INTER PREDICTION METHOD AND APPARATUS, AND CORRESPONDING ENCODER AND DECODER THAT REDUCE REDUNDANCY IN VIDEO CODING

Abstract

An inter prediction method and apparatus, and a corresponding encoder and decoder are disclosed. The method includes: obtaining an index value of a length of a motion vector difference of the current picture block; determining target length information from a set of candidate length information based on the index value of the length; obtaining the motion vector difference of the current picture block based on the target length information; determining the motion vector target value of the current picture block based on the motion vector difference of the current picture block and the motion vector predictor of the current picture block; and obtaining a prediction block of the current picture block based on the motion vector target value of the current picture block.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS [0001] This application is a continuation of U.S. patent application Ser. No. 18/597,291, filed on Mar. 6, 2024, which is a continuation of U.S. patent application Ser. No. 17/360,786, filed on Jun. 28, 2021, now U.S. Pat. No. 11,956,444, which is a continuation of International Application No. PCT/CN2019/128136, filed on Dec. 25, 2019, which claims priority to Chinese Patent Application No. 201811645808.X, filed on Dec. 29, 2018. All of the aforementioned patent applications are hereby incorporated by reference in their entireties.

TECHNICAL FIELD
[0002] The present application relates to the field of video coding technologies, and in particular, to an inter prediction method and apparatus, and a corresponding encoder and decoder.
BACKGROUND
[0003] Digital video capabilities can be incorporated into a wide variety of apparatuses, including digital televisions, digital live broadcast systems, wireless broadcast systems, personal digital assistants (PDA), laptop or desktop computers, tablet computers, e-book readers, digital cameras, digital recording apparatuses, digital media players, video game apparatuses, video game consoles, cellular or satellite radio phones (also referred to as "smartphones"), video conferencing apparatuses, video streaming apparatuses, and the like. Digital video apparatuses implement video compression technologies, for example, video compression technologies described in standards including MPEG-2, MPEG-4, ITU-T H.263, and ITU-T H.264/MPEG-4 part 10 advanced video coding (AVC), the video coding standard H.265/high efficiency video coding (HEVC) standard, and extensions of these standards. The video apparatuses can transmit, receive, encode, decode, and/or store digital video information more efficiently by implementing the video compression technologies.
[0004] The video compression technologies are used to perform spatial (intra-picture) prediction and/or temporal (inter-picture) prediction to reduce or remove inherent redundancy in video sequences. In block-based video coding, a video slice (namely, a video frame or a part of a video frame) may be partitioned into picture blocks, and the picture block may also be referred to as a tree block, a coding unit (CU), and/or a coding node. A picture block in a to-be-intra-coded (I) slice of a picture is coded through spatial prediction based on a reference sample in a neighboring block in the same picture. For a picture block in a to-be-inter-coded (P or B) slice of a picture, spatial prediction based on a reference sample in a neighboring block in the same picture or temporal prediction based on a reference sample in another reference picture may be used. A picture may be referred to as a frame, and a reference picture may be referred to as a reference frame.

SUMMARY

[0005] Embodiments of this application provide an inter prediction method and apparatus, and a corresponding encoder and decoder, to reduce redundancy in a coding process to some degree, and improve coding efficiency.

[0006] According to a first aspect, an embodiment of this application provides an inter prediction method. The method includes: obtaining a motion vector predictor of a current picture block; obtaining an index value of a length of a motion vector difference of the current picture block, where the motion vector difference of the current picture block is used to indicate a difference between the motion vector predictor and a motion vector target value of the current picture block; determining target length information from a set of candidate length information based on the index value of the length, where the set of candidate length information includes candidate length information of only N motion vector differences, and N is a positive integer greater than 1 and less than 8; obtaining the motion vector difference of the current picture block based on the target length information; determining the motion vector target value of the current picture block based on the motion vector difference of the current picture block and the motion vector predictor of the current picture block; and obtaining a prediction block of the current picture block based on the motion vector target value of the current picture block.

[0007] The set of candidate length information may be preset.

[0008] In an embodiment, the method further includes: obtaining an index value of a direction of the motion vector difference of the current picture block; and determining target direction information from candidate direction information of M motion vector differences based on the index value of the direction, where M is a positive integer greater than 1; and [0009] the obtaining the motion vector difference of the current picture block based on the target length information includes: determining the motion vector difference of the current picture block based on the target direction information and the target length information.

[0010] In an embodiment, N is 4.

[0011] In an embodiment, [0012] the candidate length information of the N motion vector differences includes at least one of the following: when the index value of the length is a first preset value, a length indicated by the target length information is one quarter of a pixel length; when the index value of the length is a second preset value, a length indicated by the target length information is a half of a pixel length; when the index value of the length is a third preset value, a length indicated by the target length information is one pixel length; or when the index value of the length is a fourth preset value, a length indicated by the target length information is two pixel lengths. In an embodiment, the obtaining a motion vector predictor of a current picture block includes: constructing a candidate motion information list of the current picture block, where the candidate motion information list includes L motion vectors, and L is 1, 3, 4, or 5; obtaining an index value of prediction information of motion information of the current picture block in the candidate motion information list, where the prediction information of motion information of the current picture block includes the motion vector predictor; and obtaining the motion vector predictor based on the index value of the motion information of the current picture block in the candidate motion information list and the candidate motion information list.

[0013] According to a second aspect, an embodiment of this application provides an inter prediction method. The method includes: obtaining a motion vector predictor of a current picture block; performing motion search in a region of a location indicated by the motion vector predictor of the current picture block, to obtain a motion vector target value of the current picture block; and obtaining an index value of a length of a motion vector difference of the current picture block based on the motion vector target value of the current picture block and the motion vector predictor of the current picture block, where the motion vector difference of the current picture block is used to indicate a difference between the motion vector predictor and the motion vector target value of the current picture block, the index value of the length of the motion vector difference of the

current picture block is used to indicate one piece of candidate length information in a set of preset candidate length information, the set of candidate length information includes candidate length information of only N motion vector differences, and N is a positive integer greater than 1 and less than 8.

[0014] In an embodiment, the obtaining an index value of a length of a motion vector difference of the current picture block based on the motion vector target value of the current picture block and the motion vector predictor of the current picture block includes: obtaining the motion vector difference of the current picture block based on the motion vector target value of the current picture block and the motion vector predictor of the current picture block; and determining the index value of the length of the motion vector difference of the current picture block and an index value of a direction of the motion vector difference of the current picture block based on the motion vector difference of the current picture block.

[0015] In an embodiment, N is 4.

[0016] According to a third aspect, an embodiment of this application provides an inter prediction method. The method includes: obtaining a motion vector predictor of a current picture block; obtaining an index value of a direction of a motion vector difference of the current picture block, where the motion vector difference of the current picture block is used to indicate a difference between the motion vector predictor and a motion vector target value of the current picture block; determining target direction information from a set of candidate direction information based on the index value of the direction, where the set of candidate direction information includes candidate direction information of M motion vector differences, and M is a positive integer greater than 4; obtaining the motion vector difference of the current picture block based on the target direction information; determining the motion vector target value of the current picture block based on the motion vector difference of the current block and the motion vector predictor of the current picture block; and obtaining a prediction block of the current picture block based on the motion vector target value of the current picture block.

[0017] In an embodiment, the method further includes: obtaining an index value of a length of the motion vector difference of the current picture block; and determining target length information from candidate length information of N motion vector differences based on the index value of the length, where N is a positive integer greater than 1; and the obtaining the motion vector difference of the current picture block based on the target direction information includes: determining the motion vector difference of the current picture block based on the target direction information and the target length information.

[0018] In an embodiment, M is 8.

[0019] In an embodiment, the candidate direction information of the M motion vector differences includes at least one of the following: [0020] when the index value of the direction is a first preset value, a direction indicated by the target direction information is exactly right; [0021] when the index value of the direction is a second preset value, a direction indicated by the target direction information is exactly left; [0022] when the index value of the direction is a third preset value, a direction indicated by the target direction information is exactly down; [0023] when the index value of the direction is a fourth preset value, a direction indicated by the target direction information is exactly up; [0024] when the index value of the direction is a fifth preset value, a direction indicated by the target direction information is lower right; [0025] when the index value of the direction is a sixth preset value, a direction indicated by the target direction information is upper right; [0026] when the index value of the direction is a seventh preset value, a direction indicated by the target direction information is lower left; or [0027] when the index value of the direction is an eighth preset value, a direction indicated by the target direction information is upper left.

[0028] In an embodiment, the obtaining a motion vector predictor of a current picture block includes: constructing a candidate motion information list of the current picture block, where the

candidate motion information list includes L motion vectors, and L is 1, 3, 4, or 5; obtaining an index value of prediction information of motion information of the current picture block in the candidate motion information list, where the prediction information of motion information of the current picture block includes the motion vector predictor; and obtaining the motion vector predictor based on the index value of the motion information of the current picture block in the candidate motion information list and the candidate motion information list.

[0029] According to a fourth aspect, an embodiment of this application provides an inter prediction method. The method includes: obtaining a motion vector predictor of a current picture block; performing motion search in a region of a location indicated by the motion vector predictor of the current picture block, to obtain a motion vector target value of the current picture block; and obtaining an index value of a direction of a motion vector difference of the current picture block based on the motion vector target value of the current picture block and the motion vector predictor of the current picture block, where the motion vector difference of the current picture block is used to indicate a difference between the motion vector predictor and the motion vector target value of the current picture block, the index value of the direction of the motion vector difference of the current picture block is used to indicate one piece of candidate direction information in a set of preset candidate direction information, the set of candidate length information includes candidate direction information of M motion vector differences, and M is a positive integer greater than 4.

[0030] In an embodiment, the obtaining an index value of a direction of a motion vector difference of the current picture block based on the motion vector target value of the current picture block and the motion vector predictor of the current picture block includes: obtaining the motion vector difference of the current picture block based on the motion vector target value of the current picture block and the motion vector predictor of the current picture block; and determining the index value of the length of the motion vector difference of the current picture block and the index value of the direction of the motion vector difference of the current picture block based on the motion vector difference of the current picture block.

[0031] In an embodiment, M is 8.

[0032] According to a fifth aspect, an embodiment of this application provides an inter prediction method. The method includes: obtaining a first motion vector predictor of a current picture block and a second motion vector predictor of the current picture block, where the first motion vector predictor corresponds to a first reference frame, and the second motion vector predictor corresponds to a second reference frame; obtaining a first motion vector difference of the current picture block, where the first motion vector difference of the current picture block is used to indicate a difference between the first motion vector predictor and a first motion vector target value of the current picture block, and the first motion vector target value and the first motion vector predictor correspond to a same reference frame; determining a second motion vector difference of the current picture block based on the first motion vector difference, where the second motion vector difference of the current picture block is used to indicate a difference between the second motion vector predictor and a second motion vector target value of the current picture block, the second motion vector target value and the second motion vector predictor correspond to a same reference frame, and when a direction of the first reference frame relative to a current frame in which the current picture block is located is the same as a direction of the second reference frame relative to the current frame, the second motion vector difference is the first motion vector difference, or when the direction of the first reference frame relative to the current frame in which the current picture block is located is opposite to the direction of the second reference frame relative to the current frame, a plus or minus sign of the second motion vector difference is opposite to a plus or minus sign of the first motion vector difference, and an absolute value of the second motion vector difference is the same as an absolute value of the first motion vector difference; determining the first motion vector target value of the current picture block based on the first motion vector difference and the first motion vector predictor; determining the second motion

vector target value of the current picture block based on the second motion vector difference and the second motion vector predictor; and obtaining a prediction block of the current picture block based on the first motion vector target value and the second motion vector target value.

[0033] According to a sixth aspect, an embodiment of this application provides an inter prediction apparatus, and the apparatus includes: [0034] a prediction unit, configured to obtain a motion vector predictor of a current picture block; and [0035] an obtaining unit, configured to configured to obtain an index value of a length of a motion vector difference of the current picture block, where the motion vector difference of the current picture block is used to indicate a difference between the motion vector predictor and a motion vector target value of the current picture block, where [0036] the prediction unit is further configured to: determine target length information from a set of candidate length information based on the index value of the length, where the set of candidate length information includes candidate length information of only N motion vector differences, and N is a positive integer greater than 1 and less than 8; obtain the motion vector difference of the current picture block based on the target length information; determine the motion vector target value of the current picture block based on the motion vector difference of the current picture block and the motion vector predictor of the current picture block; and obtain a prediction block of the current picture block based on the motion vector target value of the current picture block.

[0037] In an embodiment, the obtaining unit is further configured to obtain an index value of a direction of the motion vector difference of the current picture block; [0038] the prediction unit is further configured to determine target direction information from candidate direction information of M motion vector differences based on the index value of the direction, where M is a positive integer greater than 1; and [0039] the prediction unit is configured to determine the motion vector difference of the current picture block based on the target direction information and the target length information.

[0040] In an embodiment, N is 4.

[0041] In an embodiment, [0042] the candidate length information of the N motion vector differences includes at least one of the following: when the index value of the length is a first preset value, a length indicated by the target length information is one quarter of a pixel length; when the index value of the length is a second preset value, a length indicated by the target length information is a half of a pixel length; when the index value of the length is a third preset value, a length indicated by the target length information is one pixel length; or when the index value of the length is a fourth preset value, a length indicated by the target length information is two pixel lengths.

[0043] In an embodiment, the prediction unit is configured to: construct a candidate motion information list of the current picture block, where the candidate motion information list may include L motion vectors, and L is 1, 3, 4, or 5; obtain an index value of prediction information of motion information of the current picture block in the candidate motion information list, where the prediction information of motion information of the current picture block includes the motion vector predictor; and obtain the motion vector predictor based on the index value of the motion information of the current picture block in the candidate motion information list and the candidate motion information list.

[0044] According to a seventh aspect, an embodiment of this application provides an inter prediction apparatus, and the apparatus includes: [0045] an obtaining unit, configured to obtain a motion vector predictor of a current picture block; and [0046] a prediction unit, configured to perform motion search in a region of a location indicated by the motion vector predictor of the current picture block, to obtain a motion vector target value of the current picture block, where [0047] the prediction unit is further configured to obtain an index value of a length of a motion vector difference of the current picture block based on the motion vector target value of the current picture block and the motion vector predictor of the current picture block, where the motion vector

difference of the current picture block is used to indicate a difference between the motion vector predictor and the motion vector target value of the current picture block, the index value of the length of the motion vector difference of the current picture block is used to indicate one piece of candidate length information in a set of preset candidate length information, the set of candidate length information includes candidate length information of only N motion vector differences, and N is a positive integer greater than 1 and less than 8.

[0048] In an embodiment, the prediction unit is configured to: obtain the motion vector difference of the current picture block based on the motion vector target value of the current picture block and the motion vector predictor of the current picture block; and determine the index value of the length of the motion vector difference of the current picture block and an index value of a direction of the motion vector difference of the current picture block based on the motion vector difference of the current picture block.

[0049] In an embodiment, N is 4.

[0050] According to an eighth aspect, an embodiment of this application provides an inter prediction apparatus, and the apparatus includes: [0051] a prediction unit, configured to obtain a motion vector predictor of a current picture block; and [0052] an obtaining unit, configured to configured to obtain an index value of a direction of a motion vector difference of the current picture block, where the motion vector difference of the current picture block is used to indicate a difference between the motion vector predictor and a motion vector target value of the current picture block, where [0053] the prediction unit is further configured to: determine target direction information from a set of candidate direction information based on the index value of the direction, where the set of candidate direction information includes candidate direction information of M motion vector differences, and M is a positive integer greater than 4; obtain the motion vector difference of the current picture block based on the target direction information; determine the motion vector target value of the current picture block based on the motion vector difference of the current picture block and the motion vector predictor of the current picture block; and obtain a prediction block of the current picture block based on the motion vector target value of the current picture block.

[0054] In an embodiment, the obtaining unit is further configured to obtain an index value of a length of the motion vector difference of the current picture block; [0055] the prediction unit is further configured to determine target length information from candidate length information of N motion vector differences based on the index value of the length, where N is a positive integer greater than 1; and [0056] the prediction unit is configured to determine the motion vector difference of the current picture block based on the target direction information and the target length information.

[0057] In an embodiment, M is 8.

[0058] In an embodiment, [0059] the candidate direction information of the M motion vector differences may include at least one of the following: [0060] when the index value of the direction is a first preset value, a direction indicated by the target direction information is exactly right; [0061] when the index value of the direction is a second preset value, a direction indicated by the target direction information is exactly left; [0062] when the index value of the direction is a third preset value, a direction indicated by the target direction information is exactly down; [0063] when the index value of the direction is a fourth preset value, a direction indicated by the target direction information is exactly up; [0064] when the index value of the direction is a fifth preset value, a direction indicated by the target direction information is lower right; [0065] when the index value of the direction is a sixth preset value, a direction indicated by the target direction information is upper right; [0066] when the index value of the direction is a seventh preset value, a direction indicated by the target direction information is lower left; or [0067] when the index value of the direction is an eighth preset value, a direction indicated by the target direction information is upper left.

[0068] In an embodiment, the prediction unit is configured to: construct a candidate motion information list of the current picture block, where the candidate motion information list includes L motion vectors, and L is 1, 3, 4, or 5; obtain an index value of prediction information of motion information of the current picture block in the candidate motion information list, where the prediction information of motion information of the current picture block includes the motion vector predictor; and obtain the motion vector predictor based on the index value of the motion information of the current picture block in the candidate motion information list and the candidate motion information list.

