CLAIMS

1. A method of decoding video data, the method comprising:

generating decoded modified chroma residual data by applying an inverse transform to convert a set of transform coefficients of a block of the video data from a transform domain to a sample domain;

decoding a flag from a video bitstream including the video data;

after generating the decoded modified chroma residual data, applying a first inverse residual modification function to the decoded modified chroma residual data to generate first inverse modified chroma residual data and applying a second inverse residual modification function to the second decoded modified chroma residual data to generate second inverse modified chroma residual data, wherein a first decoded modified chroma residual data is associated with a first chroma component and a second decoded modified chroma residual data is associated with a second chroma component; and

reconstructing the block of the video data based on the first inverse modified chroma residual data and the second inverse modified chroma residual data;

characterized in that the first and second inverse residual modification functions are determined by the flag.

2. The method of claim 1, wherein reconstructing the block comprises:

adding the first inverse modified chroma residual data to first predicted chroma data to obtain first reconstructed chroma data of the block; and

adding the second inverse modified chroma residual data to second predicted chroma data to obtain second reconstructed chroma data of the block.

3. The method of claim 1, wherein the method further comprises:

determining whether to apply the first inverse residual modification function or a third inverse residual modification function to the decoded modified chroma residual data to generate the first inverse modified chroma residual data; and

determining whether to apply the second inverse residual modification function or a fourth inverse residual modification function to the decoded modified chroma residual data to generate the second inverse modified chroma residual data.

4. The method of claim 3, wherein:

determining whether to apply the first inverse residual modification function or the third inverse residual modification function comprises determining, based on one or more characteristics of the block, whether to apply the first inverse residual modification function or the third inverse residual modification function to the decoded modified chroma residual data to generate the first inverse modified chroma residual data; and

determining whether to apply the second inverse residual modification function or the fourth inverse residual modification function comprises determining, based on the one or more characteristics of the block, whether to apply the second inverse residual modification function or the fourth inverse residual modification function to the decoded modified chroma residual data to generate the second inverse modified chroma residual data.

5. The method of claim 4, wherein the characteristics of the block include one or more of: whether a slice or tile that contains the block is an intra type or an inter type, whether current picture referencing is used with the block, whether a dual or shared coding tree is used with the block, dimensions of the block, or an aspect ratio of the block.

6. The method of claim 3, wherein:

determining whether to apply the first inverse residual modification function or the third inverse residual modification function comprises determining, based on data signaled in a bitstream, whether to apply the first inverse residual modification function or the third inverse residual modification function to the decoded modified chroma residual data to generate the first inverse modified chroma residual data; and

determining whether to apply the second inverse residual modification function or the fourth inverse residual modification function comprises determining, based on the data signaled in the bitstream, whether to apply the second inverse residual modification function or the fourth inverse residual modification function to the decoded modified chroma residual data to generate the second inverse modified chroma residual data.

7. The method of claim 1, wherein:

the first inverse residual modification function is: invF1(x,y) = (resCr(x,y)’ + B10) / M10 + (resCb(x,y)’ + B11) / M11,

the second inverse residual modification function is: invF2(x,y) = (resCr(x,y)’ + B20) / M20 – (resCb(x,y)’ + B21) / M21,

where resCb(x,y)’ is the first decoded modified chroma residual data, resCr(x,y)’ is the second decoded modified chroma residual data, B10, B11, B20, and B21 are rounding terms, and M10, M11, M20 and N21 are normalizing factors.

8. The method of claim 1, further comprising:

applying an inverse CRS process to the decoded modified chroma residual data before applying the first inverse residual modification function to the decoded modified chroma residual data to generate the first inverse modified chroma residual data; and

applying the inverse CRS process to the decoded modified chroma residual data before applying the second inverse residual modification function to the decoded modified chroma residual data to generate the second inverse modified chroma residual data.

9. The method of claim 1, further comprising:

applying an inverse CRS process to the decoded modified chroma residual data as part of applying the first inverse residual modification function to the decoded modified chroma residual data to generate the first inverse modified chroma residual data; and

applying the inverse CRS process to the decoded modified chroma residual data as part of applying the second inverse residual modification function to the decoded modified chroma residual data to generate the second inverse modified chroma residual data.

10. A method of encoding video data, the method comprising:

applying a residual modification function to first chroma residual data of a block of the video data and second chroma residual data of the block to generate modified chroma residual data, wherein the first chroma residual data is associated with a first chroma component and the second chroma residual data is associated with a second chroma component;

encoding the modified chroma residual data, wherein encoding the modified chroma residual data comprises, after applying the residual modification function to the first chroma residual data and the second chroma residual data, applying a forward transform to the modified chroma residual data to convert the modified chroma residual data from a sample domain to a transform domain; and

encoding a flag in the video bitstream including the video data, characterized in that the flag indicates first and second inverse residual modification functions to be applied by the decoder to the encoded modified chroma residual data.

