information to reproduce the original image.

BRIEF DESCRIPTION

Embodiments herein deviate with respect to conventional systems and methods. For example, embodiments herein are directed to unique ways of processing and reproducing signals such as image information and other types of encoded information.

More specifically, a non-limiting embodiment described herein includes reconstructing a signal at successively higher levels of quality in a hierarchy. For example, according to one embodiment, a decoder decodes a first set of data and utilizes the first set of decoded data to reconstruct the signal according to a first level of quality. The decoder decodes a second set of data and identifies an upsample operation specified by the second set of decoded data, together with a scale factor also specified by the second set of decoded data. The decoder then applies the upsample operation and the scale factor identified in the second set of decoded data to the reconstructed signal at the first level of quality to reconstruct the signal at a second level of quality. In this example, the second level of quality is higher in quality than the first level of quality. In this manner, a set of decoded data indicates how to perform upsampling from one tier to the next.

In accordance with further embodiments, to enhance the reconstructed signal at a respective level of quality, the decoder also can be configured to retrieve residual data from the second set of decoded data. The residual data can indicate how to modify the reconstructed signal at the second level of quality subsequent to application of the upsampling operation as discussed above. The decoder modifies the reconstructed signal at the second level of quality as specified by the residual data.

The decoder can repeat the above processing for each of multiple levels of quality in the hierarchy. For example, for each of multiple levels of quality above the second level of quality, the decoder repeats steps of: decoding a next higher set of data in the hierarchy above a last processed level of quality; identifying an upsample operation and a scale factor specified by the next higher set of decoded data; applying the upsample operation and the scale factor identified in the next higher set of decoded data to reconstruct the signal at a next higher level of quality; identifying residual information and/or residual

information to reproduce the original image.

BRIEF DESCRIPTION

Embodiments herein deviate with respect to conventional systems and methods. For example, embodiments herein are directed to unique ways of processing and reproducing signals such as image information and other types of encoded information.

In accordance with an aspect there is provided a method of reconstructing a signal at successively higher levels of quality in a hierarchy, the method comprising:

decoding a first set of data;

utilizing the decoded first set of data to reconstruct the signal according to a first level of quality;

decoding a second set of data;

identifying an upsample operation specified by the decoded second set of data;

applying the upsample operation identified in the decoded second set of data to the reconstructed signal at the first level of quality to reconstruct the signal at a second level of quality, the second level of quality being higher than the first level of quality;

decoding a third set of data;

identifying an upsample operation specified by the decoded third set of data; and

applying the upsample operation identified in the decoded third set of data to the reconstructed signal at the second level of quality to reconstruct the signal at a third level of quality, the third level of quality being higher than the second level of quality in the hierarchy.

In accordance with a further aspect there is provided a method of reconstructing a signal at successively higher levels of quality in a hierarchy, the method comprising:

decoding a first set of data;

utilizing the decoded first set of data to reconstruct the signal according to a first level of quality;

decoding a second set of data;

identifying an upsample operation specified by the decoded second set of data;

applying the upsample operation identified in the decoded second set of data to the reconstructed signal at the first level of quality to reconstruct the signal at a second level of quality, the second level of quality being higher than the first level of quality;

identifying residual data as specified by the decoded second set of data;

utilizing an entropy decoder to decode the residual data, the decoded residual data specifying how to modify specific elements of the reconstructed signal at the second level of quality; and

modifying the elements of the reconstructed signal at the second level of quality in a manner as specified by the decoded residual data.

In accordance with another aspect there is provided a computer system comprising:

processor hardware;

a storage unit that stores instructions associated with an application executed by the processor hardware; and

an interconnect coupling the processor hardware and the storage unit, causing the processor hardware to execute the application and perform operations of:

decoding a first set of data;

utilizing the decoded first set of data to reconstruct the signal according to a first level of quality;

decoding a second set of data;

identifying an upsample operation specified by the decoded second set of data;

applying the upsample operation identified in the decoded second set of data to the reconstructed signal at the first level of quality to reconstruct the signal at a second level of quality, the second level of quality being higher than the first level of quality;

decoding a third set of data;

identifying an upsample operation specified by the decoded third set of data; and

applying the upsample operation identified in the decoded third set of data to the reconstructed signal at the second level of quality to reconstruct the signal at a third level of quality, the third level of quality being higher than the second level of quality in the hierarchy.

In accordance with yet another aspect there is provided a computer-readable hardware storage hardware having instructions stored thereon, the instructions, when carried out by processing hardware, causes the processing hardware to perform operations of:

decoding a first set of data;

utilizing the decoded first set of data to reconstruct the signal according to a first level of quality;

decoding a second set of data;

identifying an upsample operation specified by the decoded second set of data;

applying the upsample operation identified in the decoded second set of data to the reconstructed signal at the first level of quality to reconstruct the signal at a second level of quality, the second level of quality being higher than the first level of quality;

decoding a third set of data;

identifying an upsample operation specified by the decoded third set of data; and

applying the upsample operation identified in the decoded third set of data to the reconstructed signal at the second level of quality to reconstruct the signal at a third level of quality, the third level of quality being higher than the second level of quality in the hierarchy.

