obtain the delta RPS by using the POC difference value between the current picture and the previous picture, without the need of the delta RPS being explicitly encoded and transferred via the video encoding apparatus 100, in order to signal the delta RPS to obtain the RPS to be used in predictive decoding of the current picture. Therefore, the number of bits encoded in the video encoding apparatus 100 may be reduced.

[0104] The invention can also be embodied as computer readable codes on a computer readable recording medium. The computer readable recording medium is any data storage device that can store data which can be thereafter read by a computer system. Examples of the computer readable recording medium include read-only memory (ROM), random-access memory (RAM), CD-ROMs, magnetic tapes, floppy disks, optical data storage devices, etc.

[0105] It should be understood that the exemplary embodiments described herein should be considered in a descriptive sense only and not for purposes of limitation. Descriptions of features or aspects within each embodiment should typically be considered as available for other similar features or aspects in other embodiments.

[0106] While one or more embodiments of the present invention have been described with reference to the figures, it will be understood by those of ordinary skill in the art that various changes in form and details may be made therein without departing from the scope of the present invention as defined by the following claims.

REFERENCES CITED IN THE DESCRIPTION

Non-patent literature cited in the description

- **TAN T K et al.**AHG21 : Inter reference picture set prediction syntax and semantics7. JCT-VC MEETING; M98. MPEG MEETING; 21-11-2011 - 30-11-2011; GENEVA; (JOINT COLLABORATIVE TEAM ON VIDEO CODING OF ISO/IEC JTC1/ SC29/WG11 AND ITU-T SG.16), 2011, [0002]

P A T E N T K R A V

1. Videoafkodningsapparat omfattende, for at fastslå et referencebilledsæt (reference picture set, RPS), som er et sæt af referencebilleder, der er anvendt i forudsigelsesafkodning af et aktuelt billede, som skal afkodes,

en RPS-fastslåningsenhed, der tilvejebringer, fra en bitstrøm, antallet af korttidsreferencebilledsæt indbefattende en del af bitstrømmen angående et sekvensparametersæt,

fastslår, hvorvidt et aktuelt indeks af et korttidsreferencebilledsæt er lig med antallet af korttidsreferencebilledsæt, der er indbefattet i delen af bitstrømmen angående sekvensparametersætet,

når det aktuelle indeks af korttidsreferencebilledsæt er lig med antallet af korttidsreferencebilledsæt, tilvejebringer, fra bitstrømmen, deltaindeksinformation angående en forskel mellem det aktuelle indeks af korttidsreferencebilledsættet og et indeks af et referencekorttidsreferencebilledsæt, information angående et tegn af en delta-RPS og information angående en absolutværdi af nævnte delta-RPS,

fastslår indekset af referencekorttidsreferencebilledsættet, som indikerer referencekorttidsreferencebilledsættet baseret på deltaindeksinformation og det aktuelle indeks af korttidsreferencebilledsættet,

fastslår nævnte delta-RPS baseret på informationen angående tegnet af nævnte delta-RPS og informationen angående absolutværdien af nævnte delta-RPS,

fastslår deltabilledordenstalværdier (delta-POC-værdier) mellem billedordenstalværdier (POC-værdier) af referencebilleder indbefattet i et aktuelt korttidsreferencebilledsæt og en billedordenstalværdi (POC-værdi) af det aktuelle billede ved at tilføje hver delta-POC-værdi mellem en billedordenstalværdi (POC-værdi) af referencebilledet i referencekorttidsreferencebilledsættet, der er identificeret af indekset af referencekorttidsreferencebilledsættet, og billedordenstalsværdien (POC-værdien) af det aktuelle billede til nævnte delta-RPS og fastslår POC-værdier af referencebillederne indbefattet i det aktuelle korttidsreferencebilledsæt baseret på billedordenstalværdien (POC-værdien) af det aktuelle billede og deltabilledordenstalværdierne (delta-POC-værdier) mellem billedordenstalværdierne (POC-værdierne) af referencebilleder indbefattet i det aktuelle korttidsreferencebilledsættet og billedordenstalværdien (POC-værdien) af det aktuelle billede,

hvor det aktuelle indeks af korttidsreferencebilledsættet, som er lig med antallet af korttidsreferencebilledsæt, indikerer, at korttidsreferencebilledsæt vedrørende det aktuelle indeks ikke er defineret i sekvensparametersættet men er defineret i en slice-header.

