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# Method and device for film-mode detection

The invention relates to a method and a device for film-mode detection.

## Prior art

New television systems, for example HDMAC and PALplus, use a film mode which provides for increased vertical resolution in the case of scanned-film source signals. An information item on whether such a source signal is present is transmitted together with the television signal. However, evaluation in the receiver may entail a not inconsiderable hardware complexity. In addition, it is not ensured that all television transmitters or all programmes correctly transmit this additional information item.

## Invention

The invention is based on the object of specifying a method for film-mode detection with little hardware complexity and high reliability. This object is achieved by the method specified in Claim 1.

For each vertically adjacent (luminance) pixel pair in the field n, a check is performed whether the amplitude of the two vertically intermediate pixels from the two adjacent fields n-1 and n+1 lies between the amplitudes of the pixel pair from field n. These comparisons are carried out, for example line-by-line, for active pixels of active lines. These comparison results are combined within each field. Over a certain number of fields, for example 64, in each case these combination results must correspond to a certain pattern for the film mode to be recognised.

It has been found that different criteria must be used for determining when the film mode must be switched on and when it must be switched off. The switching-off criteria are less strict. Within a predetermined number of fields, for example 64, a certain number of 'false'

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combination results, for example 6, may occur. The film mode is only switched off when this number is exceeded. For determining the film-mode switching-on conditions, each field is advantageously divided into a predetermined number of segments (for example four), a separate combination result being determined for each segment. This increases the reliability of recognition and a switching-on criterion is available after a correspondingly shorter time.

In principle, the method according to the invention comprises a film-mode detection in which a comparison is made in each case for vertically adjacent pixel pairs P2 and P3 in a field n to determine whether the amplitude of the two vertically intermediate pixels P1 and P4 from the two adjacent fields n-1 and, respectively, n+1 lies between the amplitudes of the pixel pair P2 and P3, these comparison results being combined within fields and film mode being set if these combination results correspond to a predetermined pattern in each case within a predetermined first number of fields, especially 64. The film mode is advantageously reset if the combination results for a predetermined third number of fields, especially 7, do not correspond to the predetermined pattern in each case within a predetermined second number of fields, especially 64.

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

The invention is based on the further object of specifying a device for the method according to the invention. This object is achieved by the device specified in Claim 9.

In principle, the device according to the invention is supplied with pixel samples from input lines (IL) which are forwarded to a first field buffer ($312H_1$), to a first comparator (COMP1) and to a third comparator (COMP3), the output signals of the first field buffer being supplied to the input of a line buffer (1H), to the first comparator (COMP1) and to a second comparator

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(COMP2) and the output signals of the line buffer being supplied to the input of a second field buffer ($312H_2$), to the third comparator (COMP3) and a fourth comparator (COMP4) and the output signals of the second field buffer being supplied to the second comparator (COMP2) and to the fourth comparator (COMP4), the outputs of the four comparators being connected to a counter control logic (CCL) which in each case forms from the comparison results a result value from several predetermined values, these result values being combined in a subsequent up/down counter (UDC) and resultant signs being subsequently evaluated in a status detector (SD) and compared with the predetermined pattern for film-mode detection, in which arrangement, in particular, the respective phase of the field is also determined and frames are generated with the aid of these information items in an interpolator (INT).

Drawings

Illustrative embodiments of the invention are described with reference to the drawings, in which:

Figure 1 shows four pixels in the vertical/temporal plane;

Figure 2 shows one field with a segment;

Figure 3 shows one field with four segments;

Figure 4 shows a table with combination results for determining the switching-on condition;

Figure 5 shows a table with combination results for determining the switching-off condition; and

Figure 6 shows a device according to the invention.

Illustrative embodiments

According to Figure 1, the amplitudes of pixels P1 from field n-1 and P4 from field n+1 are in each case compared with the amplitudes of the vertically adjacent pixels P2 and P3 from field n. From these, one of three possible comparison results is determined column-by-column and line-by-line for each pixel:

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+1, if {P1<min(P2,P3) OR P1>max(P2,P3)} AND
{min(P2,P3)≤P4≤max(P2,P3)}
-1, if {P4<min(P2,P3) OR P4>max(P2,P3)} AND
{min(P2,P3)≤P1≤max(P2,P3)}
else 0.

For each pixel within one segment, the comparison results are added, for example by means of an up/down counter. After that, only the resultant sign of the sum of the comparison results of this segment is utilised and forms the combination result.

Each field n is advantageously divided into four segments S1-S4 according to Figure 3 for determining the film-mode switching-on condition. One segment S1 per field n according to Figure 2 is sufficient for determining the film-mode switching-off condition.

The combination results must in each case be equal for the four segments S1-S4 of one field F for the film-mode switching-on condition according to Figure 4. In addition, these combination results must alternate between '+' and '-' field by field from field n to field n+63. This can be checked by another counter which counts the number of correct combination results within each test period. This number must then reach the value 4*64 = 256. If an error occurs in this scheme, checking is recommenced from the beginning of the next field.

For the film-mode switching-off condition NF according to Figure 5, the combination results must deviate from the correct scheme in at least 7 of 64 successive fields F (having one segment S1 in each case), that is to say successive field combination results have the same sign. In Figure 5, 7 errors E1-E7 are marked. At field n+m, m=25, the seventh error has occurred, m being less than 64. From field n+m, a new test period then begins, and otherwise from field n+64.