In accordance with still a further aspect there is provided a method of reconstructing a signal at successively higher levels of quality in a hierarchy, the method comprising:

decoding a first set of data;

utilizing the first set of decoded data to reconstruct the signal according to a first level of quality;

decoding a second set of data, the second set of data produced by an encoder to reconstruct the signal at a second level of quality;

identifying an upsample operation as specified by a decoded data subset of the second set of data; and

applying the identified upsample operation to the reconstructed signal at the first level of quality to reconstruct a preliminary rendition of the signal at the second level of quality, the second level of quality being higher than the first level of quality;

processing the decoded second set of data to produce residual data for the rendition of the signal at the second level of quality, the residual data indicating how to modify the preliminary rendition of the signal at the second level of quality; and

modifying the reconstructed preliminary rendition of the signal at the second level of quality using the residual data.

In accordance with another aspect there is provided a computer system comprising:

processor hardware;

a storage unit that stores instructions associated with an application executed by the processor hardware; and

an interconnect coupling the processor hardware and the storage unit, causing the computer system to execute the instructions and perform operations of:

decoding a first set of data;

utilizing the decoded first set of data to reconstruct the signal according to a first level of quality;

decoding a second set of data;

identifying an upsample operation specified by the decoded second set of data;

applying the upsample operation identified in the decoded second set of data to the reconstructed signal at the first level of quality to reconstruct the signal at a second level of quality, the second level of quality being higher than the first level of quality;

identifying residual data as specified by decoded second set of data;

utilizing an entropy decoder to decode the residual data, the decoded residual data specifying how to modify specific elements of the reconstructed signal at the second level of quality; and

modifying the elements of the reconstructed signal at the second level of quality in a manner as specified by the decoded residual data.

In accordance with a further aspect there is provided a computer-readable hardware storage hardware having instructions stored thereon, the instructions, when carried out by a processing device, causes the processing device to perform operations of:

decoding a first set of data;

utilizing the decoded first set of data to reconstruct the signal according to a first level of quality;

decoding a second set of data;

identifying an upsample operation specified by the decoded second set of data;

applying the upsample operation identified in the decoded second set of data to the reconstructed signal at the first level of quality to reconstruct the signal at a second level of quality, the second level of quality being higher than the first level of quality;

identifying residual data as specified by decoded second set of data;

utilizing an entropy decoder to decode the residual data, the decoded residual data specifying how to modify specific elements of the reconstructed signal at the second level of quality; and

modifying the elements of the reconstructed signal at the second level of quality in a manner as specified by the decoded residual data.

In accordance with still another aspect there is provided a method of reconstructing a signal at

successively higher levels of quality in a hierarchy, the method comprising:

decoding a first set of data;

utilizing the first set of decoded data to reconstruct the signal according to a first level of quality;

decoding a second set of data, the second set of data produced by an encoder to reconstruct the signal at a second level of quality, the encoder, during encoding of the signal, producing the second set of data to specify an upsample operation to reconstruct a preliminary rendition of the signal at the second level of quality, the encoder producing the upsample operation to reduce an entropy of residual data to be applied to the preliminary rendition of the signal at the second level of quality;

identifying the upsample operation as specified by a decoded data subset of the second set of data; and

applying the identified upsample operation to the reconstructed signal at the first level of quality to reconstruct the preliminary rendition of the signal at the second level of quality, the second level of quality being higher than the first level of quality.

In accordance with another aspect there is provided a computer system comprising:

processor hardware;

a storage unit that stores instructions associated with an application executed by the processor hardware; and

an interconnect coupling the processor hardware and the storage unit, causing the processor hardware to execute the instructions and perform operations of:

decoding a first set of data;

utilizing the first set of decoded data to reconstruct the signal according to a first level of quality;

decoding a second set of data, the second set of data produced by an encoder to reconstruct the signal at a second level of quality;

identifying an upsample operation as specified by a decoded data subset of the second set of data;

applying the identified upsample operation to the reconstructed signal at the first level of quality to reconstruct a preliminary rendition of the signal at the second level of quality, the second level of quality being higher than the first level of quality;

wherein the encoder, during encoding of the signal, produced the second set of data to

specify the upsample operation to reconstruct the preliminary rendition of the signal at the second level of quality;

wherein the encoder, during encoding of the signal, produced the upsample operation to reduce an entropy of residual data to be applied to the preliminary rendition of the signal at the second level of quality.

In accordance with yet another aspect there is provided a computer system comprising:

processor hardware;

a storage unit that stores instructions associated with an application executed by the processor hardware; and

an interconnect coupling the processor hardware and the storage unit, causing the processor hardware to execute the instructions and perform operations of:

decoding a first set of data;

utilizing the first set of decoded data to reconstruct the signal according to a first level of quality;

decoding a second set of data, the second set of data produced by an encoder to reconstruct the signal at a second level of quality;

identifying an upsample operation as specified by a decoded data subset of the second set of data; and

applying the identified upsample operation to the reconstructed signal at the first level of quality to reconstruct a preliminary rendition of the signal at the second level of quality, the second level of quality being higher than the first level of quality;

processing the decoded second set of data to produce residual data for the rendition of the signal at the second level of quality, the residual data indicating how to modify the preliminary rendition of the signal at the second level of quality; and

modifying the reconstructed preliminary rendition of the signal at the second level of quality using the residual data

More specifically, a non-limiting embodiment described herein includes reconstructing a signal at successively higher levels of quality in a hierarchy. For example, according to one embodiment, a decoder decodes a first set of data and utilizes the first set of decoded data to reconstruct the signal according to a first level of quality. The decoder decodes a second set of data and identifies an upsample operation specified by the second set of decoded data, together with a scale factor also specified by the second set of decoded data. The decoder then applies the

upsample operation and the scale factor identified in the second set of decoded data to the reconstructed signal at the first level of quality to reconstruct the signal at a second level of quality. In this example, the second level of quality is higher in quality than the first level of quality. In this manner, a set of decoded data indicates how to perform upsampling from one tier to the next.

