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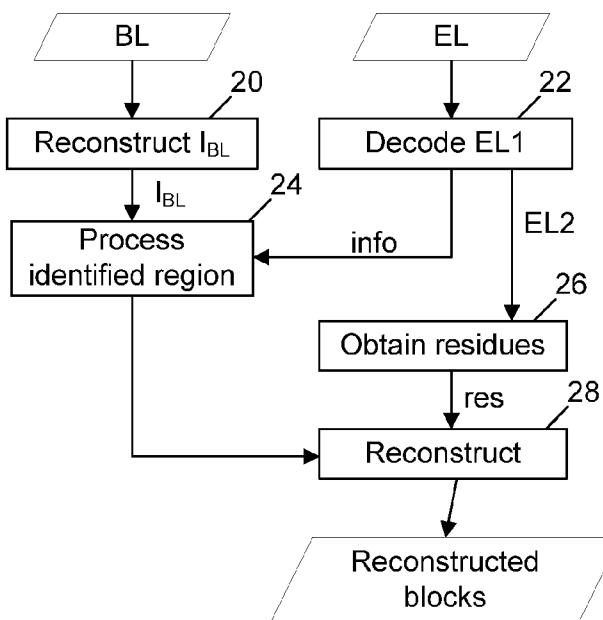
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(54) Title: METHOD AND DEVICE FOR DECODING A SCALABLE STREAM REPRESENTATIVE OF AN IMAGE SEQUENCE AND CORRESPONDING CODING METHOD AND DEVICE



(57) Abstract: A method for decoding a scalable stream comprising a base layer and at least one enhancement layer is described. The method comprises the following steps: - reconstructing (20) at least one image from the base layer, - decoding (22) a first part of the enhancement layer relating to a group of blocks into decoded enhancement data which comprise at least one item of information for identifying at least one region of the reconstructed image to process, - processing (24) the region of the reconstructed image identified by the information, - obtaining (26) residues for at least one block of the group of blocks from a second part of the enhancement layer, and - reconstructing (28) the blocks of the group from residues and from the region processed.

Figure 2



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METHOD AND DEVICE FOR DECODING A SCALABLE STREAM
REPRESENTATIVE OF AN IMAGE SEQUENCE AND CORRESPONDING
CODING METHOD AND DEVICE

5 1. Domain of the invention

The invention relates to the general domain of the scalable coding of an image sequence. More particularly, the invention also relates to a method for decoding a scalable stream representative of an image sequence comprising a base layer and at least one enhancement layer. The invention 10 also relates to a coding method and the corresponding devices.

2. Prior art

Scalable coding methods are known that enable the information to be coded in a hierarchical manner such that this information can be decoded at 15 different resolutions (spatial scalability), different qualities (SNR scalability, for "Signal to Noise Ratio"), with different gamuts or colour spaces (CGS scalability, for "Colour Gamut Scalability"). A stream generated by a scalable coder is divided into different layers: a base layer and one or more enhancement layers. Such devices can generate a stream of data that adapts 20 to different transmission conditions (bandwidth, error rate, etc.) and also to the capacities of the reception devices. A scalable coder spatially codes a first part of data relating to low resolution images in a base layer and another part of data relating to high resolution images (i.e. having a size in number of horizontal and/or vertical pixels greater than the low resolution image) in at 25 least one enhancement layer. The data coded in the enhancement layer is generally done so by taking into account data from the base layer so as to reduce the redundancy between the low resolution images and high resolution images and thus to reduce the coding cost. In reference to **figure 1**, it is known to code 10 the low resolution images, called I_{BL} images, reconstruct 30 them at least partially and process 12 them, that is to say re-sample them at the size of the high resolution images, called I_{EL} images. The I_{BL} images re-sampled in this manner are used to predict the I_{EL} images with a view to their coding 14. The different layers can possibly be multiplexed 16 into a single scalable stream S . The scalable coding is not limited to spatially scalable

coding. Hence, scalable coders are known that code, in a base layer, data relating to images represented in a first colour space and that code, in at least one enhancement layer, data relating to images represented in a second colour space different from the first colour space. The images of the base 5 layer reconstructed at least partially are then processed so that their characteristics in terms of colour are close to those of the images of the enhancement layer. The I_{BL} images processed in this manner are used to predict the I_{EL} images with a view to their coding.

Generally, an image of the base layer is fully processed before being stored in 10 the reference image buffer or DPB (decoding picture buffer) of the enhancement layer. The processing of an image of the base layer is, for example, carried out just before the decoding of an image of the enhancement layer that it is used to predict. Such a solution requires the processing of the entire image of the reconstructed base layer which can be costly in terms of 15 calculations.

According to a variant, when a block of the enhancement layer is reconstructed from an image of the base layer, the coding mode of the block indicates it. It is therefore possible, when decoding such a block of the enhancement layer to check the coding mode of this block and only process 20 the region of the image of the reconstructed base layer necessary for reconstructing the relevant block. In this case, the processing of the image of the reconstructed base layer necessary for reconstructing the relevant block is carried out just after the decoding of the coding mode of the block. This 25 solution is economic in terms of calculations as only the regions of reconstructed images of the base layer necessary for reconstructing the images of the enhancement layer are processed. However, this solution requires many accesses to the buffer storing the images of the reconstructed base layer and many calls to the processing function. Indeed, the processing function is called as many times as a block whose coding mode indicates that 30 it is predicted in relation to a base layer image (e.g. inter-layer mode) is decoded.

3. Summary of the invention

The purpose of the invention is to overcome at least one of the disadvantages of the prior art. For this purpose, a method for decoding a scalable stream comprising a base layer and at least one enhancement layer is described. The method comprises:

- 5 - reconstructing at least one image from the base layer,
- decoding a first part of the at least one enhancement layer relating to a group of blocks into decoded enhancement data which comprise at least one item of information for identifying at least one region of the reconstructed image to process,
- 10 - processing the at least one region of the reconstructed image identified by the information,
- obtaining residues for at least one block of the group of blocks from a second part of the at least one enhancement layer, and
- reconstructing the blocks of the group from residues and from
- 15 the at least one region processed.

This decoding method advantageously reduces the number of accesses to the processing function but also processes only the useful regions of the image of the reconstructed base layer.

According to a particular embodiment, the information for identifying at least

20 one region of the reconstructed image to process is a map indicating for each block of the reconstructed image corresponding to a block of the group of blocks if the block must be processed or not.

According to a variant, the information for identifying at least one region of the reconstructed image to process is a map indicating for each block of the group

25 of blocks if the block uses for its reconstruction a processed block of the reconstructed image.

According to a particular characteristic of the invention, the base layer is another enhancement layer of a lower level than the at least one enhancement layer.

30 Advantageously, the method comprises a decoding step from the enhancement layer of an additional item of information for at least one group of blocks indicating whether the information for identifying at least one region of the reconstructed image to process is coded or not for the group of blocks.

According to a particular characteristic of the invention, the group of blocks is an image slice or an image.

According to another aspect of the invention, the decoding method comprises a decoding step from the enhancement layer of a first additional item of

5 information indicating whether the information for identifying at least one region of the reconstructed image to process can be coded or not for the group of blocks.

