ENCODING COLOUR TELEVISION SIGNALS

The present invention relates to the encoding of composite image signals by synthesizing composite image signals especially for use in television.

In recent times, digital signal processing techniques have been employed more and more frequently as methods to improve the quality of an image signal. Especially, in an IDTV (Improved Definition TV) and EDTV (Enhanced Definition TV), a motion adaptive signal processing technique is used for a digital filter that separates a chrominance signal and a luminance signal and a scanning line conversion circuit that converts an interlaced scanning image signal with 525 scanning lines into a non-interlaced scanning image signal. By using such a method for a television receiver, it is possible to obtain improvements in respect of cross luminance (a phenomenon whereby a chrominance signal is mixed with a luminance signal), cross colour (a phenomenon whereby a luminance signal is mixed with a chrominance signal), and of resolution of the display image.

A prior art arrangement for achieving such improvements is shown in Figure 1 of the accompanying diagrammatic drawings, wherein a luminance signal Y and colour difference signals R-Y (I) and B-Y (Q) are separated respectively from red (R), green (G), and blue (B) colour signals which are applied to a gamma correction matrix 4. The colour difference signals I, Q are filtered by corresponding low pass filters 10, 11 and modulated by a quadrature phase modulator 5 according to a chrominance sub-carrier signal 1 and a burst flag signal 2.

The signal output from the quadrature phase modulator 5 and the luminance signal Y from the gamma correction matrix 4 are combined at a mixer 6 according to an input signal 3 which is a synchronous and blocking pedestal signals. To obtain a resulting encoded video signal CV, the combined signal output from the mixer 6 is low-pass-filtered by low pass filter 8.

Since this prior art approach is not a fundamental processing method which removes cross luminance components from the luminance signal and the chrominance signal, it may result in low quality of resolution of the display image, and interference of the image by the chrominance signal and the luminance signal may result.

Preferred embodiments of the present invention aim to provide a circuit and method of improving the quality of a display image at a receiving site by selecting a most effective bandwidth of filters according to a shape of a pattern or still and moving image signals, while elevating the resolution of the display image by using a motion and pattern adaptive three dimensional filter, which prevents mixing of a luminance signal and a chrominance signal at an encoding site and promotes maximum resolution.

To achieve the above and other objects of the present invention, the frequency zones of a vertical, horizontal, and temporal axes in a three dimensional filter are adjusted according to a motion signal detected on the basis of an intrafield image signal pattern and a frame difference signal so as to reduce an interference of a luminance signal and chrominance signal and to use an image frequency zone effectively during an encoding of red (R), green (G), and blue (B) colour signals which may be

provided from, for example, a camera into a composite image signal.

According to one aspect of the present invention, there is provided a method of encoding a composite colour television signal in an apparatus having a gamma correction matrix, a plurality of low pass filters, a quadrature phase modulator, a mixer, an image pattern and motion detector and a plurality of adaptive filters, the method comprising:

(a) receiving colour signals at inputs of the gamma correction matrix and encoding these signals to produce a luminance signal and two chrominance signals;

(b) low pass filtering the chrominance signals;

(c) processing the luminance signal in the image pattern and motion detector, such processing comprising detecting image motion from a difference between a current frame and a preceding frame of the luminance signal and outputting a first control signal in accordance with the degree of image motion detected, and detecting image pattern from the luminance signal and outputting a second control signal in accordance with the image pattern detected;

(d) adaptively filtering the luminance signal by means of one of the adaptive filters, the pass band of which adaptive filter is determined in accordance with the second control signal and an output gain of which adaptive filter is determined in accordance with the first control signal;

(e) processing the low pass filtered chrominance signals by means of the quadrature phase modulator and at least

one of the adaptive filters, the pass band of which adaptive filter or filters is determined in accordance with the second control signal and the output gain of which is determined in accordance with the first control signal, such processing producing a modulated, adaptively filtered signal; and

(f) combining the modulated adaptively filtered signal and the adaptively filtered luminance signal by means of the mixer to produce a combined signal.