11. The method of claim 10, wherein the method further comprises:

determining whether to apply the residual modification function or a third residual modification function to the first chroma residual data to generate the modified chroma residual data; and

determining whether to apply the residual modification function or a fourth residual modification function to the second chroma residual data to generate the modified chroma residual data.

12. The method of claim 11, wherein:

determining whether to apply the residual modification function or the third residual modification function comprises determining, based on one or more characteristics of the block, whether to apply the residual modification function or the third residual modification function to the first chroma residual data to generate the modified chroma residual data; and

determining whether to apply the residual modification function or the fourth residual modification function comprises determining, based on the one or more characteristics of the block, whether to apply the residual modification function or the fourth residual modification function to the second chroma residual data to generate the modified chroma residual data.

13. The method of claim 12, wherein the characteristics of the block include one or more of: whether a slice or tile that contains the block is an intra type or an inter type, whether current picture referencing is used with the block, whether a dual or shared coding tree is used with the block, dimensions of the block, or an aspect ratio of the block.

14. The method of claim 11, wherein the method further comprises:

signaling, in a bitstream, data indicating whether the residual modification function or the third residual modification function was applied to generate the modified chroma residual data; and

signaling, in the bitstream, data indicating whether the inverse residual modification function or the fourth inverse residual modification function was applied to generate the modified chroma residual data.

15. The method of claim 10, wherein:

a first residual modification function is: $F1(x,y) = (resCb(x,y) + A10) / N10 – (resCr(x,y) + A11) / N11$,

a second residual modification function is: $F2(x,y) = (resCb(x,y) + A20) / N20 + (resCr(x,y) + A21) / N21$,

where $resCb(x,y)$ is the first chroma residual data, $resCr(x,y)$ is the second chroma residual data, A10, A11, A20, and A21 are rounding terms, and N10, N11, N20 and N21 are normalizing factors.

16. The method of claim 10, further comprising:

applying a CRS process to the modified chroma residual data after applying the residual modification function to the first chroma residual data to generate the modified chroma residual data; and

applying the CRS process to the modified chroma residual data after applying the residual modification function to the second chroma residual data to generate the modified chroma residual data.

17. The method of claim 10, further comprising:

applying a CRS process to the first chroma residual data as part of applying the residual modification function to the first chroma residual data to generate the modified chroma residual data; and

applying the CRS process to the second chroma residual data as part of applying the residual modification function to the second chroma residual data to generate the modified chroma residual data.

18. A device for decoding video data, the device comprising:

a memory to store the video data; and

one or more processors implemented in circuitry, the one or more processors configured to:

generate decoded modified chroma residual data by applying an inverse transform to convert a set of transform coefficients of a block of the video data from a transform domain to a sample domain;

decoding a flag from a video bitstream including the video data;

after generating the decoded modified chroma residual data, apply a first inverse residual modification function to the decoded modified chroma residual data to generate first inverse modified chroma residual data and apply a second inverse residual modification function to the decoded modified chroma residual data to generate second inverse modified chroma residual data, wherein a first decoded modified chroma residual data is associated with a first chroma component and a second decoded modified chroma residual data is associated with a second chroma component; and

reconstruct the block of the video data based on the first inverse modified chroma residual data and the second inverse modified chroma residual data;

characterized in that the first and second inverse residual modification functions are determined by the flag.

19. The device of claim 18, wherein the one or more processors are configured such that, as part of reconstructing the block, the one or more processors:

add the first inverse modified chroma residual data to first predicted chroma data to obtain first reconstructed chroma data of the block; and

add the second inverse modified chroma residual data to second predicted chroma data to obtain second reconstructed chroma data of the block.

20. The device of claim 18, wherein the one or more processors are further configured to:

determine whether to apply the first inverse residual modification function or a third inverse residual modification function to the decoded modified chroma residual data to generate the first inverse modified chroma residual data; and

determine whether to apply the second inverse residual modification function or a fourth inverse residual modification function to the decoded modified chroma residual data to generate the second inverse modified chroma residual data.

21. The device of claim 20, wherein:

the one or more processors are configured such that, as part of determining whether to apply the first inverse residual modification function or the third inverse residual modification function, the one or more processors determine, based on one or more characteristics of the block, whether to apply the first inverse residual modification function or the third inverse residual modification function to the decoded modified chroma residual data to generate the first inverse modified chroma residual data; and

the one or more processors are configured such that, as part of determining whether to apply the second inverse residual modification function or the fourth inverse residual modification function, the one or more processors determine, based on the one or more characteristics of the block, whether to apply the second inverse residual modification function or the fourth inverse residual modification function to the decoded modified chroma residual data to generate the second inverse modified chroma residual data.