2. Apparat ifølge krav 1, hvor korttidsreferencebilledsættet tilvejebringes fra mindst én af en første del af bitstrømmen og en anden del af bitstrømmen, hvor den første del er angående sekvensparametersættet og den anden del er angående nævnte slice-header.

3. Apparat ifølge krav 2, hvor et indeks af korttidsreferencebilledsættet, som er fastslået baseret på den første del af bitstrømmen, er mindre end antallet af korttidsreferencebilledsæt, og et indeks af korttidsreferencebilledsættet, der er fastslået baseret på den

anden del af bitstrømmen, er lig med antallet af korttidsreferencebilledsæt.

4. Apparat ifølge krav 2, hvor deltaindeksinformationen indikerer en værdi, som er tilvejebragt ved at trække 1 fra forskellen mellem det aktuelle indeks af korttidsreferencebilledsættet og indekset af referencekorttidsreferencebilledsættet.

DRAWINGS

FIG. 1A

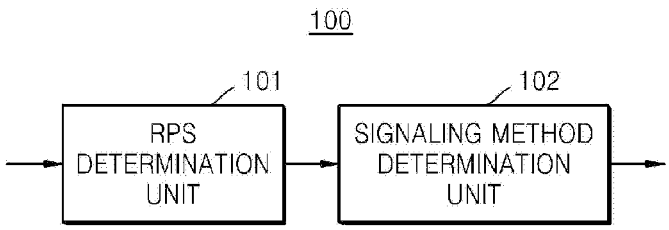


FIG. 1B

100

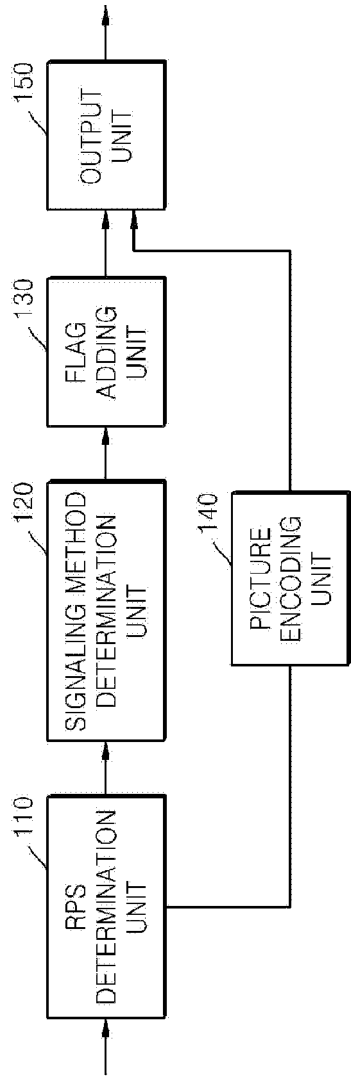

110
RPS DETERMINATION UNIT
120
SIGNALING METHOD DETERMINATION UNIT
130
FLAG ADDING UNIT
140
PICTURE ENCODING UNIT
150
OUTPUT UNIT

