

the determined interpolation filter with the phase of Q that is corresponding to the pixel unit includes:

performing horizontal interpolation filtering on a pixel of a corresponding reference pixel unit, in the reference picture, of a pixel unit i by using a determined horizontal interpolation filter with a phase of Q that is corresponding to the pixel unit i, to obtain a horizontal interpolation filtering result; and performing vertical interpolation filtering on the horizontal interpolation filtering result by using a determined vertical interpolation filter with a phase of Q that is corresponding to the pixel unit i, to obtain a predicted pixel value of the pixel unit i, where the pixel unit i is any one of the P pixel units; or

performing vertical interpolation filtering on a pixel of a corresponding reference pixel unit, in the reference picture, of a pixel unit j by using a determined vertical interpolation filter with a phase of Q that is corresponding to the pixel unit j, to obtain a vertical interpolation filtering result; and performing horizontal interpolation filtering on the vertical interpolation filtering result by using a determined horizontal interpolation filter with a phase of Q that is corresponding to the pixel unit j, to obtain a predicted pixel value of the pixel unit j, where the pixel unit j is any one of the P pixel units.

[0015] With reference to any one of the first aspect, or the first to the sixth possible implementations of the first aspect, in a seventh possible implementation of the first aspect, the motion model is a translational motion model, an affine motion model, a rotational motion model, a parabolic motion model, a shearing motion model, a zooming motion model, a perspective motion model, or a bilinear motion model.

[0016] With reference to any one of the first aspect, or the first to the seventh possible implementations of the first aspect, in an eighth possible implementation of the first aspect, the motion model is represented as follows when W is equal to 2:

$$\begin{cases} v_{Nx} = \left(\frac{(v_{1x} - v_{0x}) \times N}{L} x - \frac{(v_{1y} - v_{0y}) \times N}{L} y + Nv_{0x} \right) / n \\ v_{Ny} = \left(\frac{(v_{1y} - v_{0y}) \times N}{L} x + \frac{(v_{1x} - v_{0x}) \times N}{L} y + Nv_{0y} \right) / n \end{cases}; \text{ or}$$

pixel precision, of the pixel unit with the coordinates of (x, y) in the current picture block.

[0025] With reference to the third possible implementation of the second aspect or the fourth possible implementation of the second aspect, in a fifth possible implementation of the second aspect, the phase includes a horizontal phase and a vertical phase; and in an aspect of determining, based on the phase of each pixel unit, the interpolation filter with the phase of Q that is corresponding to the corresponding pixel unit, the interpolation filtering unit is specifically configured to: determine, based on the horizontal phase of each pixel unit, a horizontal interpolation filter with a phase of Q that is corresponding to the corresponding pixel unit; and determine, based on the vertical phase of each pixel unit, a vertical interpolation filter with a phase of Q that is corresponding to the corresponding pixel unit, where a filter coefficient used by the horizontal interpolation filter is corresponding to the horizontal phase, and a filter coefficient used by the vertical interpolation filter is corresponding to the vertical phase.

[0026] With reference to the fifth possible implementation of the second aspect, in a sixth possible implementation of the second aspect, in an aspect of performing interpolation filtering on the pixel of the corresponding reference pixel unit, in the reference picture, of each pixel unit by using the determined interpolation filter with the phase of Q that is corresponding to the corresponding pixel unit, the interpolation filtering unit is specifically configured to: perform horizontal interpolation filtering on a pixel of a corresponding reference pixel unit, in the reference picture, of a pixel unit i by using a determined horizontal interpolation filter with a phase of Q that is corresponding to the pixel unit i, to obtain a horizontal interpolation filtering result; and perform vertical interpolation filtering on the horizontal interpolation filtering result by using a determined vertical interpolation filter with a phase of Q that is corresponding to the pixel unit i, to obtain a predicted pixel value of the pixel unit i, where the pixel unit i is any one of the P pixel units; or the interpolation filtering unit is specifically configured to: perform vertical interpolation filtering on a pixel of a corresponding reference pixel unit, in the reference picture, of a pixel unit j by using a determined vertical interpolation filter with a phase of Q that is corresponding to the pixel unit j, to obtain a vertical interpolation filtering result; and perform horizontal interpolation filtering on the horizontal interpolation filtering result by using a determined horizontal

performing vertical interpolation filtering on a pixel of a corresponding reference pixel unit, in the reference picture, of a pixel unit j by using a determined vertical interpolation filter with a phase of Q that is corresponding to the pixel unit j , to obtain a vertical interpolation filtering result; and performing horizontal interpolation filtering on the horizontal interpolation filtering result by using a determined horizontal interpolation filter with a phase of Q that is corresponding to the pixel unit j , to obtain a predicted pixel value of the pixel unit j , where the pixel unit j is any one of the P pixel units.

