SAMPLE PADDING FOR CROSS-COMPONENT ADAPTIVE LOOP FILTERING

CROSS REFERENCE TO RELATED APPLICATIONS

[001] ~~Under the applicable patent law and/or rules pursuant to the Paris Convention, this application is made to timely~~ 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. ~~For all purposes under the law, the entire disclosure of the aforementioned application is incorporated by reference as part of the disclosure of this application.~~ 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 video processing, comprising:

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.

2. The method of claim 1, wherein the loop filtering tool includes a cross-component adaptive loop filtering (CC-ALF) tool.

3. The method of claim 1, wherein the loop filtering tool includes an adaptive loop filtering (ALF) tool.

4. The method of claim 1, wherein the mirrored padding process includes padding a second sample that is a corresponding sample of a first sample in a filter support region in the loop filtering tool even when the second sample is available, and wherein the first sample is unavailable and to be padded.

5. The method of claim 1, wherein the mirrored padding process is further used for deriving the unavailable luma sample and one or more corresponding luma samples to the unavailable luma sample.

6. The method of claim 5, wherein a corresponding luma sample is determined based on a distance of the corresponding luma sample from a representative luma sample and/or a distance of the unavailable sample from the representative luma sample.

7. The method of claim 6, wherein the representative luma sample is defined as a collocated luma sample of a chroma sample to be filtered.

8. The method of claim 7, wherein a position of the collocated luma sample of the chroma sample depends on a color format of the video.

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).

~~9. The method of claim 8, wherein the collocated luma sample of the chroma sample located at (x, y) is defined as one located at (2x, 2y) in the color format being 4:2:0.~~

~~10. The method of claim 8, wherein the collocated luma sample of the chroma sample located at (x, y) is defined as one located at (2x, y) in the color format being 4:2:2.~~

~~11. The method of claim 8, wherein the collocated luma sample of the chroma sample located at (x, y) is defined as one located at (x, y) in the color format being 4:4:4.~~

~~12. The method of claim 6, wherein the distance refers to a distance along a first direction between a first row containing the corresponding luma sample and a second row containing the representative luma sample.~~

~~13. The method of claim 6, wherein the distance is calculated as a difference along a first direction between a pixel line along a second direction containing the corresponding luma sample and a row containing the representative luma sample.~~

~~14. The method of claim 13, wherein C represents a center line along the second direction where the representative luma sample is located, M represents a line along the second direction where the unavailable sample is located and N represents a line along the second direction in which the corresponding luma sample is located, where C, M and N are positive integers and M is not equal to N.~~

~~15. The method of claim 5, wherein the one or more corresponding luma samples to be padded in the mirrored padding process are based on a number of rows of samples utilized by a shape of a filter used by the CC-ALF tool.~~

~~16. The method of claim 5, wherein the unavailable luma sample is located at row M and samples located at row N are determined as the one or more corresponding luma samples to be padded, and wherein d(C, M) = d (N, C), whereby d(x, y) denotes a distance between row x and row y, and M, C, N are positive integers.~~

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.

17. The method of claim 6, wherein the mirrored padding process corresponds to one used during an application of an adaptive loop filtering (ALF) tool in a case that 1) a center luma sample is selected as the representative luma sample and 2) the CC-ALF tool has a K x L filter shape, whereby K is odd number and L is a positive integer.

18. The method of claim 6, wherein, in a case that the CC-ALF tool has a K x L filter shape and the unavailable luma sample is located at row M above or row N below from a virtual boundary, the mirrored padding process includes padding the one or more corresponding luma samples located at row N or M away from the virtual boundary from a nearest sample row above the row N or below the row M, whereby K is odd number and, L, M, N are positive integers.

19. The method of claim 18, wherein the unavailable luma sample is padded using a nearest row below the virtual boundary in a case that the virtual boundary is above the representative luma sample and wherein the one or more corresponding luma samples are padded using a nearest row above a row containing the one or more corresponding luma samples in a case that the virtual boundary is above the representative luma sample.