FIG. 2A

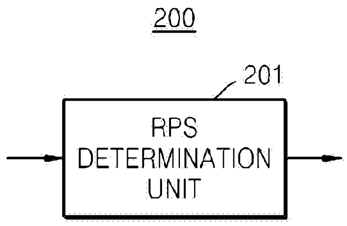

200
201
RPS
DETERMINATION
UNIT

FIG. 2B

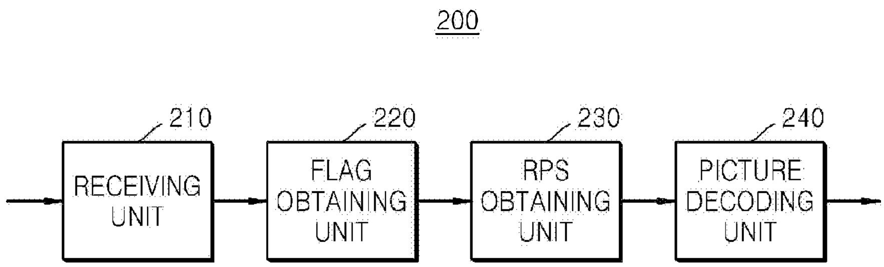

200
210
RECEIVING
UNIT
220
FLAG
OBTAINING
UNIT
230
RPS
OBTAINING
UNIT
240
PICTURE
DECODING
UNIT

FIG. 3

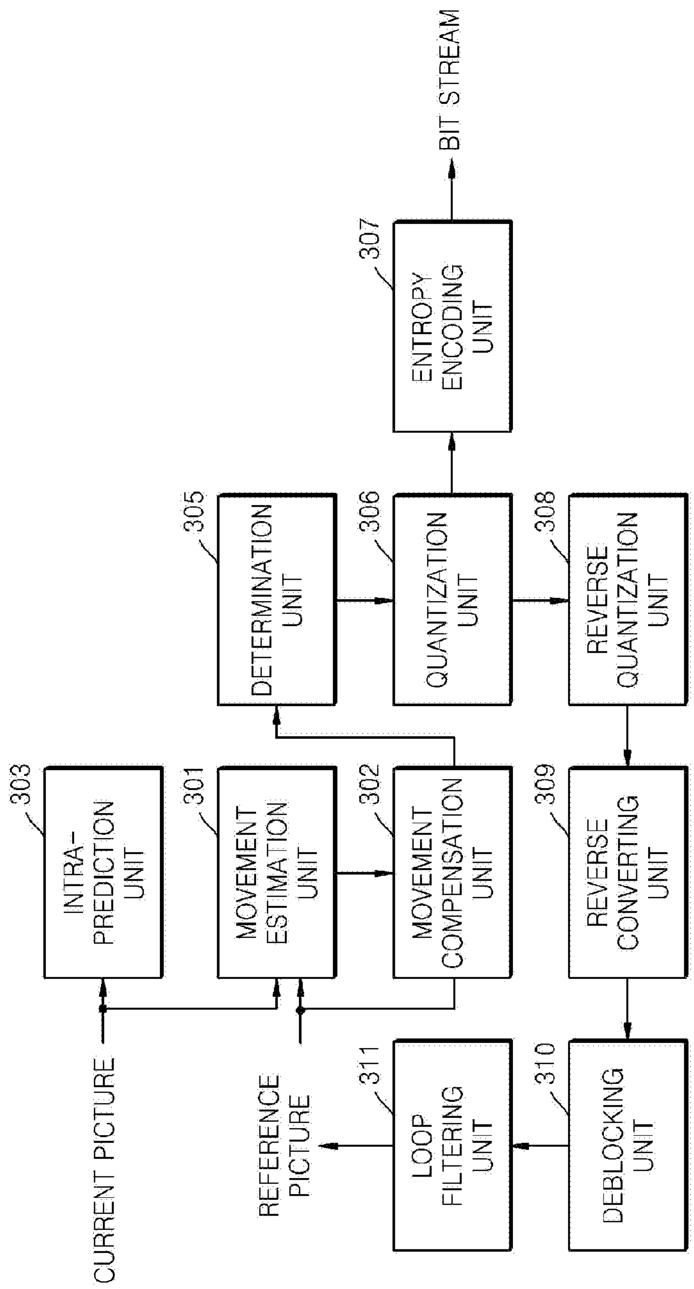
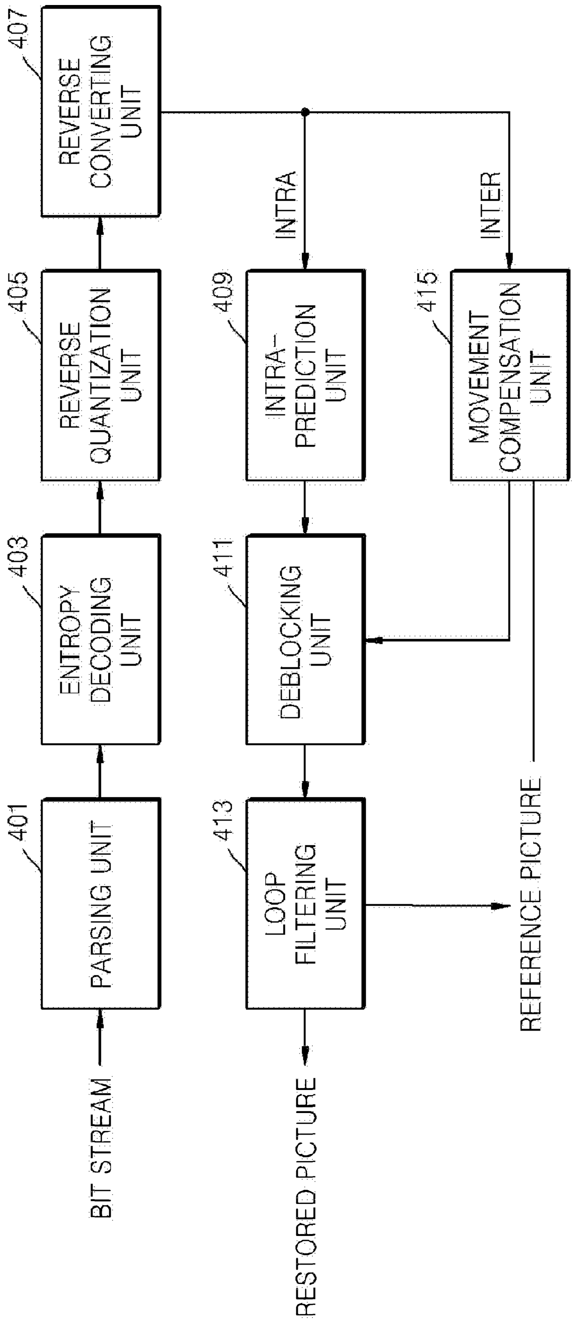