[0094] In addition, if a pixel unit has only one phase (that is, has only a horizontal phase or a vertical phase), interpolation filtering needs to be performed on a pixel of a reference pixel unit of the pixel unit only once, to obtain a predicted pixel value of the pixel unit.

[0095] Optionally, in some possible implementations of the present invention, the determining motion vectors of W control points in a current picture block includes:

determining the W control points in the current picture block, and determining a candidate motion information unit set corresponding to each of the W control points, where the candidate motion information unit set corresponding to each control point includes at least one candidate motion information unit;

determining a combined motion information unit set e including W motion information units, where each motion information unit in the combined motion information unit set e is selected from at least some motion information units in the candidate motion information unit set corresponding to each of the W control points, and each combined motion information unit in the combined motion information unit set e includes a motion vector; and

performing prediction or motion estimation on W motion vectors in the combined motion information unit set e to obtain the motion vectors of the W control points, or using W motion vectors included in the combined motion information unit set e as the motion vectors of the W control points.

[0096] In some possible implementations of the present invention, precision of each motion vector in the candidate motion information unit set may be $1/n$ of the pixel precision.

[0097] The picture prediction method may be applied to a video encoding process, or the picture prediction method may be applied to a video decoding process.

[0098] To better understand the technical solutions of the embodiments of the present

coefficient used by the vertical interpolation filter is corresponding to the vertical phase.

[0138] Specifically, for example, a horizontal interpolation filter with a phase of Q that is corresponding to the pixel unit i may be determined based on a horizontal phase of the pixel unit i , and a vertical interpolation filter with a phase of Q that is corresponding to the pixel unit i may be determined based on a vertical phase of the pixel unit i , where a filter coefficient used by the horizontal interpolation filter is corresponding to the horizontal phase of the pixel unit i , and a filter coefficient used by the vertical interpolation filter is corresponding to the vertical phase of the pixel unit i . The pixel unit i may be any one of the P pixel units. For example, the interpolation filter with the phase of Q that is corresponding to each of the P pixel units may be determined according to a manner similar to that of determining the interpolation filter with the phase of Q that is corresponding to the pixel unit i .

[0139] Optionally, in some possible implementations of the present invention, the performing interpolation filtering on the pixel of the corresponding reference pixel unit, in the reference picture, of each pixel unit by using the determined interpolation filter with the phase of Q that is corresponding to the pixel unit includes:

performing horizontal interpolation filtering on the pixel of the corresponding reference pixel unit, in the reference picture, of the pixel unit i by using the determined horizontal interpolation filter with the phase of Q that is corresponding to the pixel unit i , to obtain a horizontal interpolation filtering result; and performing vertical interpolation filtering on the horizontal interpolation filtering result by using the determined vertical interpolation filter with the phase of Q that is corresponding to the pixel unit i , to obtain a predicted pixel value of the pixel unit i , where the pixel unit i is any one of the P pixel units; or

performing vertical interpolation filtering on a pixel of a corresponding reference pixel unit, in the reference picture, of a pixel unit j by using a determined vertical interpolation filter with a phase of Q that is corresponding to the pixel unit j , to obtain a vertical interpolation filtering result; and performing horizontal interpolation filtering on the horizontal interpolation filtering result by using a determined horizontal interpolation filter with a phase of Q that is corresponding to the pixel unit j , to obtain a predicted pixel value of the pixel unit j , where the pixel unit j is any one of the P pixel units.

interpolation filter with the phase of Q that is corresponding to the pixel unit i.