20. The method of claim 18, wherein the unavailable luma sample is padded using a nearest row above the virtual boundary in a case that the virtual boundary is below the representative luma sample and wherein the one or more corresponding luma samples are padded using a nearest row below a row containing the one or more corresponding luma samples in a case that the virtual boundary is below the representative luma sample.

21. The method of claim 19 or 20, wherein K=2, yL=0, yP1=1, and the virtual boundary is equal to CtbSizeY-4, whereby yL and yP1 are y-coordinates of two sample rows and CtbSizeY represents a size of coding tree unit (CTU).

22. The method of claim 21, wherein, in a case that yL is equal to CtbSizeY − 4 and a row above yL is unavailable, a sample (x, yP1) in a row at yP1 is padded using a sample (x, yL) in a row at yL.

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);

23. The method of claim 19 or 20, wherein K=4, yM1=-1, yL=0, yP1=1, yP2=2, and the virtual boundary is equal to CtbSizeY-4, whereby yM1, yL, yP1, yP2 are y-coordinates of four sample rows and CtbSizeY represents a size of coding tree unit (CTU).

24. The method of claim 23, wherein, in a case that yL is equal to CtbSizeY – 3 and a row above yM1 is unavailable, a sample (x, yP2) in a row at yP2 is padded using a sample (x, yP1) in a row at yP1.

25. The method of claim 23, wherein, in a case that yL is equal to CtbSizeY – 4 and a row above yM1 is unavailable, a sample (x, yM1) in a row at yM1 is padded using a sample (x, yL) in a row at yL and samples (x, yP2) and (x, yP1) in rows at yP2 and yP1 are padded using a sample (x, yL) in the row at yL.

26. The method of claim 19 or 20, wherein K=6, yM2=-2, yM1=-1, yL=0, yP1=1, yP2=2, yP3=3 and the virtual boundary is equal to CtbSizeY-4, whereby yM2, yM1, yL, yP1, yP2, yP3 are y-coordinates of six sample rows and CtbSizeY represents a size of coding tree unit (CTU).

27. The method of claim 26, wherein, in a case that yL is equal to CtbSizeY – 2 and a row above yM2 is unavailable, a sample (x, yP3) in a row at yP3 is padded using a sample (x, yP2) in a row at yP2.

28. The method of claim 26, wherein, in a case that yL is equal to CtbSizeY – 3 and a row above yM2 and a row at yM2 are unavailable, a sample (x, yM2) in a row at yM2 is padded using a sample (x, yM1) in a row at yM1 and samples (x, yP3) and (x, yP2) in rows at yP3 and yP2 are padded using a sample (x, yP1) in a row at yP1.

29. The method of claim 26, wherein, in a case that yL is equal to CtbSizeY – 4 and a row above yM2, a row at yM2 and a row at yM1 are unavailable, samples (x, yM2) and (x, yM1) in rows at yM2 and yM1 are padded using a sample (x, yL) at a row at yL and samples (x, yP3), (x, yP2), and (x, yP1) in rows yP3, yP2, and yP1 are padded using a sample (x, yL) in the row at yL.

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

~~30. The method of claim 21, wherein in a case that yL is equal to CtbSizeY – 5 and a row at yP1 is unavailable, a sample (x, yP1) in a row at yP1 is padded using a sample (x, yL) in a row at yL.~~

~~31. The method of claim 23, wherein, in a case that yL is equal to CtbSizeY – 6 and a row at yP2 is unavailable, a sample (x, yP2) in a row at yP2 is padded using a sample (x, yP1) in a row at yP1.~~

~~32. The method of claim 23, wherein, in a case that yL is equal to CtbSizeY – 5 and rows at yP2 and yP1 are unavailable, a sample (x, yP1) in a row at yP1 and a sample (x, yP2) in a row at yP2 are padded using a sample (x, yL) in a row at yL and a sample (x, yM1) in a row at yM1 is padded using a sample (x, yL) in a row at yL.~~

~~33. The method of claim 26, wherein, in a case that yL is equal to CtbSizeY – 7 and a row at yP3 is unavailable, a sample (x, yP3) in the row at yP3 is padded using a sample (x, yP2) in a row at yP2.~~