CURRENT PICTURE
REFERENCE PICTURE
303
INTRA-PREDICTION UNIT
301
MOVEMENT ESTIMATION UNIT
302
MOVEMENT COMPENSATION UNIT
305
DETERMINATION UNIT
306
QUANTIZATION UNIT
308
REVERSE QUANTIZATION UNIT
309
REVERSE CONVERTING UNIT
310
DEBLOCKING UNIT
311
LOOP FILTERING UNIT
307
ENTROPY ENCODING UNIT
BIT STREAM

FIG. 4



BIT STREAM
401
PARSING UNIT
403
ENTROPY DECODING UNIT
405
REVERSE QUANTIZATION UNIT
407
REVERSE CONVERTING UNIT
INTRA
INTER
409
INTRA-PREDICTION UNIT
415
MOVEMENT COMPENSATION UNIT
411
DEBLOCKING UNIT
413
LOOP FILTERING UNIT
RESTORED PICTURE
REFERENCE PICTURE

FIG. 5

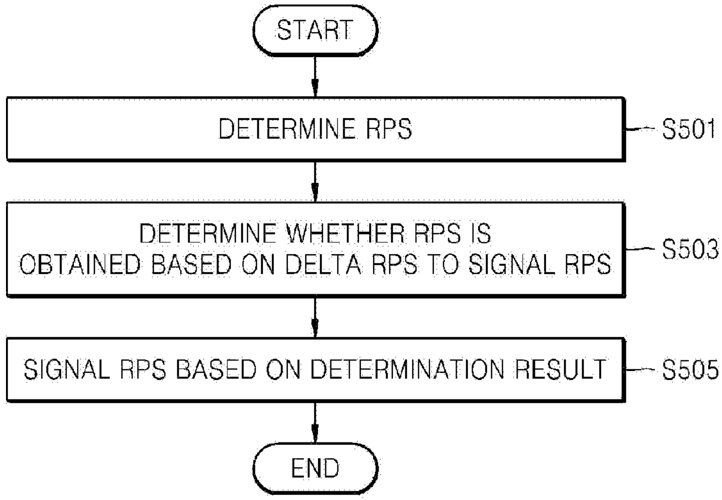

START
DETERMINE RPS
S501
DETERMINE WHETHER RPS IS
OBTAINED BASED ON DELTA RPS TO SIGNAL RPS
S503
SIGNAL RPS BASED ON DETERMINATION RESULT
S505
END

