

**~~WHAT IS CLAIMED IS:~~****CLAIMS**

1. An apparatus for decoding video data, the apparatus comprising:

a memory configured to store the video data; and

one or more processors implemented in circuitry and configured to:

decode a syntax element that indicates ~~a manner in which to perform~~ an adaptive loop filtering process, ~~the syntax element indicating that a~~ from among a plurality of adaptive loop filtering processes, wherein at least two of the plurality of adaptive loop filtering processes include application of a respective nonlinear operation is to be applied to the video data, the nonlinear operation configured to be applied in combination with a filtering operation of the, and wherein at least one of the plurality of adaptive loop filtering processes includes a first stage in which a pre filtering operation is configured to be applied before the respective nonlinear operation, and further includes a second stage in which a post filtering operation is configured to be applied after the respective nonlinear operation; and

perform, on the video data, the adaptive loop filtering process; and

~~perform the adaptive loop filtering process based on~~ indicated by the syntax element.

2. The apparatus of claim 1, wherein the syntax element indicates one of the plurality of adaptive loop filtering processes that includes the application of the respective nonlinear operation and the filtering operation, and wherein the respective nonlinear operation comprises one or more nonlinear operators that include one or more of: -a shrinkage operator, a sigmoid function, or a ReLU function.

3. The apparatus of claim 2, wherein the syntax element indicates cascaded versions of the nonlinear operators; in combination with the filtering operation.

4. The apparatus of claim 1, wherein the syntax element indicates one of the plurality of adaptive loop filtering processes that includes the application of the respective nonlinear operation and the

filtering operation, and wherein the syntax element further indicates parameters of the respective nonlinear operation.

5. The apparatus of claim 1, wherein the syntax element indicates one of the plurality of adaptive loop filtering processes that includes the application of the respective nonlinear operation and the filtering operation, and wherein to perform the adaptive loop filtering process, the one or more processors are configured to:

determine an order for combining the respective nonlinear operation and the filtering operation, wherein the order includes applying the respective nonlinear operation followed by the filtering operation; and

apply the respective nonlinear operation followed by the filtering operation.

~~6. The apparatus of claim 1,~~The apparatus of claim 1, wherein the syntax element indicates one of the plurality of adaptive loop filtering processes that includes the application of the respective nonlinear operation and the filtering operation, and wherein to perform the adaptive loop filtering process, the one or more processors are configured to:

determine the respective nonlinear operation based on sample position, block size, sample value, or color component; and

apply the respective nonlinear operation to input samples of the adaptive loop filtering process.

7. The apparatus of claim 1, wherein to perform the adaptive loop filtering process, the one or more processors are configured to:

determine ~~that the~~ respective nonlinear operation ~~based on sample position, block size, sample value, or color component~~ includes application of one or more clipping operators; and

apply the ~~determined~~ respective nonlinear operation ~~to input samples of following the adaptive loop filtering process.~~

~~7. The apparatus of claim 1, wherein the one or more processors are configured to apply the~~ pre filtering operation.

8. The apparatus of claim 1, wherein the syntax element indicates one of the ~~adaptive loop filtering process in a plurality of adaptive loop filtering stages,~~

~~wherein processes that includes the application of the plurality of filtering stages include:~~

~~a first stage in which a pre-filtering operation is configured to be applied before the respective nonlinear operation and the filtering operation, and~~

~~a second stage in which a post filtering operation is configured to be applied after the nonlinear operation.~~

~~8. The apparatus of claim 7, wherein to perform the adaptive loop filtering process, the one or more processors are configured to:~~

~~determine that the nonlinear operation includes application of one or more clipping operators; and~~

~~apply the nonlinear operation following the pre-filtering operation.~~

~~9. The apparatus of claim 1, wherein to perform the adaptive loop filtering process, the one or more processors are configured to:~~

~~apply the combination of the filtering operation and the respective nonlinear operation to a reconstructed block of the video data to produce a filtered block of the video data; and~~

~~output the filtered block to a decoded picture buffer-(DPB).~~

~~109. The apparatus of claim 1, wherein the syntax element indicates one of the plurality of adaptive loop filtering processes that includes the application of the respective nonlinear operation and the filtering operation, and wherein the one or more processors are further configured to:~~

~~perform a pre-clipping operation that precedes the adaptive loop filtering process, and wherein the respective nonlinear operation of the adaptive loop filtering process is separate from the pre-clipping operation.~~

~~110. The apparatus of claim 1, wherein the video data is one of a coding block of video data, a slice of video data, a tile of video data, a brick of video data, and/or a picture of video data.~~

~~12~~11. The apparatus of claim 1, further comprising a display configured to display decoded video data following performance of the adaptive loop filtering process.