According to a second aspect of the invention, there is provided a circuit for encoding a composite colour television image signal, the circuit comprising a gamma correction matrix, a plurality of low pass filters, a quadrature phase modulator, a mixer, an image pattern and motion detector and a plurality of adaptive filters, wherein:

colour signals at inputs of the gamma correction matrix are encoded by the matrix to produce a luminance signal and two chrominance signals;

the chrominance signals from the gamma correction matrix are filtered by first and second low pass filters;

the luminance signal from the gamma correction matrix is coupled to an input terminal of the image pattern and motion detector where image motion is detected by determining a difference between a current frame and preceding frame of the luminance signal and a first control signal is output which is dependent upon the degree of motion detected, and image pattern is detected and a second control signal is output in accordance with the image pattern detected;

the luminance signal is coupled to a first adaptive filter whose pass band is determined in accordance with the second control signal and whose output gain is determined in accordance with the first control signal;

the low pass filtered chrominance signals from the first and second low pass filters are coupled to the input of second and third adaptive filters respectively and adaptively filtered wherein the pass bands of the second and third adaptive filters are determined in accordance with the second control signal and output gains of the second and third adaptive filters are determined in accordance with the first control signal;

coupling the adaptively filtered chrominance signals from the second and third adaptive filters are coupled to the quadrature phase modulator;

outputs from the first adaptive filter and the quadrature phase modulator are coupled to the mixer which mixer produces a combined signal; and

the combined signal from the mixer is applied to a third low pass filter, the resulting output of which is the composite image signal.

According to a third aspect of the invention, there is provided a circuit for encoding a composite image signal in a colour television having a gamma correction matrix, a plurality of low pass filters, a quadrature phase modulator, a mixer, an image pattern and motion detecting circuit and a plurality of adaptive filters, wherein:

colour signals at inputs of the gamma correction matrix are encoded by the matrix to produce a luminance signal and two chrominance signals;

the chrominance signals from the gamma correction matrix are filtered by first and second low pass filters;

the outputs from said first and second low pass filters are coupled to input terminals of the quadrature phase modulator, which produces a combined modulated signal at an output thereof;

the luminance signal is coupled to an input terminal of the image pattern and motion detecting circuit where image motion is detected by determining a difference between a current frame and preceding frame of the luminance signal and a first control signal is output which is dependent upon the degree of motion detected, and image pattern is detected and a second control signal is output in accordance with the image pattern detected;

the first and second control signals output from said pattern and motion detecting circuit are applied to control inputs of first and second adaptive filters;

the luminance signal from said gamma correction matrix is coupled to an input terminal of said first adaptive filter whose pass band is determined in accordance with the second control signal and whose output gain is determined in accordance with the first control signal;

the combined modulated output signal from the quadrature phase modulator is coupled to an input of said second adaptive filter and adaptively filtered, wherein

the pass band of the second adaptive filter is determined in accordance with the second control signal, and the output gain of the second adaptive filter is determined in accordance with the first control signal, so as to produce an adaptively filtered output;

the adaptively filtered output from the second adaptive filter and the output from the first adaptive filter are coupled to the mixer, which mixer produces a combined signal; and

the combined signal from the mixer is applied to a third low pass filter, the resulting output of which is the composite image signal.

Preferably, the pattern and motion detecting circuit includes a pattern detector which comprises:

a plurality of comparators for determining whether the luminance signal displays an edge in a horizontal direction or a vertical direction;

a plurality of inverters for inverting the outputs of said comparators; and

a logic combination circuit which receives output signals from said plurality of comparators and inverters and, on the basis of such signals, generates selection signal to be provided to selection terminals of a multiplexer.

The logic combination circuit preferably comprises a plurality of AND gates for receiving outputs from said plurality of comparators and inverters, and a plurality of OR gates for receiving outputs from said AND gates and generating said selection signals.

Preferably, the pattern and motion detecting circuit includes a motion detector which comprises:

a frame memory for delaying said luminance signal by one frame;

a subtracter for subtracting the frame delayed luminance signal generated from the frame memory from the luminance signal input;

and absolute value circuit for converting the output of said subtracter to an absolute value; and

a motion signal processing circuit for processing the output from said absolute value circuit as said first control signal.