[0069] According to a ninth aspect, an embodiment of this application provides an inter prediction apparatus, and the apparatus includes: [0070] an obtaining unit, configured to obtain a motion vector predictor of a current picture block; and [0071] a prediction unit, configured to perform motion search in a region of a location indicated by the motion vector predictor of the current picture block, to obtain a motion vector target value of the current picture block, where [0072] the prediction unit is further configured to obtain an index value of a direction of a motion vector difference of the current picture block based on the motion vector target value of the current picture block and the motion vector predictor of the current picture block, where the motion vector difference of the current picture block is used to indicate a difference between the motion vector predictor and the motion vector target value of the current picture block, the index value of the direction of the motion vector difference of the current picture block is used to indicate one piece of candidate direction information in a set of preset candidate direction information, the set of candidate direction information includes candidate length information of M motion vector differences, and M is a positive integer greater than 4.

[0073] In an embodiment, the prediction unit is configured to: obtain the motion vector difference of the current picture block based on the motion vector target value of the current picture block and the motion vector predictor of the current picture block; and determine an index value of a length of the motion vector difference of the current picture block and the index value of the direction of the motion vector difference of the current picture block based on the motion vector difference of the current picture block.

[0074] In an embodiment, M is 8.

[0075] According to a tenth aspect, an embodiment of this application provides an inter prediction apparatus, and the apparatus includes: [0076] an obtaining unit, obtain a first motion vector predictor of a current picture block and a second motion vector predictor of the current picture block, where the first motion vector predictor corresponds to a first reference frame, and the second motion vector predictor corresponds to a second reference frame, where [0077] the obtaining unit is further configured to obtain a first motion vector difference of the current picture block, where the first motion vector difference of the current picture block is used to indicate a difference between the first motion vector predictor and a first motion vector target value of the current picture block, and the first motion vector target value and the first motion vector predictor correspond to a same reference frame; and [0078] a prediction unit, configured to: determine a second motion vector difference of the current picture block based on the first motion vector difference, where the second motion vector difference of the current picture block is used to indicate a difference between the second motion vector predictor and a second motion vector target value of the current picture block, the second motion vector target value and the second motion vector predictor correspond to a same reference frame, and when a direction of the first reference frame relative to a current frame in which the current picture block is located is the same as a direction of the second reference frame relative to the current frame, the second motion vector difference is the first motion vector difference, or when the direction of the first reference frame relative to the current frame in which the current picture block is located is opposite to the direction of the second reference frame relative to the current frame, a plus or minus sign of the second motion vector difference is opposite to a plus or minus sign of the first motion vector difference, and an absolute value of the

second motion vector difference is the same as an absolute value of the first motion vector difference; determine the first motion vector target value of the current picture block based on the first motion vector difference and the first motion vector predictor; determine the second motion vector target value of the current picture block based on the second motion vector difference and the second motion vector predictor; and obtain a prediction block of the current picture block based on the first motion vector target value and the second motion vector target value.

[0079] According to an eleventh aspect, an embodiment of this application provides a video decoder. The video decoder is configured to decode a bitstream to obtain a picture block, and includes: [0080] the inter prediction apparatus according to any one of the first aspect or the embodiments of the first aspect, where the inter prediction apparatus is configured to obtain a prediction block of the current picture block; and [0081] a reconstruction module, configured to reconstruct the current picture block based on the prediction block.

[0082] According to a twelfth aspect, an embodiment of this application provides a video encoder. The video encoder is configured to encode a picture block, and includes: [0083] the inter prediction apparatus according to any one of the second aspect or the embodiments of the second aspect, where the inter prediction apparatus is configured to obtain an index value of a length of a motion vector difference of a current picture block based on a motion vector predictor of the current picture block, where the index value of the length of the motion vector difference of the current picture block is used to indicate one piece of candidate length information in a set of preset candidate length information; and [0084] an entropy encoding module, configured to encode the index value of the length of the motion vector difference of the current picture block into a bitstream.

[0085] According to a thirteenth aspect, an embodiment of this application provides a video decoder. The video decoder is configured to decode a bitstream to obtain a picture block, and includes: [0086] the inter prediction apparatus according to any one of the third aspect or the embodiments of the third aspect, where the inter prediction apparatus is configured to obtain a prediction block of the current picture block; and [0087] a reconstruction module, configured to reconstruct the current picture block based on the prediction block.

[0088] According to a fourteenth aspect, an embodiment of this application provides a video encoder. The video encoder is configured to encode a picture block, and includes: [0089] the inter prediction apparatus according to any one of the fourth aspect or the embodiments of the fourth aspect, where the inter prediction apparatus is configured to obtain an index value of a direction of a motion vector difference of a current picture block based on a motion vector predictor of the current picture block, where the index value of the direction of the motion vector difference of the current picture block is used to indicate one piece of candidate direction information in a set of preset candidate direction information; and [0090] an entropy encoding module, configured to encode the index value of the direction of the motion vector difference of the current picture block into a bitstream.

[0091] According to a fifteenth aspect, an embodiment of this application provides a video data decoding device. The device includes: [0092] a memory, configured to store video data in a form of a bitstream; and [0093] the video decoder according to any one of the eleventh aspect, the thirteenth aspect, the fifteenth aspect, or any one of the eleventh aspect, the thirteenth aspect, or the fifteenth aspect.

[0094] According to a sixteenth aspect, an embodiment of this application provides a video data encoding device. The device includes: [0095] a memory, configured to store video data, where the video data includes one or more picture blocks; and [0096] the video encoder according to any one of the twelfth aspect, the fourteenth aspect, or the embodiments of the twelfth aspect and the fourteenth aspect.

[0097] According to a seventeenth aspect, an embodiment of this application provides an encoding device. The encoding device includes a nonvolatile memory and a processor that are coupled to

each other, where the processor invokes program code stored in the memory to perform a part of or all of operations in any method according to any one of the second aspect, the fourth aspect, or the embodiments of the second aspect and the fourth aspect.

[0098] According to an eighteenth aspect, an embodiment of this application provides a decoding device. The decoding device includes a nonvolatile memory and a processor that are coupled to each other. The processor invokes program code stored in the memory to perform a part of or all of operations in any method according to any one of the first aspect, the third aspect, the fifth aspect, or the embodiments of the first aspect, the third aspect, and the fifth aspect.

[0099] According to a nineteenth aspect, an embodiment of this application provides a computer-readable storage medium. The computer-readable storage medium stores program code, and the program code includes instructions used to perform a part of or all of operations in the method according to any one of the first aspect to the fifth aspect, or the embodiments of the first aspect to the fifth aspect.

[0100] According to a twentieth aspect, an embodiment of this application provides a computer program product. When the computer program product runs on a computer, the computer is enabled to perform a part of or all of operations in the method according to any one of the first aspect to the fifth aspect or the embodiments of the first aspect to the fifth aspect.

[0101] It should be understood that, technical solutions in the second aspect of this application to the tenth aspect of this application are consistent with the technical solution in the first aspect. Beneficial effects achieved by the various aspects and corresponding embodiments are similar, and details are not described again.

Description

BRIEF DESCRIPTION OF DRAWINGS

[0102] To describe the technical solutions in the embodiments of the present application more clearly, the following describes the accompanying drawings in the embodiments of the present application or the background.

[0103] FIG. **1**A is a block diagram of an example of a video coding system according to an embodiment;

[0104] FIG. **1**B is a block diagram of another example of a video coding system according to an embodiment;

[0105] FIG. **2** is a block diagram of an example structure of an encoder according to an embodiment;

[0106] FIG. **3** is a block diagram of an example structure of a decoder according to an embodiment;

[0107] FIG. **4** is a block diagram of an example of a video coding device according to an embodiment;

[0108] FIG. **5** is a block diagram of another example of an encoding apparatus or a decoding apparatus according to an embodiment;

[0109] FIG. **6** is an example block diagram of spatial neighboring blocks and temporal neighboring blocks according to an embodiment;

[0110] FIG. **7** is a schematic flowchart of an inter prediction method according to an embodiment;

[0111] FIG. **8** is a schematic flowchart of an inter prediction method according to an embodiment;

[0112] FIG. **9** is a schematic flowchart of an inter prediction method according to an embodiment;

[0113] FIG. **10** is a schematic flowchart of an inter prediction method according to an embodiment;

[0114] FIG. **11** is a schematic flowchart of an inter prediction method according to an embodiment;

[0115] FIG. **12** is a schematic block diagram of an inter prediction apparatus according to an embodiment;

[0116] FIG. **13** is a schematic block diagram of an inter prediction apparatus according to an

embodiment;

[0117] FIG. **14** is a schematic block diagram of an inter prediction apparatus according to an embodiment;

[0118] FIG. **15** is a schematic block diagram of an inter prediction apparatus according to an embodiment; and

[0119] FIG. **16** is a schematic block diagram of an inter prediction apparatus according to an embodiment.

DETAILED DESCRIPTION

[0120] The following describes the embodiments of the present application with reference to the accompanying drawings in the embodiments of the present application. In the following description, reference is made to the accompanying drawings that form a part of this disclosure and show, by way of illustration, aspects of the embodiments of the present application or aspects in which the embodiments of the present application may be used. It should be understood that the embodiments of the present application may be used in other aspects, and may include structural or logical changes not depicted in the accompanying drawings. Therefore, the following detailed description shall not be understood in a limiting sense, and the scope of the present application is defined by the appended claims. For example, it should be understood that disclosed content with reference to described methods may also hold true for a corresponding device or system configured to perform the method, and vice versa. For example, if one or more method operations are described, a corresponding device may include one or more units such as functional units for performing the described one or more method operations (for example, one unit performs the one or more operations; or a plurality of units, each of which performs one or more of the operations), even if such one or more units are not explicitly described or illustrated in the accompanying drawings. In addition, for example, if an apparatus is described based on one or more units such as a functional unit, a corresponding method may include a step used to perform one or more functionalities of one or more units (for example, one step used to perform one or more functionalities of one or more units; or operations, each of which is used perform one or more functionalities of one or more units in a plurality of units), even if such one or more of operations are not explicitly described or illustrated in the accompanying drawings. Further, it should be understood that features of the various example embodiments and/or aspects described in this specification may be combined with each other, unless otherwise specified.

[0121] The technical solutions in the embodiments of the present application may not only be applied to existing video coding standards (for example, standards such as H.264 and HEVC), but also be applied to future video coding standards (for example, the H.266 standard). Terms used in embodiments of the present application are merely intended to explain embodiments of the present application, but are not intended to limit the present application. The following first briefly describes some concepts that may be used in the embodiments of the present application.

[0122] Video coding typically refers to processing of a sequence of pictures that constitute a video or a video sequence. In the field of video coding, the terms "picture", "frame", and "image" may be used as synonyms. Video coding used in this specification refers to video encoding or video decoding. Video encoding is performed on a source side, and usually includes processing (for example, by compressing) an original video picture to reduce an amount of data for representing the video picture, for more efficient storage and/or transmission. Video decoding is performed on a destination side, and typically includes inverse processing in comparison with an encoder to reconstruct a video picture. "Coding" of a video picture in the embodiments should be understood as "encoding" or "decoding" of a video sequence. A combination of encoding components and decoding components is also referred to as codec (CODEC).

[0123] A video sequence includes a series of pictures, a picture is further split into slices, and a slice is further split into blocks. Video coding is performed by blocks. In some new video coding standards, the concept of a block is further extended. For example, a macroblock (MB) is

introduced in the H.264 standard. The macroblock may be further split into a plurality of prediction blocks (partition) that can be used for predictive coding. In the high efficiency video coding (HEVC) standard, basic concepts such as "coding unit" (CU), "prediction unit" (PU), and "transform unit" (TU) are used. Block units are obtained through functional division, and are described by using a new tree-based structure. For example, a CU may be split into smaller CUs through quadtree split, and the smaller CU may further be split, to generate a quadtree structure. The CU is a basic unit for splitting and encoding a coding picture. A PU and a TU also have similar tree structures. The PU may correspond to a prediction block, and is a basic unit for predictive coding. The CU is further partitioned into a plurality of PUs in a partitioning pattern. The TU may correspond to a transform block, and is a basic unit for transforming a prediction residual. However, all of the CU, the PU, and the TU are concepts of blocks (or picture blocks) in essence.

[0124] For example, in HEVC, a CTU is partitioned into a plurality of CUs by using a quadtree structure represented as a coding tree. A decision on whether to encode a picture area by using inter-picture (temporal) or intra-picture (spatial) prediction is made at a CU level. Each CU may further be split into one, two, or four PUs based on a PU splitting pattern. In one PU, a same prediction process is applied, and related information is transmitted to a decoder on a PU basis. After obtaining a residual block by applying the prediction process based on the PU splitting pattern, the CU may be partitioned into transform units (TU) based on another quadtree structure similar to the coding tree used for the CU. In latest development of a video compression technology, a CTU is partitioned by using quad-tree plus multi-type tree, to obtain CUs. The multi-type tree includes a binary tree and a ternary tree. In the split structure, the CU may be square or rectangular.

[0125] Herein, for ease of description and understanding, a to-be-encoded picture block in a current coded picture may be referred to as a current block. For example, in encoding, the current block is a block that is currently being encoded; and in decoding, the current block is a block that is currently being decoded. A decoded picture block, in a reference picture, used to predict the current block is referred to as a reference block. For example, the reference block is a block that provides a reference signal for the current block, and the reference signal represents a pixel value in the picture block. A block that is in the reference picture and that provides a prediction signal for the current block may be referred to as a prediction block. The prediction signal represents a pixel value, a sample value, or a sample signal in the prediction block. For example, after reference blocks are traversed, an optimal reference block is found. The optimal reference block provides prediction for the current block, and this block is referred to as a prediction block. The current block may also be referred to as a current picture block.

[0126] In a case of lossless video coding, original video pictures can be reconstructed, and this means that reconstructed video pictures have same quality as the original video pictures (assuming that no transmission loss or other data loss occurs during storage or transmission). In a case of lossy video coding, further compression is performed through, for example, quantization, to reduce an amount of data required for representing video pictures, and the video pictures cannot be completely reconstructed on a decoder side. This means that quality of reconstructed video pictures is lower or poorer than that of the original video pictures.

[0127] Several H.261 video coding standards are used for "lossy hybrid video codecs" (namely, spatial and temporal prediction in a sample domain is combined with 2D transform coding for applying quantization in a transform domain). Each picture of a video sequence is usually partitioned into a set of non-overlapping blocks, and coding is usually performed at a block level. In other words, on an encoder side, a video is usually processed, that is, encoded, at a block (video block) level. For example, a prediction block is generated through spatial (intra-picture) prediction and temporal (inter-picture) prediction, the prediction block is subtracted from a current block (a block that is currently being processed or to be processed) to obtain a residual block, and the residual block is transformed in the transform domain and quantized to reduce an amount of data

that is to be transmitted (compressed). On the decoder side, an inverse processing part relative to the encoder is applied to the encoded or compressed block to reconstruct the current block for representation. Furthermore, the encoder duplicates a processing loop of the decoder, so that the encoder and the decoder generate identical prediction (for example, intra prediction and inter prediction) and/or reconstruction for processing, that is, coding, subsequent blocks.

[0128] The following describes a system architecture to which the embodiments of the present application are applied. FIG. **1**A is a schematic block diagram of an example of a video coding system according to an embodiment. As shown in FIG. **1**A, video coding system **10** may include a source device **12** and a destination device **14**. The source device **12** generates encoded video data, and therefore the source device **12** may be referred to as a video encoding apparatus. The destination device **14** may decode the encoded video data generated by the source device **12**, and therefore the destination device **14** may be referred to as a video decoding apparatus. In various embodiments, the source device **12**, the destination device **14**, or both the source device **12** and the destination device **14** may include one or more processors and a memory coupled to the one or more processors. The memory may include but is not limited to a RAM, a ROM, an EEPROM, a flash memory, or any other medium that can be used to store desired program code in a form of an instruction or a data structure accessible by a computer, as described in this specification. The source device **12** and the destination device **14** may include various apparatuses, including a desktop computer, a mobile computing apparatus, a notebook (for example, a laptop) computer, a tablet computer, a set-top box, a telephone handset such as a so-called "smart" phone, a television, a camera, a display apparatus, a digital media player, a video game console, an in-vehicle computer, a wireless communications device, and the like.

[0129] Although FIG. **1**A depicts the source device **12** and the destination device **14** as separate devices, in an embodiment, a device may alternatively include both the source device **12** and the destination device **14** or functionalities of both the source device **12** and the destination device **14**, that is, the source device **12** or a corresponding functionality and the destination device **14** or a corresponding functionality. In such embodiments, the source device **12** or the corresponding functionality and the destination device **14** or the corresponding functionality may be implemented by using same hardware and/or software or by using separate hardware and/or software or any combination thereof.

[0130] A communication connection between the source device **12** and the destination device **14** may be implemented over a link **13**, and the destination device **14** may receive encoded video data from the source device **12** over the link **13**. The link **13** may include one or more media or apparatuses capable of moving the encoded video data from the source device **12** to the destination device **14**. In an example, the link **13** may include one or more communications media that enable the source device **12** to directly transmit the encoded video data to the destination device **14** in real time. In this example, the source device **12** may modulate the encoded video data according to a communication standard (for example, a wireless communication protocol), and may transmit modulated video data to the destination device **14**. The one or more communications media may include a wireless communications medium and/or a wired communications medium, for example, a radio frequency (RF) spectrum or one or more physical transmission lines. The one or more communications media may form a part of a packet-based network, and the packet-based network is, for example, a local area network, a wide area network, or a global network (for example, the internet). The one or more communications media may include a router, a switch, a base station, or another device that facilitates communication from the source device **12** to the destination device **14**.

[0131] The source device **12** includes an encoder **20**, and optionally, the source device **12** may further include a picture source **16**, a picture pre-processor **18**, and a communications interface **22**. In an embodiment, the encoder **20**, the picture source **16**, the picture pre-processor **18**, and the communications interface **22** may be hardware components in the source device **12**, or may be a

software program in the source device **12**. Separate descriptions are as follows.