~~13~~12. A method of decoding video data, the method comprising:

decoding a syntax element that indicates ~~a manner in which to perform~~ an adaptive loop filtering process; ~~from among a plurality of adaptive loop filtering processes, wherein at least two of the syntax element indicating that~~ plurality of adaptive loop filtering processes include application of a respective nonlinear operation in combination with a filtering operation, and wherein at least one of the plurality of adaptive loop filtering processes includes a first stage in which a pre filtering operation is configured to be applied to the video data, before the respective nonlinear operation, and further includes a second stage in which a post filtering operation is configured to be applied in combination with a filtering operation of after the adaptive loop filtering process respective nonlinear operation; and

performing, on the video data, the adaptive loop filtering process ~~based on~~ indicated by the syntax element.

~~14. The method of claim 13, wherein the~~ 13. The method of claim 12, wherein the syntax element indicates one of the plurality of adaptive loop filtering processes that includes the application of the respective nonlinear operation and the filtering operation, and wherein the respective nonlinear operation comprises one or more nonlinear operators that include one or more of: -a shrinkage operator, a sigmoid function, or a ReLU function.

~~15~~14. The method of claim ~~14~~, 13, wherein the syntax element indicates cascaded versions of the nonlinear operators in combination with the filtering operation.

~~16~~15. The method of claim ~~13~~, 12, wherein the syntax element indicates one of the plurality of adaptive loop filtering processes that includes the application of the respective nonlinear operation and the filtering operation, and wherein the syntax element further indicates parameters of the nonlinear operation.

~~1716.~~ The method of claim-~~13~~, 12, wherein the syntax element indicates one of the plurality of adaptive loop filtering processes that includes the application of the respective nonlinear operation and the filtering operation, and wherein performing the adaptive loop filtering process comprises:

determining an order for combining the respective nonlinear operation and the filtering operation, wherein the order includes applying the respective nonlinear operation followed by the filtering operation; and

applying the respective nonlinear operation followed by the filtering operation.

~~1817.~~ The method of claim-~~13~~, 12, wherein the syntax element indicates one of the plurality of adaptive loop filtering processes that includes the application of the respective nonlinear operation and the filtering operation, and wherein performing the adaptive loop filtering process comprises:

determining the respective nonlinear operation based on sample position, block size, sample value, or color component; and

applying the ~~determined~~ respective nonlinear operation to input samples of the adaptive loop filtering process.

~~1918.~~ The method of claim-~~13~~, 12, further comprising:

determining, based on side information, whether or not the filtering operation is adaptive; and

in response to the determination, enabling the adaptive loop filtering process.

~~2019.~~ The method of claim-~~13~~, ~~further comprising:~~

~~applying 12, wherein the filtering operationsyntax element indicates one of the plurality of adaptive loop filtering process in a plurality of filtering stages,~~

~~wherein the plurality of filtering stages include:~~

~~a first stage in which a pre-filtering operation is configured to be applied before processes that includes the application of the respective nonlinear operation; and~~

~~a second stage in which a post filtering operation is configured to be applied after the nonlinearfiltering operation.~~

~~21. The method of claim 20, and~~ wherein performing the adaptive loop filtering process comprises:

determining that the respective nonlinear operation includes application of one or more clipping operators; and

applying the respective nonlinear operation following the pre-filtering operation.

~~22~~20. The method of claim 12, wherein the syntax element indicates one of claim 13, the plurality of adaptive loop filtering processes that includes the application of the respective nonlinear operation and the filtering operation, and wherein performing the adaptive loop filtering process comprises:

applying the ~~combination of the~~ filtering operation and the respective nonlinear operation to a reconstructed block of the video data to produce a filtered block of the video data; and

outputting the filtered block to a decoded picture buffer\_(DPB).

~~23~~21. The method of ~~claim 13, 12~~, wherein the syntax element indicates one of the plurality of adaptive loop filtering processes that includes the application of the respective nonlinear operation and the filtering operation, the method further comprising:

performing a pre-clipping operation that precedes the adaptive loop filtering process, and wherein the respective nonlinear operation of the adaptive loop filtering process is separate from the pre-clipping operation.

~~24~~22. The method of ~~claim 13, 12~~, wherein the video data is one of a coding block of video data, a slice of video data, a tile of video data, a brick of video data, and/or a picture of video data.

~~25~~23. An apparatus for encoding video data, the apparatus comprising:

a memory configured to store the video data; and

one or more processors implemented in circuitry and configured to:

~~determine a nonlinear operation and a filtering operation to perform in an adaptive loop filtering process;~~

~~perform~~determine an adaptive loop filtering process from among a plurality of adaptive loop filtering processes, wherein at least two of the plurality of adaptive loop

filtering processes include application of a respective non-linear operation in combination with a filtering operation, and wherein at least one of the plurality of adaptive loop filtering processes includes a first stage in which a pre filtering operation is configured to be applied before the respective nonlinear operation, and further includes a second stage in which a post filtering operation is configured to be applied after the respective nonlinear operation;

perform, on the video data, the adaptive loop filtering process by applying the filtering operation and the nonlinear operation to the video data; and

encode a syntax element that indicates a manner in which the adaptive loop filtering process was performed from among the plurality of adaptive loop filtering processes.