The adaptive filters may each comprise:

first and second clock delay circuits coupled in series to the luminance signal;

a first horizontal delay circuit coupled to an input terminal of the luminance signal;

third and fourth clock delay circuits in series coupled to the output of said first horizontal delay circuit;

a second horizontal delay circuit coupled to said first horizontal delay circuit;

fifth and sixth clock delay circuits in series coupled to the output of said second horizontal delay circuit;

a horizontal filter connected to the outputs of said first horizontal delay circuit and said third and fourth clock delay circuits;

a vertical filter connected to the outputs of said first, third, and fifth clock delay circuits;

a horizontal-vertical filter connected to the outputs of said first and second horizontal delay circuits and to the outputs of said first through sixth clock delay circuits;

a multiplexer for selecting the output of said vertical, horizontal, and horizontal-vertical filters according to the output of said pattern detector;

a gain controller for receiving the output of a frame delay circuit which delays an input signal thereof by a frame unit; and

a mixer for combining a signal output from a gain controller with a signal output from a gain controller which controls the output of said multiplexer, according to the output of said motion detector.

For a better understanding of the invention and to show how the same may be carried into effect, reference will now be made, by way of example, to Figures 2 to 9 of the accompanying diagrammatic drawings, in which:

Figure 2 shows one example of a circuit for encoding colour television signals according to the present invention;

Figure 3 shows another example of a circuit for encoding colour television signals according to the present invention;

Figure 4 is a circuit diagram showing in detail examples of first through third filters 12-14 of Figure 2 and a first filter 12 of Figure 3;

Figures 5A through 5C are examples of spatial frequency zone selecting characteristics respectively of vertical, horizontal, and horizontal-vertical filters 49-51 of Figure 4;

Figure 6 is a circuit diagram showing in detail one example of a fourth filter 16 of Figure 3;

Figures 7A through 7C are examples of spatial frequency zone selecting characteristics respectively of horizontal, vertical and horizontal-vertical filters 69-71 of Fig 6;

Figure 8 is a circuit diagram showing in detail one example of a pattern detecting circuit 7a of Figures 2, 3, 4, and 6; and

Figure 9 is a circuit diagram showing in detail one example of a motion detecting circuit 7b of Figures 2, 3, 4, and 6.

Referring to Figure 2, reference numerals and symbols similar to those of Figure 1 represent like construction and function. That is, low pass filters 10, 11 are connected to a gamma correction matrix 4, and a signal output from a quadrature phase modulator 5 is combined with a luminance signal Y at a matrix 6. Then, the combined signal is low-pass-filtered at a low pass filter 8.

In detail, the luminance signal Y from the gamma correction matrix 4 is connected to an input terminal of a first filter 12, the outputs from the low pass filters 10 and 11 are connected to input terminals of a second filter 13 and a third filter 14 respectively, and the luminance signal Y is also connected to a pattern and motion detecting circuit 7 to detect pattern and motion in the luminance signal Y. The signal output from the pattern and motion detecting circuit 7 is applied to first through third filters 12-14, the output from the first

filter 12 is connected to the mixer 6, and the outputs from the second filter 13 and the third filter 14 are applied to the quadrature phase modulator 5.

Figure 3 shows another embodiment of a circuit for encoding colour television signals in which like symbols are used to refer to a gamma correction matrix 4, low pass filters 10 and 11, mixer 6, low pass filter 8, and quadrature phase modulator 5 which have the same functions as in the foregoing. In the drawing, the luminance signal Y of the gamma correction matrix 4 is entered into a first filter 12 and a pattern and motion detecting circuit 7. The output from the quadrature phase modulator 5 is entered into an input terminal of a fourth filter 16. The output of the pattern and motion detecting circuit 7 is entered into the first and the fourth filters 12, 16, and the outputs of the first filter 12 and the fourth filter 16 are entered into the mixer 6.