[0132] The picture source **16** may include or be any type of picture capture device configured to, for example, capture a real-world picture; and/or any type of device for generating a picture or comment (for screen content encoding, some text on a screen is also considered as a part of a to-be-encoded picture or image), for example, a computer graphics processor configured to generate a computer animation picture; or any type of device configured to obtain and/or provide a real-world picture or a computer animation picture (for example, screen content or a virtual reality (VR) picture); and/or any combination thereof (for example, an augmented reality (AR) picture). The picture source **16** may be a camera for capturing a picture or a memory for storing a picture. The picture source **16** may further include any type of (internal or external) interface through which a previously captured or generated picture is stored and/or a picture is obtained or received. When the picture source **16** is a camera, the picture source **16** may be, for example, a local camera or a camera integrated into the source device. When the picture source **16** is a memory, the picture source **16** may be, for example, a local memory or a memory integrated into the source device. When the picture source **16** includes an interface, the interface may be, for example, an external interface for receiving a picture from an external video source. The external video source is, for example, an external picture capture device such as a camera, an external memory, or an external picture generation device. The external picture generation device is, for example, an external computer graphics processor, a computer, or a server. The interface may be any type of interface, for example, a wired or wireless interface or an optical interface, according to any proprietary or standardized interface protocol.

[0133] A picture may be considered as a two-dimensional array or matrix of picture elements. The picture element in the array may also be referred to as a sample. A quantity of samples in horizontal and vertical directions (or axes) of the array or the picture defines a size and/or a resolution of the picture. For representation of a color, typically three color components are employed. For example, the picture may be represented as or include three sample arrays. For example, in an RGB format or a color space, a picture includes corresponding red, green, and blue sample arrays. However, in video coding, each pixel is typically represented in a luminance/chrominance format or a color space. For example, a picture in a YUV format includes a luminance component indicated by Y (sometimes L is used instead) and two chrominance components indicated by U and V. The luminance (luma) component Y represents brightness or gray level intensity (for example, both are the same in a gray-scale picture), and the two chrominance (chroma) components U and V represent chrominance or color information components. Correspondingly, the picture in the YUV format includes a luminance sample array of luminance sample values (Y) and two chrominance sample arrays of chrominance values (U and V). A picture in an RGB format may be converted or transformed into a picture in the YUV format and vice versa, and such a process is also known as color transformation or conversion. If a picture is monochrome, the picture may include only a luma sample array. In this embodiment of the present invention, a picture transmitted by the picture source **16** to a picture processor may also be referred to as original picture data **17**.

[0134] The picture pre-processor **18** is configured to receive the original picture data **17** and pre-process the original picture data **17**, to obtain a pre-processed picture **19** or pre-processed picture data **19**. For example, the pre-processing performed by the picture pre-processor **18** may include trimming, color format conversion (for example, from an RGB format to a YUV format), color correction, or denoising.

[0135] The encoder **20** (also referred to as a video encoder) is configured to receive the pre-processed picture data **19**, and process the pre-processed picture data **19** by using a related prediction mode (such as a prediction mode in each embodiment of this specification), to provide encoded picture data **21** (structural details of the encoder **20** are further described below based on FIG. **2**, FIG. **4**, or FIG. **5**). In some embodiments, the encoder **20** may be configured to perform various embodiments described below, to implement encoder-side application of the inter

prediction method described herein.

[0136] The communications interface **22** may be configured to receive the encoded picture data **21**, and transmit the encoded picture data **21** to the destination device **14** or any other device (for example, a memory) over the link **13** for storage or direct reconstruction. The any other device may be any device used for decoding or storage. The communications interface **22** may be, for example, configured to package the encoded picture data **21** into an appropriate format, for example, a data packet, for transmission over the link **13**.

[0137] The destination device **14** includes a decoder **30**, and in an embodiment, the destination device **14** may further include a communications interface **28**, a picture post-processor **32**, and a display device **34**. Separate descriptions are as follows.

[0138] The communications interface **28** may be configured to receive the encoded picture data **21** from the source device **12** or any other source. The any other source is, for example, a storage device, and the storage device is, for example, an encoded picture data storage device. The communications interface **28** may be configured to transmit or receive the encoded picture data **21** over the link **13** between the source device **12** and the destination device **14** or through any type of network. The link **13** is, for example, a direct wired or wireless connection. The any type of network is, for example, a wired or wireless network or any combination thereof, or any type of private or public network, or any combination thereof. The communications interface **28** may be, for example, configured to depackage the data packet transmitted through the communications interface **22**, to obtain the encoded picture data **21**.

[0139] Both the communications interface **28** and the communications interface **22** may be configured as unidirectional communications interfaces or bidirectional communications interfaces, and may be configured to, for example, send and receive messages to establish a connection, and acknowledge and exchange any other information related to a communication link and/or data transmission such as encoded picture data transmission.

[0140] The decoder **30** (also referred to as video decoder) is configured to receive the encoded picture data **21** and provide decoded picture data (or decoded picture) **31** (structural details of the decoder **30** are further described below based on FIG. **3**, FIG. **4**, or FIG. **5**). In some embodiments, the decoder **30** may be configured to perform various embodiments described below, to implement decoder-side application of the inter prediction method described herein.

[0141] The picture post-processor **32** is configured to post-process the decoded picture data **31** (also referred to as reconstructed picture data), to obtain post-processed picture data **33**. The post-processing performed by the picture post-processor **32** may include color format conversion (for example, from a YUV format to an RGB format), color correction, trimming, re-sampling, or any other processing. The picture post-processor **32** may be further configured to transmit the post-processed picture data **33** to the display device **34**.

[0142] The display device **34** is configured to receive the post-processed picture data **33** to display a picture, for example, to a user or a viewer. The display device **34** may be or include any type of display configured to present a reconstructed picture, for example, an integrated or external display or monitor. For example, the display may include a liquid crystal display (LCD), an organic light emitting diode (OLED) display, a plasma display, a projector, a micro LED display, a liquid crystal on silicon (LCoS), a digital light processor (DLP), or any type of other displays.

[0143] Although FIG. **1**A depicts the source device **12** and the destination device **14** as separate devices, in an embodiment, a device may alternatively include both the source device **12** and the destination device **14** or functionalities of both the source device **12** and the destination device **14**, that is, the source device **12** or a corresponding functionality and the destination device **14** or a corresponding functionality. In such embodiments, the source device **12** or the corresponding functionality and the destination device **14** or the corresponding functionality may be implemented by using same hardware and/or software or by using separate hardware and/or software or any combination thereof.

[0144] As will be apparent for a person skilled in the art based on the descriptions, existence and (exact) split of functionalities of the different units or functionalities of the source device **12** and/or the destination device **14** shown in FIG. **1**A may vary depending on an actual device and application. The source device **12** and the destination device **14** each may be any one of a wide range of devices, including any type of handheld or stationary device, for example, a notebook or laptop computer, a mobile phone, a smartphone, a pad or a tablet computer, a video camera, a desktop computer, a set-top box, a television, a camera, a vehicle-mounted device, a display device, a digital media player, a video game console, a video streaming device (such as a content service server or a content distribution server), a broadcast receiver device, or a broadcast transmitter device, and may not use or may use any type of operating system.

[0145] The encoder **20** and the decoder **30** each may be implemented as any one of various appropriate circuits, for example, one or more microprocessors, digital signal processors (DSPs), application-specific integrated circuits (ASICs), field-programmable gate arrays (FPGAs), discrete logic, hardware, or any combinations thereof. If the technologies are implemented partially by using software, a device may store software instructions in an appropriate non-transitory computer-readable storage medium and may execute the instructions by using hardware such as one or more processors, to perform the technologies of this disclosure. Any one of the foregoing content (including hardware, software, a combination of hardware and software, and the like) may be considered as one or more processors.

[0146] In some embodiments, the video coding system **10** shown in FIG. **1**A is merely an example and the techniques of this application may be applied to video coding settings (for example, video encoding or video decoding) that do not necessarily include any data communication between an encoding device and a decoding device. In other examples, data may be retrieved from a local memory, streamed over a network, or the like. A video encoding device may encode and store data in the memory, and/or a video decoding device may retrieve and decode data from the memory. In some examples, the encoding and the decoding are performed by devices that do not communicate with one another, but simply encode data to the memory and/or retrieve and decode data from the memory.

[0147] FIG. **1**B is an illustrative diagram of an example of a video coding system according to an embodiment. In FIG. **1**B, video coding system **40** includes the encoder **20** in FIG. **2** and/or the decoder **30** in FIG. **3**, according to an embodiment. The video coding system **40** can implement a combination of various techniques in the embodiments described herein. In the illustrated embodiment, the video coding system **40** may include an imaging device **41**, the encoder **20**, the decoder **30** (and/or a video encoder/decoder implemented by a logic circuit **47** of a processing unit **46**), an antenna **42**, one or more processors **43**, one or more memories **44**, and/or a display device **45**.

[0148] As shown in FIG. **1**B, the imaging device **41**, the antenna **42**, the processing unit **46**, the logic circuit **47**, the encoder **20**, the decoder **30**, the processor **43**, the memory **44**, and/or the display device **45** can communicate with each other. As described, although the video coding system **40** is illustrated with the encoder **20** and the decoder **30**, the video coding system **40** may include only the encoder **20** or only the decoder **30** in different examples.

[0149] In some embodiments, the antenna **42** may be configured to transmit or receive an encoded bitstream of video data. In addition, in some examples, the display device **45** may be configured to present the video data. In some examples, the logic circuit **47** may be implemented by the processing unit **46**. The processing unit **46** may include an application-specific integrated circuit (ASIC) logic, a graphics processor, a general-purpose processor, or the like. The video coding system **40** may also include processor **43** (which may be optional in some embodiments). The processor **43** may similarly include an application-specific integrated circuit (ASIC) logic, a graphics processor, a general-purpose processor, or the like. In some embodiments, the logic circuit **47** may be implemented by hardware, for example, video coding dedicated hardware, and the

processor **43** may be implemented by general-purpose software, an operating system, or the like. In addition, the memory **44** may be any type of memory, for example, a volatile memory (for example, a static random access memory (SRAM), a dynamic random access memory (DRAM)), or a nonvolatile memory (for example, a flash memory). In a non-restrictive example, the memory **44** may be implemented by a cache memory. In some embodiments, the logic circuit **47** may access the memory **44** (for example, for implementing a picture buffer). In other examples, the logic circuit **47** and/or the processing unit **46** may include a memory (for example, a cache) for implementing a picture buffer.

[0150] In some embodiments, the encoder **20** implemented by using the logic circuit may include a picture buffer (which is implemented by, for example, the processing unit **46** or the memory **44**) and a graphics processing unit (which is implemented by, for example, the processing unit **46**). The graphics processing unit may be communicatively coupled to the picture buffer. The graphics processing unit may include the encoder **20** implemented by using the logic circuit **47**, to implement various modules that are described with reference to FIG. **2** and/or any other encoder system or subsystem described in this specification. The logic circuit may be configured to perform various operations described in this specification.

[0151] In some embodiments, the decoder **30** may be implemented by the logic circuit **47** in a similar manner, to implement various modules that are described with reference to the decoder **30** in FIG. **3** and/or any other decoder system or subsystem described in this specification. In some examples, the decoder **30** implemented by using the logic circuit may include a picture buffer (which is implemented by a processing unit **2820** or the memory **44**) and a graphics processing unit (which is implemented by, for example, the processing unit **46**). The graphics processing unit may be communicatively coupled to the picture buffer. The graphics processing unit may include the decoder **30** implemented by using the logic circuit **47**, to implement various modules that are described with reference to FIG. **3** and/or any other decoder system or subsystem described in this specification.

[0152] In some embodiments, the antenna **42** may be configured to receive an encoded bitstream of video data. As described, the encoded bitstream may include data, an indicator, an index value, mode selection data, or the like related to video frame coding described in this specification, for example, data related to coding partitioning (for example, a transform coefficient or a quantized transform coefficient, an optional indicator (as described), and/or data defining the coding partitioning). The video coding system **40** may further include the decoder **30** that is coupled to the antenna **42** and that is configured to decode the encoded bitstream. The display device **45** is configured to present a video frame.

[0153] It should be understood that, in this embodiment, for the example described with reference to the encoder **20**, the decoder **30** may be configured to perform an inverse process. With regard to a signaling syntax element, the decoder **30** may be configured to receive and parse such a syntax element and correspondingly decode related video data. In some examples, the encoder **20** may entropy encode the syntax element into an encoded video bitstream. In such embodiments, the decoder **30** may parse such a syntax element and correspondingly decode related video data.

[0154] It should be noted that the inter prediction method described in the embodiments of the present invention is mainly used in an inter prediction process, and the process exists in both the encoder **20** and the decoder **30**. The encoder **20**/the decoder **30** in the embodiments of the present invention may be an encoder/decoder corresponding to a video standard protocol such as H.263, H.264, HEVV, MPEG-2, MPEG-4, VP8, or VP9, or corresponding to a next-generation video standard protocol (such as H.266).

[0155] FIG. **2** is a schematic/conceptual block diagram of an example encoder according to an embodiment. In the example of FIG. **2**, encoder **20** includes a residual calculation unit **204**, a transform processing unit **206**, a quantization unit **208**, an inverse quantization unit **210**, an inverse transform processing unit **212**, a reconstruction unit **214**, a buffer **216**, a loop filter unit **220**, a

decoded picture buffer (DPB) **230**, a prediction processing unit **260**, and an entropy encoding unit **270**. The prediction processing unit **260** may include an inter prediction unit **244**, an intra prediction unit **254**, and a mode selection unit **262**. The inter prediction unit **244** may include a motion estimation unit and a motion compensation unit (not depicted in the figure). The encoder **20** shown in FIG. **2** may also be referred to as a hybrid video encoder or a video encoder based on a hybrid video codec.

[0156] For example, the residual calculation unit **204**, the transform processing unit **206**, the quantization unit **208**, the prediction processing unit **260**, and the entropy encoding unit **270** form a forward signal path of the encoder **20**, whereas, for example, the inverse quantization unit **210**, the inverse transform processing unit **212**, the reconstruction unit **214**, the buffer **216**, the loop filter **220**, the DPB **230**, and the prediction processing unit **260** form a reverse signal path of the encoder. The reverse signal path of the encoder corresponds to a signal path of a decoder (refer to the decoder **30** in FIG. **3**).

[0157] The encoder **20** receives, for example, from an input **202**, a picture **201** or a picture block **203** of the picture **201**, for example, a picture in a sequence of pictures forming a video or a video sequence. The picture block **203** may also be referred to as a current picture block or a to-be-encoded picture block. The picture **201** may be referred to as a current picture or a to-be-encoded picture (particularly in video coding, to distinguish the current picture from other pictures, the other pictures are, for example, previously encoded and/or decoded pictures in a same video sequence, that is, the video sequence that also includes the current picture).

[0158] In an embodiment, the encoder **20** may include a partitioning unit (not depicted in FIG. **2**), configured to partition the picture **201** into a plurality of blocks such as the picture blocks **203**. The picture **201** is usually partitioned into a plurality of non-overlapping blocks. The partitioning unit may be configured to use a same block size for all pictures in the video sequence and a corresponding grid defining the block size, or change a block size between pictures or subsets or groups of pictures, and partition each picture into corresponding blocks.

[0159] In an embodiment, the prediction processing unit **260** of the encoder **20** may be configured to perform any combination of the partitioning techniques described above.

[0160] Like the picture **201**, the picture block **203** is also or may be considered as a two-dimensional array or matrix of samples with sample values, although of a smaller size than the picture **201**. In other words, the picture block **203** may include, for example, one sample array (for example, a luma array in a case of a monochrome picture **201**), three sample arrays (for example, one luma array and two chroma arrays in a case of a color picture), or any other quantity and/or type of arrays depending on an applied color format. A quantity of samples in horizontal and vertical directions (or axes) of the picture block **203** defines a size of the picture block **203**.

[0161] The encoder **20** shown in FIG. **2** is configured to encode the picture **201** block by blocks, for example, the encoder encodes and predicts each picture block **203**.

[0162] The residual calculation unit **204** is configured to calculate a residual block **205** based on the picture block **203** and a prediction block **265** (further details about the prediction block **265** are provided below), for example, obtain the residual block **205** in a sample domain by subtracting sample values of the prediction block **265** from sample values of the picture block **203** sample by sample (pixel by pixel).

[0163] The transform processing unit **206** is configured to apply a transform, for example, a discrete cosine transform (DCT) or a discrete sine transform (DST), on sample values of the residual block **205** to obtain transform coefficients **207** in a transform domain. The transform coefficients **207** may also be referred to as transform residual coefficients and represent the residual block **205** in the transform domain.

[0164] The transform processing unit **206** may be configured to apply an integer approximation of DCT/DST, such as transforms specified in HEVC/H.265. In comparison with an orthogonal DCT transform, such an integer approximation is typically scaled by a factor. To preserve a norm of a

residual block which is processed by using forward and inverse transforms, applying an additional scale factor is a part of a transform process. The scale factor is usually chosen based on some constraints. For example, the scale factor is a power of two for a shift operation, a bit depth of the transform coefficient, or a tradeoff between accuracy and implementation costs. Specific scaling factors are, for example, specified for the inverse transform, for example, by the inverse transform processing unit **212** on the decoder side **30** (and the corresponding inverse transform, for example, by the inverse transform processing unit **212** on the encoder side **20**), and corresponding scaling factors for the forward transform, for example, by the transform processing unit **206** on the encoder side **20** may be specified accordingly.

