The invention relates to a movement detector and a method of detecting dynamic picture components of a video signal.

For the detection of dynamic picture components, movement detectors are known wherein the vectorial direction of movement as well as the speed of a picture element are detected. For this purpose a matrix of for example 3x3 picture elements is positioned around the picture element. This 3x3 matrix is compared with a corresponding matrix of the previous image. In order to detect a movement, all the picture elements of a, for example, 15x15 matrix in the surrounding field of the picture element are investigated in respect of their direction of movement and speed in order to determine in which region the correlation of the matrix exhibits a maximum. In this way both a direction of movement of the picture element and also the speed with which the picture movement occurs are determined. Thus the direction of movement of blocks is determined. The detected values serve as additional information for the emission of a HD/TV signal. In the transmitter, from the transmitted directions of movement and speeds, for example 16 vectors per image or field are selected. However, only four directions of movement and speeds in respect of each block are permitted in the receiver. This means that in a block comprising for example 32x32 picture elements only four directions of movement and speeds are permitted. In view of the very large number of directions of movement and speeds, this represents a very severe restriction which, for example in the case of a zoom recording where each picture element exhibits a different direction and speed, would lead to an unacceptable reproduction. In such a case the additional information is switched off by the receiver. A switch-over takes place to interpolation which for example can consist of the averaging of two lines to form an intervening line.

A known movement detector of this type requires a high circuitry outlay and high-speed signal processing.

In US-A-4 667 233 a movement detection is carried out for two-dimensional picture element blocks. This requires extensive hardware and high-speed signal processing. As movement is detected only for whole blocks, the movement of small objects cannot be detected.

The aim of the invention is to provide a movement detector which, with the lowest possible circuitry outlay and with a low signal processing speed, reliably detects movement picture element by picture element, where the hardware and the control thereof can additionally be utilized for vertical filtering dependent upon the result of the movement detection. This aim is fulfilled by the features described in Claim 4. Advantageous further developments of the invention are described in the dependent claims. The corresponding method is described in Claim 1.

The movement detector according to the invention processes the values of picture elements, which are disposed vertically one above another, in parallel but offset by one cycle. Movement detectors corresponding to the number of picture elements used for the movement detection are required. For the movement detection of a picture element, the absolute vslues of the differences between vertically adjacent, weighted picture elements from two sequential frames are determined. These absolute values are added and the sum of all the values is weighted. If it proves that the sum exceeds a predetermined threshold value, this picture element is detected as moving picture element.

For improved weighting of this information in relation to the adjacent picture elements occurring in the horizontal direction, the results of the movement detector output

signals, which have been offset by one cycle and intermediatley stored, are investigated and in the event that a number of the movement detectors have detected movement, the picture element is treated as moving picture element.

Advantageously in the case of the determination according to the invention of the movement of a picture element, noise, such as can occur for example in the case of picture components of large surfae area, is not detected as movement even when an extremely high value is determined by the movement detector for one of the picture elements while all the other picture elements are below the movement thresholds. This is because for each picture element a logic value indicating whether movement has been detected for this picture element is determined.

A furher advantage resides in the signal processing speed. As movement detectors corresponding to the number of picture elements used for the movement detection are provided, in each processing cycle one movement detector output signal is determined for one picture element. As a result an increased processing speed is not required. Additionally, the circuitry outlay is low.

In the following an exemplary embodiment will be explained making reference to the drawings wherein:

Fig. 1 illustrates a movement detector and
Fig. 2 illustrates the averaging of movement detector signals.

Figure 1 illustrates a movement detector according to the invention. The signal to be investigated is present at the input of a delay chain 1-4. This signal can be both a luminance signal and a chrominance signal. This signal

represents the picture contents of the previous image n-1. A signal of the current image n is present at the input of a second delay chain 5-8. The input signals of the delay chain 1-4, 5-8, as well as the output signals of these delay chains 1-4, 5-8, are in each case fed to a subtracter 9-13. The outputs of the subtracters 9-13 are fed to absolute value forming devices 14-18, where the consecutive outputs of the absolute value forming devices 14-18 in each case lead to the adders 19-22. The sum of all the absolute values then is present at the output of the adder 22. This output 22 leads to a change-over switch 38 which combines the outputs of parallel movement detectors of identical construction and, depending upon the current calculating state, switches the latter to a comparator 24. This comparator 24 suplies a signal relating to the movement of the picture element when the sum of the absolute values from the output of the adder 22 exceeds a threshold value.