[0182] Optionally, in some possible implementations of the present invention, the performing interpolation filtering on the pixel of the corresponding reference pixel unit, in the reference picture, of each pixel unit by using the determined interpolation filter with the phase of Q that is corresponding to the pixel unit includes:

performing horizontal interpolation filtering on the pixel of the corresponding reference pixel unit, in the reference picture, of the pixel unit i by using the determined horizontal interpolation filter with the phase of Q that is corresponding to the pixel unit i, to obtain a horizontal interpolation filtering result; and performing vertical interpolation filtering on the horizontal interpolation filtering result by using the determined vertical interpolation filter with the phase of Q that is corresponding to the pixel unit i, to obtain a predicted pixel value of the pixel unit i, where the pixel unit i is any one of the P pixel units; or

performing vertical interpolation filtering on a pixel of a corresponding reference pixel unit, in the reference picture, of a pixel unit j by using a determined vertical interpolation filter with a phase of Q that is corresponding to the pixel unit j, to obtain a vertical interpolation filtering result; and performing horizontal interpolation filtering on the horizontal interpolation filtering result by using a determined horizontal interpolation filter with a phase of Q that is corresponding to the pixel unit j, to obtain a predicted pixel value of the pixel unit j, where the pixel unit j is any one of the P pixel units.

[0183] In addition, if a pixel unit has only one phase (that is, has only a horizontal phase or a vertical phase), interpolation filtering needs to be performed on a pixel of a reference pixel unit of the pixel unit only once, to obtain a predicted pixel value of the pixel unit.

[0184] 406. The video decoding apparatus reconstructs the current picture block by using a predicted pixel value of the current picture block and a predicted residual, in a video bitstream, of the current picture block.

[0185] It can be learnt from the foregoing that, in the solution of this embodiment, the video decoding apparatus obtains, by means of calculation, the motion vector, whose precision is $1/N$ of the pixel precision, of each pixel unit of the current picture block by using the motion model and the motion vectors, whose precision is $1/n$ of the pixel precision, of the W control points, where N is greater than n. In other words, the precision of the motion vector

second condition, a third condition, a fourth condition, or a fifth condition.

[0189] The first condition includes: A motion manner, indicated by a motion information unit in any one of the A candidate combined motion information unit sets, of the current picture block is a non-translational motion.

5 **[0190]** The second condition includes: Prediction directions corresponding to two motion information units in any one of the A candidate combined motion information unit sets are the same.

[0191] The third condition includes: Reference-frame indexes corresponding to two motion information units in any one of the A candidate combined motion information unit sets
10 are the same.

[0192] The fourth condition includes: An absolute value of a difference between horizontal components of motion vectors of two motion information units in any one of the A candidate combined motion information unit sets is less than or equal to a horizontal component threshold, or an absolute value of a difference between horizontal components of a
15 motion vector of a control point Z and a motion vector of one motion information unit in any one of the A candidate combined motion information unit sets is less than or equal to a horizontal component threshold, where the control point Z of the current picture block is different from any one of the W control points.

[0193] The fifth condition includes: An absolute value of a difference between vertical
20 components of motion vectors of two motion information units in any one of the A candidate combined motion information unit sets is less than or equal to a vertical component threshold, or an absolute value of a difference between vertical components of a motion vector of a control point Z and a motion vector of any motion information unit in one of the A candidate combined motion information unit sets is less than or equal to a horizontal component
25 threshold, where the control point Z of the current picture block is different from any one of the W control points.

[0194] Optionally, in some possible implementations of the present invention, the determining, from A candidate combined motion information unit sets by the video encoding/decoding apparatus, the combined motion information unit set e including the W
30 motion information units may include: determining, from the A candidate combined motion

of performing interpolation filtering on the pixel of the corresponding reference pixel unit, in the reference picture, of each pixel unit by using the determined interpolation filter with the phase of Q that is corresponding to the corresponding pixel unit, the interpolation filtering unit is specifically configured to:

5 perform horizontal interpolation filtering on a pixel of a corresponding reference pixel unit, in the reference picture, of a pixel unit i by using a determined horizontal interpolation filter with a phase of Q that is corresponding to the pixel unit i, to obtain a horizontal interpolation filtering result; and perform vertical interpolation filtering on the horizontal interpolation filtering result by using a determined vertical interpolation filter with
10 a phase of Q that is corresponding to the pixel unit i, to obtain a predicted pixel value of the pixel unit i, where the pixel unit i is any one of the P pixel units; or

perform vertical interpolation filtering on a pixel of a corresponding reference pixel unit, in the reference picture, of a pixel unit j by using a determined vertical interpolation filter with a phase of Q that is corresponding to the pixel unit j, to obtain a
15 vertical interpolation filtering result; and perform horizontal interpolation filtering on the horizontal interpolation filtering result by using a determined horizontal interpolation filter with a phase of Q that is corresponding to the pixel unit j, to obtain a predicted pixel value of the pixel unit j, where the pixel unit j is any one of the P pixel units.