In accordance with further embodiments, to enhance the reconstructed signal at a respective level of quality, the decoder also can be configured to retrieve residual data from the second set of decoded data. The residual data can indicate how to modify the reconstructed signal at the second level of quality subsequent to application of the upsampling operation as discussed above. The decoder modifies the reconstructed signal at the second level of quality as specified by the residual data.

The decoder can repeat the above processing for each of multiple levels of quality in the hierarchy. For example, for each of multiple levels of quality above the second level of quality, the decoder repeats steps of: decoding a next higher set of data in the hierarchy above a last processed level of quality; identifying an upsample operation and a scale factor specified by the next higher set of decoded data; applying the upsample operation and the scale factor identified in the next higher set of decoded data to reconstruct the signal at a next higher level of quality; identifying residual information and/or residual

CLAIMS

1. A method of reconstructing a signal at successively higher levels of quality in a hierarchy, the method comprising:

decoding a first set of data;

utilizing the decoded first set of data to reconstruct the signal according to a first level of quality;

decoding a second set of data;

identifying an upsample operation specified by the decoded second set of data; applying the upsample operation identified in the decoded second set of data to the reconstructed signal at the first level of quality to reconstruct the signal at a second level of quality, the second level of quality being higher than the first level of quality;

decoding a third set of data;

identifying an upsample operation specified by the decoded third set of data; and

applying the upsample operation identified in the decoded third set of data to the reconstructed signal at the second level of quality to reconstruct the signal at a third level of quality, the third level of quality being higher than the second level of quality in the hierarchy.

2. The method as in claim 1, wherein the upsample operation identified in the second set of decoded data is a first upsample operation; and

wherein the upsample operation identified in the third set of decoded data is a second upsample operation, the first upsample operation being different from the second upsample operation.

3. The method as in claim 1, wherein the upsample operation applied to the reconstructed signal at the first level of quality includes at least one operation selected from the group consisting of:

i) a linear filter operation, in particular a bilinear filter or a trilinear filter,

ii) a cubic filter operation, in particular a bicubic filter or a tricubic filter,

iii) a deblending filter, and

iv) an unsharp masking filter.

4. The method as in claim 1 further comprising:

applying the upsample operation specified by the second set of decoded data to at least one reconstructed signal at least one level higher than the second level of quality until a respective set of decoded data for a higher level of quality than the second level of quality specifies to use a different upsample operation than the upsample operation identified in the second set of decoded data.

5. The method as in claim 1 further comprising:

decoding a third set of data; and

in response to identifying that the third set of decoded data does not specify a particular upsample operation, applying the upsample operation identified in the second set of decoded data to the reconstructed signal at the second level of quality to reconstruct the signal at a third level of quality, the third level of quality being higher than the second level of quality in the hierarchy.

6. The method as in claim 1 further comprising:

retrieving residual data from the second set of decoded data, the residual data indicating how to modify the reconstructed signal at the second level of quality subsequent to application of the upsampling operation;

modifying the reconstructed signal at the second level of quality as specified by the residual data; and

modifying, as specified by the residual data retrieved from the second set of decoded data, a reconstructed signal at a level of quality.

7. The method as in claim 1 further comprising:

processing the second set of decoded data to identify a specific portion of the reconstructed signal at the first level of quality in which to apply the upsample operation specified by the second set of decoded data; and

wherein applying the upsample operation includes applying the upsample operation to the specific portion of the reconstructed signal at the first level of quality to reconstruct the signal at the second level of quality.

8. The method as in claim 1 further comprising:

processing the second set of decoded data to identify an attribute type of a specifically identified portion of the reconstructed signal at the first level of quality;

mapping the attribute type to a set of at least one upsample operation, the set of at least one upsample operation configured to a type of data in the signal as specified by the attribute type; and

for each portion of the signal, utilizing the set of at least one upsample operation defined by its attribute type as a default upsample operations for the reconstruction of subsequent levels of quality of that portion of the signal, until a respective set of decoded data for a higher level of quality than the first level of quality specifies to use for the signal or for portions of the signal different attribute types.

9. The method as in claim 1 further comprising:

applying different upsample operations identified in the second set of decoded data to different portions of the reconstructed signal at the first level of quality to reconstruct the signal at the second level of quality; and

for each portion of the signal, utilizing the set of at least one upsample operation identified in the second set of decoded data as default upsample operations for the reconstruction of subsequent levels of quality of that portion of the signal, until a respective set of decoded data for a higher level of quality than the first level of quality specifies to use for the signal or for portions of the signal different upsample operations.

10. The method as in claim 1 further comprising:

processing the second set of decoded data to identify a scale factor value, the scale factor value indicating the resolution in which to upsample the reconstructed signal at the first level of quality into the reconstructed signal at the second level of quality; and

in accordance with the scale factor, upsampling the reconstructed signal at the first level of quality into the reconstructed signal at the second level of quality, in lieu of performing the upsampling in accordance with a default scale factor value.