[0165] The quantization unit **208** is configured to quantize the transform coefficients **207** to obtain quantized transform coefficients **209**, for example, by applying scalar quantization or vector quantization. The quantized transform coefficients **209** may also be referred to as quantized residual coefficients **209**. The quantization process may reduce a bit depth associated with some or all of the transform coefficients **207**. For example, an n-bit transform coefficient may be rounded down to an m-bit transform coefficient during quantization, where n is greater than m. A quantization degree may be modified by adjusting a quantization parameter (QP). For example, for scalar quantization, different scales may be applied to achieve finer or coarser quantization. A smaller quantization step corresponds to finer quantization, and a larger quantization step corresponds to coarser quantization. An applicable quantization step may be indicated by the quantization parameter (QP). The quantization parameter may be, for example, an index of a predefined set of applicable quantization steps. For example, a smaller quantization parameter may correspond to finer quantization (a smaller quantization step) and a larger quantization parameter may correspond to coarser quantization (a larger quantization step) or vice versa. The quantization may include division by a quantization step and corresponding quantization and/or inverse quantization, for example, performed by the inverse quantization unit **210**, or may include multiplication by a quantization step. In some embodiments according to some standards such as HEVC, a quantization parameter may be used to determine the quantization step. Generally, the quantization step may be calculated based on a quantization parameter using a fixed point approximation of an equation including division. An additional scaling factor may be introduced for quantization and dequantization to restore the norm of the residual block, where the norm of the residual block may be modified because of a scale used in the fixed point approximation of the equation for the quantization step and the quantization parameter. In an embodiment, scales of the inverse transform and the dequantization may be combined. Alternatively, a customized quantization table may be used and signaled from the encoder to the decoder, for example, in a bitstream. The quantization is a lossy operation, where loss increases with an increasing quantization step.

[0166] The inverse quantization unit **210** is configured to apply inverse quantization of the quantization unit **208** to quantization coefficients to obtain dequantization coefficients **211**, for example, apply, based on or by using a same quantization step as the quantization unit **208**, inverse of a quantization scheme applied by the quantization unit **208**. The dequantization coefficients **211** may also be referred to as dequantized residual coefficients **211** and correspond, although typically not identical to the transform coefficients due to the loss by quantization, to the transform coefficients **207**.

[0167] The inverse transform processing unit **212** is configured to apply an inverse transform of the transform applied by the transform processing unit **206**, for example, an inverse DCT or an inverse DST, to obtain an inverse transform block **213** in the sample domain. The inverse transform block **213** may also be referred to as an inverse transform dequantized block **213** or an inverse transform residual block **213**.

[0168] The reconstruction unit **214** (for example, a summer) is configured to add the inverse transform block **213** (e.g., a reconstructed residual block) to the prediction block **265** to obtain a

reconstructed block **215** in a sample domain, for example, by adding a sample value of the reconstructed residual block **213** and the sample value of the prediction block **265**.

[0169] In an embodiment, a buffer unit (or buffer) **216** of, for example, a line buffer **216**, is configured to buffer or store the reconstructed block **215** and a corresponding sample value, for example, for intra prediction. In other embodiments, the encoder may be configured to use an unfiltered reconstructed block and/or a corresponding sample value stored in the buffer unit **216** for any type of estimation and/or prediction, for example, intra prediction.

[0170] For example, in an embodiment, the encoder **20** may be configured so that the buffer unit **216** is not only used for storing the reconstructed block **215** for the intra prediction unit **254** but also used for the loop filter unit **220** (not depicted in FIG. **2**), and/or so that, for example, the buffer unit **216** and the decoded picture buffer unit **230** form one buffer. In other embodiments, a filtered block **221** and/or a block or a sample from the decoded picture buffer **230** (the block or sample is not depicted in FIG. **2**) are/is used as an input or a basis for the intra prediction unit **254**.

[0171] The loop filter unit (or loop filter) **220** is configured to filter the reconstructed block **215** to obtain the filtered block **221**, to smooth pixel transition or improve video quality. The loop filter unit **220** is intended to represent one or more loop filters such as a deblocking filter, a sample-adaptive offset (SAO) filter, or another filter such as a bilateral filter, an adaptive loop filter (ALF), a sharpening or smoothing filter, or a collaborative filter. Although the loop filter unit **220** is shown in FIG. **2** as an in-loop filter, in other embodiments, the loop filter unit **220** may be implemented as a post-loop filter. The filtered block **221** may also be referred to as a filtered reconstructed block. The decoded picture buffer **230** may store a reconstructed encoded block after the loop filter unit **220** performs a filtering operation on the reconstructed encoded block.

[0172] In an embodiment, the encoder **20** (correspondingly, the loop filter unit **220**) may be configured to output a loop filter parameter (such as sample adaptive offset information), for example, directly or after entropy encoding performed by the entropy encoding unit **270** or any other entropy encoding unit, so that, for example, the decoder **30** can receive the same loop filter parameter and apply the same loop filter parameter to decoding.

[0173] The DPB **230** may be a reference picture memory that stores reference picture data for use in encoding video data by the encoder **20**. The DPB **230** may be formed by any one of a variety of memory devices, such as a dynamic random access memory (DRAM) (including a synchronous DRAM (SDRAM), a magnetoresistive RAM (MRAM), and a resistive RAM (RRAM)), or another type of memory devices. The DPB **230** and the buffer **216** may be provided by a same memory device or separate memory devices. In an example, the DPB **230** is configured to store the filtered block **221**. The decoded picture buffer **230** may be further configured to store another previously filtered block, for example, the previously reconstructed and filtered block **221**, of a same current picture or of different pictures, for example, a previously reconstructed picture, and may provide a complete previously reconstructed, that is, decoded picture (and a corresponding reference block and sample) and/or a partially reconstructed current picture (and a corresponding reference block and sample), for example, for inter prediction. In an example, if the reconstructed block **215** is reconstructed without in-loop filtering, the DPB **230** is configured to store the reconstructed block **215**.

[0174] The prediction processing unit **260**, also referred to as a block prediction processing unit, is configured to receive or obtain the picture block **203** (e.g., a current picture block of the current picture **201**) and reconstructed picture data, for example, reference samples of a same (current) picture from the buffer **216** and/or reference picture data **231** of one or more previously decoded pictures from the decoded picture buffer **230**, and to process such data for prediction, that is, to provide the prediction block **265** that may be an inter prediction block **245** or an intra prediction block **255**.

[0175] The mode selection unit **262** may be configured to select a prediction mode (for example, an intra prediction mode or an inter prediction mode) and/or a corresponding prediction block **245** or

255 to be used as the prediction block **265**, for calculation of the residual block **205** and for reconstruction of the reconstructed block **215**.

[0176] In an embodiment, the mode selection unit **262** may be configured to select the prediction mode (for example, from prediction modes supported by the prediction processing unit **260**). The prediction mode provides an optimal match or a minimum residual (the minimum residual means better compression for transmission or storage), or provides minimum signaling overheads (the minimum signaling overheads mean better compression for transmission or storage), or considers or balances both. The mode selection unit **262** may be configured to determine the prediction mode based on rate distortion optimization (rate distortion optimization, RDO), that is, select a prediction mode that provides minimum rate distortion optimization or select a prediction mode for which related rate distortion at least satisfies a prediction mode selection criterion.

[0177] In the following, prediction processing (for example, performed the prediction processing unit **260**) and mode selection (for example, performed the mode selection unit **262**) performed by the example encoder **20** are to be explained in detail.

[0178] As described above, the encoder **20** is configured to determine or select the optimal or optimum prediction mode from a set of (pre-determined) prediction modes. The set of prediction modes may include, for example, an intra prediction mode and/or an inter prediction mode.

[0179] A set of intra prediction modes may include 35 different intra prediction modes, for example, non-directional modes such as a DC (or average) mode and a planar mode, or directional modes such as those defined in H.265, or may include 67 different intra prediction modes, for example, non-directional modes such as a DC (or average) mode and a planar mode, or directional modes such as those defined in H.266 under development.

[0180] In an embodiment, a set of inter prediction modes depends on available reference pictures (namely, for example, at least some decoded pictures stored in the DPB **230**, as described above) and other inter prediction parameters, for example, depends on whether an entire reference picture or only a part of the reference picture, for example, a search window region around a region of the current block, is used for searching for an optimal matched reference block, and/or for example, depends on whether pixel interpolation such as half-pixel and/or quarter-pixel interpolation is applied. The set of inter prediction modes may include, for example, an advanced motion vector prediction (AMVP) mode and a merge mode. In an embodiment, the set of inter prediction modes may include a refined control point-based AMVP mode and a refined control point-based merge mode in the embodiments of the present invention. In an example, the intra prediction unit **254** may be configured to perform any combination of inter prediction techniques described below.

[0181] In addition to the foregoing prediction modes, a skip mode and/or a direct mode may also be applied in the embodiments of the present invention.

[0182] The prediction processing unit **260** may be further configured to partition the picture block **203** into smaller block partitions or sub-blocks, for example, by iteratively using quad-tree (QT) partitioning, binary-tree (BT) partitioning, triple-tree (TT) partitioning, or any combination thereof, and to perform, for example, prediction on each of the block partitions or sub-blocks, where mode selection includes selection of a tree structure of the partitioned picture block **203** and selection of a prediction mode applied to each of the block partitions or sub-blocks.

[0183] The inter prediction unit **244** may include a motion estimation (ME) unit (not depicted in FIG. **2**) and a motion compensation (motion compensation, MC) unit (not depicted in FIG. **2**). The motion estimation unit is configured to receive or obtain the picture block **203** (the current picture block of the current picture **201**) and the decoded pictures **231**, or at least one or more previously reconstructed blocks, for example, reconstructed blocks of one or more other/different previously decoded pictures **231**, for motion estimation. For example, a video sequence may include the current picture and a previously decoded picture **31**. In other words, the current picture and the previously decoded picture **31** may be a part of a sequence of pictures forming a video sequence or form the sequence of pictures.

[0184] For example, a motion estimation unit (not depicted in FIG. **2**) may be configured to select a reference block from a plurality of reference blocks of a same picture or different pictures of a plurality of other pictures and provide, for a motion compensation unit (not depicted in FIG. **2**), a reference picture and/or provide an offset (a spatial offset) between a motion vector (a location (coordinates X and Y) of the reference block) and a location of the current block as an inter prediction parameter. This offset is also referred to as a motion vector (MV).

[0185] The motion compensation unit is configured to obtain the inter prediction parameter, and perform inter prediction based on or by using the inter prediction parameter, to obtain the inter prediction block **245**. Motion compensation performed by the motion compensation unit (not depicted in FIG. **2**) may include extracting or generating a prediction block based on a motion/block vector determined through motion estimation (interpolation may be performed at a sub-sample precision level). Interpolation filtering may generate additional pixel samples from known pixel samples, thereby potentially increasing a quantity of candidate prediction blocks that may be used to code a picture block. Upon receiving a motion vector for a PU of the current picture block, the motion compensation unit **246** may locate a prediction block to which the motion vector points in one of reference picture lists. The motion compensation unit **246** may further generate a syntax element associated with a block and a video slice, for use by the decoder **30** in decoding a picture block of the video slice.

[0186] In an embodiment, the inter prediction unit **244** may transmit a syntax element to the entropy encoding unit **270**, where the syntax element includes an inter prediction parameter (for example, indication information of an inter prediction mode that is selected for prediction of a current block after inter prediction modes are traversed, or at least one of an index value of a length of a motion vector difference of the current picture block and an index value of a direction of the motion vector difference of the current picture block). In an embodiment, if there is only one inter prediction mode, the inter prediction parameter may alternatively not be carried in the syntax element. In this case, the decoder side **30** may directly perform decoding in a default prediction mode. It can be understood that the inter prediction unit **244** may be configured to perform any combination of inter prediction techniques.

[0187] The intra prediction unit **254** is configured to obtain, for example, receive, a picture block **203** (the current picture block) and one or more previously reconstructed blocks, for example, reconstructed neighboring blocks, of a same picture for intra estimation. The encoder **20** may be, for example, configured to select an intra prediction mode from (predetermined) intra prediction modes.

[0188] In an embodiment, the encoder **20** may be configured to select an intra prediction mode according to an optimization criterion, for example, based on a minimum residual (for example, an intra prediction mode providing the prediction block **255** that is most similar to the current picture block **203**) or minimum rate distortion.

[0189] The intra prediction unit **254** is further configured to determine the intra prediction block **255** based on, for example, an intra prediction parameter of the selected intra prediction mode. In any case, after selecting the intra prediction mode for a block, the intra prediction unit **254** is further configured to provide the intra prediction parameter, that is, information indicating the selected intra prediction mode for the block, to the entropy encoding unit **270**. In an embodiment, the intra prediction unit **254** may be configured to perform any combination of intra prediction techniques.

[0190] In an embodiment, the intra prediction unit **254** may transmit a syntax element to the entropy encoding unit **270**, where the syntax element includes an intra prediction parameter (for example, indication information of an intra prediction mode that is selected for prediction for the current block after a plurality of intra prediction modes are traversed). In a possible application scenario, if there is only one intra prediction mode, the intra prediction parameter may alternatively not be carried in the syntax element. In this case, the decoder side **30** may directly perform

decoding in a default prediction mode.

[0191] The entropy encoding unit **270** is configured to apply (or bypass) an entropy encoding algorithm or a scheme (for example, a variable length coding (VLC) scheme, a context adaptive VLC (CAVLC) scheme, an arithmetic coding scheme, a context adaptive binary arithmetic coding (CABAC), syntax-based context-adaptive binary arithmetic coding (SBAC), probability interval partitioning entropy (PIPE) coding, or another entropy coding methodology or technique) on one or all of the following: the quantization coefficients **209**, the inter prediction parameter, the intra prediction parameter, and/or the loop filter parameter, to obtain the encoded picture data **21** which can be output through an output **272**, for example, in a form of an encoded bitstream. The encoded bitstream may be transmitted to the video decoder **30**, or archived for later transmission or retrieval by the video decoder **30**. The entropy encoding unit **270** may be further configured to entropy encode another syntax element for a current video slice being encoded.

[0192] Other structural variations of the video encoder **20** may be configured to encode a video stream. For example, a non-transform based encoder **20** may quantize a residual signal directly without the transform processing unit **206** for some blocks or frames. In another embodiment, the encoder **20** includes the quantization unit **208** and the inverse quantization unit **210** that can be combined into a single unit.

[0193] In an embodiment, the encoder **20** can be configured to implement an inter prediction method described in the following embodiments.

[0194] It should be understood that other structural variations of the video encoder **20** may be configured to encode a video stream. For example, for some picture blocks or picture frames, the video encoder **20** may quantize the residual signal directly without processing by the transform processing unit **206**, and correspondingly, without processing by the inverse transform processing unit **212**. Alternatively, for some picture blocks or picture frames, the video encoder **20** does not generate residual data, and correspondingly, there is no need for the transform processing unit **206**, the quantization unit **208**, the inverse quantization unit **210**, and the inverse transform processing unit **212** to perform processing. Alternatively, the video encoder **20** may directly store a reconstructed picture block as a reference block, without processing by the filter **220**. Alternatively, the quantization unit **208** and the inverse quantization unit **210** in the video encoder **20** may be combined together. The loop filter **220** may be optional in some embodiments. In a case of lossless compression encoding, the transform processing unit **206**, the quantization unit **208**, the inverse quantization unit **210**, and the inverse transform processing unit **212** may be optional in some embodiments. It should be understood that in different application scenarios, the inter prediction unit **244** and the intra prediction unit **254** may be used selectively.

[0195] FIG. **3** is a schematic/conceptual block diagram of an example decoder according to an embodiment. Decoder **30** (e.g., a video decoder) is configured to receive encoded picture data (for example, an encoded bitstream) **21** encoded by, for example, the encoder **20**, to obtain a decoded picture **231**. In a decoding process, the decoder **30** receives video data from the video encoder **20**, for example, an encoded video bitstream that represents a picture block of an encoded video slice and associated syntax elements.

[0196] In the example of FIG. **3**, the decoder **30** includes an entropy decoding unit **304**, an inverse quantization unit **310**, an inverse transform processing unit **312**, a reconstruction unit **314** (for example, a summer), a buffer **316**, a loop filter **320**, a decoded picture buffer **330**, and a prediction processing unit **360**. The prediction processing unit **360** may include an inter prediction unit **344**, an intra prediction unit **354**, and a mode selection unit **362**. In some embodiments, the video decoder **30** may perform a decoding pass generally reciprocal to the encoding pass described with reference to the encoder **20** in FIG. **2**.

[0197] The entropy decoding unit **304** is configured to perform entropy decoding on the encoded picture data **21** to obtain, for example, quantization coefficients **309** and/or decoded encoding parameters (not depicted in FIG. **3**), for example, any one or all of an inter prediction parameter, an

intra prediction parameter, a loop filter parameter, and/or another syntax element (that are decoded). The entropy decoding unit **304** is further configured to forward the inter prediction parameter, the intra prediction parameter, and/or the another syntax element to the prediction processing unit **360**. The video decoder **30** may receive syntax elements at a video slice level and/or a video block level.

[0198] The inverse quantization unit **310** may have a same function as the inverse quantization unit **110**. The inverse transform processing unit **312** may have a same function as the inverse transform processing unit **212**. The reconstruction unit **314** may have a same function as the reconstruction unit **214**. The buffer **316** may have a same function as the buffer **216**. The loop filter **320** may have a same function as the loop filter **220**. The decoded picture buffer **330** may have a same function as the decoded picture buffer **230**.

[0199] The prediction processing unit **360** may include the inter prediction unit **344** and the intra prediction unit **354**. The inter prediction unit **344** may resemble the inter prediction unit **244** in functions, and the intra prediction unit **354** may resemble the intra prediction unit **254** in functions. The prediction processing unit **360** is usually configured to perform block prediction and/or obtain a prediction block **365** from the encoded data **21**, and receive or obtain (explicitly or implicitly) a prediction related parameter (for example, at least one of an index value of a length of a motion vector difference of a current picture block and an index value of a direction of the motion vector difference of the current picture block) and/or information about a selected prediction mode, for example, from the entropy decoding unit **304**.