According to a particular characteristic of the invention, the first item of additional information being decoded for at least one image, the method

10 comprises, when the first item of additional information indicates that an item of information for identifying at least one region of the reconstructed image to process can be coded, a decoding step from the enhancement layer of a second item of additional information indicating for a group of blocks whether the information for identifying at least one region of the reconstructed image is

15 coded or not for the group of blocks.

A coding method of a sequence of images in the form of a scalable stream comprising a base layer and at least one enhancement layer is also described. The coding method comprises:

20 - coding in the base layer and reconstructing at least one image,
- coding enhancement data in a first part of the enhancement layer relating to a group of blocks, the enhancement data comprising an item of information for identifying at least one region of the reconstructed image to process,

25 - processing the at least one region of the reconstructed image identified by the information,
- obtaining residues for at least one block of the group of blocks from the blocks of the group and from the at least one region processed, and

30 - coding the residues in a second part of the enhancement layer.

According to a particular embodiment, the information for identifying at least one region of the reconstructed image to process is a map indicating for each block of the reconstructed image corresponding to a block of the group of blocks if the block must be processed or not.

According to a variant, the information for identifying at least one region of the reconstructed image to process is a map indicating for each block of the group of blocks if the block uses for its reconstruction a processed block of the reconstructed image.

5 According to a particular characteristic of the invention, wherein the base layer is another enhancement layer of a lower level than the at least one enhancement layer.

Advantageously, the method comprises a coding step in the enhancement layer of an additional item of information for at least one group of blocks

10 indicating whether the information for identifying at least one region of the reconstructed image to process is coded or not for the group of blocks.

As a variant, the coding method comprises a coding step in the enhancement layer of a first additional item of information indicating whether the information for identifying at least one region of the reconstructed image to process can

15 be coded or not for a group of blocks.

According to a particular characteristic of the invention, the first item of additional information being coded for at least one image, the method comprises, when the first item of additional information indicates that an item of information for identifying at least one region of the reconstructed image to

20 process can be coded, a coding step in the enhancement layer of a second item of additional information indicating for a group of blocks whether the information for identifying at least one region of the reconstructed image is coded or not for the group of blocks.

25 A decoder configured for decoding a scalable stream comprising a base layer and at least one enhancement layer is also described. The decoder comprises:

- means for reconstructing at least one image from the base layer,

30 - means for decoding a first part of the at least one enhancement layer relating to a group of blocks into decoded enhancement data which comprise at least one item of information for identifying at least one region of the reconstructed image to process,

- means for processing the at least one region of the reconstructed image identified by the information,
- means for obtaining residues for at least one block of the group of blocks from a second part of the at least one enhancement layer, and
- means for reconstructing the blocks of the group from residues and from the at least one region processed.

5 The decoder is configured to execute the steps of the decoding method according to one of the embodiments.

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A coder configured to code a sequence of images in the form of a scalable stream comprising a base layer and at least one enhancement layer is described which comprises:

- means for coding in the base layer and for reconstructing at least one image,
- means for coding enhancement data in a first part of the enhancement layer relating to a group of blocks, the enhancement data comprising an item of information for identifying at least one region of the reconstructed image to process,
- means for processing the at least one region of the reconstructed image identified by the information,
- means for obtaining residues for at least one block of the group of blocks from the blocks of the group and from the at least one region processed, and
- means for coding the residues in a second part of the enhancement layer.

20 The coder is configured to execute the steps of the coding method according to one of the embodiments described.

25

A coded data stream representative of a sequence of images comprising a base layer and at least one enhancement layer, the base layer comprising data relative to at least one image of the base layer and the enhancement layer comprising in a first part relating to a group of blocks

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enhancement data which comprise an item of information for identifying at least one region of the image of the base layer to process after reconstruction and in a second part data representative of residues which are obtained from at least one block of the group and from the at least one region processed.

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A computer program product is described that comprises program code instructions for executing the steps of the decoding method according to one of the embodiments, when the program is executed on a computer.

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A computer program product is described that comprises program code instructions for executing the steps of the coding method according to one of the embodiments, when the program is executed on a computer.

4. List of figures

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The invention will be better understood and illustrated by means of non-restrictive embodiments and advantageous implementations, with reference to the accompanying drawings, wherein:

20

- Figure 1 shows a coding method according to the prior art,
- Figure 2 shows a decoding method according to a particular and non-restrictive embodiment of the invention,
- Figures 3 and 4 show an item of information *info* in a specific map form to identify at least one region of an image of the reconstructed base layer to process,
- Figures 5 to 7 show parts of an enhancement layer according to different embodiments of the invention,
- Figure 8 shows a coding method according to a particular and non-restrictive embodiment of the invention,
- Figures 9 and 10 show a decoding device according to particular and non-restrictive embodiments of the invention, and
- Figures 11 and 12 show a coding device according to particular and non-restrictive embodiments of the invention.

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5. Detailed description of the invention

The invention relates to a device for decoding a scalable stream representative of an image sequence comprising a base layer and at least one enhancement layer.

5 An image sequence is a series of several images. Each image comprises pixels or image points, with each of which is associated at least one item of image data. An item of image data is for example an item of luminance data or an item of chrominance data. In the remainder of the description, the coding and decoding methods are described with reference to
10 blocks of pixels. It is clear that these methods can be applied to several blocks of an image and to several images of a sequence with a view to coding respectively the reconstruction of one or more images. In the specific case of scalability, a scalable stream represents an image sequence in different versions, for example, different resolutions, different gamuts/colour spaces,
15 etc.

The expression "motion data" is to be understood in the widest sense. It signifies the motion vectors and possibly the reference image indexes enabling a reference image to be identified in the image sequence. It can also comprise an item of information indicating the interpolation type used to
20 determine the prediction block. In fact, in the case where the motion vector associated with a block B_c does not have integer coordinates, the image data must be interpolated in the reference image I_{ref} to determine the prediction block. The motion data associated with a block is generally calculated by a motion estimation method, for example by block pairing. However, the
25 invention is in no way limited by the method enabling a motion vector to be associated with a block.

The expression "residual data" designates data obtained after extraction of other data. The extraction is generally a subtraction pixel by pixel of prediction data from source data. However, the extraction is more general and comprises notably a weighted subtraction. The expression "residual data" is synonymous with the term "residue".
30

The expression "transformed residual data" designates residual data to which a transform has been applied. A DCT (Discrete Cosine Transform) is an example of such a transform described in chapter 3.4.2.2 of the book by I. E.

Richardson entitled "H.264 and MPEG-4 video compression" published by J. Wiley & Sons in September 2003. The wavelet transform described in chapter 3.4.2.3 of the book by I. E. Richardson and the Hadamard transform are other examples. Such transforms "transform" a block of image data, e.g. luminance

5 and/or chrominance residual data, into a "block of transformed data" also called "transformed block", "frequency data block" or "block of coefficients". The block of coefficients generally comprises a low-frequency coefficient known under the name of direct current coefficient or DC coefficient and high-frequency coefficients known under the name of AC coefficients.

10 The expression "prediction data" designates data used to predict other data. A prediction block or predictor is a block of pixels with which prediction data is associated.

