SAMPLE PADDING FOR CROSS-COMPONENT ADAPTIVE LOOP FILTERING

CROSS REFERENCE TO RELATED APPLICATIONS

[001] This application is based on International Patent Application No. PCT/CN2020/135134, filed on December 10, 2020, which claims claim the priority to and benefits of International Patent Application No. PCT/CN2019/124481, filed on December 11, 2019. All the aforementioned patent applications are hereby incorporated by reference in their entireties.

TECHNICAL FIELD

[002] This patent document relates to image and video coding and decoding.

BACKGROUND

[003] Digital video accounts for the largest bandwidth use on the internet and other digital communication networks. As the number of connected user devices capable of receiving and displaying video increases, it is expected that the bandwidth demand for digital video usage will continue to grow.

SUMMARY

[004] The present document discloses techniques that can be used by video encoders and decoders to perform cross-component adaptive loop filtering during video encoding or decoding.

[005] In one example aspect, a method of video processing is disclosed. The method includes determining, for a conversion between a video unit of a video and a bitstream representation of the video, whether to enable a mirrored padding process for padding an unavailable luma sample during an application of a loop filtering tool to the video unit; and performing the conversion based on the determining.

[006] In another example aspect, a method of video processing is disclosed. The method includes determining, for a conversion between a video unit of a video and a bitstream representation of the video, whether to apply a repetitive padding process and/or a mirrored padding process for padding a sample located at a virtual boundary based on coded information of the video unit; and performing the conversion based on the determining.

[007] In yet another example aspect, a video encoder apparatus is disclosed. The video encoder comprises a processor configured to implement above-described methods.

CLAIMS

1. A method of processing video data, comprising:

determining, for a conversion between a video unit of a video and a bitstream of the video, that a mirrored padding process for padding an unavailable luma sample which is unavailable due to a virtual boundary is used during an application of a cross-component adaptive loop filtering (CC-ALF) tool to the video unit, in a case that the virtual boundary is applied to the video unit; and

performing the conversion based on the determining,

wherein the mirrored padding process includes padding a corresponding sample of the unavailable luma sample and considering the corresponding sample as unavailable even when the corresponding sample is available for the virtual boundary, whereby the corresponding sample is located in a filter support region in the CC-ALF tool, and

wherein the unavailable luma sample is denoted as located at row M in the video unit and the corresponding sample to be padded is denoted as located at row N in the video unit, and wherein d (C, M) = d (N, C), whereby d (x, y) denotes a distance between row x and row y, wherein C represents a row where a representative luma sample is located in the video unit, where C, M and N are integers and M is not equal to N, and wherein the representative luma sample is a collocated luma sample of a chroma sample to be filtered in the video unit.

2. The method of claim 1, wherein a position of the collocated luma sample of the chroma sample depends on a color format of the video.

3. The method of claim 2, wherein the collocated luma sample of the chroma sample located at (x, y) is defined as one located at (2x, 2y) if the color format is 4:2:0, or one located at (2x, y) if the color format is 4:2:2, or one located at (x, y) if the color format is 4:4:4.

4. The method of any of claims 1-3, wherein the CC-ALF tool has a K x L filter shape, whereby K=4 and L=3; yM1, yL, yP1, yP2 are y-coordinates of four sample rows in the K x L filter shape, whereby yM1=-1, yL=0, yP1=1, yP2=2, the representative luma sample is in the row yL=0; and the virtual boundary is located at a row CtbSizeY-4 in the video unit, whereby CtbSizeY represents a size of the video unit which is a coding tree unit (CTU).

5. The method of claim 4, wherein the unavailable luma sample is padded using a nearest available row below the virtual boundary in a case that the virtual boundary is above the representative luma sample and wherein the corresponding sample is padded using a nearest available row above a row containing the corresponding sample.

6. The method of claim 5, wherein, in a case that yL is equal to CtbSizeY – 3 and a row above yM1 is unavailable, a corresponding sample (x, yP2) in a row at yP2 is padded using a sample (x, yP1) in a row at yP1.