22. The device of claim 21, wherein the characteristics of the block include one or more of: whether a slice or tile that contains the block is an intra type or an inter type, whether current picture referencing is used with the block, whether a dual or shared coding tree is used with the block, dimensions of the block, or an aspect ratio of the block.

23. The device of claim 20, wherein:

the one or more processors are configured such that, as part of determining whether to apply the first inverse residual modification function or the third inverse residual modification function, the one or more processors determine, based on data signaled in a bitstream, whether to apply the first inverse residual modification function or the third inverse residual modification function to the decoded modified chroma residual data to generate the first inverse modified chroma residual data; and

the one or more processors are configured such that, as part of determining whether to apply the second inverse residual modification function or the fourth inverse residual modification function, the one or more processors determine, based on the data signaled in the bitstream, whether to apply the second inverse residual modification function or the fourth inverse residual modification function to the decoded modified chroma residual data to generate the second inverse modified chroma residual data.

24. The device of claim 18, wherein:

the first inverse residual modification function is: invF1(x,y) = (resCr(x,y)' + B10) / M10 + (resCb(x,y)' + B11) / M11,

the second inverse residual modification function is: invF2(x,y) = (resCr(x,y)' + B20) / M20 – (resCb(x,y)' + B21) / M21,

where resCb(x,y)' is the first decoded modified chroma residual data, resCr(x,y)' is the second decoded modified chroma residual data, B10, B11, B20, and B21 are rounding terms, and M10, M11, M20 and N21 are normalizing factors.

25. The device of claim 18, wherein the one or more processors are further configured to:

apply an inverse CRS process to the decoded modified chroma residual data before applying the first inverse residual modification function to the decoded modified chroma residual data to generate the first inverse modified chroma residual data; and

apply the inverse CRS process to the decoded modified chroma residual data before applying the second inverse residual modification function to the decoded modified chroma residual data to generate the second inverse modified chroma residual data.

26. The device of claim 18, wherein the one or more processors are configured to:

apply an inverse CRS process to the decoded modified chroma residual data as part of applying the first inverse residual modification function to the decoded modified chroma residual data to generate the first inverse modified chroma residual data; and

apply the inverse CRS process to the decoded modified chroma residual data as part of applying the second inverse residual modification function to the decoded modified chroma residual data to generate the second inverse modified chroma residual data.

27. The device of claim 18, further comprising a display configured to display decoded video data.

28. The device of claim 18, wherein the device comprises one or more of a camera, a computer, a mobile device, a broadcast receiver device, or a set-top box.

29. A device for encoding video data, the device comprising:

a memory to store the video data; and

one or more processors implemented in circuitry, the one or more processors configured to:

apply a residual modification function to first chroma residual data of a block of the video data and second chroma residual data of the block to generate modified chroma residual data, wherein the first chroma residual data is associated with a first chroma component and the second chroma residual data is associated with a second chroma component;

encode the modified chroma residual data, wherein the one or more processors are configured such that, as part of encoding the first modified chroma residual data, the one or more processors, after applying the residual modification function to the first chroma residual data and the second chroma residual data, apply a forward transform to the modified chroma residual data to convert the modified chroma residual data from a sample domain to a transform domain; and

encode a flag in the video bitstream including the video data, characterized in that the flag indicates first and second inverse residual

modification functions to be applied by the decoder to the encoded modified chroma residual data.

30. The device of claim 29, wherein the one or more processors are further configured to:

determine whether to apply the residual modification function or a third residual modification function to the first chroma residual data to generate the modified chroma residual data; and

determine whether to apply the residual modification function or a fourth residual modification function to the second chroma residual data to generate the modified chroma residual data.

31. The device of claim 30, wherein:

the one or more processors are configured such that, as part of determining whether to apply the residual modification function or the third residual modification function, the one or more processors determine, based on one or more characteristics of the block, whether to apply the residual modification function or the third residual modification function to the first chroma residual data to generate the modified chroma residual data; and

the one or more processors are configured such that, as part of determining whether to apply the residual modification function or the fourth residual modification function, the one or more processors determine, based on the one or more characteristics of the block, whether to apply the residual modification function or the fourth residual modification function to the second chroma residual data to generate the modified chroma residual data.

32. The device of claim 31, wherein the characteristics of the block include one or more of: whether a slice or tile that contains the block is an intra type or an inter type, whether current picture referencing is used with the block, whether a dual or shared coding tree is used with the block, dimensions of the block, or an aspect ratio of the block.