The device according to the invention in Figure 6 is supplied with pixel samples from input lines IL which are forwarded to a first field buffer $312H_1$ (312 lines), to a first comparator COMP1 and to a third comparator COMP3. The output signals of the first field buffer are

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supplied to the input of a line buffer 1H, to the first comparator COMP1 and to a second comparator COMP2. The output signals of the line buffer are supplied to the input of a second field buffer $312H_2$, to the third comparator COMP3 and to a fourth comparator COMP4. The output signals of the second field buffer are supplied to the second comparator COMP2 and to the fourth comparator COMP4.

Pixel P4 is in each case available at the input of the first field buffer, pixel P3 at the input of the line buffer and pixel P2 at the input of the second field buffer and pixel P1 at the output of the second field buffer according to Figure 1. The outputs of the four comparators are connected to a counter control logic CCL which in each case processes the comparison results described at Figure 1 (+1, -1, 0), these comparison results being combined in a subsequent up/down counter UDC ('+1' via line U, '-1' via line D).

In the subsequent status detector SD, the resultant signs are evaluated via line S and the film-mode switching-on condition or film-mode switching-off condition is detected as described above and output via line SW. In addition, the respective phase of the field (first or second field) can be detected in accordance with the sign determined and can be output via line FP. If a corresponding error occurs, the counter UDC is reset via line R.

The information items on line SW and FP are advantageously used in a subsequent interpolator INT which supplies from in each case one or more of the pixels P1 to P4 original and estimated values for the pixel values of the output lines. In the case of film mode, frames can be generated in this interpolator which consist of in each case two fields which have been pulled together. If no film mode is present, a double median interpolation can be advantageously carried out as is described in DE-A-4211955.

In addition, the chrominance amplitudes can also be checked in accordance with the invention and the

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result can be logically combined with that for the luminance.

The invention can also be used for transmitter-side generation of the film-mode information item, for example in the case of old archive material.

The numerical values specified have been successful for the PAL standard. These numerical values can be easily adapted depending on the television standard or transmission conditions.

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Patent claims

1. Method for film-mode detection, characterised in that a comparison is in each case made for vertically adjacent pixel pairs P2 and P3 in a field n whether the amplitude of the two vertically intermediate pixels P1 and P4 from the two adjacent fields n-1 and, respectively, n+1 is between the amplitudes of the pixel pair P2 and P3, these comparison results being combined within fields and film mode being set if these combination results correspond to a predetermined pattern in each case within a predetermined first number of fields - especially 64.

2. Method according to Claim 1, characterised in that film mode is reset if the combination results for a predetermined third number of fields - especially 7 - do not correspond to the predetermined pattern in each case within a predetermined second number of fields - especially 64.

3. Method according to Claim 1 or 2, characterised in that the comparison results are determined line by line for active luminance and/or chrominance pixels of active lines.

4. Method according to one or more of Claims 1 to 3, characterised in that separate combination results are determined for segments (S1) within fields, fields being divided into a predetermined fourth number of segments (S1-S4) - especially 4 - and the combination results having to be equal for all segments of a field for it to be possible for the film mode to be set.

5. Method according to one or more of Claims 1 to 4, characterised in that the comparison results '+1', '-1' and '0' are determined:

+1, if {P1<min(P2,P3) OR P1>max(P2,P3)} AND
{min(P2,P3)≤P4≤max(P2,P3)}

-1, if {P4<min(P2,P3) OR P4>max(P2,P3)} AND
{min(P2,P3)≤P1≤max(P2,P3)}

else 0.

6. Method according to one or more of Claims 1 to 5, characterised in that, for determining the combination

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results, the comparison results are added pixel by pixel in each field or segment - especially by means of an up/down counter -, the combination result in each case consisting in the sign of the resultant sum.

7. Method according to one or more of Claims 1 to 6, characterised in that the pattern consists of signs alternating field by field.

8. Method according to one or more of Claims 1 to 7, characterised in that the correspondence with the pattern is checked with another counter which counts the number of correct combination results within the first or second number of fields, checking being recommenced from the beginning of the next field if a corresponding deviation from the pattern has occurred.

9. Method according to one or more of Claims 1 to 8, characterised in that the first number is equal to the second number.

10. Device for a method according to one or more of Claims 1 to 9, which is supplied with pixel samples of input lines (IL) which are forwarded to a first field buffer ($312H_1$), to a first comparator (COMP1) and to a third comparator (COMP3), the output signals of the first field buffer being supplied to the input of a line buffer (1H), to the first comparator (COMP1) and to a second comparator (COMP2) and the output signals of the line buffer being supplied to the input of a second field buffer ($312H_2$), the third comparator (COMP3) and to a fourth comparator (COMP4) and the output signals of the second field buffer being supplied to the second comparator (COMP2) and to the fourth comparator (COMP4), the outputs of the four comparators being connected to a counter control logic (CCL) which in each case forms from the comparison results a result value from several predetermined values, these result values being combined in a subsequent up/down counter (UDC) and resultant signs being subsequently evaluated in a status detector (SD) and compared with the predetermined pattern for film-mode detection, in which arrangement, in particular, the respective phase of the field is also determined and

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frames are generated with the aid of these information items in an interpolator (INT).

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