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(99)

☒ Description : paged ...1... to paged ...8...
☒ Claim(s) : paged ...9... to paged ...11...
☒ Drawing(s) : paged ...1/1... to paged ...1/1...
☒ Abstract : paged ...12... to paged ...12...

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A Method and Device for Estimating Movement

The invention relates to a method and device for estimating movement in video signals.

Prior Art

The data-reducing coding/decoding of digital video signals is in many cases based on a movement-compensated interpolation of picture element values (interframe coding). For this purpose, movement vectors or displacement vectors are required for picture element blocks. These movement vectors are normally generated in the encoder by means of movement estimation.

A comparison is carried out in each case for a picture element block with e.g. 8*8 luminance picture elements from the current image within a search zone consisting of an enlarged picture element block of e.g. 16*16 luminance picture elements of the preceding image and referred to as search window. By means of MSE (mean squared error) or MAE (mean absolute error), within the search zone the 8*8 block with the highest correlation is determined and from the spatial position of the latter compared to the block from the current image the respective movement vector is determined.

This method is extremely compute-intensive and requires very high cycle rates. Even in hierarchical search methods complex and high-speed hardware is required.

Invention

The aim of the invention is to provide a less compute-intensive method of estimating movement. This aim is fulfilled by the method described in Claim 1.



The invention is based on the further aim of providing a device for the method according to the invention. This aim is fulfilled by the device described in Claim 7.

In conventional methods of estimating movement, picture element values with a full word length of e.g. 8 bits are used. Detailed investigations have now shown that a movement estimation can also be effected by analysing only specific bits, e.g. the MSB or the two MSBs, of the picture element values. For this purpose these bits (of the picture element values of the current and the preceding and/or following image) are linked by logic operations and the individual results for the different block positions of the current block (e.g. 8*8 block) within the search window are in each case combined. By means of a following minimum or maximum comparison, the respective vector for the current block is then determined. The logic operations are preferably EXOR and/or EXNOR functions, the results of which within the respective search block are counted and/or added.

In principle the method according to the invention consists in that for the estimation of movement in video signals, where in each case within a search zone a reference picture element block (BS) is compared with corresponding picture element blocks (SAS) of one or several adjacent images and a movement vector is determined in accordance with the position of the principally highest correlation, in this comparison of the picture element values in each case only the MSB (most significant bit) and/or further of the MSBs (most significant bits), provided with the general reference MSBs in the following, is/are used.

Advantageous further developments of the method according to the invention are described in the associated dependent claims.

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In principle the device according to the invention for estimating movement in video signals, where in each case within a search zone a reference picture element block is compared with corresponding picture element blocks of one or several adjacent images and a movement vector is determined in accordance with the position of the principally highest correlation, is provided with:

- storage means for storing the reference picture element block and the picture element blocks of one or several adjacent images;
- EXOR or EXNOR gates which are connected to the storage means and which are in each case supplied with only the MSB (most significant bit) and/or further of the MSBs (most significant bits), referred to in general in the following as MSBs, of these picture element values;
- means for the addition, counting and/or intermediate storage of the comparison results for each of these picture element values from the EXOR or EXNOR gates which determine the movement vector from the search position with the minimum or maximum of the sum or the counting result.

Advantageous further developments of the device according to the invention are described in the associated dependent claims.

Drawings

Exemplary embodiments of the invention will be described making reference to the drawing in which:

Fig. 1 shows a block from the current image and a search zone from the preceding image;

Fig. 2 is a block diagram of a movement estimator according to the invention;

Fig. 3 is a block diagram of a further movement estimator according to the invention.

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Exemplary Embodiments

The blocks shown in Fig. 1 relate, for reasons of clarity of layout, to a block size of 2*2 picture elements. In reality block sizes of e.g. 8*8 or 16*16 picture elements are used. For the determination of a first combination result, in consecutive cycles CL in an EXOR or EXNOR function the MSBs of the picture elements of the current block are logic-linked with the MSBs of the search zone picture elements A...T (size of the search zone can be arbitrarily selected) in accordance with the following table:

EXOR	CL
$1 \oplus A$	1
$2 \oplus B$	2
$3 \oplus F$	3
$4 \oplus G$	4

For the determination of the second combination result, in consecutive cycles CL the MSBs are logic-linked in accordance with the following table:

EXOR	CL
$1 \oplus B$	1
$2 \oplus C$	2
$3 \oplus G$	3
$4 \oplus H$	4

The sequence can differ:

A)

In accordance with the above tables, firstly with the cycle CL = '1', MSB '1' (or the several MSBs corresponding to the position of MS '1') are simultaneously logic-linked in a corresponding number of EXOR functions with the MSBs (or the several MSBs corresponding to the position of MSB '1') of A, B, C,...,N, whereupon in cycle CL = '2', MSB '2' is



simultaneously logic-linked in these EXOR or EXNOR functions with the MSBs of B, C, ..., O etc. The individual results at the outputs of these EXOR or EXNOR functions are in each case added and intermediately stored. Following the processing of the search zone for a block, in the case of EXOR functions the minimum of these sums, and in the case of EXNOR functions the maximum of these sums is determined for the search zone, and from the associated search position (i.e. where as many as possible of the 2*2 MSBs of the two blocks are identical) the corresponding movement vector is determined.

B)

Firstly, with the cycle CL = '1', in parallel EXOR- or EXNOR functions MSB'1' is logic-linked with MSB'A', MSB'2' is logic-linked with MSB'B', MSB'3' is logic-linked with MSB 'F', and MSB'4' is logic-linked with MSB'G' and directly the combination result or sum of these four individual results is determined and intermediately stored. Then, in cycle CL = '2' in parallel EXOR functions MSB '1' is logic-linked with MSB 'B', MSB '2' is logic-linked with MSB 'C', MSB '3' is logic-linked with MSB 'G', and MSB '4' is logic-linked with MSB 'H' and the corresponding combination result is determined etc. Following the processing of the search zone for a block, in the case of EXOR functions the minimum of these sums, and in the case of EXNOR functions the maximum of these sums is determined for the search zone and from the associated search position (e.g. where as many as possible of the 2*2 MSBs of the two blocks are identical) the corresponding movement vector is determined.

The movement estimator according to Fig. 2 is suitable for version A) and contains block storage means BS for the picture element values or the required bits (e.g. the MSB or the 2 or 4 MSBs) of these values of the current block. The picture elements values or the corresponding MSBs for the search zone are stored in search zone storage means SAS.



The required bit or the required bits of these picture element values are fed to EXOR or EXNOR gates G1, G2,...G6... One output of BS, via which the MSBs '1', '2', '3' and '4' are output, is connected to all the gates. From SAS a number of lines corresponding to the number of picture elements of the search zone is in each case connected to one of the gates G1, G2....., G6. The gate output values are added for each of the search positions in each case in an adder. Advantageously, on the basis of the 1-bit values this addition of the individual results can be carried out using counters C1, C2,...,C6... For each search for a block, the maximum or minimum of the counting results is determined in following comparator means COM and from the associated search position the corresponding movement vector is determined.

If a plurality of (n) MSBs are analysed in parallel for the search, the circuit can be extended in different ways:

- a) n gates, n counters (in the case of MSB and MSB^{-1} or MSB^{-1} and MSB^{-2} , $n = 2$), which are arranged in parallel in an appropriate fashion;
- b) preferably n gates, a counter operating at n-fold speed or an adder;
- c) as a) or b) but to/from one or several of the MSBs from BS and from SAS prior to the analysis in the gates a defined value, e.g. 48, is added or subtracted. This defined value or defined values can be continuously adapted to the image statistic;
- d) not always the same bits are analysed, e.g. within a block in each case two of the bits MSB, MSB^{-1} and MSB^{-2} are selected.

These possibilities can also be combined in an appropriate fashion.



The movement estimator according to Fig. 3 is suitable for version B) and contains block storage means BS for the picture element values or the required bits (e.g. the MSB or the 2 or 4 MSBs) of these values of the current block. The picture element values or the corresponding MSBs for the search zone are stored in search zone storage means SAS. BS has four (depending upon the block size) outputs, each of which is connected to one of the fourth EXOR or EXNOR gates G1...G4 and via which the required bit or required bits of these picture element values are fed to the gates. Similar applies to SAS. The gate output values are added for each of the search positions in each case in an adder circuit CO and intermediately stored for all the search positions. Advantageously, on the basis of the 1-bit values this addition of the individual results can be carried out using counters. For each search for a block, the maximum or minimum of the counter results is determined in following comparator means COM and the corresponding movement vector is determined from the associated search position.