11. The method as in claim 10 further comprising:

utilizing the scale factor value to upsample the reconstructed signal at the first level of quality into the reconstructed signal at the second level of quality in lieu of performing the upsampling in accordance with a default scale factor value.

12. The method as in claim 1 further comprising:

utilizing scale factor values as specified by sets of decoded data at different levels of the hierarchy to reconstruct the signal in lieu of performing upsampling in accordance with default scale factor values for the different levels of quality in the hierarchy.

13. The method as in claim 12, wherein the scale factor values include a first scale factor value and second scale factor value, the first scale factor value specified by the first set of decoded data and the second scale factor value specified by the second set of decoded data, the first scale factor value being different than the second scale factor value, the method further comprising:

utilizing the first scale factor value to upsample and reconstruct the signal at the resolution indicated by the first scale factor and by the resolution of the first level of quality; and

utilizing the second scale factor value to reconstruct the signal at the second level of quality.

14. The method as in claim 6 further comprising:

identifying residual data as specified by second set of decoded data; and

modifying the elements of the reconstructed signal at the second level of quality in a manner as specified by the residual data; and

using the residual data as specified by the second set of decoded data also for the reconstruction of higher levels of quality than the second level of quality until a

respective set of decoded data for a higher level of quality than the second level of quality specifies to use different residual data.

15. The method as in claim 1 further comprising:

identifying residual data as specified by second set of decoded data,

utilizing a multi-scale entropy decoder to decode the residual data, the decoded residual data specifying how to modify specific elements of the reconstructed signal at the second level of quality; and

modifying the elements of the reconstructed signal at the second level of quality in a manner as specified by the decoded residual data.

16. The method as in claim 1 further comprising:

decoding the second set of data to identify characteristics of simulated residuals, the characteristics indicating to the decoder how to simulate residuals to be added to the reconstructed version of the signal, but not indicating the specific elements of the reconstructed signal that should be modified and the specific modifications to apply; and for each signal element, using the characteristics of simulated residuals data as specified by the second set of decoded data also to characterize simulated residuals for higher levels of quality than the second level of quality of the signal elements co-located with that signal element, until a respective set of decoded data for a higher level of quality than the second level of quality specifies to use for the signal or for portions of the signal different characteristics of simulated residuals; and

utilizing the set of characteristics to modify the elements of the reconstructed signal at the displayed level of quality in a manner as specified by the simulated residual data.

17. The method as in claim 1 further comprising:

decoding the second set of data to identify spectral characteristics associated with residuals that represent lower priority information (e.g., film grain, camera sensor noise, lower priority details of the signal, etc.), the spectral characteristics indicating to the

decoder how to simulate the residuals to add to the reconstructed signal, without indicating the actual location or the specific values of the residuals; and

for each signal element, utilizing the spectral characteristics as specified by the second set of decoded data also to characterize simulated residuals for higher levels of quality than the second level of quality of the portion of the signal co-located with that signal element, until a respective set of decoded data for a higher level of quality than the second level of quality specifies to use for the signal or for specific portions of the signal different spectral characteristics of simulated residuals; and

utilizing the set of spectral characteristics to modify the elements of the reconstructed signal at the displayed level of quality in a manner as specified by the simulated residual data.

18. The method as in claim 1, wherein the hierarchy includes an additions set of data to reconstruct the signal according to a subsequent level of quality in the hierarchy, the subsequent level of quality being higher than the current level of quality in the hierarchy, the method further comprising:

display of image information on a display device in accordance with the reconstructed signal at the current level of quality.

19. The method as in claim 1 further comprising:

for each of multiple levels of quality above the second level of quality, repeating steps of:

decoding a next higher set of data in the hierarchy above a last processed level of quality; identifying an upsample operation and/or scale factor specified by the next higher set of decoded data;

applying the upsample operation identified in the next higher set of decoded data to reconstruct the signal at a next higher level of quality;

identifying residual information and/or residual characteristics specified by the next higher set of decoded data; and

applying the residual information to modify the reconstructed signal at the higher level of quality.

20. The method as in claim 1 wherein:

the decoder receives separate signal hierarchies for the different color planes of the signal, the separate signal hierarchies featuring independent and potentially different scale factors, operations and highest levels of quality;

when the different reconstructed color planes feature different levels of quality, the decoder upsamples the lower-resolution color planes in order for them to match the resolution of the color plane with the highest level of quality, and subsequently joins all the reconstructed color planes into a reconstructed color signal to send to the display device.

21. The method as in claim 1 wherein:

decoding separate received signal hierarchies for different color planes associated with the signal, the separate received signal hierarchies featuring independent and potentially different scale factors, operations and highest levels of quality; and

when different reconstructed color planes feature different levels of quality, upsampling the lower-resolution color planes to match the resolution of the color plane with the highest level of quality, and subsequently joining the reconstructed color planes into a reconstructed color signal to send to a display device.

22. The method as in claim 1 further comprising:

retrieving auxiliary information, in particular information on motion, wrap information and so on, from the second set of decoded data, the auxiliary information indicating parameters influencing the application the modification of the reconstructed signal at the second level of quality as specified by the residual data.