A prediction block is obtained from a block or several blocks of the same image as the image to which belongs the block that it predicts (spatial

15 prediction or intra-image prediction) or from one (mono-directional prediction) or several blocks (bi-directional or bi-predicted prediction) of a different image (temporal prediction or inter-image prediction) of the image to which the block that it predicts belongs. In the scalable case, a prediction block can also be obtained for a block of an enhancement layer from at least one block of an

20 image of the base layer, e.g. the co-located block (inter-layer prediction).

The expression "prediction mode" designates the way in which a block is predicted. The expression "coding mode" designates the way in which a block is coded in the stream. It includes the prediction mode if it is predicted. Among the prediction modes, there is the INTRA mode that corresponds to a spatial

25 prediction, the INTER mode that corresponds to a temporal prediction, the INTER-LAYER mode that corresponds to an inter-layer prediction. Note that the INTER-LAYER mode can be implemented like an INTER mode if the reconstructed image of the base layer is stored in the reference buffer of the enhancement layer. The standard INTER modes are thus distinguished from

30 an INTER mode corresponding to an INTER-LAYER mode by the value of the reference index. The prediction mode can specify the way in which the block is partitioned to be coded. Thus, the 8x8 INTER prediction mode associated with a block of size 16x16 signifies that the 16x16 block is partitioned into 4 8x8 blocks and predicted by temporal prediction.

The expression "reconstructed data" designates data (for example pixels, blocks) obtained after merging residues with prediction data. The merge is generally a sum of prediction data with residues. However, merging is more general and comprises notably the weighted sum. A reconstructed block is a 5 block of reconstructed pixels.

A "causal neighbouring area" of a current block designates a neighbouring area of this block that comprises pixels codes/reconstructed before those of the current block.

In reference to image decoding, the terms "reconstruction" and "decoding" are 10 very often used as being synonymous. Thus, a "reconstructed block" is also designated under the terminology of "decoded block".

The term coding is to be taken in the widest sense. The coding can possibly comprise the transformation and/or the quantization of image data. It can also designate the entropy coding only.

15

Figure 2 shows a decoding method of a scalable stream S comprising a base layer and at least one enhancement layer according to a particular and non-restrictive embodiment of the invention. Naturally, the invention described for a base layer and an enhancement layer can be applied to two enhancement 20 layers of different levels, the lower enhancement layer playing the role of a base layer with respect to the upper level layer.

During a step 20, at least one image I_{BL} of the base layer is reconstructed from the base layer. For this purpose, the base layer is decoded at least partially by entropy decoding, for example by CABAC decoding ("Context-adaptive binary arithmetic coding") or CAVLC ("Context-adaptive variable-length coding") decoding. The decoded data notably comprises data representative of residues, for example quantized DCT coefficients, coding modes, possibly motion data. The reconstruction of the image I_{BL} for a current block of the image comprises the obtaining of a spatial or temporal predictor 25 according to the coding mode of the block. The predictor is obtained from a part of an image previously reconstructed either in the same image as the current block to reconstruct (spatial prediction) or in another image (temporal prediction) called reference image. The predictor is added to residues to reconstruct the current block. The residues are, for example, obtained by 30

inverse quantization and inverse transformation of data relating to residues obtained during the entropy decoding of the base layer. The term inverse is used to signify that the quantization and transformation operations on the decoder are inverse from those used on the coder. According to a variant, no 5 predictor is added to the residues in the specific case where the current block is coded without prediction (e.g. according to the IPCM Intra mode of H.264). The residues correspond in the latter case directly to the reconstructed current block. According to another variant, the residues are null. This is particularly 10 the case for a current block coded according to a particular coding mode called skip mode. The reconstructed current block is the prediction block in this case. The reconstruction process described for a current block is reiterated to reconstruct the image I_{BL} of the base layer. Naturally, this process can also be reiterated to reconstruct all the images of the base layer.

During a step 22, a first part EL1 of the enhancement layer relating to a 15 group of blocks is decoded into decoded enhancement data, the group of blocks belonging to an image of the enhancement layer to reconstruct. The part EL1 is decoded by entropy decoding, e.g. by CABAC decoding. The decoded enhancement data thus comprise information relating to the group of blocks of the image of the enhancement layer to reconstruct. A group of 20 blocks is for example an image or an image slice. For example, this enhancement data is obtained by decoding an image slice header, a PPS (Picture Parameter Set) or even a message SEI (Supplemental Enhancement Information). The terms PPS and SEI are notably defined in paragraph 3.107 (definition) and the appendix D respective of the ISO/IEC document 14496-10 25 describing the video coding standard H.264. Indeed, such elements contain information relating to a group of blocks. However, note that an image slice can only contain a single block. However, coding images with image slices of a single block is ineffective in terms of bitrate. Slice coding, each slice containing several blocks, e.g. 2 blocks, groups common information together 30 and thus prevents duplicating the same information in the headers of each block. Advantageously, this decoded enhancement data comprises an item of information *info* for identifying at least one region of the image I_{BL} reconstructed in step 20 to process. Hence, from the decoding of the first part of enhancement layer EL1 relating to the group of blocks, the decoder has

knowledge of the region of the reconstructed image I_{BL} to process, i.e. the one that will effectively be used during the reconstruction of an image of the enhancement layer. This information can thus distinguish between the regions of the reconstructed image I_{BL} that will be used during the reconstruction of an image of the enhancement layer and hence that must be processed and those that will not be used and hence that must not be processed.

5 This information *info* is presented for example in the form of a map indicating for each block of the group of blocks of the enhancement layer whether the corresponding region, e.g. the block, of the base layer must be processed or not. A region of the reconstructed image I_{BL} corresponds to a block of an image of the enhancement layer if it is co-located, i.e. if it occupies in the image the same spatial position possibly after processing (spatial scalability 10 case).

15 As a variant, the information *info* is presented for example in the form of a map indicating for each region, e.g. block, of the reconstructed image I_{BL} corresponding to a block of the group of blocks if this region must be processed or not.

20 This information irrespective of whether it relates to the base layer or to the enhancement layer is coded in the form of a regular map, e.g. in the case of the HEVC standard for each CTU (Coding Tree Unit) or for example for each macroblock as shown in **figure 3**. According to an embodiment variant, this information is coded in the form of an irregular map, e.g. in the case of the HEVC standard for each CU (Coding Unit) as shown in **figure 4**. In these figures, a value 0 indicates that the reconstructed region I_{BL} is not to be 25 processed and a value 1 indicates that it is to be processed. Naturally, the inverse can be chosen by convention. This information is decoded by entropy decoding, for example CAVLC or CABAC.

30 During a step 24, the region or regions of the image of the reconstructed base layer identified by the information *info* decoded in step 22 is processed. The processing is for example a re-sampling of the region in the case of spatial scalability, a colour conversion in the case of CGS scalability, a noise reduction filtering in the case of SNR scalability.

This solution advantageously enables only the useful regions of the reconstructed image I_{BL} to be processed, i.e. used in the reconstruction of

blocks of an image I_{EL} of the enhancement layer. Moreover, by proceeding thus the useful regions of the base layer are processed before the reconstruction of the blocks of the group of blocks and are thus all available during the reconstruction of the group of blocks which avoids too frequent 5 accesses to the image buffer of the reconstructed base layer and too many calls on the processing function.