The extension possibilities referred to with reference to Fig. 2 can be applied in a corresponding fashion in the circuit according to Fig. 3.

The invention can also be used to form (e.g. local) movement vectors in a decoder.

In the case of a moving image content in interlaced images, the vector search can also be carried out within blocks which are composed only of lines of one field.

The search zone can also be non-square and/or varied in its dimensions, in particular as a function of search results preceding in respect of time and/or space.



The invention can also be implemented in the vector search for a reference block by comparison with corresponding blocks of a preceding and a following image (double-sided block matching).

Instead of MSE or MAE it is also possible to use other methods of fault level calculation. Instead of determining the movement vector in accordance with the respective highest correlation, it is also possible deliberately not to select the position of the highest correlation if a closely located position is better adapted to the surrounding vectors.

The invention can be applied for example in MPEG TV systems, in digital video recorders and in moving image transmission via telephone lines (ISDN).

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Claims

1. A method of estimating movement in video signals wherein in each case within a search zone a reference picture element block (BS) is compared with corresponding picture element blocks (SAS) of one or several adjacent images and a movement vector is determined in accordance with the position with the principally highest correlation, characterised in that in this comparison (G1...G6, C1...C6, COM) of the picture element values, in each case only the MSB (most significant bit) and/or further of the MSBs (most significant bits), referred to in general as MSBs in the following, is/are used.
2. A method as claimed in Claim 1, characterised in that in the comparison the MSBs of the picture element values from the reference block (BS) and from the search zone (SAS) are logic-linked with EXOR- or EXNOR functions.
3. A method as claimed in Claim 2, characterised in that in the logic-linking, for each of these picture element values the result of the EXOR or EXNOR function is added or counted, and the movement vector is determined from the search position with the minimum or maximum of the sum or the counting result.
4. A method as claimed in Claim 3, characterised in that at least $n=2$ MSBs for each picture element value *(from?) n EXOR or EXNOR functions are added or counted, where in each case either n parallel counters are used or a counter with n -fold speed is used.
5. A method as claimed in one or more of Claims 1 to 4, characterised in that prior to the comparison, to/from one or more of the MSBs defined values, in particular adapted to





an image statistic, are in each case added and/or subtracted.

6. A method as claimed in one or more of Claims 1 to 5, characterised in that in the comparison, within a picture element block different ones of the MSBs are analysed for different picture element values.

7. A device for a method as claimed in one or more of Claims 1 to 6 for estimating movement in video signals, wherein in each case within a search zone a reference picture element block (BS) is compared with corresponding picture element blocks (SAS) of one or more adjacent images, and a movement vector is determined in accordance with the position with the principally highest correlation, provided with:

- storage means (BS, SAS) for storing the reference picture element block and the picture element blocks of one or more adjacent images;
- EXOR or EXNOR gates (G1, G2, ..., G6...) which are connected to the storage means and which are in each case supplied with only the MSB (most significant bit) and/or further of the MSBs (most significant bits), referred to in general as MSBs in the following, of these picture element values;
- means (C1, C2, ..., C6, ...COM, CO) for the addition, counting and/or intermediate storage of the comparison results for each of these picture element values from the EXOR or EXNOR gates which determine the movement vector from the search position with the minimum or maximum of the sum or counting result.

8. A device as claimed in Claim 7, characterised in that at least $n=2$ MSBs for each picture element value in n parallel EXOR or EXNOR gates (G1, G2, ..., G6...) are added or



counted, where in each case either n parallel counters are used or one counter with n -fold speed is used.

9. A device as claimed in Claim 7 or 8, characterised in that prior to the comparison, to/from one or more of the MSBs defined values, in particular adapted to an image statistic, are in each case added and/or subtracted.

10. A method or device as claimed in one or more of Claims 1 to 9 for use in MPEG TV systems, in digital video recorders and/or in moving image transmission via telephone lines (ISDN).

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* C L M S *

Abstract

The data-reducing coding/decoding of digital video signals is in many cases based upon a movement-compensated interpolation of picture element values. For the determination of the movement vectors for picture element blocks, a comparison is in each case carried out for a picture element block from the current image within a search zone consisting of an enlarged picture element block. By means of MSE or MAE, within the search zone the block with the highest correlation is determined and from the spatial position of the latter compared to the block from the current image the respective movement vector is determined. This method is extremely compute-intensive and requires very high cycle rates. Even in hierarchical search methods, complex and high-speed hardware is required.