Figure 4 is a detailed circuit diagram of examples of the first through third filters 12-14 of Figure 2 and the fourth filter 16 in Figure 3. In the drawing, first and second clock delay circuits 41, 42 coupled in series are connected to a luminance input terminal Yi and a first horizontal delay circuit 47 is connected to the luminance input terminal Yi. The output of the first horizontal delay circuit 47 is coupled to a third clock delay circuit 43 which is connected to a fourth clock delay circuit 44 in series. A second horizontal delay circuit 48 is connected to the first horizontal delay circuit 47 and the output of the second horizontal delay circuit 48 is coupled to a fifth clock delay circuit 45 that is connected to a sixth clock delay circuit 46 in series.

A horizontal filter 49 is connected to an output S4 from the first horizontal delay circuit 47 and outputs S5 and S6 from the third and fourth clock delay circuits 43, 44. A vertical filter 50 is connected to outputs S2, S5, and S8 from the first, third, and fifth clock delay circuits 41, 43, and 45, respectively. A horizontal-vertical filter 51 is connected to outputs S4 and S7 from the first and the second horizontal delay circuits 47 and 48 and to outputs S2, S3, S5, S6, S8, and S9 from the first through sixth clock delay circuits 41-46. A multiplexer 53 selects an output from the vertical, horizontal, and horizontal-vertical filters 49-51 according to an output from a pattern detector 7a. A gain controller 55 takes an output from a frame delay circuit 52 as an input to delay the input signal 5 by a frame unit, and a mixer 56 outputs a mixed gain-controlled signal that is gain-controlled by gain controllers 54 and 55 according to an output from a motion detector 7b.

Figures 5A through 5C show respectively spatial frequency zone selecting characteristics of the horizontal filter 49, the vertical filter 50, and the horizontal-vertical filter 51 of Figure 4.

Figure 6 is a more specific circuit diagram of one example of the fourth filter 16 of Figure 3, wherein the reference numerals 67 and 68 represent horizontal delay circuits; 61 through 66 represent clock delay circuits; 69 represents a horizontal filter; 70 represents a vertical filter; 71 represents a horizontal-vertical filter; 72 represents a multiplexer; and 74 and 75 represent gain controllers. All of these components have connections similar to those described above with reference to Figure 4.

Figures 7A through 7C are respective spatial frequency zone selecting characteristics of the vertical, horizontal, and horizontal-vertical filters 69-71 of Figure 6.

Figure 8 is a detailed diagram of one example of the pattern detector 7a of Figures 4 and 6. In Figure 8, comparators 81-84 compare with a specific threshold voltage the outputs from the first and second horizontal delay circuits 47, 48 and the first through sixth clock delay circuits 41-46. Inverters 85-88 invert the output from the comparators 81-84, and the control signals to be provided to the selection terminals A and B of the multiplexer 53 are generated by AND gates 89-92 and OR gates 93-94, which perform a specific logic combination for the signals output from the comparators 81-84 and the inverters 85-88.

Figure 9 is a detailed circuit diagram of one example of the motion detector 7b of Figures 4 and 6, in which a frame memory 101 delays the luminance signal input Yi by one frame, and a subtractor 102 subtracts the output from the frame memory 101 from the luminance signal input Yi. Then, an absolute value circuit 103 converts the output from the subtractor 102 to its absolute value, and a motion signal processing circuit 104 processes the output from the absolute value circuit 103 to a motion signal.

Referring back to Figures 2-9, the operations of the embodiments of the present invention will now be described. First of all, with reference to the operating effect of the first filter 12, in the event that there is no edge in a horizontal direction (the horizontal correlation is high), then $|S4-S6| \leq Kh$ and $|Yh2-Yh8| \geq Kyv$ for the luminance signal Y. The multiplexer 53 in

Figure 4 selects the output from the horizontal filter i.e., $Yh = 0.25 \cdot S4 + 0.5 \cdot S5 + 0.25 \cdot S6$, if there is edge in a vertical direction. In this case, the selecting characteristics in the spatial frequency zone is as in Figure 5A. Here, the fact that there is no edge in the horizontal direction means a signal spectrum is distributed to a lower zone of a horizontal frequency direction. On the other hand, when there is an edge in the vertical direction, higher frequency components in the signal spectrum are contained in a vertical direction. Therefore, a filter which has the characteristics as shown in Figure 5A is adequate.