During a step 26, residues are obtained for at least one block of the group of blocks from a second part of the enhancement layer $EL2$. According to a variant, residues are obtained for each block of the group of blocks. This 10 second part comprises data representative of residues for example quantized DCT coefficients from which residues are calculated or else a particular coding mode (skip mode) indicating that these residues are null. This step possibly comprises the entropy decoding, the inverse quantization and the inverse transformation of data of the second part, e.g. quantized DCT 15 coefficients, to obtain the residues res . This second part possibly comprises motion data.

During a step 28, the blocks of the group are reconstructed from residues res and from the region processed. For this purpose, for each block of the group a predictor is obtained either from an image part previously 20 reconstructed or from the same image as the current block of the group to reconstruct (spatial prediction) or from another image of the enhancement layer (temporal prediction) or even from the region of the reconstructed image I_{BL} processed (inter-layer prediction). The predictor is added to the residues of the current block to reconstruct the current block. Note that according to a 25 variant no predictor is added to the residues of the current block, in the specific case where the current block is coded without prediction (e.g. according to the IPCM coding mode of H.264). The residues correspond in the latter case directly to the reconstructed current block. In the group of blocks, the coding modes can be varied, some blocks being coded according to an 30 IPCM mode, by spatial prediction, others by temporal prediction, others by inter-layer prediction and even others according to a skip mode.

According to a particular embodiment, an additional item of information is decoded from the scalable stream, more precisely, from the enhancement

layer for example of a PPS or of an image slice header that indicates for a group of blocks whether the item of information for identifying at least one region of the reconstructed image I_{BL} to process is coded or not for this group of blocks. Using this particular information, it is possible to specify for each image or even for each image slice if the item of information for identifying at least one region of the reconstructed image I_{BL} to process is coded or not.

5 The additional information is for example a flag, i.e. a binary data. As a simple illustrative example, a first PPS1 is decoded with the additional value equal to Flg1, e.g. 1, indicating that the item of information for identifying the region of

10 the reconstructed image I_{BL} to process is coded. A second PPS1 is decoded with the additional value equal to Flg2, for example 0, indicating that the information for identifying at least one region of the reconstructed image I_{BL} to process is not coded. Hence, each image of the enhancement layer can

15 according to the case refer to one or other of the PPS. If an image of the enhancement layer I_{EL} refers to the first PPS1, then an item of information for identifying at least one region of the reconstructed image I_{BL} to process is decoded, e.g. in each slice header of the image of the enhancement layer as

shown in **figure 5**. In the case where an image J_{EL} refers to the PPS2 no item of information *info* is present. According to a variant, this flag can be coded in

20 each image slice header, in which case if the value indicates that the item of information for identifying at least one region of the reconstructed image I_{BL} to process is coded, this item of information for identifying at least one region of the reconstructed image I_{BL} to process follows in the additional information stream Flg as shown in **figure 6**.

25 According to another embodiment illustrated by **figure 7**, a first item of additional information Flg1 is decoded from the enhancement layer that indicates whether the information *info* for identifying at least one region of the reconstructed image I_{BL} to process can be decoded or not for a group of blocks. This first item of additional information Flg1 is for example decoded

30 from the PPS. For example, if its value is 0 this signifies that no item of information for identifying at least one region of the reconstructed image I_{BL} to process can be decoded from the stream. If its value is 1, this signifies that an item of information for identifying at least one region of the reconstructed image I_{BL} to process can be decoded. In this case, a second item of additional

information Flg2 is decoded for example in the header of each image slice that indicates for a group of blocks whether the item of information *info* for identifying at least one region of the reconstructed image I_{BL} to process is coded or not for this group of blocks. In the case where the second item of information indicates for a group of blocks that said item of information for identifying at least one region of the reconstructed image I_{BL} to process is coded, this item of information *info* follows the second item of information in the stream. This solution enables greater flexibility.

10 **Figure 8** shows a coding method of an image sequence in the form of a scalable stream comprising a base layer and at least one enhancement layer according to a particular and non-restrictive embodiment of the invention. The same variants as the ones described in relation to the decoding method apply to the coding method even in the case where they may not be 15 described explicitly in the remainder of the description.

During a step 80, at least one image I_{BL} of the base layer is coded in the base layer. The coding generally comprises, for blocks of the image, the spatial or temporal prediction of the blocks, the obtaining of residues by subtracting a predictor from the block to code, the transformation and 20 quantization of residues before the entropy coding. The same coding modes described in relation to the decoding method can be used, particularly the skip mode and IPCM coding mode of AVC. Other data is also coded such as coding modes, possibly motion data. The coding comprises the reconstruction of the image of the base layer. Indeed, the latter can then be used for the 25 prediction of other data. These steps are well known to those skilled in the specialised art of video coding and will not be described in further detail. The process can be reiterated for all the images of the base layer so as to code the entire sequence.

During a step 82, enhancement data is coded in a first part of the 30 enhancement layer EL1 relating to a group of blocks of the image of the enhancement layer to reconstruct. A group of blocks is for example an image or a slice of images. For example, this enhancement data is coded in an image slice header, in PPS or even in an SEI message. Indeed, such elements contain information relating to a group of blocks. However, note that

an image slice can only contain a single block. However, coding images with image slices of a single block is ineffective in terms of bitrate. Slice coding, each slice containing several blocks, e.g. 2 blocks, groups common information together and thus prevents duplicating the same information in the 5 headers of each block. Advantageously, this coded enhancement data comprises an item of information *info* for identifying at least one region of the reconstructed image I_{BL} to process. For example, this information is obtained during a previous step of deciding on the coding mode. Indeed, as soon as the coding modes of the blocks of the group are selected, for example by 10 minimising a bitrate-distortion type criterion, this map can be constructed. Indeed, all the blocks of the map that correspond to an inter-layer prediction mode are predicted in relation to a block of the image of the reconstructed base layer processed. This block must then be identified in the map as belonging to the region to process. Hence, from the decoding of the first part 15 of enhancement layer EL1 relating to the group of blocks, the decoder has knowledge of the region or regions of the reconstructed image I_{BL} to process, i.e. the one(s) that will effectively be used during the reconstruction of an image of the enhancement layer. This information can thus distinguish between the regions of the reconstructed image I_{BL} that will be used during 20 the reconstruction of an image of the enhancement layer and hence that must be processed and those that will not be used and hence that must not be processed. This information *info* is presented for example in the form of a map indicating for each block of the group of blocks of the enhancement layer whether the corresponding region, e.g. the block, of the base layer must be 25 processed or not. A region of the reconstructed image I_{BL} corresponds to a block of an image of the enhancement layer if it is co-located, i.e. if it occupies in the image the same spatial position possibly after processing (spatial scalability case). As a variant, the information *info* is presented for example in the form of a map indicating for each region, e.g. block, of the reconstructed 30 image I_{BL} corresponding to a block of the group of blocks if said region must be processed or not. This information irrespective of whether it relates to the base layer or to the enhancement layer is coded in the form of a regular map, e.g. in the case of the HEVC standard for each CTU (Coding Tree Unit) or for example for each macroblock as shown in **figure 3**. According to an

embodiment variant, this information is coded in the form of an irregular map, e.g. in the case of the HEVC standard for each CU (Coding Unit) as shown in **figure 4**. In these figures, a value 0 indicates that the reconstructed region I_{BL} is not to be processed and a value 1 indicates that it is to be processed.