23. A computer system comprising:

a processor;

a memory unit that stores instructions associated with an application executed by the processor; and

an interconnect coupling the processor and the memory unit, enabling the computer system to execute the application and perform operations of:

decoding a first set of data;

utilizing the first set of decoded data to reconstruct the signal according to a first level of quality;

decoding a second set of data; identifying an upsample operation identified in the second set of decoded data;

applying the upsample operation identified in the second set of decoded data to the reconstructed signal at the first level of quality to reconstruct the signal at a second level of quality, the second level of quality being higher than the first level of quality;

decoding a third set of data;

identifying an upsample operation specified by the third set of decoded data; and

applying the upsample operation identified in the third set of decoded data to the reconstructed signal at the second level of quality to reconstruct the signal at a third level of quality, the third level of quality being higher than the second level of quality in the hierarchy.

24. A computer-readable hardware storage hardware having instructions stored thereon, the instructions, when carried out by a processing device, causes the processing device to perform operations of:

decoding a first set of data;

utilizing the first set of decoded data to reconstruct the signal according to a first level of quality;

decoding a second set of data;

identifying an upsample operation specified by the second set of decoded data;

applying the upsample operation identified in the second set of decoded data to the reconstructed signal at the first level of quality to reconstruct the signal at a second level of quality, the second level of quality being higher than the first level of quality;

decoding a third set of data;

identifying an upsample operation specified by the third set of decoded data; and

applying the upsample operation identified in the third set of decoded data to the reconstructed signal at the second level of quality to reconstruct the signal at a third level of quality, the third level of quality being higher than the second level of quality in the hierarchy.

CLAIMS

1. A method of reconstructing a signal at successively higher levels of quality in a hierarchy, the method comprising:

decoding a first set of data;

utilizing the decoded first set of data to reconstruct the signal according to a first level of quality;

decoding a second set of data;

identifying an upsample operation specified by the decoded second set of data;

applying the upsample operation identified in the decoded second set of data to the reconstructed signal at the first level of quality to reconstruct the signal at a second level of quality, the second level of quality being higher than the first level of quality;

decoding a third set of data;

identifying an upsample operation specified by the decoded third set of data; and

applying the upsample operation identified in the decoded third set of data to the reconstructed signal at the second level of quality to reconstruct the signal at a third level of quality, the third level of quality being higher than the second level of quality in the hierarchy.

2. The method as in claim 1, wherein the upsample operation identified in the decoded second set of data is a first upsample operation; and

wherein the upsample operation identified in the decoded third set of data is a second upsample operation, the first upsample operation being different from the second upsample operation.

3. The method as in claim 1, wherein the upsample operation applied to the reconstructed signal at the first level of quality includes at least one operation selected from the group consisting of:

i) a bicubic filter operation,

ii) a deblending filter, and

iii) an unsharp masking operation.

4. The method as in claim 1 further comprising:

from the decoded second set of data, producing a first subset of upsample operation data corresponding to a first portion of the signal, wherein the first subset of upsample operation data specifies a first upsample operation to apply to the signal at the first level of quality in order to produce a preliminary rendition of the first portion of the signal at the second level of quality; and

from the decoded second set of data, producing a second subset of upsample operation data corresponding to a second portion of the signal, wherein the second subset of upsample operation data specifies a second upsample operation to apply to the signal at the first level of quality in order to produce a preliminary rendition for the second portion of the signal at the second level of quality.

5. The method as in claim 4 further comprising:

applying the first upsample operation to the reconstructed signal at the second level of quality to reconstruct a rendition of the first portion of the signal at the third level of quality; and

from the third set of decoded data, decoding a third subset of upsample operation data corresponding to the second portion of the signal, wherein the third subset of upsample operation data specifies a third upsample operation to apply to the signal at the second level of quality in order to produce a preliminary rendition of the second portion of the signal at the third level of quality.

6. The method as in claim 1 further comprising:

in response to identifying from the second set of decoded data that a particular upsample operation specified for use in one level of quality is to be used at successively higher levels of quality to reconstruct a respective portion of the signal, applying the particular upsample operation identified in the second set of decoded data to the reconstructed signal at the successively higher levels of quality.

7. The method as in claim 1 further comprising:

retrieving residual data from the decoded second set of data, the residual data

indicating how to modify a preliminary rendition of the reconstructed signal at the second level of quality subsequent to application of the upsampling operation;

modifying the preliminary rendition of the reconstructed signal at the second level of quality as specified by the residual data; and

modifying, as specified by the residual data retrieved from the second set of decoded data, a rendition of the reconstructed signal at a level of quality higher than the second level of quality.

8. The method as in claim 7 further comprising:

identifying residual data as specified by the decoded second set of data; and

modifying the elements of the reconstructed signal at the second level of quality in a manner as specified by the residual data; and

using the residual data as specified by the decoded second set of data also for the reconstruction of higher levels of quality than the second level of quality until a respective decoded set of data for a higher level of quality than the second level of quality specifies to use different residual data.

9. The method as in claim 1 further comprising:

processing the decoded second set of data to identify a first upsample operation to apply to a specific portion of the reconstructed signal at the first level of quality; and

applying the first upsample operation to the specific portion of the reconstructed signal at the first level of quality to reconstruct the signal at the second level of quality.

