Electronic Picture Reproduction Device

The invention is concerned with an electronic picture reproduction device for digital video signals.

In the planned transmission of HDTV television signals (HDTV, high definition television) according to the HDMAC method (HDMAC, high definition multiflexed analogue components) a motion-adaptive signal processing is planned. The signal processing (high resolution in steady picture areas or low resolution in moving picture areas) is uniform within each video signal block of, for example, 16 x 16 picture points (Technical papers IBC 1988, Brighton, GB, pp. 70 through 73). The picture points of such a video signal block within each video signal block are marked as belonging to the respective block type through a DATV signal (DATV, digital assisted television) which is transmitted as additional information to the television signal and contains further information, for example, motion vectors. The numerical values of picture points to be reproduced are determined according to the calculation rule for the different block types by two or more different methods. Through a different method of signal processing within the blocks the picture characteristics in the blocks, for example the picture sharpness, are different. In an HDTV television receiver the moving signal blocks are interpolated in a motion-compensated way with relatively high effort with the aid of the motion/steady information and the motion vectors from this DATV signal, i.e. in addition moving picture portions can be reconstructed in the receiver with a relatively high resolution.

It is possible to not evaluate the motion vectors but rather, only the motion/steady information.

Accordingly, with such a device the picture points are interpolated in moving video signal blocks in the field at low resolution and in steady video signal blocks with high vertical resolution in the full frame. This makes possible also simple devices.

For picture contents with fine and partly moving details or with noisy picture signals however, motion/steady block borders can then become apparent in a disturbing way.

In WO-A-8704033 picture blocks are transmitted either coded with high or with low resolution and are decoded in a receiver. The picture points from low resolution blocks are interpolated from the block average value and from block average values of the adjacent blocks.

In WO-A-8803346 a value representing the coder buffer fullness is transmitted additionally. Depending on that buffer fullness the strength of a picture window filter is controlled. When using such block-overlapping lowpass filtering, annoying visible block borders can be blurred in the event of higher buffer fullness levels at the expense of lowering the picture sharpness.

It is the object of the invention to reduce the visibility of the block borders for an electronic picture reproduction device, for example, a television receiving device, in such a way, that this reduction is independent from control parameters in a coder and that the picture sharpness is kept.

This task is solved by the features stated in patent claim 1. Advantageous further developments of the invention are derived from the subclaims.

In principle, the invention lies in the fact that with an electronic picture reproduction device a block border softener is used. In such a block border softener the numerical values of the picture points bordering other blocks are calculated in parallel for the moving and for the steady case in all video signal blocks. For the numerical value of picture points of one block which are directly adjacent to another block, now the arithmetical average of both numerical values which have been calculated for the respective picture point for the moving and for the steady case can be used. This can occur at the horizontal and/or vertical block borders. Thereby, the difference of the picture sharpness in adjacent different block types is not perceived as being too disturbing. The composition of the picture point numerical values from proportions of both moving and steadily calculated values can also be extended to more than one line and/or column bordering an adjacent block.

For video signals which are transmitted in the field method (interlace) for reconstruction of picture point blocks marked as moving picture points in a field may be used. For video signal blocks which are marked as steady, however, picture points from two successive fields can be used.

Within a block of for example 16 times 16 picture points, however, moving as well as steady picture points may be present. The reproduction of steady picture points in a block marked as moving, for example, results in only slight vertical blurredness of these picture points. The blurredness is adapted to the blurredness of the moving picture points in this block and is hardly perceived as disturbing. The reproduction of moving picture points in a block marked as steady on the other

hand, leads to severe horizontal blurredness and doubled contours of moving edges. For this reason it can be of advantage according to the subclaims to combine components of moving and steady picture point calculated numerical values at the block edges only in blocks marked as steady.

Below an exemplary embodiment of the invention is explained with the aid of the drawings. These show in

Fig.1 a block diagram of an electronic picture reproduction device with a block border softener

Fig.2 a picture point blocks with corrected picture points

Fig.3 a picture point block with improved correction

Fig.1 shows a television tuner 50, an intermediate frequency amplifier 51 and a demodulator 52 which supplies an audio signal, a luminance signal, a chrominance signal and a DATV signal. These signals are transmitted sequentially, for example. The audio signal is processed in circuit 53, amplified in circuit 54 and transferred to the loudspeaker 55. The DATV signal is processed in circuit 69 which generates block-wise moving/steady information for the circuits 57 and 61 as well as for the block border softeners 58 and 62 and feeds it to them. The luminance signal is digitalized in the analog-to-digital converter 56, digitally processed in circuit 57, varied in the block border softener 58 and presented in an analog form in the digital-to-analog converter 59. The chrominance signal is digitalized in the analog-to-digital converter 60,

digitally processed in circuit 61, varied in the block border softener 62 and presented in analog form in the digital-to-analog converter 63. The block border softener 62 can be left out for the chrominance signal under certain circumstances. The luminance and the chrominance signals from the digital-to-analog converters 59 and 63 are converted in a matrix 64 into RGB signals and fed to the picture tube 66 via the RGB amplifier 65. On the picture tube 66 television lines 67 and picture point blocks 68 are shown.

Fig.2 shows five video signal blocks 2,22,24,26 and 28 of a correspondingly received television picture with a block size of, for example, eight times eight picture points each which lie on the lines 15 of a video signal. Only a part of the picture points is shown here. The block 2, for example, stands for a block which is marked by the DATV additional signal as a steady block. It has a number of picture points 1 or, respectively, P which directly border the adjacent blocks 22,24,26 and 28 and are arranged in a ring. This arrangement shall hereinafter be referred to as ring 11. The rings occupy the edges of the block to which they belong.