In accordance with the invention, the movement estimation is carried out by the analysis of only specific bits, e.g. the MSB or the two MSBs, of the picture element values. For this purpose these bits are logic-linked by means of EXOR and/or EXNOR functions and the individual results for the different block positions of the current block within the search window are in each case combined. By means of a following minimum or maximum comparison the respective vector for the current block is then determined.

Fig. 2.

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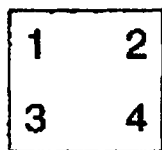


Fig.1A

A	B	C	D	E
F	G	H	I	J
K	L	M	N	O
P	Q	R	S	T

Fig.1B

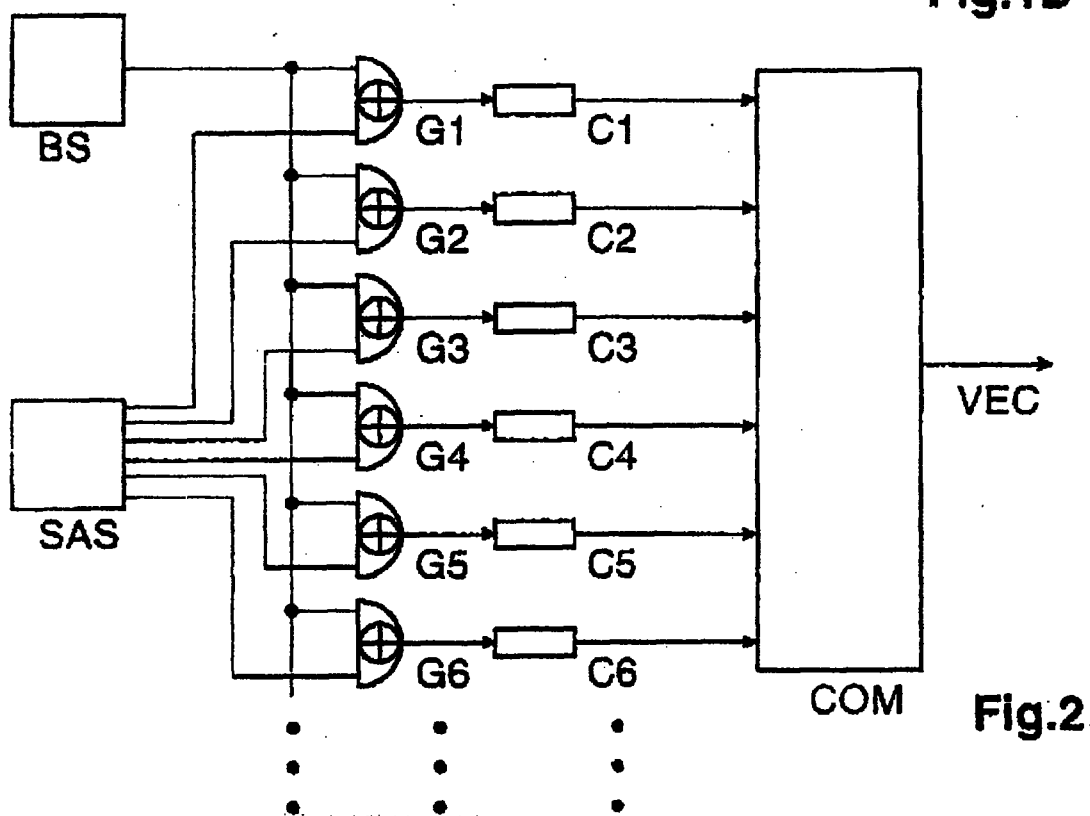


Fig.2

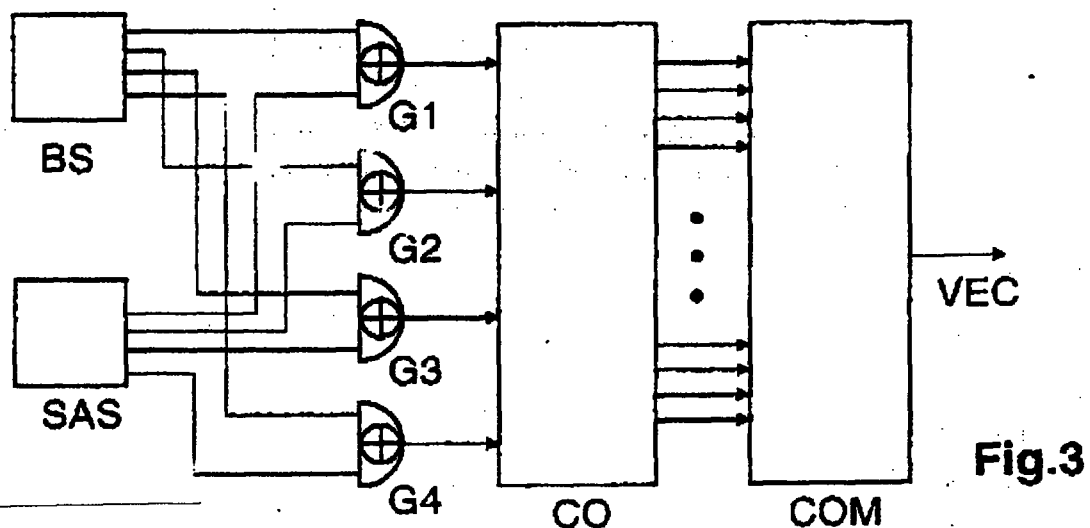


Fig.3



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Method and device for motion estimation

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The invention relates to a method and a device for motion estimation in picture signals.

Prior Art

Motion-compensated interpolation of pixel values is a fundamental approach (interframe coding) in many instances in the case of data-reducing coding/decoding of digital picture signals. Motion vectors for pixel blocks are required for this purpose. These motion vectors are normally generated in the encoder by means of motion estimation. In this process, a comparison is carried out in each case for a pixel block having, for example, 8×8 luminance pixels from the current image inside a search area which consists of an enlarged pixel block of, for example, 16×16 luminance pixels of the preceding image. The MSE (mean squared error) or MAE (mean absolute error) is used inside the search area to determine the 8×8 block having the highest correlation, and its spatial position in comparison to the block from the current image is used to determine the respective motion vector. This method is extremely demanding computationally and requires very high clock pulse rates. Complex and fast hardware is still required even in the case of hierarchical search methods.

Invention

It is the object of the invention to specify a method for motion estimation which is less demanding computationally. This object is achieved by means of the method specified in Claim 1:

It is also the object of the invention to specify a device for the method according to the invention. This object is achieved by means of the device specified in Claim 7.

Pixel values having a full word length of, for example, 8 bits are used in conventional motion estimation methods. Detailed investigations have shown that it