[0200] When a video slice is coded as an intra coded (I) slice, the intra prediction unit **354** of the prediction processing unit **360** is configured to generate a prediction block **365** for a picture block of the current video slice based on a signaled intra prediction mode and data that is from a previously decoded block of a current frame or picture. When a video frame is coded as an inter coded (B or P) slice, the inter prediction unit **344** (for example, a motion compensation unit) of the prediction processing unit **360** is configured to generate a prediction block **365** for a video block of the current video slice based on a motion vector and another syntax element (for example, the syntax element may be at least one of an index value of a length of a motion vector difference of a current picture block and an index value of a direction of the motion vector difference of the current picture block) received from the entropy decoding unit **304**. For inter prediction, the prediction block may be generated from one of reference pictures in one reference picture list. The video decoder **30** may construct reference frame lists: a list 0 and a list 1, by using a default construction technique based on reference pictures stored in the DPB **330**.

[0201] The prediction processing unit **360** is configured to determine prediction information for the video block of the current video slice by parsing the motion vector and/or the another syntax element, and use the prediction information to generate the prediction block for the current video block being decoded. In an embodiment, the prediction processing unit **360** determines, by using some received syntax elements, a prediction mode (for example, intra prediction or inter prediction) for encoding the video block in the video slice, an inter prediction slice type (for example, a B slice, a P slice, or a GPB slice), construction information of one or more of the reference picture lists for the slice, a motion vector of each inter encoded video block in the slice, an inter prediction status of each inter encoded video block in the slice, and other information, to decode the video block in the current video slice. In another embodiment, the syntax elements received by the video decoder **30** from a bitstream include syntax elements in one or more of an adaptive parameter set (APS), a sequence parameter set (SPS), a picture parameter set (PPS), or a slice header.

[0202] The inverse quantization unit **310** may be configured to inverse quantize (namely, dequantize) a quantized transform coefficient provided in the bitstream and decoded by the entropy decoding unit **304**. An inverse quantization process may include: using a quantization parameter calculated by the video encoder **20** for each video block in the video slice, to determine a

quantization degree that should be applied and, likewise, an inverse quantization degree that should be applied.

[0203] The inverse transform processing unit **312** is configured to apply an inverse transform (for example, an inverse DCT, an inverse integer transform, or a conceptually similar inverse transform process) to the transform coefficient to generate a residual block in a pixel domain.

[0204] The reconstruction unit **314** (for example, the summer) is configured to add an inverse transform block **313** (namely, a reconstructed residual block **313**) to the prediction block **365** to obtain a reconstructed block **315** in a sample domain, for example, by adding a sample value of the reconstructed residual block **313** and a sample value of the prediction block **365**.

[0205] The loop filter unit **320** (during a coding loop or after a coding loop) is configured to filter the reconstructed block **315** to obtain a filtered block **321**, to smooth pixel transition or improve video quality. In an embodiment, the loop filter unit **320** may be configured to perform any combination of filtering techniques described below. The loop filter unit **320** is intended to represent one or more loop filters such as a deblocking filter, a sample-adaptive offset (SAO) filter, or another filter such as a bilateral filter, an adaptive loop filter (ALF), a sharpening or smoothing filter, or a collaborative filter. Although the loop filter unit **320** is shown in FIG. **3** as an in-loop filter, in other configurations, the loop filter unit **320** may be implemented as a post-loop filter.

[0206] A decoded video block **321** in a given frame or picture is then stored in the decoded picture buffer **330** that stores a reference picture used for subsequent motion compensation.

[0207] The decoder **30** is configured to, for example, output the decoded picture **31** through an output **332**, for presentation to a user or viewing by a user.

[0208] Other variations of the video decoder **30** may be configured to decode a compressed bitstream. For example, the decoder **30** may generate an output video stream without the loop filter unit **320**. For example, a non-transform based decoder **30** may inversely quantize a residual signal directly without the inverse transform processing unit **312** for some blocks or frames. In another embodiment, the video decoder **30** includes the inverse quantization unit **310** and the inverse transform processing unit **312** that can be combined into a single unit.

[0209] In an embodiment, the decoder **30** is configured to implement an inter prediction method described in the following embodiments.

[0210] It should be understood that other structural variations of the decoder **30** may be configured to decode the encoded video bitstream. For example, the decoder **30** may generate an output video stream without processing performed by the filter **320**. Alternatively, for some picture blocks or picture frames, the entropy decoding unit **304** of the video decoder **30** does not obtain quantization coefficients through decoding, and correspondingly, there is no need for the inverse quantization unit **310** and the inverse transform processing unit **312** to perform processing. The loop filter **320** may be optional in some embodiments. In a case of lossless compression, the inverse quantization unit **310** and the inverse transform processing unit **312** may be optional in some embodiments. It should be understood that in different application scenarios, the inter prediction unit and the intra prediction unit may be used selectively.

[0211] It should be understood that on the encoder **20** and the decoder **30** in this application, a processing result for a procedure may be output to a next procedure after being further processed. For example, after a procedure such as interpolation filtering, motion vector derivation, or loop filtering, an operation such as clip or shift is further performed on a processing result of a corresponding procedure.

[0212] For example, a motion vector of a control point of the current picture block or a motion vector of a sub-block of the current picture block derived from a motion vector of a neighboring affine coded block may be further processed. This is not limited in this application. For example, a value of a motion vector is restricted to be within a specific bit width range. Assuming that an allowed bit width of a motion vector is bitDepth, a value of the motion vector ranges from $-2^{(bitDepth-1)}$ to $2^{(bitDepth-1)}-1$, where the

symbol "{circumflex over ( )}" represents exponentiation. If bitDepth is 16, the value range is from −32768 to 32767. If bitDepth is 18, the value ranges from −131072 to 131071. For another example, values of motion vectors (for example, motion vectors MVs of four 4×4 sub-blocks in an 8×8 picture block) are restricted, so that a maximum difference between integer parts of the MVs of the four 4×4 sub-blocks does not exceed N pixels, for example, does not exceed one pixel.

[0213] The following two manners may be used to restrict the motion vector to be within a specific bit width:

[0214] Manner 1: An overflow most significant bit of the motion vector is removed:

[00001] $ux = (vx + 2^{bitDepth})\%2^{bitDepth}$ $vx = (ux >= 2^{bitDepth-1})?(ux - 2^{bitDepth}):ux$
$uy = (vy + 2^{bitDepth})\%2^{bitDepth}$ $vy = (uy >= 2^{bitDepth-1})?(uy - 2^{bitDepth}):uy$

[0215] vx represents a horizontal component of the motion vector of the picture block or the sub-block of the picture block. vy represents a vertical component of the motion vector of the picture block or the sub-block of the picture block. ux and uy are intermediate values. bitDepth represents a bit depth.

[0216] For example, a value of vx is −32769, and 32767 is derived according to the foregoing formulas. A value is stored in a computer in a two's complement representation, a two's complement representation of −32769 is 1,0111,1111,1111,1111 (17 bits), and processing performed by the computer for overflowing is discarding a most significant bit. Therefore, a value of vx is 0111,1111,1111,1111, that is, 32767. This value is consistent with the result derived through processing according to the formulas.

[0217] Manner 2: Clipping is performed on the motion vector, as shown in the following formulas:

[00002] $vx = Clip3(-2^{bitDepth-1}, 2^{bitDepth-1} - 1, vx)$ $vy = Clip3(-2^{bitDepth-1}, 2^{bitDepth-1} - 1, vy)$

[0218] vx represents a horizontal component of the motion vector of the picture block or the sub-block of the picture block. vy represents a vertical component of the motion vector of the picture block or the sub-block of the picture block. x, y, and z correspond to three input values of an MV clamping process clip3. Clip3 is defined to indicate clipping a value of z to a range [x, y].

[00003] $Clip3(x, y, z) = \begin{cases} x; & z < x \\ y; & z > y \\ z; & \text{otherwise} \end{cases}$

[0219] FIG. **4** is a schematic structural diagram of a video coding device according to an embodiment. In FIG. **4**, video coding device **400** may be a video encoding device or a video decoding device. In an embodiment, the video coding device **400** may be a video decoder (for example, the decoder **30** in FIG. **1**A) or a video encoder (for example, the encoder **20** in FIG. **1**A). In another embodiment, the video coding device **400** may be one or more components of the decoder **30** in FIG. **1**A or the encoder **20** in FIG. **1**A.

[0220] The video coding device **400** includes: ingress ports **410** and a receiver unit (Rx) **420** that are configured to receive data; a processor, a logic unit, or a central processing unit (CPU) **430** that is configured to process data; a transmitter unit (Tx) **440** and egress ports **450** that are configured to transmit data; and a memory **460** configured to store data. The video coding device **400** may further include an optical-to-electrical component and an electrical-to-optical (EO) component that are coupled to the ingress ports **410**, the receiver unit **420**, the transmitter unit **440**, and the egress ports **450**, for egress or ingress of optical or electrical signals.

[0221] The processor **430** is implemented by using hardware and software. The processor **430** may be implemented as one or more CPU chips, cores (for example, multi-core processors), FPGAs, ASICs, and DSPs. The processor **430** communicates with the ingress ports **410**, the receiver unit **420**, the transmitter unit **440**, the egress ports **450**, and the memory **460**. The processor **430** includes a coding module **470** (for example, an encoding module **470** or a decoding module **470**). The encoding/decoding module **470** implements the embodiments disclosed in this specification, to implement the inter prediction method provided in the embodiments of the present invention. For

example, the encoding/decoding module **470** implements, processes, or provides various coding operations. Therefore, inclusion of the encoding/decoding module **470** provides a substantial improvement to functions of the video coding device **400** and affects a transform of the video coding device **400** to a different state. Alternatively, the encoding/decoding module **470** is implemented as instructions stored in the memory **460** and executed by the processor **430**.

[0222] The memory **460** includes one or more disks, tape drives, and solid state drives and may be used as an overflow data storage device, to store programs when such programs are selectively executed, and to store instructions and data that are read during program execution. The memory **460** may be volatile and/or nonvolatile, and may be a read-only memory (ROM), a random access memory (RAM), a ternary content-addressable memory (TCAM), and/or a static random access memory (SRAM).

[0223] FIG. **5** is simplified block diagram of an apparatus according to an embodiment. In FIG. **5**, the apparatus can be used as either or both of the source device **12** and the destination device **14** in FIG. **1**A according to an embodiment. The apparatus can implement the technologies of this application. In other words, FIG. **5** is a schematic block diagram of an embodiment of a coding device (e.g., an encoding device or a decoding device)) according to an embodiment. The coding device may include a processor **510**, a memory **530**, and a bus system **550**. The processor and the memory are connected through the bus system. The memory is configured to store instructions. The processor is configured to execute the instructions stored in the memory. The memory of the coding device stores program code. The processor can invoke the program code stored in the memory, to perform the video encoding or decoding method described in this application, and in particular, various new inter prediction methods. To avoid repetition, details are not described herein again.

[0224] In this embodiment, the processor **510** may be a central processing unit (CPU), or the processor **510** may be another general purpose processor, a digital signal processor (DSP), an application-specific integrated circuit (ASIC), a field-programmable gate array (FPGA) or another programmable logic device, a discrete gate or transistor logic device, a discrete hardware component, or the like. The general-purpose processor may be a microprocessor, or may be any conventional processor or the like.

[0225] The memory **530** may include a read-only memory (ROM) device or a random access memory (RAM) device. Any other suitable type of storage device may alternatively be used as the memory **530**. The memory **530** may include code and data **531** accessed by the processor **510** by using the bus **550**. The memory **530** may further include an operating system **533** and an application program **535**. The application program **535** includes at least one program that allows the processor **510** to perform the video encoding or decoding method (in particular, the inter prediction method described in this application) described in this application. For example, the application program **535** may include applications **1** to N, and further includes a video coding application (e.g., a video encoding or decoding application) that performs the video encoding or decoding method described in this application.

[0226] The bus system **550** may not only include a data bus, but also include a power bus, a control bus, a status signal bus, and the like. However, for clear description, various types of buses in the figure are marked as the bus system **550**.

[0227] In an embodiment, the coding device **500** may further include one or more output devices, for example, a display **570**. In an embodiment, the display **570** may be a touch sensitive display that combines a display and a touch sensitive unit that is operable to sense a touch input. The display **570** may be connected to the processor **510** through the bus **550**.

[0228] The following describes in detail the solutions in the embodiments of this application.

[0229] Inter prediction in the video encoding method or the video decoding method performed by the inter prediction unit **244**, the inter prediction unit **344**, the encoder **20**, the decoder **30**, the video coding device **400**, or the coding device **500** includes determining of motion information. In an embodiment, the motion information may be determined by a motion estimation unit, and the

motion information may include at least one type of reference picture information and motion vector information. The reference picture information may include at least one of the following: unidirectional/bidirectional prediction information (bidirectional prediction means that two reference blocks are required to determine a prediction block of a current picture block, and in bidirectional prediction, two groups of motion information are required to determine two reference blocks), information about a reference picture list, a reference picture index corresponding to the reference picture list. The motion vector information may include a motion vector, and the motion vector refers to location offsets in a horizontal direction and a vertical direction. The motion vector information may further include a motion vector difference (MVD). Determining of the motion information and determining of the prediction block may include one of the following modes:

[0230] In an AMVP mode, an encoder side first constructs a candidate motion vector list based on a motion vector of a spatially or temporally neighboring block (for example, but not limiting to an encoded block) of a current block, and then determines a motion vector of a motion vector predictor (MVP) of the current block from the candidate motion vector list by calculating bit rate distortion. The encoder side transfers, to a decoder side, an index value of the selected motion vector predictor in the candidate motion vector list and an index value of a reference frame (the reference frame may also be referred to as a reference picture). Further, the encoder side performs motion search in an MVP-centered neighboring domain, to obtain a better motion vector (also referred to as a motion vector target value) of the current block. The encoder side transfers a difference (e.g., motion vector difference) between the MVP and the optimal motion vector to the decoder side. The decoder side first constructs a candidate motion vector list by using a motion vector of a spatially or temporally neighboring block (for example, but not limited to a decoded block) of the current block; obtains a motion vector predictor based on the obtained index value of the motion vector predictor in the candidate motion vector list and the candidate motion vector list; obtains, based on the obtained difference between the MVP and the better motion vector, a better motion vector; and obtains, based on the better motion vector and a reference frame that is obtained based on an index value of the reference frame, a prediction block of the current block. It should be noted that, when there is one candidate in the candidate motion vector list, an index value of a selected motion vector predictor in the candidate motion vector list may not be transmitted.

[0231] The encoder side may be the source device **12**, the video coding system **40**, the encoder **20**, the video coding device **400**, or the coding device **500**. The decoder side may be the destination device **14**, the video coding system **40**, the decoder **30**, the video coding device **400**, or the coding device **500**. The index value of the motion vector predictor in the candidate motion vector list and the index value of the reference frame (the reference frame may also be referred to as a reference picture) may be syntax elements used for transmission in the foregoing descriptions.

[0232] In a merge mode, an encoder side first constructs a candidate motion information list based on motion information of a spatially or temporally neighboring block (for example, but not limited to an encoded block) of a current block; determines, as motion information of the current block, optimal motion information from the candidate motion information list by calculating rate distortion; and transfers, to a decoder side, an index value (denoted as a merge index, which is also applied to the following descriptions) of a location of the optimal motion information (which is also referred to as motion information of the current block or prediction information of motion information of the current block) the candidate motion information list. Spatial and temporal candidate motion information of the current block is shown in FIG. **6**. The spatial candidate motion information is motion information of five spatially neighboring blocks (A0, A1, B0, B1, and B2). If a neighboring block is unavailable or an intra coding mode is used, the spatial candidate motion information is not added into the candidate motion information list. The temporal candidate motion information of the current block is obtained by scaling an MV of a collocated block in a reference frame based on the reference frame and a picture order count (POC) of a current frame. Whether a block at a location TO in the reference frame is available is first determined. If the block is not

available, a block at a location Tl is selected. The decoder side first constructs a candidate motion information list based on motion information of a spatially or temporally neighboring block (for example, but not limited to a decoded block) of the current block, where the motion information in the motion information list includes a motion vector and an index value of a reference frame. The decoder side then obtains optimal motion information based on the candidate motion information list and an index value of a location of the optimal motion information in the candidate motion information list, and obtains a prediction block of the current block based on the optimal motion information. It should be noted that, when there is one candidate in the candidate motion information list, the index value of the location of the optimal motion information in the candidate motion information list may not be transmitted.

[0233] It should be noted that, the candidate motion information list in the embodiments of the present invention is constructed based on the motion information of the spatially or temporally neighboring block of the current block, but this is not limited. The candidate motion information list may be constructed or refined by using at least one of the following: the motion information of the spatially neighboring block, the motion information of the temporally neighboring block, a pairwise average merging candidate (pairwise average merging candidates), a history-based merging candidate (history-based merging candidates), and a zero motion vector candidate (zero motion vector merging candidates). For detailed descriptions of the construction process, refer to JVET-L1001-v6. The embodiments of the application are not limited thereto.

[0234] In a merge mode with motion vector difference (MMVD), there is additionally MVD transmission based on the merge mode. Specifically, the encoder side further performs motion search in a neighboring domain centering at the optimal motion information in the candidate motion information list, to obtain a better motion vector (which may also be referred to as a motion vector target value) of the current block; and the encoder side transmits, to the decoder side, a difference (e.g., motion vector difference) between the better motion vector and a motion vector included in the optimal motion information in the candidate motion information list. After obtaining the optimal motion information, the decoder side further obtains a better motion vector based on the difference and the motion vector included in the optimal motion information in the candidate motion information list, and then obtains a prediction block of the current block based on the better motion vector and the reference frame indicated by the index value of the reference frame included in the optimal motion information in the candidate motion information list.

[0235] It should be noted that the MMVD mode is a mode in which there is additionally MVD transmission based on a skip mode. In comparison with the merge mode, the skip mode can be understood as that residual information between the prediction block of the current block and an original block of the current block. Similarly, based on the skip mode, the encoder side further performs motion search in a neighboring domain centering at the optimal motion information in the candidate motion information list, to obtain a better motion vector of the current block; and the encoder side transmits, to the decoder side, a difference (e.g., motion vector difference) between the better motion vector and a motion vector included in the optimal motion information in the candidate motion information list. After obtaining the optimal motion information, the decoder side further obtains a better motion vector based on the difference and the motion vector included in the optimal motion information in the candidate motion information list, and then obtains a prediction block of the current block based on the better motion vector and the reference frame indicated by the index value of the reference frame included in the optimal motion information in the candidate motion information list. For descriptions of the skip mode, refer to an existing H.266 draft (working draft, for example, JVET-L1001-v6). Details are not described herein again.

