Regarding the encoding scheme as described above, proposals of new schemes have been desired for increase in coding efficiency, increase in image quality, reduction in processing amount, reduction in circuit scales, appropriate selection, etc. of an element that is a reference picture, a reference block, or the like, or an operation.

[0006]

~~The~~Embodiments of the present disclosure provide~~s~~, for example, a configuration or a method which can contribute to at least one of increase in coding efficiency, increase in image quality, reduction in processing amount, reduction in circuit scale, appropriate selection, etc. of an element, or an operation. It is to be noted that the present disclosure may encompass possible configurations or methods which can contribute to advantages other than the above advantages.

[Solution to Problem]

[0007]

~~For example, an encoder according to an aspect of the present disclosure is~~Disclosed herein is an encoder including circuitry and memory connected to the circuitry. In operation, the circuitry: derives an absolute value of a sum of horizontal gradient values which indicates an absolute value of a sum of a horizontal gradient value at a relative pixel position in a first range and a horizontal gradient value at a relative pixel position in a second range, for each of a plurality of pairs of a relative pixel position in the first range and a relative pixel position in the second range among a plurality of pairs of relative pixel positions, the first range including a first reference block for a current block, the second range including a second reference block for the current block, the plurality of pairs of relative pixel positions being determined commonly and relatively for the first range and the second range; derives, as a first parameter, a total sum of a plurality of absolute values of sums of horizontal gradient values derived respectively for the plurality of pairs of relative pixel positions; derives an absolute value of a sum of vertical gradient values which indicates an absolute value of a sum of a vertical gradient value at the relative pixel position in the first range and a vertical gradient value at the relative pixel position in the second range, for each of the plurality of pairs of relative pixel positions; derives, as a second parameter, a total sum of a plurality of absolute values of sums of vertical gradient values derived respectively for the plurality of pairs of relative pixel positions; derives, for each of the plurality of pairs of relative pixel positions, a pixel difference value which indicates a difference between the pixel value at the relative pixel position in the first range and the

pixel value at the relative pixel position in the second range; inverts or maintains a plus or minus sign of the pixel difference value derived for each of the plurality of pairs of relative pixel positions, according to a plus or minus sign of the sum of the horizontal gradient values which indicates the sum of the horizontal gradient value at the relative pixel position in the first range and the horizontal gradient value at the relative pixel position in the second range, and derives a horizontal-related pixel difference value which indicates a pixel difference value derived for the pair of relative pixel positions, the horizontal-related pixel difference value having the plus or minus sign inverted or maintained according to the plus or minus sign of the sum of the horizontal gradient values; derives, as a third parameter, a total sum of a plurality horizontal-related pixel difference values derived respectively for the plurality of pairs of relative pixel positions; inverts or maintains a plus or minus sign of the pixel difference value derived for each of the plurality of pairs of relative pixel positions, according to a plus or minus sign of a sum of vertical gradient values which indicates a sum of the vertical gradient value at the relative pixel position in the first range and the vertical gradient value at the relative pixel position in the second range, and derives a vertical-related pixel difference value which indicates a pixel difference value derived for the pair of relative pixel positions, the vertical-related pixel difference value having the plus or minus sign inverted or maintained according to the plus or minus sign of the sum of the vertical gradient values; derives, as a fourth parameter, a total sum of a plurality of vertical-related pixel difference values derived respectively for the plurality of pairs of relative pixel positions; inverts or maintains a plus or minus sign of the sum of the horizontal gradient values derived for each of the plurality of pairs of relative pixel positions, according to the plus or minus sign of the sum of the vertical gradient values, and derives a vertical-related sum of horizontal gradient values which indicates a sum of the horizontal gradient values having the plus or minus sign inverted or maintained according to the plus or minus sign of the sum of the vertical gradient values; derives, as a fifth parameter, a total sum of a plurality vertical-related sums of horizontal gradient values derived respectively for the plurality of pairs of relative pixel positions; and generates a prediction image to be used to encode the current block using the first parameter, the second parameter, the third parameter, the fourth parameter, and the fifth parameter.