7. The method of claim 5, wherein, in a case that yL is equal to CtbSizeY – 4 and a row above yM1 and a row at yM1 are unavailable, a unavailable luma sample (x, yM1) in a row at yM1 is padded using a sample (x, yL) in a row at yL, a corresponding sample (x, yP1) in a row at yP1 is padded using a sample (x, yL) in a row at yL, and a corresponding sample (x, yP2) in a row at yP2 is padded using a sample (x, yL) in a row at yL.

8. The method of claim 4, wherein the unavailable luma sample is padded using a nearest available row above the virtual boundary in a case that the virtual boundary is below the representative luma sample and wherein the corresponding sample is padded using a nearest available row below a row containing the corresponding sample.

9. The method of claim 8, wherein in a case that yL is equal to CtbSizeY – 6 and a row at yP2 is unavailable, the unavailable luma sample (x, yP2) in the row at yP2 is padded using a sample (x, yP1) in a row at yP1.

10. The method of claim 8, wherein, in a case that yL is equal to CtbSizeY – 5 and rows at yP2 and yP1 are unavailable, a unavailable luma sample (x, yP2) at a row yP2 is padded using a sample (x, yL) in a row at yL, a unavailable luma sample (x, yP1) at a row yP1 is padded using the sample (x, yL) in the row at yL, and a corresponding sample (x, yM1) in a row at yM1 is padded using the sample (x, yL) in the row at yL.

11. The method of any of claims 1-10, wherein the conversion comprising includes encoding the video into the bitstream.

12. The method of any of claims 1-10, wherein the conversion includes decoding the video from the bitstream.

13. An apparatus for processing video data comprising a processor and a non-transitory memory with instructions thereon, wherein the instructions upon execution by the processor, cause the processor to:

determine, for a conversion between a video unit of a video and a bitstream of the video, that a mirrored padding process for padding an unavailable luma sample which is unavailable due to a virtual boundary is used during an application of a cross-component adaptive loop filtering (CC-ALF) tool to the video unit, in a case that the virtual boundary is applied to the video unit; and

perform the conversion based on the determination,

wherein the mirrored padding process includes padding a corresponding sample of the unavailable luma sample and considering the corresponding sample as unavailable even when the corresponding sample is available for the virtual boundary, whereby the corresponding sample is located in a filter support region in the CC-ALF tool, and

wherein the unavailable luma sample is denoted as located at row M in the video unit and the corresponding sample to be padded is denoted as located at row N in the video unit, and wherein d (C, M) = d (N, C), whereby d (x, y) denotes a distance between row x and row y, wherein C represents a row where a representative luma sample is located in the video unit, where C, M and N are integers and M is not equal to N, and wherein the representative luma sample is a collocated luma sample of a chroma sample to be filtered in the video unit.

14. The apparatus of claim 13, wherein a position of the collocated luma sample of the chroma sample depends on a color format of the video;

wherein the collocated luma sample of the chroma sample located at (x, y) is defined as one located at (2x, 2y) if the color format is 4:2:0, or one located at (2x, y) if the color format is 4:2:2, or one located at (x, y) if the color format is 4:4:4.

15. The apparatus of claim 13 or 14, wherein the CC-ALF tool has a K x L filter shape, whereby K=4 and L=3; yM1, yL, yP1, yP2 are y-coordinates of four sample rows in the K x L filter shape, whereby yM1=-1, yL=0, yP1=1, yP2=2, the representative luma sample is in the row yL=0; and the virtual boundary is located at a row CtbSizeY-4 in the video unit, whereby CtbSizeY represents a size of the video unit which is a coding tree unit (CTU);

wherein the unavailable luma sample is padded using a nearest available row below the virtual boundary in a case that the virtual boundary is above the representative luma sample and wherein the corresponding sample is padded using a nearest available row above a row containing the corresponding sample, wherein, in a case that yL is equal to CtbSizeY – 3 and a row above yM1 is unavailable, a corresponding sample (x, yP2) in a row at yP2 is padded using a sample (x, yP1) in a row at yP1; or wherein, in a case that yL is equal to CtbSizeY – 4 and a row above yM1 and a row at yM1 are unavailable, a unavailable luma sample (x, yM1) in a row at yM1 is padded using a sample (x, yL) in a row at yL, a corresponding sample (x, yP1) in a row at yP1 is padded using a sample (x, yL) in a row at yL, and a corresponding sample (x, yP2) in a row at yP2 is padded using a sample (x, yL) in a row at yL; or