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is also possible to perform motion estimation by evaluating only specific bits, for example the MSB or the two MSBs, of the pixel values. For this purpose, these bits (from the pixel values of the current and of the preceding and/or following image) are combined by means of logic operations, and the individual results for the various block positions of the current block (for example, 8*8 block) are respectively combined inside the search window. The respective vector for the current block is then determined by means of a subsequent minimum or maximum comparison. The logic operations are preferably EXOR and/or EXNOR functions whose results are counted and/or added inside the respective search block.

In principle, that [sic] method according to the invention consists in that for the purpose of motion estimation in picture signals, in which method inside a search area in each case a reference pixel block (BS) is compared with corresponding pixel blocks (SAS) of one or more neighbouring images and a motion vector is determined in accordance with the position having the highest correlation in principle, in this comparison of the pixel values in each case only the MSB (most significant bit) and/or further ones of the MSBs (most significant bits), denoted below generally as MSBs, is/are compared [sic].

Advantageous developments of the method according to the invention follow from the associated dependent claims.

In principle, the device according to the invention for motion estimation in picture signals, in which device inside a search area in each case a reference pixel block is compared with corresponding pixel blocks of one or more neighbouring images and a motion vector is determined in accordance with the position having the highest correlation in principle, is provided with:

- storage means for storing the reference pixel block and the pixel blocks of one or more neighbouring images;
- EXOR or EXNOR gates which are connected to the storage means and to which only the MSB (most significant bit) and/or further ones of the MSBs (most significant bits),

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denoted below generally as MSBs, of these pixel values is or are fed; and

- means for adding, counting and/or buffering the comparison results for each of these pixel values from the EXOR or EXNOR gates, which determine the motion vector from the search position having the minimum or the maximum of the sum or of the counting result.