5 Naturally, the inverse can be chosen by convention. This information is coded by entropy coding, for example CAVLC or CABAC.

During a step 84, the region or regions of the image of the reconstructed base layer identified by the information *info* coded in step 82 is/are processed.

10 The processing is for example a re-sampling of the region in the case of spatial scalability, a colour conversion in the case of CGS scalability, a noise reduction filtering in the case of SNR scalability.

This solution advantageously enables only the useful regions of the reconstructed image I_{BL} to be processed, i.e. used in the coding of blocks of

15 an image I_{EL} of the enhancement layer. Moreover, by proceeding thus the useful regions of the base layer are processed before the coding of the blocks of the group of blocks and are thus all available during the coding of the group of blocks which avoids too frequent accesses to the image buffer of the reconstructed base layer and too many calls on the processing function.

20 During a step 86, residues are obtained for at least one block of the group from blocks of the group and from the region processed. According to a variant, residues are obtained for each block of the group of blocks. For this purpose, for each block of the group a predictor is obtained either from an image part previously reconstructed or from the same image as the current

25 block to code (spatial prediction) or from another image of the enhancement layer (temporal prediction) or even from the region of said reconstructed image I_{BL} processed (inter-layer prediction). The predictor is subtracted from the current block to obtain residues. Note that according to a variant no predictor is subtracted from the current block, in the case where the block was

30 coded without prediction (e.g. IPCM coding mode of H.264). The residues block corresponds in the latter case directly to the block to code. In the case of the skip mode, the residues are null. It is the coding mode of the block coded in the stream that indicates it. In the group of blocks, the coding modes can be varied, some blocks being coded according to an IPCM mode, by

spatial prediction, others by temporal prediction, others by inter-layer prediction and even others according to a skip mode.

During a step 88, the residues relating to at least one block of the group of blocks are coded in a second part of the enhancement layer. This step possibly comprises the transformation and quantization of the residues before their entropy coding.

According to a particular embodiment, the additional information shown in figures 5 to 7 and described in relation to the decoding method is coded in the scalable stream S. All the embodiments described in relation to the decoding method apply symmetrically to the coding method.

The invention also relates to a scalable stream representative of an image sequence. This stream is for example produced by the coding method described previously.

15 This scalable stream comprises a base layer and at least one enhancement layer. The base layer comprises data relating to at least one image of the base layer.

The enhancement layer comprises in a first part EL1 relating to a group of blocks enhancement data which comprise an item of information for 20 identifying at least one region of the image of the base layer to process after its reconstruction.

The enhancement layer comprises in a second part EL2 data representative of residues for at least one block of the group of blocks, the residues being obtained from at least one block of the group and from the region processed.

25 According to a variant, the enhancement layer comprises in a second part EL2 data representative of residues for each of the blocks of the group of blocks. This data comprises for example a coding mode, possibly motion data, of data relating to residues (e.g. quantized DCT coefficients) or of data enabling such residues to be determined, e.g. the skip coding mode.

30 Advantageously, the scalable stream comprises the additional information shown in figures 5 to 7 and described in relation to the decoding method.

Figure 9 shows a decoding device 9 according to a non-restrictive embodiment of the invention.

The decoding device 9 comprises a decoding module 90 able to decode a base layer BL of a scalable stream S and to reconstruct images of the base layer. The decoding module 90 is notably configured to implement step 20 of the decoding method. The decoding device 9 further comprises a processing module 92 able to process at least one region of an image of the reconstructed base layer. The processing module 92 is notably configured to implement step 24 of the decoding method. The decoding device 9 also comprises another decoding module 94 able to decode an enhancement layer EL of a scalable stream S and to reconstruct images of the enhancement layer. The decoding module 94 is also able to supply the processing module 92 with the information *info*. The decoding module 94 is notably configured to implement steps 22, 26 and 28 of the decoding method. The decoding device 9 optionally comprises a demultiplexing module 96 configured to demultiplex the scalable stream S into a base layer BL and one or more enhancement layers EL.

Figure 10 shows a particular implementation of such a decoding device 9. The decoding device 9 comprises hardware components such as at least a processor 900 (e.g. CPU/GPU), a memory 902 (e.g. RAM), a user interface 904 (e.g. keyboards, mouse, etc.) and one or more input/output interfaces 906 able to be connected to other devices. These components are for example interconnected by an address and data bus 908. According to an implementation example, when powered up, the processor 900 loads the instructions corresponding to the steps of the decoding method into the memory 902 and executes them.

According to a particular embodiment, the decoding device 9 advantageously comprises an interface to read a computer program stored on a digital data support 910 that stores the program code instructions, that when they are executed by the processor 900, carry out the steps of the decoding method according to any one of the embodiments of the invention described previously. According to a variant, the user interface is external to the decoding device 9.

Figure 11 shows a coding device 11 according to a non-restrictive embodiment of the invention. The coding device 11 comprises a coding

module 110 able to code and reconstruct images I_{BL} in a base layer BL of a scalable stream. The coding module 110 is notably configured to implement step 80 of the coding method. The coding device 11 further comprises a processing module 112 able to process at least one part of an image of the 5 reconstructed base layer. The processing module 112 is notably configured to implement step 84 of the coding method. The coding device 11 also comprises another coding module 114 able to code images I_{EL} in an enhancement layer EL of the scalable stream S. The coding module 114 is also able to supply the processing module 112 with the information *info*. The 10 coding module 114 is notably configured to implement steps 82, 86 and 88 of the coding method. The coding device 11 optionally comprises a multiplexing module 116 configured to multiplex the base layer and enhancement layer or layers into a single scalable stream S.

Figure 12 shows a particular implementation of such a coding device 15. The coding device 11 comprises hardware components such as at least a processor 1100 (e.g. CPU/GPU), a memory 1102 (e.g. RAM), a user interface 1104 and one or more input/output interfaces 1106 able to be connected to other devices. These components are for example interconnected by an address and data bus 1108. According to an implementation example, when 20 powered up, the processor 1100 loads the instructions corresponding to the steps of the coding method into the memory 1102 and executes them.

The coding device 11 advantageously comprises an interface to read a computer program stored on a digital data support 1110 that stores the program code instructions, that when they are executed by the processor 25 1100, carry out the steps of the coding method according to any one of the embodiments of the invention described previously. According to a variant, the user interface is external to the coding device 11.

The decoding 9 and coding 11 devices described are simplified for 30 reasons of clarity. Real devices may comprise other elements such as for example an internal or external battery, non-volatile memory (e.g. flash memory, hard disk drive, etc.), etc. According to variants, decoding 9 and coding 11 devices compatible with the invention are implemented according to a purely hardware embodiment, for example in the form of a dedicated component (for example in an ASIC (Application Specific Integrated Circuit) or

FPGA (Field-Programmable Gate Array) or VLSI (Very Large Scale Integration) or of several electronic components integrated into a device or even in a form of a combination of hardware elements and software elements.