[0236] In the MMVD mode, merge candidates in the VVC are used. One or more of the merge candidates are selected, and then MV extension expression is performed based on the selected one or more candidates. The MV extension expression is implemented by using a simplified identification method. The identification method includes identifying a start point of an MV, a

motion step, and a motion direction. By using an existing merge candidate list, the selected candidate may be a MRG_TYPE_DEFAULT_N mode. An initial location of the MV is determined based on the selected candidate. A base candidate IDX (Table 1) indicates a specific candidate that is selected as a best candidate in the candidate list.

TABLE-US-00001 TABLE 1 Base candidate IDX

Base candidate IDX	0	1	2	3
N.sup.th MVP	1st MVP	2nd MVP	3rd MVP	4th MVP

[0237] The base candidate IDX represents an index value of a location of optimal motion information in the candidate motion information list. The Nth MVP indicates that an Nth item in the candidate motion information list is an MVP.

[0238] When an MVD is transmitted, an offset value such as x and y may be transmitted; a length of the MVD and a direction of the MVD may be transmitted; or an index value (indicating a ¼ pixel distance to a 32 pixel distance) of a length of the MVD and an index value of a direction (up, down, left, or right) of the MVD may be transmitted.

[0239] The index value of the length of the MVD is used to indicate the length of the MVD. A correspondence between the index value (Distance IDX) of the length of the MVD and the length (Pixel distance) of the MVD may be preset, and the correspondence may be shown in Table 2.

TABLE-US-00002 TABLE 2 Distance IDX

Distance IDX	0	1	2	3	4	5	6	7
Pixel distance	1/4-pel	1/2-pel	1-pel	2-pel	4-pel	8-pel	16-pel	32-pel

[0240] The index value of the direction of the MVD is used to indicate the direction of the MVD. A correspondence between the index value (Direction IDX) of the direction of the MVD and the direction (x-axis or y-axis) of the MVD may be preset, and the correspondence may be shown in Table 3.

TABLE-US-00003 TABLE 3 Direction IDX

Direction IDX	0	1	2	3
x-axis	+	−	N/A	N/A
y-axis	N/A	N/A	+	−

[0241] In Table 3, if a value of y-axis is N/A, it may indicate that the direction of the MVD is unrelated to a direction in the y axis; and if a value of x-axis is N/A, it may indicate that the direction of the MVD is unrelated to a direction in the x axis.

[0242] In a decoding process, an MMVD flag (mmvd_flag, used to indicate whether the current block is decoded in the MMVD mode) is parsed after a skip flag (cu_skip_flag, used to indicate whether the current block is decoded in the skip mode) or a merge flag (merge_flag, used to indicate whether the current block is decoded in the merge mode). If the skip flag or the merge flag is true, a value of the MMVD flag needs to be parsed. If the MMVD flag is true, the other flag value corresponding to the MMVD need to be encoded or decoded.

[0243] Further, in a bidirectional inter prediction (or referred to as bidirectional prediction) scenario, a decoder side or an encoder side may decode or encode MVD information of only one direction, and MVD information of the other direction may be obtained based on the MVD information of the one direction. A specific process may be as follows:

[0244] Whether a reference frame corresponding to an MVD of one direction and a reference frame corresponding to the MVD in the other direction are in a same direction or in opposite directions may be specifically determined based on a POC value of a frame in which the current block is located and POC values of the reference frames in the two directions. For example, if a plus or minus sign of a first difference obtained by subtracting a POC value of a reference frame in one direction from a POC value of a frame in which a current block is located is the same as a plus or minus sign of a second difference obtained by subtracting a POC value of a reference frame in the other direction from the POC value of the frame in which the current block is located, the reference frame corresponding to the MVD in one direction and the reference frame corresponding to the MVD in the other direction are in a same direction. Otherwise, if a plus or minus sign of a first difference obtained by subtracting a POC value of a reference frame in one direction from a POC value of a frame in which a current block is located is opposite to a plus or minus sign of a second difference obtained by subtracting a POC value of a reference frame in the other direction from the POC value of the frame in which the current block is located, the reference frame corresponding to

the MVD in one direction and the reference frame corresponding to the MVD in the other direction are in different directions.

[0245] It should be noted that a direction of a reference frame may be the direction of the reference frame relative to a direction of a current frame (the frame in which the current block is located), or a direction of a current frame relative to the direction of the reference frame. In an embodiment, whether the reference frame corresponding to the MVD of one direction and the reference frame corresponding to the MVD in the other direction are in a same direction or in opposite directions may be determined based on a difference obtained by subtracting the POC value of the current frame from the POC value of the current frame, or may be determined based on a difference obtained by subtracting the POC value of the current frame from the POC value of the reference frame.

[0246] When the reference frame corresponding to the MVD in one direction and the reference frame corresponding to the MVD in the other direction are in a same direction, a sign of the MVD in the other direction is the same as a sign of the MVD in the one direction. For example, if the MVD in the one direction is (x, y), the MVD in the other direction is (x, y). In an embodiment, the MVD in the one direction may be obtained based on an index value of a length of the MVD in the one direction and an index value of a direction of the MVD in the one direction.

[0247] Alternatively, when the reference frame corresponding to the MVD in one direction and the reference frame corresponding to the MVD in the other direction are in different directions, a sign of the MVD in the other direction is opposite to a sign of the MVD in the one direction. For example, if the MVD in the one direction is (x, y), the MVD in the other direction is (−x,−y).

[0248] The MVD in the other direction is scaled based on the MVD in the one direction, a first POC difference, and a second POC difference, to obtain a better MVD in the other direction. The first POC difference is the difference between the POC value of the frame in which the current block is located and the POC value of the reference frame corresponding to the MVD in the one direction, and the second POC difference is the difference between the POC value of the frame in which the current block is located and the POC value of the reference frame corresponding to the MVD in the other direction. For specific descriptions of a scaling method, refer to the existing H.266 draft (working draft, for example, JVET-L1001-v6). Details are not described herein.

[0249] The foregoing MVD solution can be further optimized. For example, an index value with a relatively large value of pixel distance is seldom used, and the value of the direction of the MVD can indicate only four directions; and the step (3) of scaling the MVD in the other direction based on the MVD in the one direction, a first POC difference, and a second POC difference, to obtain a better MVD in the other direction is complex in the specific process. Therefore, the embodiments of the present invention provide a series of improved solutions.

[0250] FIG. **7** is a schematic flowchart of an inter prediction method according to an embodiment. The method may be performed by the destination device **14**, the video coding system **40**, the decoder **30**, the video coding device **400**, or the coding device **500**. The method may be performed by the video decoder **30**, or performed by the entropy decoding unit **304** and the prediction processing unit **360** (or, for example, the inter prediction unit **344** in the prediction processing unit **360**). The method may include the following operations.

[0251] S**701**: Obtain a motion vector predictor of a current picture block.

[0252] In an embodiment, the obtaining a motion vector predictor of a current picture block may include: constructing a candidate motion information list of the current picture block, where the candidate motion information list includes L motion vectors, and L is 1, 3, 4, or 5; obtaining an index value of prediction information of motion information of the current picture block in the candidate motion information list, where the prediction information of motion information of the current picture block includes the motion vector predictor; and obtaining the motion vector predictor based on the index value of the motion information of the current picture block in the candidate motion information list and the candidate motion information list. The candidate motion

information list of the current picture block may be a merge candidate motion information list. Correspondingly, the inter prediction method provided in this embodiment of the present invention may be applied to an MMVD mode.

[0253] The index value in the candidate motion information list may be an index value in a variable-length coding form. For example, when L is 3, 1 may be used to indicate a first item in the candidate motion information list, 01 may be used to indicate a second item in the candidate motion information list, and 00 may be used to indicate a third item in the candidate motion information list. Alternatively, when L is 4, 1 may be used to indicate a first item in the candidate motion information list, 01 may be used to indicate a second item in the candidate motion information list, 001 may be used to indicate a third item in the candidate motion information list, and 000 may be used to indicate a fourth item in the candidate motion information list. Others may be deduced by analogy.

[0254] For the manner of obtaining the motion vector predictor by constructing the candidate motion information list of the current picture block, refer to the foregoing descriptions of the modes such as the AMVP mode, the merge mode, the MMVD mode, or the skip mode. Details are not described herein again.

[0255] S**702**: Obtain an index value of a length of a motion vector difference of the current picture block, where the motion vector difference of the current picture block is used to indicate a difference between the motion vector predictor and a motion vector target value of the current picture block.

[0256] The index value of the length of the motion vector difference may be used to indicate one piece of candidate length information in a set of candidate length information.

[0257] The set of candidate length information may include at least two pieces of candidate length information, or may include one piece of candidate length information.

[0258] One piece of candidate length information may be used to indicate a length of one motion vector difference, and the candidate length information may be a length value, or may be information used to derive a length value. The length may be represented by using a Euclidean distance, or the length may include an absolute value of a component x and an absolute value of a component y of the motion vector difference. Certainly, the length may alternatively be represented by using another norm. This is not limited herein.

[0259] It should be noted that, because a motion vector is a two-dimensional array, the motion vector difference may be represented by using a two-dimensional array. If a motion vector is a three-dimensional array, the motion vector difference may be represented by a three-dimensional array.

[0260] S**703**: Determine target length information from the set of candidate length information based on the index value of the length, where the set of candidate length information includes candidate length information of only N motion vector differences, and N is a positive integer greater than 1 and less than 8.

[0261] N may be 4. In some embodiments, index values of different lengths may indicate different lengths. For example, the candidate length information of the N motion vector differences includes at least one of the following: When the index value of the length is a first preset value, a length indicated by the target length information is one quarter of a pixel length; when the index value of the length is a second preset value, a length indicated by the target length information is a half of a pixel length; when the index value of the length is a third preset value, a length indicated by the target length information is one pixel length; or when the index value of the length is a fourth preset value, a length indicated by the target length information is two pixel lengths. It should be noted that the first preset value to the fourth preset value may not be sequential, and they are independent of each other and are merely used to distinguish between different preset values. Certainly, the first preset value to the fourth preset value may alternatively be sequential, or have a sequence attribute. In some embodiments, a correspondence between an index value of a length and

a length of an MVD may be shown in Table 4:

TABLE-US-00004 TABLE 4 Index value of a length of an MVD 0 1 2 3 Length of an MVD 1/4-pel 1/2-pel 1-pel 2-pel MmvdDistance 1 2 3 4

[0262] "pel" has a same meaning as "pixel". For example, ¼-pel indicates a length of one quarter of a pixel. For similar descriptions, refer to the descriptions in Table 2.

[0263] MmvdDistance represents a value for obtaining a length of an MVD. For example, the value of the length of the MVD can be obtained by shifting MmvdDistance rightward by two bits.

[0264] S**704**: Obtain the motion vector difference of the current picture block based on the target length information.

[0265] The method may further include: obtaining an index value of a direction of the motion vector difference of the current picture block; and determining target direction information from candidate direction information of M motion vector differences based on the index value of the direction, where M is a positive integer greater than 1.

[0266] The candidate direction information of the M motion vector differences may be M pieces of candidate direction information.

[0267] The index value of the direction of the motion vector difference may be used to indicate one piece of candidate direction information in the candidate direction information of the M motion vector differences.

[0268] One piece of candidate direction information may be used to indicate a direction of one motion vector difference. In an embodiment, the candidate direction information may be a sign indicating a plus or minus sign, and the sign may be a sign of a component x of a motion vector difference, or a sign of a component y of a motion vector difference, or a sign of a component x and a sign of a component y of a motion vector. Alternatively, the candidate direction information may be information used to derive the sign.

[0269] In an embodiment, the obtaining the motion vector difference of the current picture block based on the target length information may include: determining the motion vector difference of the current picture block based on the target direction information and the target length information.

[0270] S**705**: Determine the motion vector target value of the current picture block based on the motion vector difference of the current picture block and the motion vector predictor of the current picture block.

[0271] In some embodiments, a sum of the motion vector difference of the current picture block and the motion vector predictor of the current picture block may be used as the motion vector target value of the current picture block.

[0272] S**706**: Obtain a prediction block of the current picture block based on the motion vector target value of the current picture block.

[0273] For more content of inter prediction, refer to the foregoing descriptions. Details are not described herein again.

[0274] FIG. **8** is a schematic flowchart of an inter prediction method according to an embodiment. The method may be performed by the source device **12**, the video coding system **40**, the encoder **20**, the video coding device **400**, or the coding device **500**. The method may be performed by the prediction processing unit **260** (or, for example, the inter prediction unit **244** in the prediction processing unit **260**) in the encoder **30**. The method may include the following operations.

[0275] S**801**: Obtain a motion vector predictor of a current picture block.

[0276] For the process, refer to the foregoing descriptions of the AMVP mode, the merge mode, the MMVD mode, or the skip mode. Details are not described herein again.

[0277] S**802**: Perform motion search in a region of a location indicated by the motion vector predictor of the current picture block, to obtain a motion vector target value of the current picture block.

[0278] S**803**: Obtain an index value of a length of a motion vector difference of the current picture block based on the motion vector target value of the current picture block and the motion vector

predictor of the current picture block, where the motion vector difference of the current picture block is used to indicate a difference between the motion vector predictor and the motion vector target value of the current picture block, the index value of the length of the motion vector difference of the current picture block is used to indicate one piece of candidate length information in a set of preset candidate length information, the set of candidate length information includes candidate length information of only N motion vector differences, and N is a positive integer greater than 1 and less than 8.

[0279] The obtaining an index value of a length of a motion vector difference of the current picture block based on the motion vector target value of the current picture block and the motion vector predictor of the current picture block may include: obtaining the motion vector difference of the current picture block based on the motion vector target value of the current picture block and the motion vector predictor of the current picture block; and determining the index value of the length of the motion vector difference of the current picture block and an index value of a direction of the motion vector difference of the current picture block based on the motion vector difference of the current picture block.

[0280] N may be 4.

[0281] FIG. **8** describes an encoder side method corresponding to the decoder side method described in FIG. **7**. For related descriptions, refer to FIG. **7** or the foregoing related descriptions. Details are not described herein again.

[0282] FIG. **9** is a schematic flowchart of an inter prediction method according to an embodiment. The method may be performed by the destination device **14**, the video coding system **40**, the decoder **30**, the video coding device **400**, or the coding device **500**. The method may be performed by the video decoder **30**, or performed by the entropy decoding unit **304** and the prediction processing unit **360** (or, for example, the inter prediction unit **344** in the prediction processing unit **360**). The method may include the following operations.

[0283] S**901**: Obtain a motion vector predictor of a current picture block.

[0284] In an embodiment, the obtaining a motion vector predictor of a current picture block may include: constructing a candidate motion information list of the current picture block, where the candidate motion information list includes L motion vectors, and L is 1, 3, 4, or 5; obtaining an index value of prediction information of motion information of the current picture block in the candidate motion information list, where the prediction information of motion information of the current picture block includes the motion vector predictor; and obtaining the motion vector predictor based on the index value of the motion information of the current picture block in the candidate motion information list and the candidate motion information list. The candidate motion information list of the current picture block may be a merge candidate motion information list. Correspondingly, the inter prediction method provided in this embodiment of the present invention may be applied to an MMVD mode.

[0285] For the manner of obtaining the motion vector predictor by constructing the candidate motion information list of the current picture block, refer to the foregoing descriptions of the modes such as the AMVP mode, the merge mode, the MMVD mode, or the skip mode. Details are not described herein again.

[0286] S**902**: Obtain an index value of a direction of a motion vector difference of the current picture block, where the motion vector difference of the current picture block is used to indicate a difference between the motion vector predictor and a motion vector target value of the current picture block.

[0287] The index value of the direction of the motion vector difference may be used to indicate one piece of candidate direction information in a set of candidate direction information.

[0288] The set of candidate direction information may include at least two pieces of candidate direction information, or may include one piece of candidate direction information.

[0289] One piece of candidate direction information may be used to indicate a direction of one

motion vector difference. In an embodiment, the candidate direction information may be a sign indicating a plus or minus sign, and the sign may be a sign of a component x of a motion vector difference, or a sign of a component y of a motion vector difference, or a sign of a component x and a sign of a component y of a motion vector. Alternatively, the candidate direction information may be information used to derive the sign.

[0290] It should be noted that, because a motion vector is a two-dimensional array, the motion vector difference may be represented by using a two-dimensional array. If a motion vector is a three-dimensional array, the motion vector difference may be represented by a three-dimensional array.

[0291] S**903**: Determine target direction information from a set of candidate direction information based on the index value of the direction, where the set of candidate direction information includes candidate direction information of M motion vector differences, and M is a positive integer greater than 4.

[0292] M may be 8. In some embodiments, index values of different directions may indicate different directions. For example, the candidate direction information of the M motion vector differences may include at least one of the following: When the index value of the direction is a first preset value, a direction indicated by the target direction information is exactly right; when the index value of the direction is a second preset value, a direction indicated by the target direction information is exactly left; when the index value of the direction is a third preset value, a direction indicated by the target direction information is exactly down; when the index value of the direction is a fourth preset value, a direction indicated by the target direction information is exactly up; when the index value of the direction is a fifth preset value, a direction indicated by the target direction information is lower right; when the index value of the direction is a sixth preset value, a direction indicated by the target direction information is upper right; when the index value of the direction is a seventh preset value, a direction indicated by the target direction information is lower left; or when the index value of the direction is an eighth preset value, a direction indicated by the target direction information is upper left. It should be noted that the first preset value to the eighth preset value may not be sequential, and they are independent of each other and are merely used to distinguish between different preset values. Certainly, the first preset value to the eighth preset value may alternatively be sequential, or have a sequence attribute.