wherein the unavailable luma sample is padded using a nearest available row above the virtual boundary in a case that the virtual boundary is below the representative luma sample and wherein the corresponding sample is padded using a nearest available row below a row containing the corresponding sample, wherein in a case that yL is equal to CtbSizeY – 6 and a row at yP2 is unavailable, the unavailable luma sample (x, yP2) in the row at yP2 is padded using a sample (x, yP1) in a row at yP1; or wherein, in a case that yL is equal to CtbSizeY – 5 and rows at yP2 and yP1 are unavailable, a unavailable luma sample (x, yP2) at a row yP2 is padded using a sample (x, yL) in a row at yL, a unavailable luma sample (x, yP1) at a row yP1 is padded using the sample (x, yL) in the row at yL, and a corresponding sample (x, yM1) in a row at yM1 is padded using the sample (x, yL) in the row at yL.

16. A non-transitory computer-readable storage medium storing instructions that cause a processor to:

determine, for a conversion between a video unit of a video and a bitstream of the video, that a mirrored padding process for padding an unavailable luma sample which is unavailable due to a virtual boundary is used during an application of a cross-component adaptive loop filtering (CC-ALF) tool to the video unit, in a case that the virtual boundary is applied to the video unit; and

perform the conversion based on the determination,

wherein the mirrored padding process includes padding a corresponding sample of the unavailable luma sample and considering the corresponding sample as unavailable even when the corresponding sample is available for the virtual boundary, whereby the corresponding sample is located in a filter support region in the CC-ALF tool, and

wherein the unavailable luma sample is denoted as located at row M in the video unit and the corresponding sample to be padded is denoted as located at row N in the video unit, and

wherein d (C, M) = d (N, C), whereby d (x, y) denotes a distance between row x and row y, wherein C represents a row where a representative luma sample is located in the video unit, where C, M and N are integers and M is not equal to N, and wherein the representative luma sample is a collocated luma sample of a chroma sample to be filtered in the video unit.

17. The non-transitory computer-readable storage medium of claim 16, wherein a position of the collocated luma sample of the chroma sample depends on a color format of the video;

wherein the collocated luma sample of the chroma sample located at (x, y) is defined as one located at (2x, 2y) if the color format is 4:2:0, or one located at (2x, y) if the color format is 4:2:2, or one located at (x, y) if the color format is 4:4:4.

18. The non-transitory computer-readable storage medium of claim 16 or 17, wherein the CC-ALF tool has a K x L filter shape, whereby K=4 and L=3; yM1, yL, yP1, yP2 are y-coordinates of four sample rows in the K x L filter shape, whereby yM1=-1, yL=0, yP1=1, yP2=2, the representative luma sample is in the row yL=0; and the virtual boundary is located at a row CtbSizeY-4 in the video unit, whereby CtbSizeY represents a size of the video unit which is a coding tree unit (CTU);

wherein the unavailable luma sample is padded using a nearest available row below the virtual boundary in a case that the virtual boundary is above the representative luma sample and wherein the corresponding sample is padded using a nearest available row above a row containing the corresponding sample, wherein, in a case that yL is equal to CtbSizeY – 3 and a row above yM1 is unavailable, a corresponding sample (x, yP2) in a row at yP2 is padded using a sample (x, yP1) in a row at yP1; or wherein, in a case that yL is equal to CtbSizeY – 4 and a row above yM1 and a row at yM1 are unavailable, a unavailable luma sample (x, yM1) in a row at yM1 is padded using a sample (x, yL) in a row at yL, a corresponding sample (x, yP1) in a row at yP1 is padded using a sample (x, yL) in a row at yL, and a corresponding sample (x, yP2) in a row at yP2 is padded using a sample (x, yL) in a row at yL; or

wherein the unavailable luma sample is padded using a nearest available row above the virtual boundary in a case that the virtual boundary is below the representative luma sample and wherein the corresponding sample is padded using a nearest available row below a row containing the corresponding sample, wherein in a case that yL is equal to CtbSizeY – 6 and a row at yP2 is unavailable, the unavailable luma sample (x, yP2) in the row at yP2 is padded using a sample (x, yP1) in a row at yP1; or wherein, in a case that yL is equal to CtbSizeY – 5 and rows at yP2 and yP1 are unavailable, a unavailable luma sample (x, yP2) at a row yP2 is

padded using a sample (x, yL) in a row at yL, a unavailable luma sample (x, yP1) at a row yP1 is padded using the sample (x, yL) in the row at yL, and a corresponding sample (x, yM1) in a row at yM1 is padded using the sample (x, yL) in the row at yL.