Advantageous developments of the device according to the invention follow from the associated dependent claims.

Drawings

Exemplary embodiments of the invention are described with the aid of the drawings, in which:

- Fig. 1 shows a block composed of the current image and the search area from the preceding image;
Fig. 2 shows a block diagram of a motion estimator according to the invention; and
Fig. 3 shows a block diagram of a further motion estimator according to the invention.

Exemplary embodiments

The blocks represented in Fig. 1 relate for reasons of clarity to a block size of 2*2 pixels. In actuality, block sizes of, for example, 8*8 or 16*16 pixels are used. In order to determine a first combination result, the MSBs of the pixel values of the current block are compared with the MSBs of the search area pixels A...T (the size of the search area can be chosen arbitrarily) are combined in successive clock pulses CL in an EXOR or EXNOR function in accordance with the following table:

EXOR	CL
1 ⊕ A	1
2 ⊕ B	2
3 ⊕ F	3
4 ⊕ G	4

In order to determine the second combination result, the MSBs are combined in successive clock pulses

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CL in accordance with the following table:

EXOR	CL
1 ⊕ B	1
2 ⊕ C	2
3 ⊕ G	3
4 ⊕ H	4

The sequence can differ:

A)

In accordance with the preceding tables, the first step at clock pulse CL='1' is to combine the MSB '1' (or the plurality of MSBs corresponding to the position of MSB '1') with the MSBs (or the plurality of MSBs corresponding to the position of MSB '1') of A, B, C, ..., N simultaneously in a corresponding number of EXOR functions, after which at clock pulse CL='2' MSB '2' is simultaneously combined with the MSBs of B, C, ..., O in these EXOR or EXNOR functions, etc. The individual results at the outputs of these EXOR or EXNOR functions are summed and buffered in each case. After processing of the search area for a block, in the case of EXOR functions the minimum of these sums, in the case of EXNOR functions the maximum of the sums are determined for the search region, and the corresponding motion vector is determined from the associated search position (that is to say, where as many of the 2*2 MSBs of the two blocks are equal).

B)

Firstly, at clock pulse CL='1' in parallel EXOR or EXNOR functions MSB '1' is combined with MSB 'A', MSB '2' is combined with MSB 'B', MSB '3' is combined with MSB 'F' and MSB '4' is combined with MSB 'G', and the combination result or the sum of these four individual results is determined and buffered. Subsequently, at clock pulse CL='2' in parallel EXOR functions MSB '1' is combined with MSB 'B', MSB '2' is combined with MSB 'C', MSB '3' is combined with MSB 'G' and MSB '4' is combined with MSB 'H' and the corresponding combination result is determined, etc. After processing of the search region

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for a block, in the case of EXOR functions the minimum of these sums, and in the case of EXNOR functions the maximum of these sums, is determined for the search region, and the corresponding motion vector is determined from the associated search position (that is to say where as many of the 2*2 MSBs of the two blocks as possible are equal).

The motion estimator according to Fig. 2 is suitable for version A) and contains block storage means BS for the pixel values or the required bits (for example, the MSB or the 2 or the 4 MSBs) of these values of the current block. The pixel values or the corresponding MSBs for the search region are stored in search region storage means SAS. The required bit or the required bits of these pixel values are fed to EXOR or EXNOR gates G1, G2, ..., G6... An output of BS via which the MSBs '1', '2', '3' and '4' are successively output is connected to all the gates. From the SAS a number of lines corresponding to the number of the pixels of the search area are connected to one of the gates G1, G2, ..., G6..., in each case. The gate output values are summed for each of the search positions in one adder each. Because of the 1-bit values, it is advantageously possible for this summing of the individual results to be performed using counters C1, C2, ..., C6.... For each search for a block, the maximum or the minimum of the counter results is determined in subsequent comparator means COM, and the corresponding motion vector is determined from the associated search position.

If several (n) MSBs are evaluated in parallel for the search, the circuit can be extended in various ways:

- a) n gates, n counters ($n = 2$ in the case of MSB and MSB^{-1} or MSB^{-1} and MSB^{-2}), which are arranged correspondingly in parallel;
- b) preferably n gates, a counter operating at n times the speed, or an adder;
- c) as a) or b), but before the evaluation in the gates a fixed value, for example 48, is added to or subtracted from one or to several of the MSBs from BS and SAS. This

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fixed value or these fixed values can be continuously matched to the image statistics; and

d) not always the same bits are evaluated. For example, two of the bits MSB , MSB^{-1} and MSB^{-2} are respectively selected inside a block.