10. The method as in claim 1 further comprising:

processing the decoded second set of data to identify an attribute type of a specifically identified portion of the reconstructed signal at the first level of quality;

mapping the attribute type to a set of at least one upsample operation, the set of at least one upsample operation configured to process a type of data in the signal as specified by the attribute type; and

for each portion of the signal, utilizing the set of at least one upsample operation defined by its attribute type as default upsample operations for the reconstruction of

subsequent levels of quality of that portion of the signal, until a respective set of decoded data for a higher level of quality than the first level of quality specifies to use for the signal or for portions of the signal different attribute types.

11. The method as in claim 1 further comprising:

applying different upsample operations identified in the decoded second set of data to different portions of the reconstructed signal at the first level of quality to reconstruct the signal at the second level of quality; and

for each portion of the signal, utilizing the set of at least one upsample operation identified in the decoded second set of data as default upsample operations for the reconstruction of subsequent levels of quality of that portion of the signal, until a respective decoded set of data for a higher level of quality than the first level of quality specifies to use for the signal or for portions of the signal different upsample operations.

12. The method as in claim 1 further comprising:

processing the decoded second set of data to identify a scale factor value, the scale factor value indicating the resolution in which to upsample the reconstructed signal at the first level of quality into the reconstructed signal at the second level of quality; and

in accordance with the scale factor, upsampling the reconstructed signal at the first level of quality into the reconstructed signal at the second level of quality, in lieu of performing the upsampling in accordance with a default scale factor value.

13. The method as in claim 1 further comprising:

utilizing scale factor values as specified by decoded sets of data at different levels of the hierarchy to reconstruct the signal in lieu of performing upsampling in accordance with default scale factor values for the different levels of quality in the hierarchy.

14. The method as in claim 13, wherein the scale factor values include a first scale factor value and second scale factor value, the first scale factor value specified by the first set of decoded data and the second scale factor value specified by the second set of decoded data, the first scale factor value being different than the second scale factor value, the

method further comprising:

utilizing the first scale factor value to upsample and reconstruct the signal at the resolution indicated by the first scale factor and by the resolution of the first level of quality; and

utilizing the second scale factor value to reconstruct the signal at the second level of quality.

15. The method as in claim 1 further comprising:

decoding the second set of data to identify characteristics of simulated residuals, the characteristics indicating to a decoder how to simulate residuals to be added to the reconstructed signal, the characteristics not indicating the specific elements of the reconstructed signal that should be modified and the specific modifications to apply; and

for each signal element, using the characteristics of simulated residuals data as specified by the decoded second set of data also to characterize simulated residuals for higher levels of quality than the second level of quality of the signal elements co-located with that signal element, until a respective set of decoded data for a higher level of quality than the second level of quality specifies to use for the signal or for portions of the signal different characteristics of simulated residuals; and

utilizing the set of characteristics to modify the elements of the reconstructed signal at the displayed level of quality in a manner as specified by the simulated residual data.

16. The method as in claim 1 further comprising:

decoding the second set of data to identify spectral characteristics associated with residuals that represent lower priority information, the spectral characteristics indicating to the decoder how to simulate the residuals to apply to the reconstructed signal, the spectral characteristics not indicating the actual location or specific values of the residuals; and

for each signal element, utilizing the spectral characteristics as specified by the second set of decoded data also to characterize simulated residuals for higher levels of quality than the second level of quality of the portion of the signal co-located with that

signal element, until a respective set of decoded data for a higher level of quality than the second level of quality specifies to use for the signal or for specific portions of the signal different spectral characteristics of simulated residuals; and

utilizing the set of spectral characteristics to modify the elements of the reconstructed signal at the displayed level of quality in a manner as specified by the simulated residual data.

17. The method as in claim 1, wherein the hierarchy includes an additional set of data to reconstruct the signal according to a subsequent level of quality in the hierarchy, the subsequent level of quality being higher than a current level of quality in the hierarchy, the method further comprising:

displaying image information on a display device in accordance with the reconstructed signal at the current level of quality.

18. The method as in claim 1 further comprising:

for each of multiple levels of quality above the third level of quality, repeating steps of:

decoding a next higher set of data in the hierarchy above a last processed level of quality;

identifying an upsample operation and/or scale factor specified by the next higher set of decoded data;

applying the upsample operation identified in the next higher set of decoded data to reconstruct the signal at a next higher level of quality; identifying residual information and/or residual characteristics specified by the next higher set of decoded data; and

applying the residual information to modify the reconstructed signal at the higher level of quality.

19. The method as in claim 1 wherein:

a decoder receives separate signal hierarchies for the different color planes of the signal, the separate signal hierarchies featuring independent scale factors, operations and

highest levels of quality;

the decoder upsamples a lower resolution color plane based on a different color plane with a higher level of quality in order for the lower resolution color plane to match a resolution of a color plane at a higher level of quality; and

the decoder combines all of the reconstructed color planes into a reconstructed color signal to send to a display device.

20. The method as in claim 1 wherein:

decoding separate received signal hierarchies for different color planes associated with the signal, the separate received signal hierarchies featuring independent and potentially different scale factors, operations and highest levels of quality; and

when different reconstructed color planes feature different levels of quality, upsampling the lower-resolution color planes to match the resolution of the color plane with the highest level of quality, and subsequently joining the reconstructed color planes into a reconstructed color signal to send to a display device.

21. The method as in claim 1 wherein reconstructing the signal at the second level of quality further comprises:

applying the upsample operation specified by the decoded second set of data to the reconstructed signal at the second level of quality to reconstruct a preliminary rendition of the signal at the second level of quality;

identifying residual data specified by the decoded second set of data; and combining the residual data and the preliminary rendition of the signal at the second level of quality to reconstruct a rendition of the signal at the second level of quality.