5 Each embodiment can be used independently from the other embodiments or else the embodiments can be combined with each other.

Naturally, the invention described for a base layer and an enhancement layer can be applied to two enhancement layers of different levels, the lower enhancement layer playing the role of a base layer with respect to the upper 10 level layer. Furthermore, the invention is not restricted by the type of quantizing, transform or entropy coding used.

Claims

1. A method for decoding a scalable stream comprising a base layer and at least one enhancement layer, the method comprising:

- 5 - reconstructing (20) at least one image from said base layer,
- decoding (22) a first part of said at least one enhancement layer relating to a group of blocks into decoded enhancement data which comprise at least one item of information for identifying at least one region of said reconstructed image to process,
- 10 - processing (24) said at least one region of said reconstructed image identified by said information,
- obtaining (26) residues for at least one block of the group of blocks from a second part of said at least one enhancement layer, and
- 15 - reconstructing (28) the blocks of the group from said residues and from said at least one region processed.

2. Method according to claim 1, wherein said information for identifying at least one region of said reconstructed image to process is a map 20 indicating for each block of said reconstructed image corresponding to a block of the group of blocks if the block must be processed or not.

3. Method according to claim 1, wherein said information for identifying at least one region of said reconstructed image to process is a map 25 indicating for each block of the group of blocks if the block uses for its reconstruction a processed block of said reconstructed image.

4. Method according to one of claims 1 to 3, wherein said base layer is another enhancement layer of a lower level than said at least one enhancement layer.

30 5. Method according to one of claims 1 to 4, comprising a decoding step from said enhancement layer of an additional item of information for at

least one group of blocks indicating whether said information for identifying at least one region of said reconstructed image to process is coded or not for the group of blocks.

5 6. Method according to claim 5, wherein the group of blocks is an image slice or an image.

10 7. Method according to one of claims 1 to 4, comprising decoding, from said enhancement layer, a first additional item of information indicating whether said information for identifying at least one region of said reconstructed image to process can be coded or not for a group of blocks.

15 8. Method according to claim 7, wherein said first item of additional information being decoded for at least one image, the method comprises, when said first item of additional information indicates that an item of information for identifying at least one region of said reconstructed image to process can be coded, decoding, from said enhancement layer, a second item of additional information indicating for a group of blocks whether said information for identifying at least one region of said reconstructed image to process is coded or not for the group of blocks.

20 9. A method for coding a sequence of images in the form of a scalable stream comprising a base layer and at least one enhancement layer, the method comprising:

- coding (80) at least one image in said base layer and reconstructing (80) said at least one image,
- coding (82) enhancement data in a first part of said enhancement layer relating to a group of blocks, said enhancement data comprising an item of information for identifying at least one region of said reconstructed image to process,
- processing (84) said at least one region of said reconstructed image identified by said information,

- obtaining (86) residues for at least one block of the group of blocks from said blocks of the group and from said at least one region processed, and
- coding (88) the residues in a second part of said enhancement layer.

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10. Method according to claim 9, wherein said information for identifying at least one region of said reconstructed image to process is a map indicating for each block of said reconstructed image corresponding to a block of the group of blocks if the block must be processed or not.

10

11. Method according to claim 9, wherein said information for identifying at least one region of said reconstructed image to process is a map indicating for each block of the group of blocks if the block uses for its reconstruction a processed block of said reconstructed image.

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12. Method according to one of claims 9 to 11, wherein said base layer is another enhancement layer of a lower level than said at least one enhancement layer.

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13. Method according to one of claims 9 to 12, comprising coding, in said enhancement layer, an additional item of information for at least one group of blocks indicating whether said information for identifying at least one region of said reconstructed image to process is coded or not for the group of blocks.

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14. Method according to one of claims 9 to 12, comprising coding, in said enhancement layer, a first additional item of information indicating whether said information for identifying at least one region of said reconstructed image to process can be coded or not for a group of blocks.

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15. Method according to claim 14, wherein said first item of additional information being coded for at least one image, the method comprises,

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when said first item of additional information indicates that an item of information for identifying at least one region of said reconstructed image to process can be coded, coding, in said enhancement layer, a second item of additional information indicating for a group of blocks whether said information for identifying at least one region of said reconstructed image to process is coded or not for the group of blocks.

10

16. A decoder configured for decoding a scalable stream comprising a base layer and at least one enhancement layer, the decoder comprising:

15

- means (90, 900, 902, 904, 906, 908) for reconstructing at least one image from said base layer,
- means (94, 900, 902, 904, 906, 908) for decoding a first part of said at least one enhancement layer relating to a group of blocks into decoded enhancement data which comprise at least one item of information for identifying at least one region of said reconstructed image to process,
- means (92, 900, 902, 904, 906, 908) for processing said at least one region of said reconstructed image identified by said information,
- means (94, 900, 902, 904, 906, 908) for obtaining residues for at least one block of the group of blocks from a second part of said at least one enhancement layer, and
- means (94, 900, 902, 904, 906, 908) for reconstructing said blocks of the group from said residues and from said at least one region processed.

20

17. The decoder according to claim 16, the decoder being configured to execute the steps of the decoding method according to one of claims 1 to 8.

30

18. A coder configured to code a sequence of images in the form of a scalable stream comprising a base layer and at least one enhancement layer, the coder comprising:

- means for coding in said base layer and for reconstructing (110, 1100, 1102, 1104, 1106, 1108) at least one image,
- means for coding (114, 1100, 1102, 1104, 1106, 1108) enhancement data in a first part of said enhancement layer relating to a group of blocks, said enhancement data comprising an item of information for identifying at least one region of said reconstructed image to process,
- means for processing (112, 1100, 1102, 1104, 1106, 1108) said at least one region of said reconstructed image identified by said information,
- means for obtaining (114, 1100, 1102, 1104, 1106, 1108) residues for at least one block of the group of blocks from said blocks of the group and from said at least one region processed, and
- means for coding (114, 1100, 1102, 1104, 1106, 1108) said residues in a second part of said enhancement layer.

19. Coder according to claim 18, the coder being configured to execute the
20 steps of the coding method according to one of claims 9 to 15.

20. A data stream representative of an image sequence comprising a base layer and at least one enhancement layer, the base layer comprising data relative to at least one image of the base layer and

25 the enhancement layer comprising in a first part relative to a group of blocks of enhancement data which comprise an item of information for identifying at least one region of said image of the base layer to process after reconstruction and in a second part of data representative of residues which are obtained from at least one block of the group and
30 from said at least one region processed.

21. A computer program product, characterised in that it comprises program code instructions for executing the steps of the method according to any one of claims 1 to 8 when the program is executed on a computer.

22. A computer program product, characterised in that it comprises program code instructions for executing the steps of the method according to any one of claims 9 to 15 when the program is executed on a computer.