These possibilities can also be appropriately combined.

The motion estimator according to Fig. 3 is suitable for version B) and contains block storage means BS for the pixel values or the required bits (for example, the MSB or the 2 or the 4 $MSBs$) of these values of the current block. The pixel values or the corresponding $MSBs$ for the search area are stored in search area storage means SAS. BS has four (depending on block size) outputs, of which each is connected to one of the four EXOR or EXNOR gates $G1...G4$, and via which the required bit or the required bits of these pixel values are fed to the gates. The corresponding statement holds for SAS. The gate output values are summed for each of the search positions in an adder circuit CO in each case and buffered for all search positions. Because of the 1-bit values, this summing of the individual results can advantageously be performed using counters. For each search for a block, the maximum or the minimum of the counter results is determined in subsequent comparator means COM, and the corresponding motion vector is determined from the associated search position.

The expansion possibilities named in relation to Fig. 2 can be applied correspondingly in the circuit according to Fig. 3.

The invention can also be used to form (for example, local) motion vectors in a decoder.

In the case of a moving image content for interlaced images, the vector search can also be carried out inside blocks which are combined only from rows of a field.

The search area can also be non-square and/or be varied in its extent, in particular as a function of search results which precede in time and/or in space.

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In the case of the vector search for a reference block, as well, the invention can be performed by a comparison with corresponding blocks from a preceding and from a subsequent image (double-sided block matching).

The invention can be applied, for example, in MPEG-TV systems, in digital video recorders and in the case of the transmission of moving images over telephone lines (ISDN).

Claims

1. Method for motion estimation in picture signals, in which method inside a search area in each case a reference pixel block (BS) is compared with corresponding pixel blocks (SAS) of one or more neighbouring images and a motion vector is determined in accordance with the position having the highest correlation in principle, characterized in that in this comparison (G1...G6, C1...C6, COM) of the pixel values in each case only the MSB (most significant bit) and/or further ones of the MSBs (most significant bits), denoted below generally as MSBs, is/are compared.
2. Method according to Claim 1, characterized in that in the comparison the MSBs of the pixel values are combined from the reference block (BS) and from the search area (SAS) using EXOR or EXNOR functions.
3. Method according to Claim 2, characterized in that in the combination the result of the EXOR or EXNOR function is added or counted for each of these pixel values, and the motion vector is determined from the search position using the minimum or the maximum of the sum or of the counting result.
4. Method according to Claim 3, characterized in that at least $n=2$ MSBs for each pixel value [lacuna] n EXOR or EXNOR functions are added or counted, in each case either n parallel counters being used or a counter with n times the speed.
5. Method according to one or more of Claims 1 to 4, characterized in that before the comparison fixed values, in particular values matched to an image statistic, are respectively added and/or subtracted to or from one or more of the MSBs.
6. Method according to one or more of Claims 1 to 5, characterized in that during the comparison in the case of different pixel values different ones of the MSBs are evaluated inside a pixel block.
7. Device for a method according to one or more of Claims 1 to 6 for motion estimation in picture signals,

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in which device inside a search area in each case a reference pixel block (BS) is compared with corresponding pixel blocks (SAS) of one or more neighbouring images and a motion vector is determined in accordance with the position having the highest correlation in principle, provided with [sic]:

- storage means (BS, SAS) for storing the reference pixel block and the pixel blocks of one or more neighbouring images;

- EXOR or EXNOR gates (G1, G2, ..., G6...) which are connected to the storage means and to which only the MSB (most significant bit) and/or further ones of the MSBs (most significant bits), denoted below generally as MSBs, of these pixel values is or are fed; and

- means (C1, C2, ..., C6, ..., COMN, CO) for adding, counting and/or buffering the comparison results for each of these pixel values from the EXOR or EXNOR gates, which determine the motion vector from the search position having the minimum or the maximum of the sum or of the counting result.

8. Device according to Claim 7, characterized in that at least $n=2$ MSBs for each pixel value are added or counted in n parallel EXOR or EXNOR gates (G1, G2, ..., G6...), in each case either n parallel counters being used or a counter with n times the speed.