In the case where $|S2-S8| \leq Kv$ and $|Yv4-Yv6| \geq Kyh$, there is no edge in the vertical direction (the vertical correlation is high), but there is an edge in a horizontal direction, the multiplexer 53 in Figure 4 selects an output from the vertical filter 50. Thus, $Yv = 0.25 \cdot S2 + 0.5 \cdot S5 + 0.25 \cdot S8$. In this case, the selecting characteristics in the spatial frequency zone is as in Figure 5B. Here, the fact that there is no edge in the vertical direction means a signal spectrum is distributed to a lower zone of a vertical frequency direction. On the other hand, when there is an edge in the horizontal direction, higher frequency components in the signal spectrum are contained in a horizontal direction. Therefore, a filter which has the characteristics as shown in Figure 5B is adequate.

In the case where $|S2-S8| \leq Kv$ and $|Yv4 -Yv6| \geq Kyh$, and $|S4- S6| \leq Kh$ and $|S2-S8| \leq Kv$, the multiplexer 53 in Figure 4 selects an output from the horizontal-vertical filter 51. Thus, $Yhv = 3/4 \cdot S5 + 1/8 \cdot (S2+S8+S4+S6) - 1/16 \cdot (S1+S3+S7+S9)$. In this case, the selection characteristics in the spatial frequency zone is as in

Figure 5C. Here, it means either there is no edge in both of the vertical and horizontal directions or there is an edge in both of the vertical and horizontal directions.

If there are edges in both directions, the signal spectrum is distributed widely in both vertical and horizontal directions. Thus, it is necessary to remove the signal spectrum occupied by a modulated chrominance signal as in Figure 5C to prevent the modulated chrominance signal from interference. If there is no edge in either direction, the signal spectrum is distributed to lower parts of the vertical and horizontal frequency directions. Thus, selecting characteristics in the spatial frequency zone as in Figure 5C is adequate.

The chrominance signals I and Q are filtered by the second and third filters 13, 14 which have similar effects to the first filter 12 and then modulated by the quadrature phase modulator 5. The output from the quadrature phase modulator 5 is combined with the output from the first filter 12. At this time, a spatial frequency of a chrominance sub-carrier for the quadrature phase modulator 5 is fh=hsc and fv=525/4 to separate the luminance signal and the modulated chrominance signal.

Referring to the operation of Figure 3, the luminance signal Y is treated the same as in Figure 2, but for the chrominance signal C, a quadrature phase modulation is performed by a generally method, and the modulated output is filtered by the fourth filter 16 which uses a similar principle as the first filter 12. The output from the fourth filter 16 and the luminance signal Y filtered by the first filter 12 are combined to form a composite image signal.

In the case where $|S4-S6| \leq Kh$ and $|Yh2-Yh8| \geq Kyv$, the multiplexer 72 in Figure 6 selects the horizontal filter 69; $Ch = -1/4 \cdot N4 + 1/2 \cdot N5 - 1/4 \cdot N6$. In other words, for the luminance signal Y, there is no edge in a horizontal direction, but there is an edge in a vertical direction. The selecting characteristics of spatial frequency zone for the horizontal filter 69 all as shown in Figure 7A.

In the case where $|S2-S8| \leq Kv$ and $|Yv4-Yv6| \geq Kyv$, the multiplexer 72 in Figure 6 selects the vertical filter 70; $Cv = -1/4 \cdot N2 + 1/2 \cdot N5 - 1/4 \cdot N8$. In other words, for the luminance signal Y, there is no edge in a vertical direction, but there is an edge in a horizontal direction. The selecting characteristics of spatial frequency zone for the horizontal filter 70 are as shown in Figure 7B.

In the case where $|Yh2-Yh8| \geq Kyv$ and $|Yv4-Yv6| \geq Kyh$, and $|S4-S6| \leq Kh$ and $|S2-S8| \leq Kv$, the multiplexer 72 in Figure 6 selects a horizontal-vertical filter 71; $Chv = 1/4 \cdot N5 - [-1/8 \cdot (N2+N8+N4+N6)] + 1/16 \cdot (N1+N3+N7+N9)$. The selecting characteristics of spatial frequency zone for the horizontal filter 71 are as shown in Figure 7C.