~~34. The method of claim 26, wherein, in a case that yL is equal to CtbSizeY – 6 and a row at yP3 and a row at yP2 are unavailable, a sample (x, yP3) in the row at yP3 and a sample (x, yP2) in the row at yP2 are padded using a sample (x, yP1) in a row at yP1 and a sample (x, yM2) is padded using a sample (x, yM1) in a row at yM1.~~

~~35. The method of claim 26, wherein, in a case that yL is equal to CtbSizeY – 5 and rows at yP3, yP2, and yP1 are unavailable, a sample (x, yP3) in a row at yP3, a sample (x, yP2) in a row at yP2, and a sample (x, yP1) in a row at yP1 are padded using a sample (x, yL) in a row at yL and a sample (x, yM2) in a row at yM2 and a sample (x, yM1) in a row at yM1 are padded using a sample (x, yL) in the row at yL.~~

~~36. The method of claim 5, wherein the unavailable luma sample is located at row M and samples located at row N are determined as the one or more corresponding luma samples to be padded, and wherein d(C, M) = d (N, C) - offset or d(C, M) < d(N, C), whereby d(x, y) denotes a distance between row x and row y, offset is an integer, and M, C, N are positive integers.~~

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

37. The method of claim 5, wherein the unavailable luma sample is located at row M and samples located at row N are determined as the one or more corresponding luma samples to be padded, and wherein d(M, C) = d(C, N) – offset or d(C, M) < d(N, C), whereby d(x, y) denotes a distance between row x and row y, offset is an integer, and M, C, N are positive integers.

38. The method of claim 36 or 37, wherein the offset is equal to 1.

39. The method of claim 36, wherein, in a case that the unavailable luma sample is located at row M above or row N below from a virtual boundary, the mirrored padding process includes padding the one or more corresponding luma samples located at row N below the virtual boundary or row M above the virtual boundary from a nearest sample row above the row N or below the row M, whereby M and N are positive integers.

40. The method of claim 39, wherein the unavailable luma sample is padded using a nearest row above the virtual boundary in a case that the virtual boundary is below the representative luma sample and wherein the one or more corresponding luma samples are padded using a nearest row below a row containing the one or more corresponding luma samples.

41. The method of claim 39, wherein the unavailable luma sample is padded using a nearest row below the virtual boundary in a case that the virtual boundary is above the representative luma sample and wherein the one or more corresponding samples are padded using a nearest row above a row containing the one or more corresponding luma samples.

42. The method of claim 40 or 41, wherein K=2, yL=0, yP1=1, and the virtual boundary is equal to CtbSizeY-4, whereby yL and yP1 are y-coordinates of two sample rows and CtbSizeY represents a size of coding tree unit (CTU).

43. The method of claim 42, wherein, in a case that yL is equal to CtbSizeY – 5 and a row at yP1 is unavailable, a sample (x, yP1) in a row at yP1 is padded using a sample (x, yL) in a row at yL.

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);

44. The method of claim 40 or 41, wherein K=4, yM1=-1, yL=0, yP1=1, yP2=2, and the virtual boundary is equal to CtbSizeY-4, whereby yM1, yL, yP1, yP2 are y-coordinates of four sample rows and CtbSizeY represents a size of coding tree unit (CTU).

45. The method of claim 44, wherein, in a case that yL is equal to CtbSizeY – 4 and a row above yM1 and a row at yM1 are unavailable, a sample (x, yM1) in a row at yM1 is padded using a sample (x, yL) in a row at yL and a sample (x, yP2) in a row at yP2 is padded using a sample (x, yP1) in a row at yP1.

46. The method of claim 44, wherein in a case that that yL is equal to CtbSizeY – 6 and a row at yP2 is unavailable, a sample (x, yP2) in the row at yP2 is padded using a sample (x, yP1) in a row at yP1.

47. The method of claim 44, wherein, in a case that yL is equal to CtbSizeY – 5 and rows at yP2 and yP1 are unavailable, a sample (x, yP2) at row yP2 are padded using a sample (x, yL) in a row at yL and a sample (x, yM1) in a row at yM1 is padded using a sample (x, yL) in the row at yL.