9. Device according to Claims 7 or 8, characterized in that before the comparison fixed values, in particular values matched to an image statistic, are respectively added and/or subtracted to or from one or more of the MSBs.

10. Method or device according to one of more of Claims 1 to 9 for use in MPEG-TV systems, in digital video recorders and/or in the case of transmitting moving images over telephone lines (ISDN).



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METHOD AND DEVICE FOR MOTION ESTIMATION

Abstract

In most cases data reducing coding/decoding of digital picture signals is based on motion compensated interpolation of pixels. For generating the required motion vectors each pixel block of the current picture is compared with corresponding blocks out of a search window in an adjacent picture. Using MSE or MAE, a block within the search window having the highest correlation is selected and the corresponding motion vector is obtained from the spatial position of that block with respect to the block of the current picture. This method requires excessive computation capabilities and very high clock rates. Even in case of hierarchical search methods a complex and fast hardware is required. The inventive motion estimation is performed using evaluation of only the MSB or several MSB's of the related pixel values. These bits are concatenated by EXOR and/or EXNOR functions and the results combined.

FIGURE 2.

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1	2
3	4

Fig. 1A

A	B	C	D	E
F	G	H	I	J
K	L	M	N	O
P	Q	R	S	T

Fig. 1B

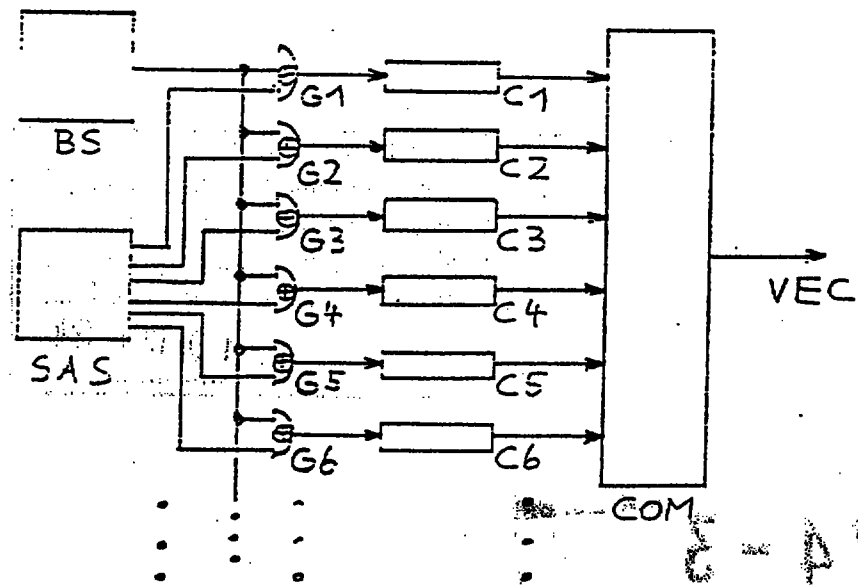


Fig. 2

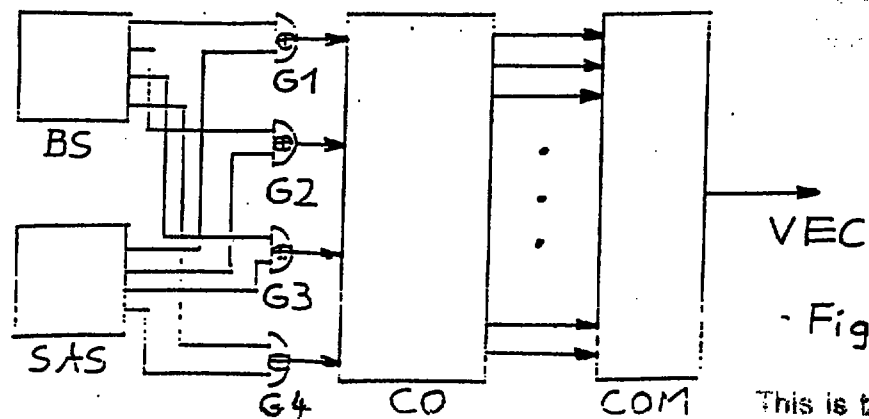


Fig. 3

This is the replacement sheet

Date: 19 OCT 1996