[0293] In some embodiments, a correspondence between an index value of a direction and a direction of an MVD may be shown in Table 5, Table 6, or Table 7.

TABLE-US-00005 TABLE 5 Index value of a direction of an MVD 000 001 010 011 100 101 110 111 x-axis + − N/A N/A + + − − y-axis N/A N/A + − + − + −

TABLE-US-00006 TABLE 6 Index value of a direction of an MVD 0 1 2 3 4 5 6 7 x-axis +1 −1 0 0 +1 +1 −1 −1 y-axis 0 0 +1 −1 +1 −1 +1 −1

TABLE-US-00007 TABLE 7 Index value of a direction of an MVD 0 1 2 3 4 5 6 7 x-axis +1 −1 0 0 +0.5 +0.5 −0.5 −0.5 y-axis 0 0 +1 −1 +0.5 −0.5 +0.5 −0.5

[0294] In Table 5, if a value of x-axis is "+", it may indicate that the direction of the MVD is a positive direction of the x-axis. If a value of y-axis is "+", it may indicate that the direction of the MVD is a positive direction of the y-axis. If a value of x-axis is "−", it may indicate that the direction of the MVD is a negative direction of the x-axis. If a value of y-axis is "−", it may indicate that the direction of the MVD is a negative direction of the y-axis. If a value of x-axis is N/A, it may indicate that the direction of the MVD is unrelated to a direction in the x-axis. If a value of y-axis is N/A, it may indicate that the direction of the MVD is unrelated to a direction in the y-axis. If a value of x-axis and a value of y-axis are both "+", it may indicate that the direction of the MVD whose projection in the x-axis direction is a positive direction and the direction of the MVD whose projection in the y-axis direction is also a positive direction. If a value of x-axis and a value of y-axis are both "−", it may indicate that the direction of the MVD whose projection in the x-axis direction is a negative direction and the direction of the MVD whose projection in the y-axis

direction is also a negative direction. If a value of x-axis is "+" and a value of y-axis is "−", it may indicate that the direction of the MVD whose projection in the x-axis direction is a positive direction and the direction of the MVD whose projection in the y-axis direction is a negative direction. If a value of x-axis is "−" and a value of y-axis is "+", it may indicate that the direction of the MVD whose projection in the x-axis direction is a negative direction and the direction of the MVD whose projection in the y-axis direction is a positive direction. The positive direction of the x-axis may indicate a leftward direction, and the positive direction of the y-axis may indicate a downward direction.

[0295] In Table 6 or Table 7, the x-axis may represent a sign coefficient of the component x of the MVD, and a product of the sign coefficient of the component x and an absolute value of the component x of the MVD is the component x of the MVD. The y-axis may represent a sign coefficient of the component y of the MVD, and a product of the sign coefficient of the component y and the absolute value of the component y is the component y of the MVD.

[0296] S**904**: Obtain the motion vector difference of the current picture block based on the target direction information.

[0297] The method may further include: obtaining an index value of a length of the motion vector difference of the current picture block; and determining target length information from the candidate length information of the N motion vector differences based on the index value of the length, where N is a positive integer greater than 1.

[0298] The candidate length information of the N motion vector differences may be the set of candidate length information in the embodiment in FIG. **7**, and may be the set of candidate length information provided in Table 4. For descriptions of the length of the motion vector difference, the index value of the length of the motion vector difference, the candidate length information, and the motion vector difference, refer to FIG. **7** or the foregoing descriptions. Details are not described herein again.

[0299] In an embodiment, the obtaining the motion vector difference of the current picture block based on the target direction information may include: determining the motion vector difference of the current picture block based on the target direction information and the target length information.

[0300] S**905**: Determine the motion vector target value of the current picture block based on the motion vector difference of the current picture block and the motion vector predictor of the current picture block.

[0301] In some embodiments, a sum of the motion vector difference of the current picture block and the motion vector predictor of the current picture block may be used as the motion vector target value of the current picture block.

[0302] S**906**: Obtain a prediction block of the current picture block based on the motion vector target value of the current picture block.

[0303] For more content of inter prediction, refer to the foregoing descriptions. Details are not described herein again.

[0304] For content of the embodiment in FIG. **9** similar to content in FIG. **7** and the foregoing descriptions, refer to FIG. **7** and the foregoing descriptions. Details are not described herein again.

[0305] FIG. **10** is a schematic flowchart of an inter prediction method according to an embodiment. The method may be performed by the source device **12**, the video coding system **40**, the encoder **20**, the video coding device **400**, or the coding device **500**. The method may be performed by the prediction processing unit **260** (or, for example, the inter prediction unit **244** in the prediction processing unit **260**) in the encoder **30**. The method may include the following operations.

[0306] S**1001**: Obtain a motion vector predictor of a current picture block.

[0307] For the process, refer to the foregoing descriptions of the AMVP mode, the merge mode, the MMVD mode, or the skip mode. Details are not described herein again.

[0308] S**1002**: Perform motion search in a region of a location indicated by the motion vector

predictor of the current picture block, to obtain a motion vector target value of the current picture block.

[0309] S**1003**: Obtain an index value of a direction of a motion vector difference of the current picture block based on the motion vector target value of the current picture block and the motion vector predictor of the current picture block, where the motion vector difference of the current picture block is used to indicate a difference between the motion vector predictor and the motion vector target value of the current picture block, the index value of the direction of the motion vector difference of the current picture block is used to indicate one piece of candidate direction information in a set of preset candidate direction information, the set of candidate direction information includes candidate length information of M motion vector differences, and M is a positive integer greater than 4.

[0310] The obtaining an index value of a direction of a motion vector difference of the current picture block based on the motion vector target value of the current picture block and the motion vector predictor of the current picture block may include: obtaining the motion vector difference of the current picture block based on the motion vector target value of the current picture block and the motion vector predictor of the current picture block; and determining an index value of a length of the motion vector difference of the current picture block and the index value of the direction of the motion vector difference of the current picture block based on the motion vector difference of the current picture block.

[0311] M may be 8.

[0312] FIG. **10** describes an encoder side method corresponding to the decoder side method described in FIG. **9**. For related descriptions, refer to FIG. **9** or the foregoing related descriptions. Details are not described herein again.

[0313] FIG. **11** is a schematic flowchart of an inter prediction method according to an embodiment. The method may be performed by the destination device **14**, the video coding system **40**, the decoder **30**, the video coding device **400**, or the coding device **500**. The method may be performed by the video decoder **30**, or performed by the entropy decoding unit **304** and the prediction processing unit **360** (or, for example, the inter prediction unit **344** in the prediction processing unit **360**). The method may include the following operations.

[0314] S**1101**: Obtain a first motion vector predictor of a current picture block and a second motion vector predictor of the current picture block, where the first motion vector predictor corresponds to a first reference frame, and the second motion vector predictor corresponds to a second reference frame.

[0315] S**1102**: Obtain a first motion vector difference of the current picture block, where the first motion vector difference of the current picture block is used to indicate a difference between the first motion vector predictor and a first motion vector target value of the current picture block, and the first motion vector target value and the first motion vector predictor correspond to a same reference frame.

[0316] S**1103**: Determine a second motion vector difference of the current picture block based on the first motion vector difference, where the second motion vector difference of the current picture block is used to indicate a difference between the second motion vector predictor and a second motion vector target value of the current picture block, the second motion vector target value and the second motion vector predictor correspond to a same reference frame, and when a direction of the first reference frame relative to a current frame in which the current picture block is located is the same as a direction of the second reference frame relative to the current frame, the second motion vector difference is the first motion vector difference, or when the direction of the first reference frame relative to the current frame in which the current picture block is located is opposite to the direction of the second reference frame relative to the current frame, a plus or minus sign of the second motion vector difference is opposite to a plus or minus sign of the first motion vector difference, and an absolute value of the second motion vector difference is the same as an

absolute value of the first motion vector difference.

[0317] S**1104**: Determine the first motion vector target value of the current picture block based on the first motion vector difference and the first motion vector predictor.

[0318] The first motion vector target value may be a sum of the first motion vector difference and the first motion vector predictor.

[0319] S**1105**: Determine the second motion vector target value of the current picture block based on the second motion vector difference and the second motion vector predictor.

[0320] The second motion vector target value may be a sum of the second motion vector difference and the second motion vector predictor.

[0321] S**1106**: Obtain a prediction block of the current picture block based on the first motion vector target value and the second motion vector target value.

[0322] For content of the embodiment in FIG. **11** similar to content in the foregoing descriptions, refer to the foregoing descriptions. Details are not described herein again.

[0323] Based on a same inventive concept as the foregoing method, as shown in FIG. **12**, an embodiment further provides an inter prediction apparatus **1200**. The inter prediction apparatus **1200** may be the destination device **14**, the video coding system **40**, the decoder **30**, the video coding device **400**, or the coding device **500**; or may be a component of the destination device **14**, the video coding system **40**, the decoder **30**, the video coding device **400**, or the coding device **500**. Alternatively, the inter prediction apparatus **1200** may include the entropy decoding unit **304** and the prediction processing unit **360** (or for example, the inter prediction unit **344** in the prediction processing unit **360**). The inter prediction apparatus **1200** includes an obtaining unit **1201** and a prediction unit **1202**. The obtaining unit **1201** and the prediction unit **1202** may be implemented by using software. For example, the obtaining unit **1201** and the prediction unit **1202** may be software modules, or the obtaining unit **1201** and the prediction unit **1202** are a processor and a memory that execute instructions. The obtaining unit **1201** and the prediction unit **1202** may alternatively be implemented by using hardware. For example, the obtaining unit **1201** and the prediction unit **1202** may be modules in a chip.

[0324] The prediction unit **1202** may be configured to obtain a motion vector predictor of a current picture block.

[0325] The obtaining unit **1201** may be configured to obtain an index value of a length of a motion vector difference of the current picture block, where the motion vector difference of the current picture block is used to indicate a difference between the motion vector predictor and a motion vector target value of the current picture block.

[0326] In some embodiments, the obtaining unit **1201** may include the entropy decoding unit **304**, configured to obtain the index value of the length of the motion vector difference of the current picture block, or obtain an index value of a direction of the motion vector difference of the current picture block. The prediction unit **1202** may include the prediction unit **360**, and may include the inter prediction unit **344**.

[0327] The prediction unit **1202** may be further configured to: determine target length information from a set of candidate length information based on the index value of the length, where the set of candidate length information includes candidate length information of only N motion vector differences, and N is a positive integer greater than 1 and less than 8; obtain the motion vector difference of the current picture block based on the target length information; determine the motion vector target value of the current picture block based on the motion vector difference of the current picture block and the motion vector predictor of the current picture block; and obtain a prediction block of the current picture block based on the motion vector target value of the current picture block.

[0328] The obtaining unit **1201** may be further configured to obtain the index value of the direction of the motion vector difference of the current picture block. Correspondingly, the prediction unit **1202** may be further configured to determine target direction information from candidate direction

information of M motion vector differences based on the index value of the direction, where M is a positive integer greater than 1. After the target direction information is obtained, the prediction unit **1202** may be configured to determine the motion vector difference of the current picture block based on the target direction information and the target length information.

[0329] N may be, for example, 4. In some embodiments, the candidate length information of the N motion vector differences may include at least one of the following: When the index value of the length is a first preset value, a length indicated by the target length information is one quarter of a pixel length; when the index value of the length is a second preset value, a length indicated by the target length information is a half of a pixel length; when the index value of the length is a third preset value, a length indicated by the target length information is one pixel length; or when the index value of the length is a fourth preset value, a length indicated by the target length information is two pixel lengths.

[0330] The prediction unit **1202** may be configured to: construct a candidate motion information list of the current picture block, where the candidate motion information list may include L motion vectors, and Lis 1, 3, 4, or 5; obtain an index value of prediction information of motion information of the current picture block in the candidate motion information list, where the prediction information of motion information of the current picture block includes the motion vector predictor; and obtain the motion vector predictor based on the index value of the motion information of the current picture block in the candidate motion information list and the candidate motion information list.

[0331] It can be understood that, functions of units of the inter prediction apparatus **1200** in this embodiment may be implemented according to the method in the foregoing inter prediction method embodiment. For a specific implementation process, refer to related descriptions in the foregoing method embodiment. Details are not described herein again.

[0332] Based on a same inventive concept as the foregoing method, as shown in FIG. **13**, an embodiment further provides an inter prediction apparatus **1300**. The inter prediction apparatus **1300** may be the source device **12**, the video coding system **40**, the encoder **20**, the video coding device **400**, or the coding device **500**; or may be a component of the source device **12**, the video coding system **40**, the encoder **20**, the video coding device **400**, or the coding device **500**. Alternatively, the inter prediction apparatus **1300** may include the prediction processing unit **260** (or for example, the inter prediction unit **244** in the prediction processing unit **260**). The inter prediction apparatus **1300** includes an obtaining unit **1301** and a prediction unit **1302**. The obtaining unit **1301** and the prediction unit **1302** may be implemented by using software. For example, the obtaining unit **1301** and the prediction unit **1302** may be software modules, or the obtaining unit **1301** and the prediction unit **1302** are a processor and a memory that execute instructions. The obtaining unit **1301** and the prediction unit **1302** may alternatively be implemented by using hardware. For example, the obtaining unit **1301** and the prediction unit **1302** may be modules in a chip.

[0333] The obtaining unit **1301** may be configured to obtain a motion vector predictor of a current picture block.

[0334] The prediction unit **1302** may be configured to perform motion search in a region of a location indicated by the motion vector predictor of the current picture block, to obtain a motion vector target value of the current picture block.

[0335] In some embodiments, the obtaining unit **1301** and the prediction unit **1302** may be used as an implementation of the prediction processing unit **260**.

[0336] The prediction unit **1302** may be further configured to obtain an index value of a length of a motion vector difference of the current picture block based on the motion vector target value of the current picture block and the motion vector predictor of the current picture block, where the motion vector difference of the current picture block is used to indicate a difference between the motion vector predictor and the motion vector target value of the current picture block, the index value of

the length of the motion vector difference of the current picture block is used to indicate one piece of candidate length information in a set of preset candidate length information, the set of candidate length information includes candidate length information of only N motion vector differences, and N is a positive integer greater than 1 and less than 8.

[0337] The prediction unit **1302** may be configured to: obtain the motion vector difference of the current picture block based on the motion vector target value of the current picture block and the motion vector predictor of the current picture block; and determine the index value of the length of the motion vector difference of the current picture block and an index value of a direction of the motion vector difference of the current picture block based on the motion vector difference of the current picture block.

[0338] N may be, for example, 4.

[0339] It can be understood that, functions of units of the inter prediction apparatus **1300** in this embodiment may be implemented according to the method in the foregoing method embodiment. For a specific implementation process, refer to related descriptions in the foregoing method embodiment. Details are not described herein again.

[0340] Based on a same inventive concept as the foregoing method, as shown in FIG. **14**, an embodiment further provides an inter prediction apparatus **1400**. The inter prediction apparatus **1400** may be the destination device **14**, the video coding system **40**, the decoder **30**, the video coding device **400**, or the coding device **500**; or may be a component of the destination device **14**, the video coding system **40**, the decoder **30**, the video coding device **400**, or the coding device **500**. Alternatively, the inter prediction apparatus **1400** may include the entropy decoding unit **304** and the prediction processing unit **360** (or for example, the inter prediction unit **344** in the prediction processing unit **360**). The inter prediction apparatus **1400** includes an obtaining unit **1401** and a prediction unit **1402**. The obtaining unit **1401** and the prediction unit **1402** may be implemented by using software. For example, the obtaining unit **1401** and the prediction unit **1402** may be software modules, or the obtaining unit **1401** and the prediction unit **1402** are a processor and a memory that execute instructions. The obtaining unit **1401** and the prediction unit **1402** may alternatively be implemented by using hardware. For example, the obtaining unit **1401** and the prediction unit **1402** may be modules in a chip.

[0341] The prediction unit **1402** may be configured to obtain a motion vector predictor of a current picture block.

[0342] The obtaining unit **1401** may be configured to obtain an index value of a direction of a motion vector difference of the current picture block, where the motion vector difference of the current picture block is used to indicate a difference between the motion vector predictor and a motion vector target value of the current picture block.

[0343] In some embodiments, the obtaining unit **1401** may include the entropy decoding unit **304**, configured to obtain an index value of a length of the motion vector difference of the current picture block, or obtain the index value of the direction of the motion vector difference of the current picture block. The prediction unit **1402** may include the prediction unit **360**, and may include the inter prediction unit **344**.

[0344] The prediction unit **1402** may be further configured to: determine target direction information from a set of candidate direction information based on the index value of the direction, where the set of candidate direction information includes candidate direction information of M motion vector differences, and M is a positive integer greater than 4; obtain the motion vector difference of the current picture block based on the target direction information; determine the motion vector target value of the current picture block based on the motion vector difference of the current picture block and the motion vector predictor of the current picture block; and obtain a prediction block of the current picture block based on the motion vector target value of the current picture block.

[0345] The obtaining unit **1401** may be further configured to obtain the index value of the length of

the motion vector difference of the current picture block. Correspondingly, the prediction unit **1402** may be further configured to determine target length information from candidate length information of N motion vector differences based on the index value of the length, where N is a positive integer greater than 1. After the target length information is obtained, the prediction unit **1402** may be configured to determine the motion vector difference of the current picture block based on the target direction information and the target length information.