FIG. 6

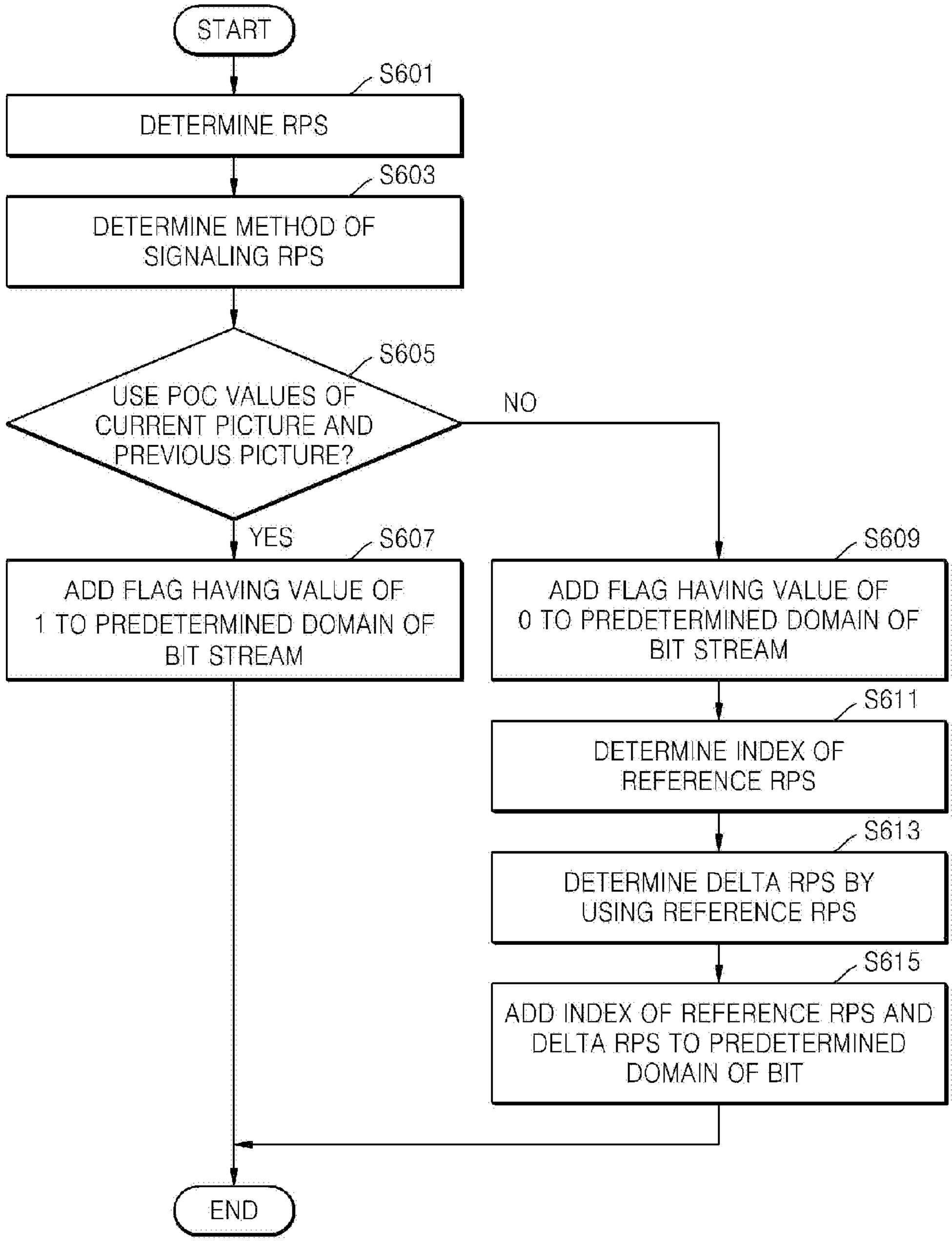

START
S601
DETERMINE RPS
S603
DETERMINE METHOD OF SIGNALING RPS
S605
USE POC VALUES OF CURRENT PICTURE AND PREVIOUS PICTURE?
NO
YES
S607
ADD FLAG HAVING VALUE OF 1 TO PREDETERMINED DOMAIN OF BIT STREAM
S609
ADD FLAG HAVING VALUE OF 0 TO PREDETERMINED DOMAIN OF BIT STREAM
S611
DETERMINE INDEX OF REFERENCE RPS
S613
DETERMINE DELTA RPS BY USING REFERENCE RPS
S615
ADD INDEX OF REFERENCE RPS AND DELTA RPS TO PREDETERMINED DOMAIN OF BIT
END