[0007a]

According to an aspect of the present disclosure, there is provided an encoder including :

a memory; and

a processor connected to the memory and configured to generate a prediction image in order to encode a current block based on a first parameter, a second parameter, a third parameter, a fourth parameter, and a fifth parameter that are derived in a bi-directional optical flow (BDOF) process, wherein

the first parameter is derived based on the following expression:

[Math. 1]

$$\sum_{[i,j]\in\Omega} \mathrm{abs}\left(I_x^{\,1} + I_x^{\,0}\right);$$

the second parameter is derived based on the following expression:

[Math. 2]

$$\sum_{[i,j]\in\Omega} \mathrm{abs}\left(I_y^{\,1} + I_y^{\,0}\right);$$

the third parameter is derived based on the following expression:

[Math. 3]

$$\sum_{[i,j]\in\Omega} \left(-\mathrm{sign}\left(I_x^{\,1} + I_x^{\,0}\right) \times \left(I^0 - I^1\right)\right);$$

the fourth parameter is derived based on the following expression:

[Math. 4]

$$\sum_{[i,j]\in\Omega} \left(-\mathrm{sign}\left(I_y^{\,1} + I_y^{\,0}\right) \times \left(I^0 - I^1\right)\right);$$ and

the fifth parameter is derived based on the following expression,

[Math. 5]

$$\sum_{[i,j]\in\Omega} \left(\mathrm{sign}\left(I_y^{\,1} + I_y^{\,0}\right) \times \left(I_x^{\,1} + I_x^{\,0}\right)\right),$$

where:

Ω indicates a set of relative pixel positions;

[i, j] indicates a relative pixel position in the set Ω defined by a horizontal position i and a vertical position j;

I_x^0 indicates a horizontal gradient value at a first pixel position in a first gradient image, and I_x^1 denotes a horizontal gradient value at the first pixel position in a second gradient image, the first pixel position being determined based on a relative pixel position [i, j], the first gradient image and the second gradient image corresponding to the current block;

I_y^0 indicates a vertical gradient value at the first pixel position in the first gradient image, and I_y^1 denotes a vertical gradient value at the first pixel position in the second gradient image;

I^0 indicates a pixel value at the first pixel position in a first interpolated image corresponding to the current block;

I^1 indicates a pixel value at the first pixel position in a second interpolated image corresponding to the current block;

the abs function outputs an absolute value of an argument; and

the sign function outputs a sign of an argument which is -1, 0, or 1.

[0008]

Some of implementations of embodiments according to the present disclosure may: improve coding efficiency; simplify an encoding/decoding process; increase an encoding and/or decoding speed; and efficiently select appropriate components/operations to be used for encoding and decoding, such as appropriate filters, block sizes, motion vectors, reference pictures, reference blocks, etc.

[0009]

Further benefits and advantages according to one or more ~~aspects~~embodiments of the present disclosure will become apparent from the Specification and the Drawings. These benefits and advantages are obtainable by features described in some embodiments, the Specification, and the Drawings. However, all the features do not always need to be provided to obtain one or more of the advantages and/or effects.

[0010]

It is to be noted that these general or specific aspects may be implemented as a system, a method, an integrated circuit, a computer program, a recording medium, or any combination of these.

[Advantageous Effects of Invention]

[0011]

The configuration or method according to ~~an aspect~~embodiments of the present disclosure can contribute to at least one of increase in coding efficiency, increase in image quality, reduction in processing amount, reduction in circuit scale, appropriate selection, etc. of an element, or an operation. It is to be noted that the configuration or method according to ~~the aspect~~embodiments of the present disclosure may contribute to advantages other than those described above.

[Brief Description of Drawings]

[0012]

[FIG. 1]

FIG. 1 is a block diagram illustrating a functional configuration of an encoder according to an embodiment.

[FIG. 2]

FIG. 2 is a flow chart indicating one example of an overall encoding process performed by the encoder.

[FIG. 3]

FIG. 3 is a conceptual diagram illustrating one example of block