2624. The apparatus of claim-25, 23, wherein to encode the syntax element, the one or more processors are configured to:

encode the syntax element to indicate the filtering operation or the respective nonlinear operation as a first operation of the adaptive loop filtering process.

2725. The apparatus of claim-25, 23, wherein to encode the syntax element, the one or more processors are configured to:

encode the syntax element to indicate a composition order for the filtering operation and the respective nonlinear operation.

2826. An apparatus for decoding video data, the apparatus including:

means for decoding a syntax element that indicates a manner in which to perform an adaptive loop filtering process, the syntax element indicating that a nonlinear operation is to be applied to the video data, the nonlinear operation configured to be applied in combination with a filtering operation of the from among a plurality of adaptive loop filtering process; and

means for performing the processes, wherein at least two of the plurality of adaptive loop filtering process based on the syntax element.

~~29. The apparatus of claim 28, wherein the means for performing the processes include application of a respective nonlinear operation in combination with a filtering operation, and wherein at least one of the plurality of adaptive loop filtering process comprises:~~

~~means for applying the nonlinear operation; and~~

~~means for applying the processes includes a first stage in which a pre filtering operation following is configured to be applied before the respective nonlinear operation-~~

~~30. The apparatus of claim 28, and further comprising: includes a second stage in which a post filtering operation is configured to be applied after the respective nonlinear operation; and~~

~~means for applying performing, on the filtering operation of video data, the adaptive loop filtering process in a plurality of filtering stages that are separated indicated by the nonlinear operationsyntax element.~~

~~31. The apparatus of claim 28, wherein the means for performing the adaptive loop filtering process comprises:~~

~~means for applying the nonlinear operation to a reconstructed block of the video data.~~

~~3227. A non-transitory computer-readable storage medium having stored thereon instructions that, when executed, cause one or more processors to:~~

~~decode a syntax element that indicates a manner in which to perform an adaptive loop filtering process, the syntax element indicating that a from among a plurality of adaptive loop filtering processes, wherein at least two of the plurality of adaptive loop filtering processes include application of a respective nonlinear operation is to be applied to video data in combination with a filtering operation; and wherein at least one of the plurality of adaptive loop filtering processes includes a first stage in which a pre filtering operation is configured to be applied before the respective nonlinear operation, and further includes a second stage in which a post filtering operation is configured to be applied after the respective nonlinear operation; and~~

~~perform, on video data, the adaptive loop filtering process based on indicated by the syntax element.~~

~~3328~~. The non-transitory computer-readable storage medium of claim ~~32~~, wherein the 27, wherein the syntax element indicates one of the plurality of adaptive loop filtering processes that includes the application of the respective nonlinear operation and the filtering operation, and wherein the respective nonlinear operation comprises one or more nonlinear operators that include one or more of: -a shrinkage operator, a sigmoid function, or a ReLU function.

~~3429~~. The non-transitory computer-readable storage medium of claim ~~32~~, 27, wherein the syntax element indicates one of the plurality of adaptive loop filtering processes that includes the application of the respective nonlinear operation and the filtering operation, and wherein the instructions, when executed, cause the one or more processors to:

apply the filtering operation and the respective nonlinear operation to a reconstructed block of the video data to produce a filtered block of the video data.

~~3530~~. The non-transitory computer-readable storage medium of claim ~~32~~, 27, wherein the syntax element indicates one of the plurality of adaptive loop filtering processes that includes the application of the respective nonlinear operation and the filtering operation, and wherein the instructions, when executed, cause the one or more processors to:

determine one or more filtering coefficients for the filtering operation; and  
determine one or more parameters for the respective nonlinear operation.

~~3631~~. The non-transitory computer-readable storage medium of claim ~~32~~, 27, wherein the syntax element indicates one of the plurality of adaptive loop filtering processes that includes the application of the respective nonlinear operation and the filtering operation, and wherein the instructions, when executed, cause the one or more processors to:

determine an order for combining the respective nonlinear operation and the filtering.

32. The apparatus of claim 1, wherein at least one of the plurality of adaptive loop filtering processes includes the filtering operation- ~~applied alone~~.

33. The method of claim 12, wherein at least one of the plurality of adaptive loop filtering processes includes the filtering operation applied alone.

34. The apparatus of claim 23, wherein at least one of the plurality of adaptive loop filtering processes includes the filtering operation applied alone.