22. The method as in claim 1, wherein the upsample operation identified in the decoded second set of data is a first upsample operation derived from first upsample operation data specified by the second set of decoded data;

wherein the upsample operation identified in the third set of decoded data is a second upsample operation derived from second upsample operation data specified by the decoded third set of data; and

wherein the second upsample operation includes upsample kernel data that is different from each of multiple sets of upsample kernel data used by the upsample operation specified by the decoded second set of data.

23. The method as in claim 1, wherein the upsample operation specified by the decoded third set of data is based at least in part on the upsample operation specified by the decoded second set of data.

24. The method as in claim 1, wherein the upsample operation data is decoded by means of a tier based decoding method, the method comprising:

decoding upsample operation data at the first level of quality;

based on the decoded upsample operation data at the first level of quality, producing a preliminary rendition of upsample operation data at a second level of quality;

decoding a set of upsample operation adjustments; and

combining upsample operation adjustments with the preliminary rendition of upsample operation data at the second level of quality to produce upsample operation data at the second level of quality.

25. The method as in claim 1, wherein the signal is a three-dimensional signal and the upsample operation specified by the decoded second set of data indicates to upsample the signal along three dimensions.

26. The method as in claim 25, wherein the signal is a video signal and the upsample operation as specified by the decoded second set of data indicates to upsample the signal along both spatial and time dimensions.

27. A method of reconstructing a signal at successively higher levels of quality in a hierarchy, the method comprising:

decoding a first set of data;

utilizing the decoded first set of data to reconstruct the signal according to a first level of quality;

decoding a second set of data;

identifying an upsample operation specified by the decoded second set of data;

applying the upsample operation identified in the decoded second set of data to the reconstructed signal at the first level of quality to reconstruct the signal at a second level of quality, the second level of quality being higher than the first level of quality;

identifying residual data as specified by the decoded second set of data;

utilizing an entropy decoder to decode the residual data, the decoded residual data specifying how to modify specific elements of the reconstructed signal at the second level of quality; and

modifying the elements of the reconstructed signal at the second level of quality in a manner as specified by the decoded residual data.

28. A computer system comprising:

processor hardware;

a storage unit that stores instructions associated with an application executed by the processor hardware; and

an interconnect coupling the processor hardware and the storage unit, causing the processor hardware to execute the application and perform operations of:

decoding a first set of data;

utilizing the decoded first set of data to reconstruct the signal according to a first level of quality;

decoding a second set of data;

identifying an upsample operation specified by the decoded second set of data;

applying the upsample operation identified in the decoded second set of data to the reconstructed signal at the first level of quality to reconstruct the signal at a second level of quality, the second level of quality being higher than the first level of quality;

decoding a third set of data;

identifying an upsample operation specified by the decoded third set of data; and

applying the upsample operation identified in the decoded third set of data to the reconstructed signal at the second level of quality to reconstruct the signal at a third level of quality, the third level of quality being higher than the second level of quality in the hierarchy.

29. A computer-readable hardware storage hardware having instructions stored thereon, the instructions, when carried out by processing hardware, causes the processing hardware to perform operations of:

decoding a first set of data;

utilizing the decoded first set of data to reconstruct the signal according to a first level of quality;

decoding a second set of data;

identifying an upsample operation specified by the decoded second set of data;

applying the upsample operation identified in the decoded second set of data to the reconstructed signal at the first level of quality to reconstruct the signal at a second level of quality, the second level of quality being higher than the first level of quality;

decoding a third set of data;

identifying an upsample operation specified by the decoded third set of data; and

applying the upsample operation identified in the decoded third set of data to the reconstructed signal at the second level of quality to reconstruct the signal at a third level of quality, the third level of quality being higher than the second level of quality in the hierarchy.

30. A method of reconstructing a signal at successively higher levels of quality in a hierarchy, the method comprising:

decoding a first set of data;

utilizing the first set of decoded data to reconstruct the signal according to a first level of quality;

decoding a second set of data, the second set of data produced by an encoder to reconstruct the signal at a second level of quality;

identifying an upsample operation as specified by a decoded data subset of the

second set of data; and

applying the identified upsample operation to the reconstructed signal at the first level of quality to reconstruct a preliminary rendition of the signal at the second level of quality, the second level of quality being higher than the first level of quality;

processing the decoded second set of data to produce residual data for the rendition of the signal at the second level of quality, the residual data indicating how to modify the preliminary rendition of the signal at the second level of quality; and

modifying the reconstructed preliminary rendition of the signal at the second level of quality using the residual data.

31. The method as in claim 30, wherein the upsample operation comprises a first upsample kernel for reconstruction of a first portion of the signal at the second level of quality and a second upsample kernel for reconstruction of a second portion of the signal at the second level of quality, the first upsample kernel being different from the second upsample kernel; and

wherein parameters of the first upsample kernel and of the second upsample kernel are specified by the decoded data subset of the second set of data.

32. The method as in claim 30 further comprising:

decoding a third set of data;

identifying an upsample operation specified by the decoded third set of data; and

applying the upsample operation identified in the decoded third set of data to the reconstructed signal at the second level of quality to reconstruct a preliminary rendition of the signal at a third level of quality, the third level of quality being higher than the second level of quality in the hierarchy.