FIG. 7

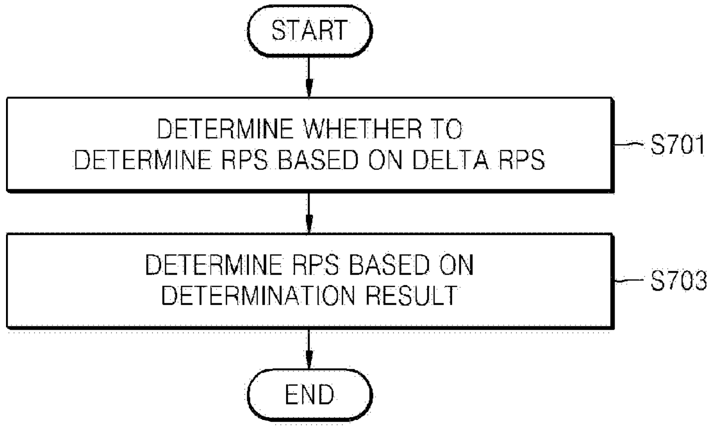

START
DETERMINE WHETHER TO DETERMINE RPS BASED ON DELTA RPS
S701
DETERMINE RPS BASED ON DETERMINATION RESULT
S703
END

FIG. 8

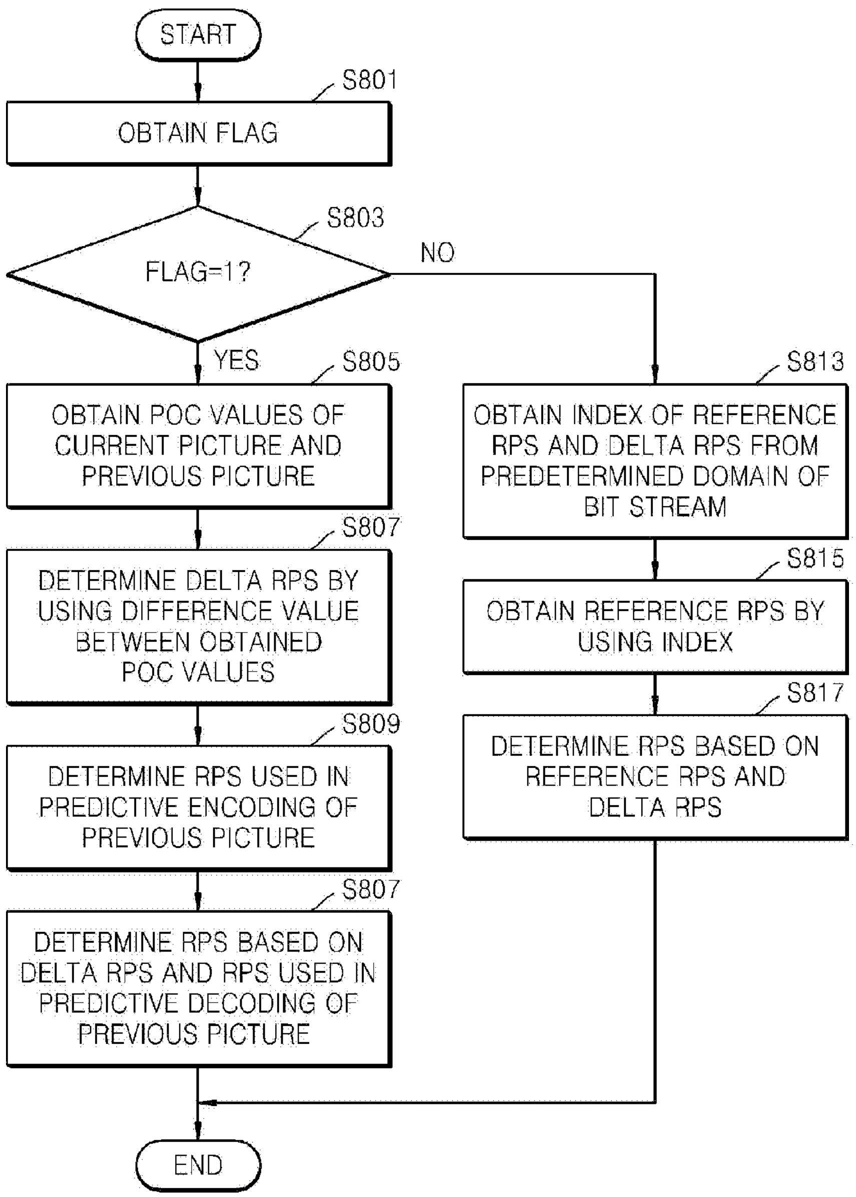

START
S801
OBTAIN FLAG
S803
FLAG=1?
NO
YES
S805
OBTAIN POC VALUES OF CURRENT PICTURE AND PREVIOUS PICTURE
S807
DETERMINE DELTA RPS BY USING DIFFERENCE VALUE BETWEEN OBTAINED POC VALUES
S809
DETERMINE RPS USED IN PREDICTIVE ENCODING OF PREVIOUS PICTURE
S807
DETERMINE RPS BASED ON DELTA RPS AND RPS USED IN PREDICTIVE DECODING OF PREVIOUS PICTURE
S813
OBTAIN INDEX OF REFERENCE RPS AND DELTA RPS FROM PREDETERMINED DOMAIN OF BIT STREAM
S815
OBTAIN REFERENCE RPS BY USING INDEX
S817
DETERMINE RPS BASED ON REFERENCE RPS AND DELTA RPS
END

FIG. 9

1	num_short_term_ref_pic_sets	ue(v)
	for(i=0;i<num_short_term_ref_pic_sets;i++)	
3	short_term_ref_pic_set(i)	
	long_term_ref_pics_present_flag	u(1)