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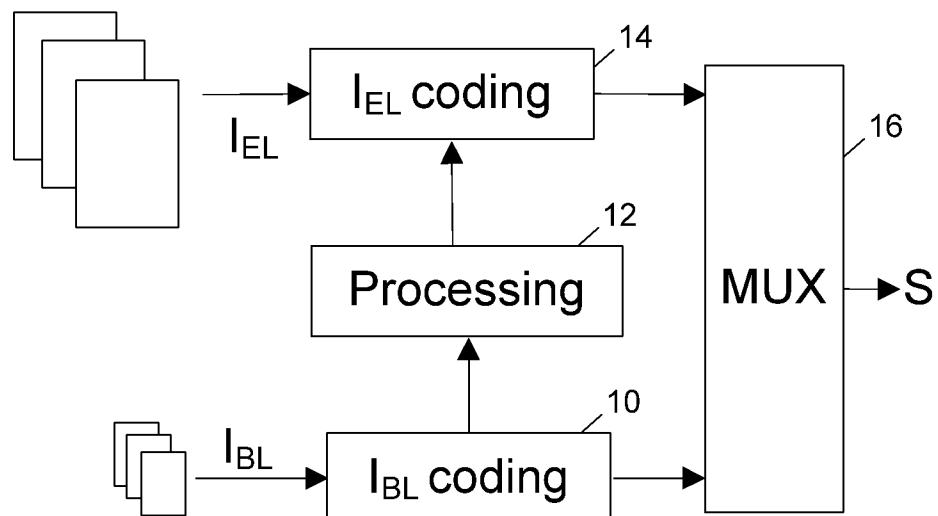


Figure 1- PRIOR ART

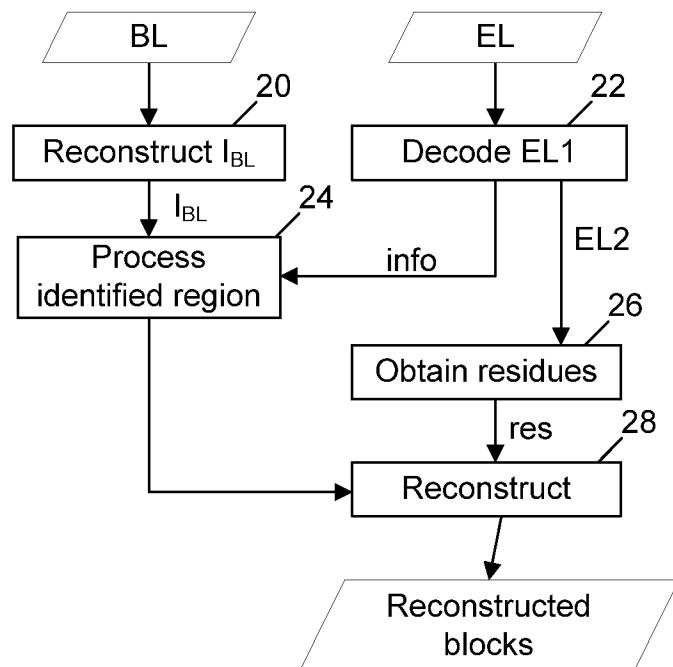


Figure 2

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0	1	1	0
0	0	0	1

Figure 3

0	1		0		0	1
		1		1		
1	0	1		1	1	0
0	1	1	0	1	1	0

Figure 4

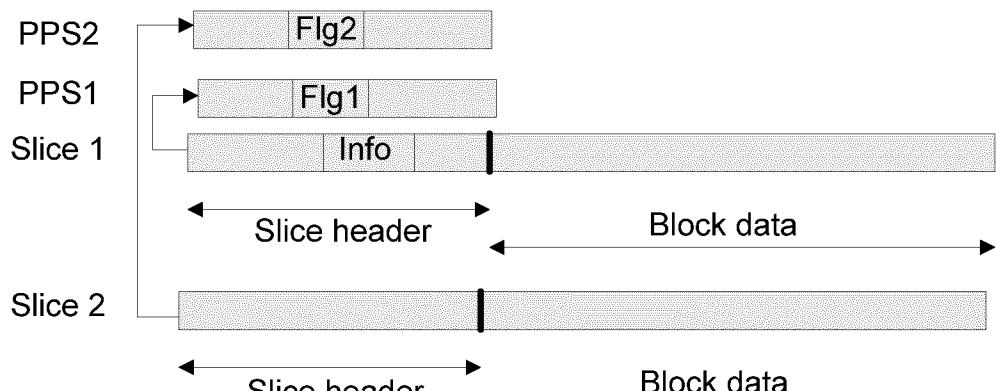


Figure 5

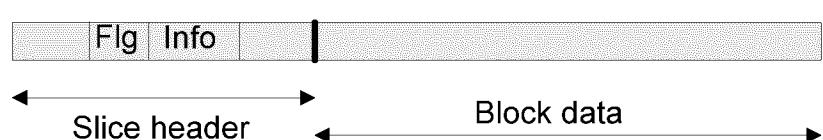


Figure 6

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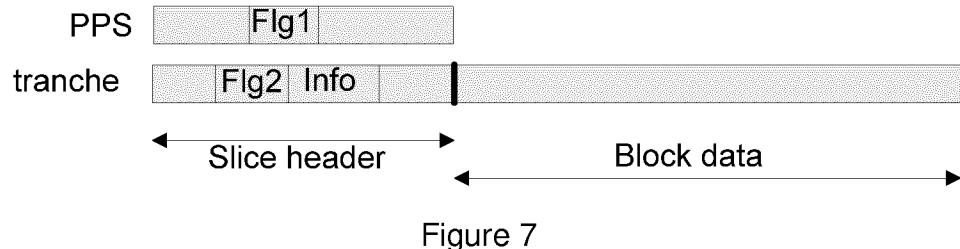