19. A non-transitory computer-readable recording medium storing a bitstream of a video which is generated by a method performed by a video processing apparatus, wherein the method comprises:

determining that a mirrored padding process for padding an unavailable luma sample which is unavailable due to a virtual boundary is used during an application of a cross-component adaptive loop filtering (CC-ALF) tool to a video unit of a video, in a case that the virtual boundary is applied to the video unit; and

generating the bitstream based on the determining,

wherein the mirrored padding process includes padding a corresponding sample of the unavailable luma sample and considering the corresponding sample as unavailable even when the corresponding sample is available for the virtual boundary, whereby the corresponding sample is located in a filter support region in the CC-ALF tool, and

wherein the unavailable luma sample is denoted as located at row M in the video unit and the corresponding sample to be padded is denoted as located at row N in the video unit, and wherein d (C, M) = d (N, C), whereby d (x, y) denotes a distance between row x and row y, wherein C represents a row where a representative luma sample is located in the video unit, where C, M and N are integers and M is not equal to N, and wherein the representative luma sample is a collocated luma sample of a chroma sample to be filtered in the video unit.

20. The non-transitory computer-readable recording medium of claim 19, wherein a position of the collocated luma sample of the chroma sample depends on a color format of the video;

wherein the collocated luma sample of the chroma sample located at (x, y) is defined as one located at (2x, 2y) if the color format is 4:2:0, or one located at (2x, y) if the color format is 4:2:2, or one located at (x, y) if the color format is 4:4:4;

wherein the CC-ALF tool has a K x L filter shape, whereby K=4 and L=3; yM1, yL, yP1, yP2 are y-coordinates of four sample rows in the K x L filter shape, whereby yM1=-1, yL=0, yP1=1, yP2=2, the representative luma sample is in the row yL=0; and the virtual boundary is located at a row CtbSizeY-4 in the video unit, whereby CtbSizeY represents a size of the video unit which is a coding tree unit (CTU);

wherein the unavailable luma sample is padded using a nearest available row below the virtual boundary in a case that the virtual boundary is above the representative luma sample and wherein the corresponding sample is padded using a nearest available row above a row containing the corresponding sample, wherein, in a case that yL is equal to CtbSizeY – 3 and a row above yM1 is unavailable, a corresponding sample (x, yP2) in a row at yP2 is padded using a sample (x, yP1) in a row at yP1; or wherein, in a case that yL is equal to CtbSizeY – 4 and a row above yM1 and a row at yM1 are unavailable, a unavailable luma sample (x, yM1) in a row at yM1 is padded using a sample (x, yL) in a row at yL, a corresponding sample (x, yP1) in a row at yP1 is padded using a sample (x, yL) in a row at yL, and a corresponding sample (x, yP2) in a row at yP2 is padded using a sample (x, yL) in a row at yL; or

wherein the unavailable luma sample is padded using a nearest available row above the virtual boundary in a case that the virtual boundary is below the representative luma sample and wherein the corresponding sample is padded using a nearest available row below a row containing the corresponding sample, wherein in a case that yL is equal to CtbSizeY – 6 and a row at yP2 is unavailable, the unavailable luma sample (x, yP2) in the row at yP2 is padded using a sample (x, yP1) in a row at yP1; or wherein, in a case that yL is equal to CtbSizeY – 5 and rows at yP2 and yP1 are unavailable, a unavailable luma sample (x, yP2) at a row yP2 is padded using a sample (x, yL) in a row at yL, a unavailable luma sample (x, yP1) at a row yP1 is padded using the sample (x, yL) in the row at yL, and a corresponding sample (x, yM1) in a row at yM1 is padded using the sample (x, yL) in the row at yL.