FIG. 10

5	short_term_ref_pic_set_sps_flag	u(1)
	if(!short_term_ref_pic_set_sps_flag)	
7	short_term_ref_pic_set(num_short_term_ref_pic_sets)	
	else	
	short_term_ref_pic_set_idx	u(v)
	if(long_term_ref_pics_persent_flag){	
	num_long_term_pics	ue(v)
	for(i=0;i<num_long_term_pics;i++){	
	delta_poc_lsb_lt[i]	ue(v)
	delta_poc_msb_present_flag[i] if(delta_poc_msb_present_flag[i])	u(1)
	delta_poc_msb_cycle_lt_minus1[i]	ue(v)
	used_by_curr_pic_lt_flag[i]	u(1)
	}	
	}	

FIG. 11

	short_term_ref_pic_set(idx) {	Descriptor
9	inter_ref_pic_set_prediction_flag	u(1)
11	if(inter_ref_pic_set_prediction_flag) {	
13	if(idx==num_short_term_ref_pic_sets)	
15	derived_delta_rps_flag	u(1)
17	if(!derived_delta_rps_flag) {	
19	delta_idx_minus1	ue(v)
21	delta_rps_sign	u(1)
23	abs_delta_rps_minus1	ue(v)
	}	
	for(j=0;j<=NumDeltaPocs[RIdx];j++) {	
	used_by_curr_pic_flag[j]	u(1)
	if(!used_by_curr_pic_flag[j])	
	use_delta_flag[j]	u(1)
	}	
	}	
	else {	
	num_negative_pics	ue(v)
	num_positive_pics	ue(v)
	for(i=0;i<num_negative_pics;i++) {	
	delta_poc_s0_minus1[i]	ue(v)
	used_by_curr_pic_s0_flag[i]	u(1)
	}	
	for(i=0;i<num_negative_pics;i++) {	
	delta_poc_s1_minus1[i]	ue(v)
	used_by_curr_pic_s1_flag[i]	u(1)
	}	
	}	
	}	

FIG. 12A

#	Type	POC	QPoffset	QPfactor	temporal_id	ref_buf_size	ref_pic	#ref_pics	reference pictures	predict	deltaRIdx-1	deltaRPS	#ref_idcs	reference idcs
Frame1:	B	8	1	0.442	0	4	1	4	-8 -10 -12 -16	0	0			
Frame2:	B	4	2	0.3536	0	2	1	3	-4 -6 4	1	0	4	5	1 1 0 0 1
Frame3:	B	2	3	0.3536	0	2	1	4	-2 -4 2 6	1	0	2	4	1 1 1 1
Frame4:	B	1	4	0.68	0	2	0	4	-1 1 3 7	1	0	1	5	1 0 1 1 1
Frame5:	B	3	4	0.68	0	2	0	4	-1 -3 1 5	1	0	-2	5	1 1 1 1 0
Frame6:	B	6	3	0.3536	0	2	1	4	-2 -4 -6 2	1	0	-3	5	1 1 1 1 0
Frame7:	B	5	4	0.68	0	2	0	4	-1 -5 1 3	1	0	1	5	1 0 1 1 1
Frame8:	B	7	4	0.68	0	2	0	4	-1 -3 -7 1	1	0	-2	5	1 1 1 1 0

25 27 29 30

FIG. 12B

#	Type	POC	QPoffset	QPfactor	temporal_id	ref_buf_size	ref_pic	#ref_pics	reference pictures	predict	deltaRIdx-1	deltaRPS	#ref_idcs	reference idcs
Frame1:	B	1	3	0.4624	0	4	1	4	-1 -5 -9 -13	0				
Frame2:	B	2	2	0.4624	0	4	1	4	-1 -2 -6 -10	1	0	-1	5	1 1 1 0 1
Frame3:	B	3	3	0.4624	0	4	1	4	-1 -3 -7 -11	1	0	-1	5	0 1 1 1 1
Frame4:	B	4	4	0.578	0	4	1	4	-1 -4 -8 -12	1	0	-1	5	0 1 1 1 1

31 33 35 36