[0234] Optionally, in some possible implementations of the present invention, the motion
20 model is a translational motion model, an affine motion model, a rotational motion model, a zooming motion model, a parabolic motion model, a shearing motion model, a perspective motion model, or a bilinear motion model.

[0235] Optionally, in some possible implementations of the present invention,
the motion model is represented as follows when W is equal to 2:

$$\begin{cases} v_{Nx} = \left(\frac{(v_{1x} - v_{0x}) \times N}{L} x - \frac{(v_{1y} - v_{0y}) \times N}{L} y + Nv_{0x} \right) / n \\ v_{Ny} = \left(\frac{(v_{1y} - v_{0y}) \times N}{L} x + \frac{(v_{1x} - v_{0x}) \times N}{L} y + Nv_{0y} \right) / n \end{cases} ; \text{ or}$$

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a phase of Q that is corresponding to the pixel unit i, to obtain a predicted pixel value of the pixel unit i, where the pixel unit i is any one of the P pixel units; or

performing vertical interpolation filtering on a pixel of a corresponding reference pixel unit, in the reference picture, of a pixel unit j by using a determined vertical interpolation filter with a phase of Q that is corresponding to the pixel unit j, to obtain a vertical interpolation filtering result; and performing horizontal interpolation filtering on the horizontal interpolation filtering result by using a determined horizontal interpolation filter with a phase of Q that is corresponding to the pixel unit j, to obtain a predicted pixel value of the pixel unit j, where the pixel unit j is any one of the P pixel units.

[0254] Optionally, in some possible implementations of the present invention, the motion model is a translational motion model, an affine motion model, a rotational motion model, a parabolic motion model, a shearing motion model, a zooming motion model, a perspective motion model, or a bilinear motion model.

[0255] Optionally, in some possible implementations of the present invention, the motion model is represented as follows when W is equal to 2:

$$\begin{cases} v_{Nx} = \left(\frac{(v_{1x} - v_{0x}) \times N}{L} x - \frac{(v_{1y} - v_{0y}) \times N}{L} y + Nv_{0x} \right) / n \\ v_{Ny} = \left(\frac{(v_{1y} - v_{0y}) \times N}{L} x + \frac{(v_{1x} - v_{0x}) \times N}{L} y + Nv_{0y} \right) / n \end{cases}; \text{ or}$$

$$\begin{cases} v_{Nx} = \frac{(v_{1x} - v_{0x}) \times (N/n)}{L} x - \frac{(v_{1y} - v_{0y}) \times (N/n)}{L} y + (N/n)v_{0x} \\ v_{Ny} = \frac{(v_{1y} - v_{0y}) \times (N/n)}{L} x + \frac{(v_{1x} - v_{0x}) \times (N/n)}{L} y + (N/n)v_{0y} \end{cases}, \text{ where}$$

L represents a width or a height of the current picture block, (v_{0x}, v_{0y}) and (v_{1x}, v_{1y}) represent motion vectors, whose precision is 1/n of the pixel precision, of two

control points, v_{Nx} represents a horizontal component of a motion vector, whose precision is 1/N of the pixel precision, of a pixel unit with coordinates of (x, y) in the current picture block, and v_{Ny} represents a vertical component of the motion vector, whose precision is 1/N of the pixel precision, of the pixel unit with the coordinates of (x, y) in the current picture block.

using the determined interpolation filter with the phase of Q that is corresponding to the pixel unit comprises:

performing horizontal interpolation filtering on a pixel of a corresponding reference pixel unit, in the reference picture, of a pixel unit i by using a determined horizontal interpolation filter with a phase of Q that is corresponding to the pixel unit i, to obtain a horizontal interpolation filtering result; and performing vertical interpolation filtering on the horizontal interpolation filtering result by using a determined vertical interpolation filter with a phase of Q that is corresponding to the pixel unit i, to obtain a predicted pixel value of the pixel unit i, wherein the pixel unit i is any one of the P pixel units; or

performing vertical interpolation filtering on a pixel of a corresponding reference pixel unit, in the reference picture, of a pixel unit j by using a determined vertical interpolation filter with a phase of Q that is corresponding to the pixel unit j, to obtain a vertical interpolation filtering result; and performing horizontal interpolation filtering on the horizontal interpolation filtering result by using a determined horizontal interpolation filter with a phase of Q that is corresponding to the pixel unit j, to obtain a predicted pixel value of the pixel unit j, wherein the pixel unit j is any one of the P pixel units.