33. The device of claim 30, wherein the one or more processors are further configured to:

signal, in a bitstream, data indicating whether the residual modification function or the third residual modification function was applied to generate the modified chroma residual data; and

signal, in the bitstream, data indicating whether the inverse residual modification function or the fourth inverse residual modification function was applied to generate the modified chroma residual data.

34. The device of claim 29, wherein:

a first residual modification function is: F1(x,y) = (resCb(x,y) + A10) / N10 – (resCr(x,y) + A11) / N11,

a second residual modification function is: F2(x,y) = (resCb(x,y) + A20) / N20 + (resCr(x,y) + A21) / N21,

where resCb(x,y) is the first chroma residual data, resCr(x,y) is the second chroma residual data, A10, A11, A20, and A21 are rounding terms, and N10, N11, N20 and N21 are normalizing factors.

35. The device of claim 29, wherein the one or more processors are further configured to:

apply a CRS process to the modified chroma residual data after applying the residual modification function to the first chroma residual data to generate the modified chroma residual data; and

apply the CRS process to the modified chroma residual data after applying the residual modification function to the second chroma residual data to generate the modified chroma residual data.

36. The device of claim 29, wherein the one or more processors are further configured to:

apply a CRS process to the first chroma residual data as part of applying the residual modification function to the first chroma residual data to generate the modified chroma residual data; and

apply the CRS process to the second chroma residual data as part of applying the residual modification function to the second chroma residual data to generate the modified chroma residual data.

37. The device of claim 29, wherein the device comprises one or more of a camera, a computer, or a mobile device.

38. A device for decoding video data, the device comprising:

means for generating decoded modified chroma residual data by applying an inverse transform to convert a set of transform coefficients of a block of the video data from a transform domain to a sample domain;

means for decoding a flag from a video bitstream including the video data;

means for applying, after generating the decoded modified chroma residual data, a first inverse residual modification function to the decoded modified chroma residual data to generate first inverse modified chroma residual data;

means for applying a second inverse residual modification function to the second decoded modified chroma residual data to generate second inverse modified chroma residual data, wherein a first decoded modified chroma residual data is associated with a first chroma component and a second decoded modified chroma residual data is associated with a second chroma component; and

means for reconstructing the block of the video data based on the first inverse modified chroma residual data and the second inverse modified chroma residual data;

characterized in that the first and second inverse residual modification functions are determined by the flag.

39. A device for encoding video data, the device comprising:

means for applying a residual modification function to first chroma residual data of a block of the video data and second chroma residual data of the block to generate modified chroma residual data, wherein the first chroma residual data is associated with a first chroma component and the second chroma residual data is associated with a second chroma component;

means for encoding the modified chroma residual data, wherein encoding the modified chroma residual data comprises means for applying, after applying the residual modification function to the first chroma residual data and the second chroma residual data, a forward transform to the modified chroma residual data to convert the modified chroma residual data from a sample domain to a transform domain; and

means for encoding a flag in the video bitstream including the video data, characterized in that the flag indicates first and second inverse residual modification functions to be applied by the decoder to the encoded modified chroma residual data.

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

generate decoded modified chroma residual data by applying an inverse transform to convert a set of transform coefficients of a block of video data from a transform domain to a sample domain;

decode a flag from a video bitstream including the video data;

after generating first decoded modified chroma residual data, apply a first inverse residual modification function to the decoded modified chroma residual data to generate first inverse modified chroma residual data and apply a second inverse residual modification function to the second decoded modified chroma residual data to generate second inverse modified chroma residual data, wherein a first decoded modified chroma residual data is associated with a first chroma component and a second decoded modified chroma residual data is associated with a second chroma component; and

reconstruct the block of the video data based on the first inverse modified chroma residual data and the second inverse modified chroma residual data;

characterized in that the first and second inverse residual modification functions are determined by the flag.

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

apply a residual modification function to first chroma residual data and second chroma residual data of the block of a block of video data to generate modified chroma residual data, wherein the first chroma residual data is associated with a first chroma component and the second chroma residual data is associated with a second chroma component;

encode the modified chroma residual data, wherein as part of causing the one or more processors to encode the first modified chroma residual data, execution of the instructions causes the one or more processors to apply, after applying the residual modification function to the first chroma residual data and the second chroma residual

data, a forward transform to the modified chroma residual data to convert the modified chroma residual data from a sample domain to a transform domain; and

encode a flag in the video bitstream including the video data, characterized in that the flag indicates first and second inverse residual modification functions to be applied by the decoder to the encoded modified chroma residual data.