Figure 7

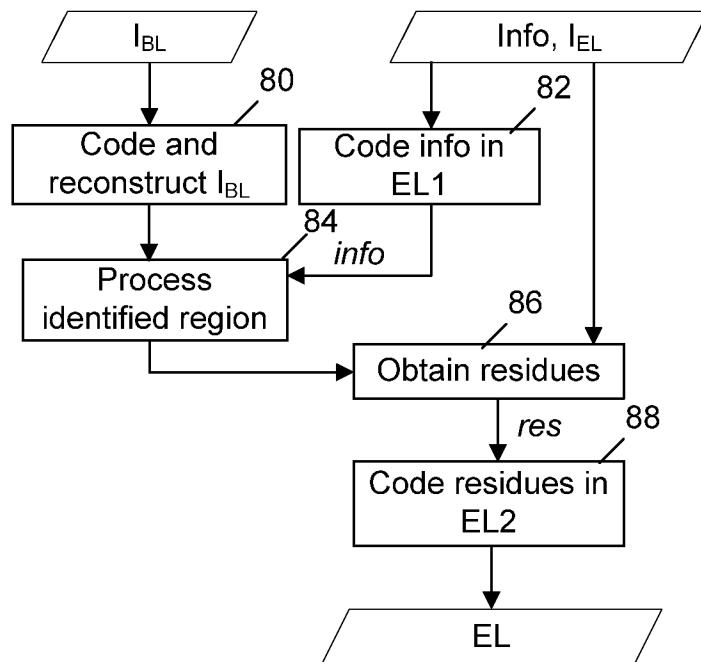


Figure 8

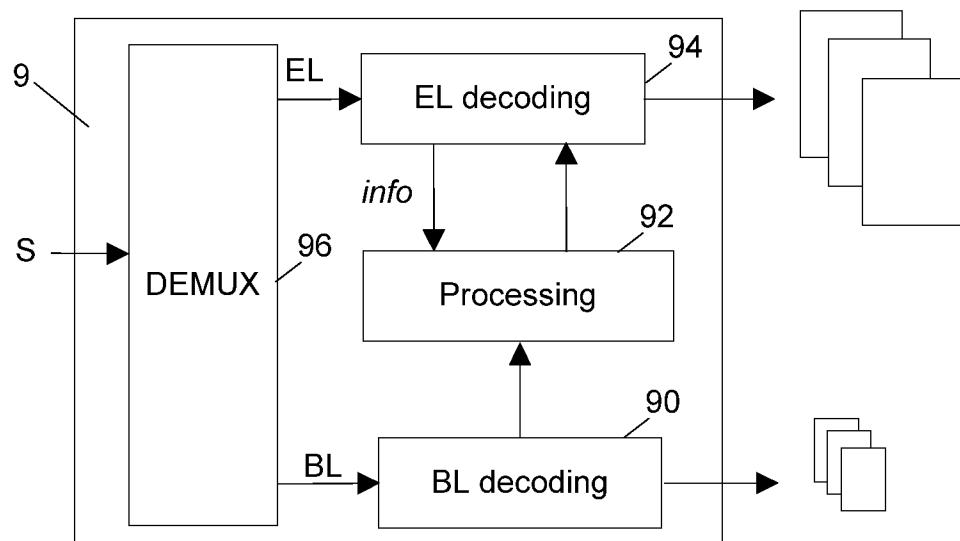


Figure 9

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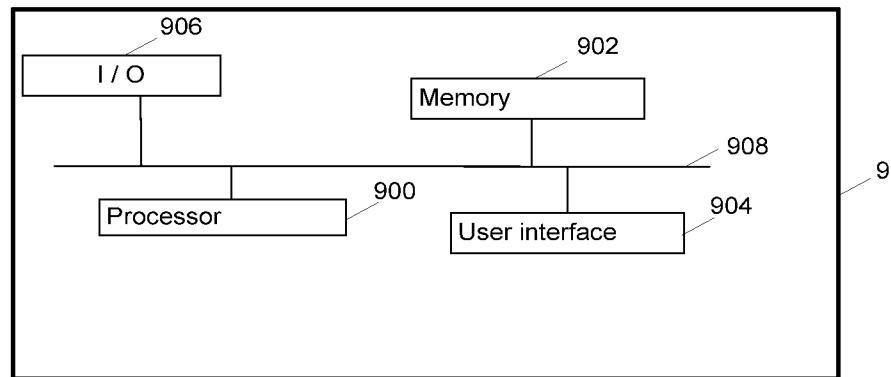


Figure 10

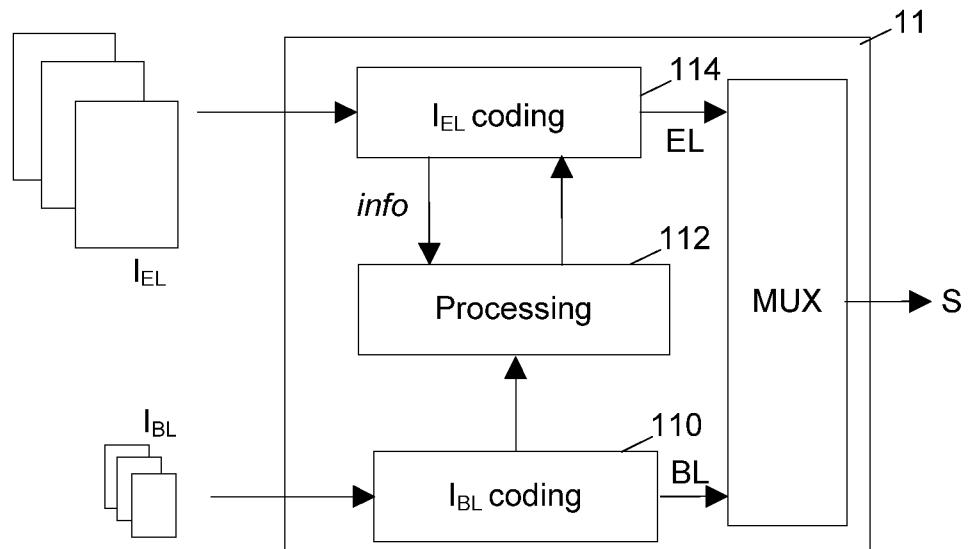


Figure 11

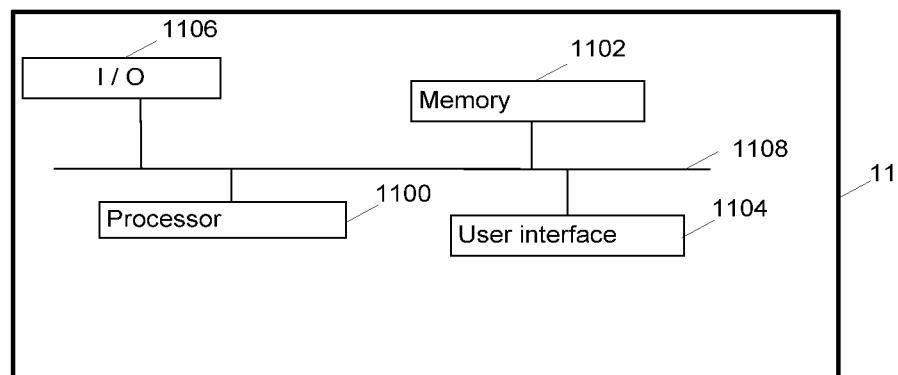


Figure 12

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2014/064817

A. CLASSIFICATION OF SUBJECT MATTER	INV.	H04N19/33	H04N19/34	H04N19/36	H04N19/50	H04N19/46
		H04N19/96	H04N19/176	H04N19/159		

ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H04N G06T

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, COMPENDEX, INSPEC, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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X	<p>KIM C ET AL: "Description of scalable video coding technology proposal by LG Electronics and MediaTek (differential coding mode on)", 11. JCT-VC MEETING; 102. MPEG MEETING; 10-10-2012 - 19-10-2012; SHANGHAI; (JOINT COLLABORATIVE TEAM ON VIDEO CODING OF ISO/IEC JTC1/SC29/WG11 AND ITU-T SG.16); URL: HTTP://WFTP3.IITU.INT/AV-ARCH/JCTVC-SITE/, no. JCTVC-K0033, 1 October 2012 (2012-10-01), XP030112965, the whole document</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">-/-</p>	1-22



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

Date of mailing of the international search report

2 October 2014

10/10/2014

Name and mailing address of the ISA/
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Authorized officer

Martinière, Anthony

INTERNATIONAL SEARCH REPORT

International application No
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