The picture points of ring 12 and the picture points of block 2 that are lying further inside are calculated as steady, or simply put together from two successive fields of the video signal.

Steady picture points have scanning values Pu, moving picture points have scanning values Pb. Picture points reproduced in the receiver at the block borders have scanning values P or, respectively, 1.

The numerical values P of of the picture points of ring 11 are combined from the numerical value Pu of the

corresponding picture point which is calculated as steady and the numerical value Pb of the same picture point which is now calculated as moving:

$$P = (Pu + Pb)/2$$

The picture points of the rings 23,25,27 and 29 are handled in the same way.

Fig.3 shows an area of a picture screen with improved softening of the block borders 36. The block 4 is marked as moving. All picture points including those of ring 41 are calculated as moving. The block 3 is marked as steady. Now, the picture points of ring 32 can be calculated according to the formula $P = (Pu + Pb)/2$. The numeral values P of the picture points of ring 31 can be calculated according to the formula $P = (Pu + 3*Pb)/4$ and the numerical values P of the picture points of ring 33 according to the formula $P = (3*Pu + Pb)/4$. The picture points lying further inside the block 3 can all be calculated as steady.

The number of the rings with picture points calculated according to one of the given formulae can be varied depending on the magnitude of the difference between moving and steady picture point calculated numerical values. The numbers in the above named formulae can assume other values too, a calculation with numerical values which can be performed by digital add and shift operations appears useful, however.

Definition of terms:

-Picture point

Scanning value of an analog or digital video signal. The scanning values are coded in digital PCM

form (pulse code modulation).

-Picture point numerical value, numerical value of a picture point.

Luminance or color information for the scanning value of a picture point in the form of a numerical value. The numerical value can be in a range of, for example, 0 to 255.

-Block, video signal block

An area of a television picture composed of several adjacent picture points. This picture area can be, for example, shaped like a square, a rectangle or a rhombus. In the case of a square the block can be made of, for example, 16 partitions of television lines lying one under the other whereby each line partition contains 16 picture point scanning values.

-Block border

An imaginary border line demarcating a block at the outside against the adjacent blocks.

-Block edge

The group of picture points which lie directly at a block border and are not separated by other picture points from the block border.

-Calculation rule

A rule according to which the numerical values of the reproduced picture points are created from numerical values of received picture points.

-Calculation mode

One of two or more available calculation rules.

-Block type

One of two or more available types of blocks. The numerical values of all picture points in such a block are first created according to the calculation rule allocated to the respective block type.

-Picture point share

For a picture point to be reproduced intermediate numerical values are created according to different calculation rules. The actual numerical value of the picture point to be reproduced is composed of percentage shares of the different intermediate numerical values.

-Mixing ratio of the numerical values

The ratio of the percentage shares. Example: 75 per cent share according to calculation mode A, 25 per cent share according to calculation mode B results in a mixing ratio of 3:1.

-HDTV

High definition television, television signal with a higher number of lines and/or picture points per line.

-DATV

Digitally assisted television, television with a digital additional signal. A television signal transmitted via a standard cable, along with which additional digital information is transmitted which is required for reconstruction of the reproduced picture in full quality.

-Motion-compensated interpolation.

For picture contents of television pictures, motion speeds and the directions of movement are determined between two television pictures. An intermediate picture which has to be newly determined and which is to be generated in the time between the

already existing television pictures, can thus be created without the disturbances that are normally caused by movement in the picture.

Claims

1. An electronic picture reproduction device for digital video signals, in which the picture points of the video signals are combined into blocks, wherein the blocks are separated from neighbouring blocks by block edges and the blocks form a raster, and wherein there is one type of block for blocks with substantially static picture content and at least a second type of block, and at the input the picture points for each block are determined as belonging to either the first or to one of the further types of block, characterised in that:
the second and possibly further types of block have substantially dynamic picture content;
each of the blocks can be evaluated independently of the type of block allocated to it upon input and independently of information concerned with spatially or temporally neighbouring blocks so that it can be reproduced corresponding to the first type of block and corresponding to at least one of the other types of block;
for generating the reproduction picture points at the block edges, the picture point values are calculated in the picture reproduction device according to two different calculation rules - namely corresponding to the specified picture type and corresponding to the picture type of the neighbouring block - and the values received according to these two calculation rules are combined in order to obtain the value for the picture point actually reproduced.

2. An electronic picture reproduction device according to claim 1, characterised in that the combination is an arithmetic averaging.

3. An electronic picture reproduction device according to claim 1 or 2 characterised in that for a part of the reproduction picture points at the block edge only the value of the corresponding picture point is used which corresponds to the then specified block type.

4. An electronic picture reproduction device according to claim 3, characterised in that the part includes the respective horizontal or vertical block edges in a block.

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5. An electronic picture reproduction device according to one or more of claims 1 to 4, characterised in that for the reproduction picture points lying in the inside of the particular block only the values of the corresponding picture points are used which correspond to the particular block type, and that the influence of that one of the two values which corresponds to the block type of the respective neighbouring block reduces from the block edge towards the block inside.

6. An electronic picture reproduction device according to claim 5, characterised in that the reproduction picture points in the blocks with dynamic picture content is calculated from the corresponding values of the picture points of one frame, and the reproduction picture points in the blocks with static picture content are calculated from the values of picture points of two neighbouring frames.

7. An electronic picture reproduction device according to claim 6, characterised in that in the blocks with dynamic picture content all reproduction picture points of the particular block are reproduced only according to the calculation rule valid for this type of block.

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