48. The method of claim 40 or 41, wherein K=6, yM2=-2, yM1=-1, yL=0, yP1=1, yP2=2, yP3=3 and the virtual boundary is equal to CtbSizeY-4, whereby yM2, yM1, yL, yP1, yP2, yP3 are y-coordinates of six sample rows and CtbSizeY represents a size of coding tree unit (CTU).

49. The method of claim 48, wherein, in a case that yL is equal to CtbSizeY – 3 and a row above yM2 and a row at yM2 are unavailable, a sample (x, yM2) in a row at yM2 is padded using a sample (x, yM1) in a row at yM1 and a sample (x, yP3) in a row at yP3 is padded using a sample (x, yP2) in a row at yP2.

50. The method of claim 48, wherein, in a case that yL is equal to CtbSizeY – 4 and a row above yM2, a row at yM2 and a row at yM1 are unavailable, samples (x, yM2) and (x, yM1) in rows at yM2 and yM1 are padded using a sample (x, yL) in a row at yL and samples (x, yP3) and (x, yP2) in rows yP3 and yP2 are padded using a sample (x, yP1) in a row at yP1.

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.

51. The method of claim 48, wherein, in a case that yL is equal to CtbSizeY - 7 and a row at yP3 is unavailable, a sample (x, yP3) in the row at yP3 is padded using a sample (x, yP2) in a row at yP2 and a sample (x, yM2) in a row at yM2 is padded using a sample (x, yM1) in a row at yM1.

52. The method of claim 48, wherein, in a case that yL is equal to CtbSizeY - 6 and a row at yP3 and a row at yP2 are unavailable, a sample (x, yP3) in the row at yP3 and a sample (x, yP2) in the row at yP2 are padded using a sample (x, yP1) in a row at yP1 and a sample (x, yM2) in a row at yM2 and a sample (x, yM1) in a row at yM1 are padded using a sample (x, yL) in a row at yL.

53. The method of claim 48, wherein, in a case that yL is equal to CtbSizeY - 5 and rows at yP3, yP2, and yP1 are unavailable, a sample (x, yP3) in a row at yP3, a sample (x, yP2) in a row at yP2, and a sample (x, yP1) in a row at yP1 are padded using a sample (x, yL) in a row at yL and a sample (x, yM2) in a row at yM2 and a sample (x, yM1) in a row at yM1 are padded using a sample (x, yL) in the row at yL.

54. The method of claim 1, wherein a result of the determining is included in the bitstream representation at a sequence level, a picture level, a slice level, or a tile group level.

55. The method of any of claims 1-54, wherein the first direction is a vertical direction and the second direction is a horizontal direction.

56. The method of any of claims 1-54, wherein the first direction is a horizonal direction and the second direction is a vertical direction.

57. The method of claim 55 or 56, wherein an orientation of the first direction and the second direction depends on an orientation of a boundary of a virtual buffer.

58. A method of video processing, comprising:

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.~~

~~59. The method of claim 58, wherein the coded information includes a size of the video unit that is a coding tree unit (CTU) or coding tree block (CTB).~~

~~60. The method of claim 59, wherein the mirrored padding process is applied in a case that the CTU or CTB size is greater than or equal to T, whereby T is a positive integer.~~

~~61. The method of claim 59, wherein the repetitive padding process is applied in a case that the CTU or CTB size is smaller than or equal to T, whereby T is a positive integer.~~

~~62. The method of any of previous claims, wherein the video unit comprises a picture, a subpicture, a slice, a tile or a 360-degree boundary of the video.~~

~~63. The method of any of previous claims, wherein in the CC-ALF tool, sample values of the video unit of a video component are predicted from sample values of the video unit of another video component.~~

~~64. The method of any of claims 1 to 63, wherein the conversion includes encoding the video into the bitstream representation.~~

~~65. The method of any of claims 1 to 63, wherein the conversion includes decoding the video from the bitstream representation.~~

~~66. A video processing apparatus comprising a processor configured to implement a method recited in any one or more of claims 1 to 65.~~

~~67. A computer readable medium storing program code that, when executed, causes a processor to implement a method recited in any one or more of claims 1 to 65.~~

~~68. A computer readable medium that stores a coded representation or a bitstream representation generated according to any of the above described methods.~~