The detailed diagram of the pattern detecting circuit 7a is shown in Figure 8. The pattern detecting circuit 7a includes the comparators 81-84, inverters 85-88, AND gates 89-92, and OR gates 93, 94. In the case where there is no edge in a horizontal direction, that is $|S4-S6| \leq Kh$, the output of the comparator 81 becomes logic high. When there is edge in the vertical direction, that is $|Yh2-Yh8| \geq Kyv$, an output from the comparator 82 becomes logic high. Here, $Yh2 = 1/4 \cdot (S1+2S2+S3)$, and $Yh8 = 1/4 \cdot (S7+2S8+S9)$. When there is no edge in a vertical direction, that is $|S2-S8| \leq Kv$, the output of the

comparator 83 becomes logic high. When there is edge in a horizontal direction, that is $|Yv4-Yv6| \geq Kyh$, the output of the comparator 84 becomes logic high. Here, $Yv4 = 1/4 \cdot (S1+2S4+S7)$, and $Yv6 = 1/4 \cdot (S3+2S6+S9)$. The combination signals output from the comparators 81-84, the inverters 85-88, the AND gates 89-92, and the OR gates 93, 94 are used to select one of the horizontal, vertical, and horizontal-vertical filters 69-73 and 49-51. The operating principle of Figure 8 will be readily apparent to the skilled reader who has general knowledge in this field.

A detailed diagram of the motion detecting circuit 7b is shown in Figure 9. The current luminance signal Yi and the output of the frame memory 101 are used to obtain the frame difference signal between the current frame and a preceding frame, and an absolute value of the frame difference signal is calculated by the absolute value circuit 103. The output of the absolute value circuit 103 is applied to the motion signal processing circuit 104 to obtain a quantity of motion to control a gain (where, $0 \leq k \leq 1$) of the gain controllers 54, 55. If the quantity of the motion becomes larger, then the k value becomes larger. Especially, when the k value is identical to 1, the outputs of the filters 49-51 and 69-71 in Figures 4 and 6 are equal to the output from the multiplexers 53, 73 and when the k value is zero, outputs of the filters 49-51 and 69-71 are one- frame-delayed signals. When the k value is a value between zero and one, the outputs of the filters 49-51 and 69-71 in Figures 4 and 6 become $Yo = k \cdot Sv + (1-k) \cdot St$ and $Co = k \cdot Nv + (1-k) \cdot Nt$, respectively.

While a preferred embodiment of the invention has been particularly shown and described above, it will be understood by those skilled in the art that the

horizontal- vertical filter 51 alone can be used without using the horizontal and vertical filters 49, 50 and the pattern detection circuit 7a of Figure 4 and that the horizontal-vertical filter 71 alone can be used without using the horizontal and vertical filters 69, 70 and the pattern detection circuit 7a of Figure 6 without departing from the scope of the invention.

If encoding methods as described above are used at a transmitting site, it is still possible to sustain compatibility with an existing TV system. Furthermore, by applying three dimensional decoding at a receiving site, image quality can be improved dramatically.

As stated above, in a composite image signal encoding circuit such as in a TV camera or VTR, the above described embodiments of the invention may have the advantage that maximum picture quality is sustained at a receiving site by decreasing interference between luminance and colour signals, shifting the bandwidth of the filters according to still and moving images, and selecting a most effective bandwidth of a filter according to a shape of a pattern.

CLAIMS

1. A method of encoding a composite colour television signal in an apparatus having a gamma correction matrix, a plurality of low pass filters, a quadrature phase modulator, a mixer, an image pattern and motion detector and a plurality of adaptive filters, the method comprising:

(a) receiving colour signals at inputs of the gamma correction matrix and encoding these signals to produce a luminance signal and two chrominance signals;

(b) low pass filtering the chrominance signals;

(c) processing the luminance signal in the image pattern and motion detector, such processing comprising detecting image motion from a difference between a current frame and a preceding frame of the luminance signal and outputting a first control signal in accordance with the degree of image motion detected, and detecting image pattern from the luminance signal and outputting a second control signal in accordance with the image pattern detected;

(d) adaptively filtering the luminance signal by means of one of the adaptive filters, the pass band of which adaptive filter is determined in accordance with the second control signal and an output gain of which adaptive filter is determined in accordance with the first control signal;

(e) processing the low pass filtered chrominance signals by means of the quadrature phase modulator and at least one of the adaptive filters, the pass band of which adaptive filter or filters is determined in accordance

with the second control signal and the output gain of which is determined in accordance with the first control signal, such processing producing a modulated, adaptively filtered signal; and

(f) combining the modulated adaptively filtered signal and the adaptively filtered luminance signal by means of the mixer to produce a combined signal.