Figure 2 illustrates a circuit for combining movement detector signals. The informaiton of the picture contents of the current image as welll as of the previous image are fed to a movement detector 30, the construction of which is described in Figure. 1. A total of five movement detectors are provided connected in parallel. The information relating to the current image is fed simultaneously to vertical filters 40 which are likewise provided for example x5 in parallel. The output of the movement detector 30 leads to a delay chain 31-34. Each input of the delay elements 31-34 and the output of the delay element 34 is connected to an input of the adder and comparator 35. The output of the adder and comparator 35 leads to an input of the change-over switch 42. The vertical filters 40 are connected via a delay circuit 41 to inputs of the change-over switch 42. The filtered signal of the current frame n can be tapped from the output of the change-over switch 42. In dependence upon the result as to whether the adder and

comparator 35 has determined a static or a dynamic item of information for the current picture element, the picture elements which have undergone filtering for the static situation or filtering for the dynamic situation are switched to the output of the change-over switch 42.

This method of combining a plurality of movement detector signals serves to avoid the need to separately investigate the surrounding field of that picture element among for example 5x5 picture elements which is to be investigated - i.e. the need to subtract 24 picture elements, form the amount and add the sums is avoided. The same result is achieved in that 5 picture elements lying vertically one above another are investigated in respect of their movement in order to determine the movement of the middle picture element, and that the end reuslts of five movement detector signals located one beside another are investigated in respect of movement. Thus only five picture elements are processed and the result of five movement detector signals is stored. The storage takes place in that four delay lines 31-34 are used so that the result of five movement detectors is simultaneoulsy available.

Since the mean value need not be determined, but only an item of information as to whether a movement is present or not, it is sufficient to store an item of binary information: movement present/no movement. This binary information is added in the adder and comparator 35 and in the event that the sum ≤ 2, "no movement" is detected for the current picture element present at the output of the delay element 41. If the sum is > 2, this means that this picture element is a moving picture element. This advantageously results in the fact that for example in the case of a threshold of 30, above which movement would be detected for a picture element, not the absolute values but the binary information is evaluated. If for example four

picture elements were to possess a value below the threshold, but due to a disturbance one picture element was well above the threshold, this value does not outweigh the four other picture elements. It represents only an equivalent item of information. In this case the picture element would be detected as a static picture element.

Claims

1. A method of detecting moving picture components of a video signal, wherein the absolute values (14-19) of difference values (9-13) between spatially corresponding picture elements of adjacent frames (n, n-1) are in each case added (19-22) and compared with a threshold value (24), wherein:

- for each picture element a detection result is determined;
- the movement detection takes place continuously picture element by picture element in the line direction;
- only the current pair of picture elements and adjacent pairs of picture elements located vertically above and below this pair of picture elements are used to form the difference values;
- the two-state comparison result obtained from these pairs of picture elements located vertically one above another is combined with the two-state comparison results for the two picture elements in each case located horizontally before and after the current picture element (35);
- if, in the case of this combination, more than two of these five comparison results exceed the threshold value, the current picture element is considered to be moving.

2. A method as claimed in Claim 1, characterised in that values of the picture elements, located vertically above one another, of the current image (n) are input values of a vertical filter (40) with a change-over switch (42) which, in each case for the current picture element, produce a filtered output picture element value corresponding to the result (42) of the movement detection.

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3. A method as claimed in Claim 1 or 2, characterised in that in addition to the current pair of picture elements, in each case two adjacent pairs of picture elements located vertically above and below the current pair of picture elements are used for the difference formation.

4. A movement detector for the determination of moving picture components of a video signal, comprising:

- a first delay chain (5-8) for picture element values of a current image (n);
- a second delay chain (1-4) for picture element values of a preceding image (n-1);
- subtracters (9-13), connected to corresponding tappings of the delay chains, for the formation of difference values between spatially corresponding picture elements of these two images (n, n-1), specifically only for the current pair of picture elements and adjacent pairs of picture elements located vertically above and below this pair of picture elements;
- an absolute value former (14-18) connected to the output of each subtracter;
- adders (19-22) which are connected to the outputs of the absolute value formers and which in each case form the sum of the absolute values;
- a following, first comparator (24) in which this sum is compared with a threshold value and which supplies a two-state comparison result;
- a following, third delay chain (31-41) for these two-state comparison results;
- a second comparator (35) which is connected to corresponding tappings of this third delay chain and in which in each case five of these comparison results, which follow one another continuously picture element by picture element in the line direction, are combined, specifically the comparison result for the current picture element and those comparison results for the

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picture elements located in each case horizontally before and after the current picture element, where the current picture element is considered to be moving when more than two of these five comparison results exceed the threshold value and such a detection result is determined for each picture element.

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