8. The method according to any one of claims 1 to 7, wherein the motion model is a translational motion model, an affine motion model, a rotational motion model, a parabolic motion model, a shearing motion model, a zooming motion model, a perspective motion model, or a bilinear motion model.

9. The method according to any one of claims 1 to 8, wherein the motion model is represented as follows when W is equal to 2:

$$\begin{cases} v_{Nx} = \left(\frac{(v_{1x} - v_{0x}) \times N}{L} x - \frac{(v_{1y} - v_{0y}) \times N}{L} y + Nv_{0x} \right) / n \\ v_{Ny} = \left(\frac{(v_{1y} - v_{0y}) \times N}{L} x + \frac{(v_{1x} - v_{0x}) \times N}{L} y + Nv_{0y} \right) / n \end{cases}; \text{ or}$$

$$\begin{cases} v_{Nx} = \frac{(v_{1x} - v_{0x}) \times (N/n)}{L} x - \frac{(v_{1y} - v_{0y}) \times (N/n)}{L} y + (N/n)v_{0x} \\ v_{Ny} = \frac{(v_{1y} - v_{0y}) \times (N/n)}{L} x + \frac{(v_{1x} - v_{0x}) \times (N/n)}{L} y + (N/n)v_{0y} \end{cases}, \text{ wherein}$$

L represents a width or a height of the current picture block, (v_{0x}, v_{0y}) and (v_{1x}, v_{1y})

reference picture, of each pixel unit by using the determined interpolation filter with the phase of Q that is corresponding to the corresponding pixel unit, the interpolation filtering unit is specifically configured to:

perform horizontal interpolation filtering on a pixel of a corresponding reference pixel unit, in the reference picture, of a pixel unit i by using a determined horizontal interpolation filter with a phase of Q that is corresponding to the pixel unit i, to obtain a horizontal interpolation filtering result; and perform vertical interpolation filtering on the horizontal interpolation filtering result by using a determined vertical interpolation filter with a phase of Q that is corresponding to the pixel unit i, to obtain a predicted pixel value of the pixel unit i, wherein the pixel unit i is any one of the P pixel units; or

perform vertical interpolation filtering on a pixel of a corresponding reference pixel unit, in the reference picture, of a pixel unit j by using a determined vertical interpolation filter with a phase of Q that is corresponding to the pixel unit j, to obtain a vertical interpolation filtering result; and perform horizontal interpolation filtering on the horizontal interpolation filtering result by using a determined horizontal interpolation filter with a phase of Q that is corresponding to the pixel unit j, to obtain a predicted pixel value of the pixel unit j, wherein the pixel unit j is any one of the P pixel units.

20. The picture prediction apparatus according to any one of claims 13 to 19, wherein the motion model is a translational motion model, an affine motion model, a rotational motion model, a zooming motion model, a parabolic motion model, a shearing motion model, a perspective motion model, or a bilinear motion model.

21. The picture prediction apparatus according to any one of claims 13 to 20, wherein the motion model is represented as follows when W is equal to 2:

$$\begin{cases} v_{Nx} = \left(\frac{(v_{1x} - v_{0x}) \times N}{L} x - \frac{(v_{1y} - v_{0y}) \times N}{L} y + Nv_{0x} \right) / n \\ v_{Ny} = \left(\frac{(v_{1y} - v_{0y}) \times N}{L} x + \frac{(v_{1x} - v_{0x}) \times N}{L} y + Nv_{0y} \right) / n \end{cases}; \text{ or}$$

$$\begin{cases} v_{Nx} = \frac{(v_{1x} - v_{0x}) \times (N/n)}{L} x - \frac{(v_{1y} - v_{0y}) \times (N/n)}{L} y + (N/n)v_{0x} \\ v_{Ny} = \frac{(v_{1y} - v_{0y}) \times (N/n)}{L} x + \frac{(v_{1x} - v_{0x}) \times (N/n)}{L} y + (N/n)v_{0y} \end{cases}, \text{ wherein}$$