33. The method as in claim 30, wherein processing the decoded second set of data to produce residual data comprises:

simultaneously processing subsets of the decoded second set of data in parallel to retrieve residual data from the decoded second set of data; and

modifying the reconstructed preliminary rendition of the signal at the second level

of quality as specified by the residual data.

34. The method as in claim 30, wherein the upsample operation is specified by the decoded data from a set of substantially unlimited possible upsample operations.

35. The method as in claim 30, wherein the encoder, during encoding of the signal, produces the second set of data to specify the upsample operation to reconstruct the preliminary rendition of the signal at the second level of quality.

36. The method as in claim 30, wherein the encoder produces the upsample operation to reduce an entropy of the residual data to be applied to the preliminary rendition of the signal at the second level of quality.

37. The method as in claim 30, wherein the encoder downsamples the signal during encoding to identify the upsample operation to be included in the second set of data to reconstruct the preliminary rendition of the signal at the second level of quality.

38. A computer system comprising:

processor hardware;

a storage unit that stores instructions associated with an application executed by the processor hardware; and

an interconnect coupling the processor hardware and the storage unit, causing the computer system to execute the instructions and perform operations of:

decoding a first set of data;

utilizing the decoded first set of data to reconstruct the signal according to a first level of quality;

decoding a second set of data;

identifying an upsample operation specified by the decoded second set of data;

applying the upsample operation identified in the decoded second set of data to the reconstructed signal at the first level of quality to reconstruct the signal at a second level of quality, the second level of quality being higher than the first level of quality;

identifying residual data as specified by decoded second set of data;

utilizing an entropy decoder to decode the residual data, the decoded residual data specifying how to modify specific elements of the reconstructed signal at the second level of quality; and

modifying the elements of the reconstructed signal at the second level of quality in a manner as specified by the decoded residual data.

39. A computer-readable hardware storage hardware having instructions stored thereon, the instructions, when carried out by a processing device, causes the processing device to perform operations of:

decoding a first set of data;

utilizing the decoded first set of data to reconstruct the signal according to a first level of quality;

decoding a second set of data;

identifying an upsample operation specified by the decoded second set of data;

applying the upsample operation identified in the decoded second set of data to the reconstructed signal at the first level of quality to reconstruct the signal at a second level of quality, the second level of quality being higher than the first level of quality;

identifying residual data as specified by decoded second set of data;

utilizing an entropy decoder to decode the residual data, the decoded residual data specifying how to modify specific elements of the reconstructed signal at the second level of quality; and

modifying the elements of the reconstructed signal at the second level of quality in a manner as specified by the decoded residual data.

40. A method of reconstructing a signal at successively higher levels of quality in a hierarchy, the method comprising:

decoding a first set of data;

utilizing the first set of decoded data to reconstruct the signal according to a first level of quality;

decoding a second set of data, the second set of data produced by an encoder to

reconstruct the signal at a second level of quality, the encoder, during encoding of the signal, producing the second set of data to specify an upsample operation to reconstruct a preliminary rendition of the signal at the second level of quality, the encoder producing the upsample operation to reduce an entropy of residual data to be applied to the preliminary rendition of the signal at the second level of quality;

identifying the upsample operation as specified by a decoded data subset of the second set of data; and

applying the identified upsample operation to the reconstructed signal at the first level of quality to reconstruct the preliminary rendition of the signal at the second level of quality, the second level of quality being higher than the first level of quality.

41. A computer system comprising:

processor hardware;

a storage unit that stores instructions associated with an application executed by the processor hardware; and

an interconnect coupling the processor hardware and the storage unit, causing the processor hardware to execute the instructions and perform operations of:

decoding a first set of data;

utilizing the first set of decoded data to reconstruct the signal according to a first level of quality;

decoding a second set of data, the second set of data produced by an encoder to reconstruct the signal at a second level of quality;

identifying an upsample operation as specified by a decoded data subset of the second set of data;

applying the identified upsample operation to the reconstructed signal at the first level of quality to reconstruct a preliminary rendition of the signal at the second level of quality, the second level of quality being higher than the first level of quality;

wherein the encoder, during encoding of the signal, produced the second set of data to specify the upsample operation to reconstruct the preliminary rendition of the signal at the second level of quality;

wherein the encoder, during encoding of the signal, produced the upsample

operation to reduce an entropy of residual data to be applied to the preliminary rendition of the signal at the second level of quality.

42. A computer system comprising:

processor hardware;

a storage unit that stores instructions associated with an application executed by the processor hardware; and

an interconnect coupling the processor hardware and the storage unit, causing the processor hardware to execute the instructions and perform operations of:

decoding a first set of data;

utilizing the first set of decoded data to reconstruct the signal according to a first level of quality;

decoding a second set of data, the second set of data produced by an encoder to reconstruct the signal at a second level of quality;

identifying an upsample operation as specified by a decoded data subset of the second set of data; and

applying the identified upsample operation to the reconstructed signal at the first level of quality to reconstruct a preliminary rendition of the signal at the second level of quality, the second level of quality being higher than the first level of quality;

processing the decoded second set of data to produce residual data for the rendition of the signal at the second level of quality, the residual data indicating how to modify the preliminary rendition of the signal at the second level of quality; and

modifying the reconstructed preliminary rendition of the signal at the second level of quality using the residual data.