[0346] M may be, for example, 8. In some embodiments, the candidate direction information of the M motion vector differences may include at least one of the following: When the index value of the direction is a first preset value, a direction indicated by the target direction information is exactly right; when the index value of the direction is a second preset value, a direction indicated by the target direction information is exactly left; when the index value of the direction is a third preset value, a direction indicated by the target direction information is exactly down; when the index value of the direction is a fourth preset value, a direction indicated by the target direction information is exactly up; when the index value of the direction is a fifth preset value, a direction indicated by the target direction information is lower right; when the index value of the direction is a sixth preset value, a direction indicated by the target direction information is upper right; when the index value of the direction is a seventh preset value, a direction indicated by the target direction information is lower left; or when the index value of the direction is an eighth preset value, a direction indicated by the target direction information is upper left.

[0347] The prediction unit **1402** may be configured to: construct a candidate motion information list of the current picture block, where the candidate motion information list may include L motion vectors, and L is 1, 3, 4, or 5; obtain an index value of prediction information of motion information of the current picture block in the candidate motion information list, where the prediction information of motion information of the current picture block includes the motion vector predictor; and obtain the motion vector predictor based on the index value of the motion information of the current picture block in the candidate motion information list and the candidate motion information list.

[0348] It can be understood that, functions of units of the inter prediction apparatus **1400** in this embodiment may be implemented according to the method in the foregoing inter prediction method embodiment. For a specific implementation process, refer to related descriptions in the foregoing method embodiment. Details are not described herein again.

[0349] Based on a same inventive concept as the foregoing method, as shown in FIG. **15**, an embodiment further provides an inter prediction apparatus **1500**. The inter prediction apparatus **1500** may be the source device **12**, the video coding system **40**, the encoder **20**, the video coding device **400**, or the coding device **500**; or may be a component of the source device **12**, the video coding system **40**, the encoder **20**, the video coding device **400**, or the coding device **500**. Alternatively, the inter prediction apparatus **1500** may include the prediction processing unit **260** (or for example, the inter prediction unit **244** in the prediction processing unit **260**). The inter prediction apparatus **1500** includes an obtaining unit **1501** and a prediction unit **1502**. The obtaining unit **1501** and the prediction unit **1502** may be implemented by using software. For example, the obtaining unit **1501** and the prediction unit **1502** may be software modules, or the obtaining unit **1501** and the prediction unit **1502** are a processor and a memory that execute instructions. The obtaining unit **1501** and the prediction unit **1502** may alternatively be implemented by using hardware. For example, the obtaining unit **1501** and the prediction unit **1502** may be modules in a chip.

[0350] The obtaining unit **1501** may be configured to obtain a motion vector predictor of a current picture block.

[0351] The prediction unit **1502** may be configured to perform motion search in a region of a location indicated by the motion vector predictor of the current picture block, to obtain a motion vector target value of the current picture block.

[0352] In some embodiments, the obtaining unit **1501** and the prediction unit **1502** may be used as an implementation of the prediction processing unit **260**.

[0353] The prediction unit **1502** may be further configured to obtain an index value of a direction of a motion vector difference of the current picture block based on the motion vector target value of the current picture block and the motion vector predictor of the current picture block, where the motion vector difference of the current picture block is used to indicate a difference between the motion vector predictor and the motion vector target value of the current picture block, the index value of the direction of the motion vector difference of the current picture block is used to indicate one piece of candidate direction information in a set of preset candidate direction information, the set of candidate direction information includes candidate length information of M motion vector differences, and M is a positive integer greater than 4.

[0354] The prediction unit **1502** may be configured to: obtain the motion vector difference of the current picture block based on the motion vector target value of the current picture block and the motion vector predictor of the current picture block; and determine an index value of a length of the motion vector difference of the current picture block and the index value of the direction of the motion vector difference of the current picture block based on the motion vector difference of the current picture block.

[0355] M may be, for example, 8.

[0356] It can be understood that, functions of units of the inter prediction apparatus **1500** in this embodiment may be implemented according to the method in the foregoing method embodiment. For a specific implementation process, refer to related descriptions in the foregoing method embodiment. Details are not described herein again.

[0357] Based on a same inventive concept as the foregoing method, as shown in FIG. **16**, an embodiment further provides an inter prediction apparatus **1600**. The inter prediction apparatus **1600** may be the destination device **14**, the video coding system **40**, the decoder **30**, the video coding device **400**, or the coding device **500**; or may be a component of the destination device **14**, the video coding system **40**, the decoder **30**, the video coding device **400**, or the coding device **500**. Alternatively, the inter prediction apparatus **1600** may include the entropy decoding unit **304** and the prediction processing unit **360** (or for example, the inter prediction unit **344** in the prediction processing unit **360**). The inter prediction apparatus **1600** includes an obtaining unit **1601** and a prediction unit **1602**. The obtaining unit **1601** and the prediction unit **1602** may be implemented by using software. For example, the obtaining unit **1601** and the prediction unit **1602** may be software modules, or the obtaining unit **1601** and the prediction unit **1602** are a processor and a memory that execute instructions. The obtaining unit **1601** and the prediction unit **1602** may alternatively be implemented by using hardware. For example, the obtaining unit **1601** and the prediction unit **1602** may be modules in a chip.

[0358] The obtaining unit **1601** may be configured to obtain a first motion vector predictor of a current picture block and a second motion vector predictor of the current picture block, where the first motion vector predictor corresponds to a first reference frame, and the second motion vector predictor corresponds to a second reference frame.

[0359] The obtaining unit **1601** may be further configured to obtain a first motion vector difference of the current picture block, where the first motion vector difference of the current picture block is used to indicate a difference between the first motion vector predictor and a first motion vector target value of the current picture block, and the first motion vector target value and the first motion vector predictor correspond to a same reference frame.

[0360] The prediction unit **1602** may be configured to: determine a second motion vector difference of the current picture block based on the first motion vector difference, where the second motion vector difference of the current picture block is used to indicate a difference between the second motion vector predictor and a second motion vector target value of the current picture block, the second motion vector target value and the second motion vector predictor correspond to

a same reference frame, and when a direction of the first reference frame relative to a current frame in which the current picture block is located is the same as a direction of the second reference frame relative to the current frame, the second motion vector difference is the first motion vector difference, or when the direction of the first reference frame relative to the current frame in which the current picture block is located is opposite to the direction of the second reference frame relative to the current frame, a plus or minus sign of the second motion vector difference is opposite to a plus or minus sign of the first motion vector difference, and an absolute value of the second motion vector difference is the same as an absolute value of the first motion vector difference; determine the first motion vector target value of the current picture block based on the first motion vector difference and the first motion vector predictor; determine the second motion vector target value of the current picture block based on the second motion vector difference and the second motion vector predictor; and obtain a prediction block of the current picture block based on the first motion vector target value and the second motion vector target value.

[0361] In some embodiments, the obtaining unit **1601** and the prediction unit **1602** may be used as an implementation of the prediction processing unit **360**.

[0362] It can be understood that, functions of units of the inter prediction apparatus **1600** in this embodiment may be implemented according to the method in the foregoing inter prediction method embodiment. For a specific implementation process, refer to related descriptions in the foregoing method embodiment. Details are not described herein again.

[0363] A person skilled in the art can understand that, the functions described with reference to various illustrative logical blocks, modules, and algorithm operations disclosed and described in this specification can be implemented by hardware, software, firmware, or any combination thereof. If implemented by software, the functions described with reference to the illustrative logical blocks, modules, and operations may be stored in or transmitted over a computer-readable medium as one or more instructions or code and executed by a hardware-based processing unit. The computer-readable medium may include a computer-readable storage medium, which corresponds to a tangible medium such as a data storage medium, or a communications medium including any medium that facilitates transfer of a computer program from one place to another (for example, according to a communication protocol). In this manner, the computer-readable medium may generally correspond to: (1) a non-transitory tangible computer-readable storage medium, or (2) a communications medium such as a signal or a carrier. The data storage medium may be any usable medium that can be accessed by one or more computers or one or more processors to retrieve instructions, code, and/or data structures for implementing the technologies described in this application. A computer program product may include a computer-readable medium.

[0364] By way of example but not limitation, such computer-readable storage media may include a RAM, a ROM, an EEPROM, a CD-ROM or another compact disc storage apparatus, a magnetic disk storage apparatus or another magnetic storage apparatus, a flash memory, or any other medium that can be used to store desired program code in a form of an instruction or a data structure and that are accessible by a computer. In addition, any connection is properly referred to as a computer-readable medium. For example, if instructions are transmitted from a website, a server, or another remote source through a coaxial cable, an optical fiber, a twisted pair, a digital subscriber line (DSL), or wireless technologies such as infrared, radio, and microwave, the coaxial cable, the optical fiber, the twisted pair, the DSL, or the wireless technologies such as infrared, radio, and microwave are included in a definition of the medium. However, it should be understood that the computer-readable storage medium and the data storage medium do not include connections, carriers, signals, or other transitory media, but actually mean non-transitory tangible storage media. Disks and discs used in this specification include a compact disc (CD), a laser disc, an optical disc, a digital versatile disc (DVD), and a Blu-ray disc. The disks usually reproduce data magnetically, whereas the discs reproduce data optically with lasers. Combinations of the foregoing should also be included in the scope of the computer-readable media.

[0365] Instructions may be executed by one or more processors such as one or more digital signal processors (DSP), general-purpose microprocessors, application-specific integrated circuits (ASIC), field programmable logic arrays (FPGA), or other equivalent integrated circuit or discrete logic circuits. Therefore, the term "processor" used in this specification may be any one of the foregoing structures or any other structure suitable for implementing the technologies described in this specification. In addition, in some aspects, the functions described with reference to the illustrative logical blocks, modules, and operations described in this specification may be provided within dedicated hardware and/or software modules configured for encoding and decoding, or may be incorporated into a combined codec. In addition, the technologies may be completely implemented in one or more circuits or logic elements.

[0366] The technologies in this application may be implemented in various apparatuses or devices, including a wireless handset, an integrated circuit (IC), or a set of ICs (for example, a chip set). Various components, modules, or units are described in this application to emphasize functional aspects of the apparatuses configured to perform the disclosed technologies, but are not necessarily implemented by different hardware units. Actually, as described above, various units may be combined into a codec hardware unit in combination with appropriate software and/or firmware, or may be provided by interoperable hardware units (including one or more processors described above).

[0367] In the foregoing embodiments, the descriptions in the embodiments have respective focuses. For a part that is not described in detail in an embodiment, refer to related descriptions in other embodiments.

[0368] The foregoing descriptions are merely embodiments of this application, but are not intended to limit the protection scope of this application. Any variation or replacement readily figured out by a person skilled in the art within the technical scope disclosed in this application shall fall within the protection scope of this application. Therefore, the protection scope of this application shall be subject to the protection scope of the claims.

Claims

1. An encoding method for an encoder, comprising: obtaining a first motion vector predictor of a current picture block and a second motion vector predictor of the current picture block, wherein the first motion vector predictor corresponds to a first reference frame, and the second motion vector predictor corresponds to a second reference frame; obtaining a first motion vector difference of the current picture block that indicates a difference between the first motion vector predictor and a first motion vector target value of the current picture block, wherein the first motion vector target value and the first motion vector predictor correspond to a same reference frame, and the first motion vector difference is used to determine a second motion vector difference of the current picture block that indicates a difference between the second motion vector predictor and a second motion vector target value of the current picture block, the second motion vector target value and the second motion vector predictor correspond to a same reference frame, and when a direction of the first reference frame relative to a current frame in which the current picture block is located is the same as a direction of the second reference frame relative to the current frame, the second motion vector difference is the first motion vector difference, or when the direction of the first reference frame relative to the current frame in which the current picture block is located is opposite to the direction of the second reference frame relative to the current frame, a plus or minus sign of the second motion vector difference is opposite to a plus or minus sign of the first motion vector difference, and an absolute value of the second motion vector difference is same as an absolute value of the first motion vector difference; obtaining an index value of a length of the first motion vector difference and an index value of a direction of the first motion vector difference; and encoding the index value of the length of the first motion vector difference and the index value of

the direction of the first motion vector difference into a bitstream.

2. The encoding method of claim 1, wherein the index value of the length of the first motion vector difference of the current picture block is used to indicate a piece of candidate length information in a set of preset candidate length information.

3. The encoding method of claim 1, wherein the index value of the direction of the first motion vector difference of the current picture block is used to indicate a piece of candidate direction information in a set of preset candidate direction information.

4. A decoding method for a decoder, comprising: obtaining an index value of a length of a first motion vector difference of a current picture block and an index value of a direction of the first motion vector difference from a bitstream; obtaining a first motion vector predictor of the current picture block and a second motion vector predictor of the current picture block, wherein the first motion vector predictor corresponds to a first reference frame, and the second motion vector predictor corresponds to a second reference frame; obtaining the first motion vector difference based on the index value of the length of the first motion vector difference and the index value of the direction of the first motion vector difference, wherein the first motion vector difference of the current picture block indicates a difference between the first motion vector predictor and a first motion vector target value of the current picture block, the first motion vector target value and the first motion vector predictor correspond to a same reference frame; determining a second motion vector difference of the current picture block based on the first motion vector difference, wherein the second motion vector difference of the current picture block indicates a difference between the second motion vector predictor and a second motion vector target value of the current picture block, the second motion vector target value and the second motion vector predictor correspond to a same reference frame, and when a direction of the first reference frame relative to a current frame in which the current picture block is located is the same as a direction of the second reference frame relative to the current frame, the second motion vector difference is the first motion vector difference, or when the direction of the first reference frame relative to the current frame in which the current picture block is located is opposite to the direction of the second reference frame relative to the current frame, a plus or minus sign of the second motion vector difference is opposite to a plus or minus sign of the first motion vector difference, and an absolute value of the second motion vector difference is same as an absolute value of the first motion vector difference; determining the first motion vector target value of the current picture block based on the first motion vector difference and the first motion vector predictor; determining the second motion vector target value of the current picture block based on the second motion vector difference and the second motion vector predictor; and obtaining a prediction block of the current picture block based on the first motion vector target value and the second motion vector target value.

5. The decoding method of claim 4, wherein the index value of the length of the first motion vector difference of the current picture block is used to indicate a piece of candidate length information in a set of preset candidate length information.

6. The decoding method of claim 4, wherein the index value of the direction of the first motion vector difference of the current picture block is used to indicate a piece of candidate direction information in a set of preset candidate direction information.

7. A decoding device, comprising: at least one processor; and a memory coupled to the at least one processor for storing instructions, which when executed by the at least one processor, cause the at least one processor to: obtain an index value of a length of a first motion vector difference of a current picture block and an index value of a direction of the first motion vector difference from a bitstream; obtain a first motion vector predictor of the current picture block and a second motion vector predictor of the current picture block, wherein the first motion vector predictor corresponds to a first reference frame, and the second motion vector predictor corresponds to a second reference frame; obtain the first motion vector difference based on the index value of the length of the first motion vector difference and the index value of the direction of the first motion vector difference,

wherein the first motion vector difference of the current picture block indicates a difference between the first motion vector predictor and a first motion vector target value of the current picture block, the first motion vector target value and the first motion vector predictor correspond to a same reference frame; determine a second motion vector difference of the current picture block based on the first motion vector difference, wherein the second motion vector difference of the current picture block indicates a difference between the second motion vector predictor and a second motion vector target value of the current picture block, the second motion vector target value and the second motion vector predictor correspond to a same reference frame, and when a direction of the first reference frame relative to a current frame in which the current picture block is located is the same as a direction of the second reference frame relative to the current frame, the second motion vector difference is the first motion vector difference, or when the direction of the first reference frame relative to the current frame in which the current picture block is located is opposite to the direction of the second reference frame relative to the current frame, a plus or minus sign of the second motion vector difference is opposite to a plus or minus sign of the first motion vector difference, and an absolute value of the second motion vector difference is same as an absolute value of the first motion vector difference; determine the first motion vector target value of the current picture block based on the first motion vector difference and the first motion vector predictor; determine the second motion vector target value of the current picture block based on the second motion vector difference and the second motion vector predictor; and obtain a prediction block of the current picture block based on the first motion vector target value and the second motion vector target value.

8. The decoding device of claim 7, wherein the index value of the length of the first motion vector difference of the current picture block is used to indicate a piece of candidate length information in a set of preset candidate length information.

9. The decoding device of claim 7, wherein the index value of the direction of the first motion vector difference of the current picture block is used to indicate a piece of candidate direction information in a set of preset candidate direction information.

10. A non-transitory computer-readable storage medium storing a bitstream generated by an encoding method, the encoding method comprising: obtaining a first motion vector predictor of a current picture block and a second motion vector predictor of the current picture block, wherein the first motion vector predictor corresponds to a first reference frame, and the second motion vector predictor corresponds to a second reference frame; obtaining a first motion vector difference of the current picture block that indicates a difference between the first motion vector predictor and a first motion vector target value of the current picture block, wherein the first motion vector target value and the first motion vector predictor correspond to a same reference frame, and the first motion vector difference is used to determine a second motion vector difference of the current picture block that indicates a difference between the second motion vector predictor and a second motion vector target value of the current picture block, the second motion vector target value and the second motion vector predictor correspond to a same reference frame, and when a direction of the first reference frame relative to a current frame in which the current picture block is located is the same as a direction of the second reference frame relative to the current frame, the second motion vector difference is the first motion vector difference, or when the direction of the first reference frame relative to the current frame in which the current picture block is located is opposite to the direction of the second reference frame relative to the current frame, a plus or minus sign of the second motion vector difference is opposite to a plus or minus sign of the first motion vector difference, and an absolute value of the second motion vector difference is same as an absolute value of the first motion vector difference; obtaining an index value of a length of the first motion vector difference and an index value of a direction of the first motion vector difference; and encoding the index value of the length of the first motion vector difference and the index value of the direction of the first motion vector difference, to obtain the bitstream.

11. The non-transitory computer-readable storage medium of claim 10, wherein the index value of the length of the first motion vector difference of the current picture block is used to indicate a piece of candidate length information in a set of preset candidate length information.

12. The non-transitory computer-readable storage medium of claim 10, wherein the index value of the direction of the first motion vector difference of the current picture block is used to indicate a piece of candidate direction information in a set of preset candidate direction information.