2. A circuit for encoding a composite colour television image signal, the circuit comprising a gamma correction matrix, a plurality of low pass filters, a quadrature phase modulator, a mixer, an image pattern and motion detector and a plurality of adaptive filters, wherein:

colour signals at inputs of the gamma correction matrix are encoded by the matrix to produce a luminance signal and two chrominance signals;

the chrominance signals from the gamma correction matrix are filtered by first and second low pass filters;

the luminance signal from the gamma correction matrix is coupled to an input terminal of the image pattern and motion detector where image motion is detected by determining a difference between a current frame and preceding frame of the luminance signal and a first control signal is output which is dependent upon the degree of motion detected, and image pattern is detected and a second control signal is output in accordance with the image pattern detected;

the luminance signal is coupled to a first adaptive filter whose pass band is determined in accordance with

the second control signal and whose output gain is determined in accordance with the first control signal;

the low pass filtered chrominance signals from the first and second low pass filters are coupled to the input of second and third adaptive filters respectively and adaptively filtered wherein the pass bands of the second and third adaptive filters are determined in accordance with the second control signal and output gains of the second and third adaptive filters are determined in accordance with the first control signal;

coupling the adaptively filtered chrominance signals from the second and third adaptive filters are coupled to the quadrature phase modulator;

outputs from the first adaptive filter and the quadrature phase modulator are coupled to the mixer which mixer produces a combined signal; and

the combined signal from the mixer is applied to a third low pass filter, the resulting output of which is the composite image signal.

3. A circuit for encoding a composite image signal in a colour television having a gamma correction matrix, a plurality of low pass filters, a quadrature phase modulator, a mixer, an image pattern and motion detecting circuit and a plurality of adaptive filters, wherein:

colour signals at inputs of the gamma correction matrix are encoded by the matrix to produce a luminance signal and two chrominance signals;

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the chrominance signals from the gamma correction matrix are filtered by first and second low pass filters;

the outputs from said first and second low pass filters are coupled to input terminals of the quadrature phase modulator, which produces a combined modulated signal at an output thereof;

the luminance signal is coupled to an input terminal of the image pattern and motion detecting circuit where image motion is detected by determining a difference between a current frame and preceding frame of the luminance signal and a first control signal is output which is dependent upon the degree of motion detected, and image pattern is detected and a second control signal is output in accordance with the image pattern detected;

the first and second control signals output from said pattern and motion detecting circuit are applied to control inputs of first and second adaptive filters;

the luminance signal from said gamma correction matrix is coupled to an input terminal of said first adaptive filter whose pass band is determined in accordance with the second control signal and whose output gain is determined in accordance with the first control signal;

the combined modulated output signal from the quadrature phase modulator is coupled to an input of said second adaptive filter and adaptively filtered, wherein the pass band of the second adaptive filter is determined in accordance with the second control signal, and the output gain of the second adaptive filter is determined in

accordance with the first control signal, so as to produce an adaptively filtered output;

the adaptively filtered output from the second adaptive filter and the output from the first adaptive filter are coupled to the mixer, which mixer produces a combined signal; and

the combined signal from the mixer is applied to a third low pass filter, the resulting output of which is the composite image signal.

4. A circuit as claimed in claim 2 or claim 3, wherein the pattern and motion detecting circuit includes a pattern detector which comprises:

a plurality of comparators for determining whether the luminance signal displays an edge in a horizontal direction or a vertical direction;

a plurality of inverters for inverting the outputs of said comparators; and

a logic combination circuit which receives output signals from said plurality of comparators and inverters and, on the basis of such signals, generates selection signal to be provided to selection terminals of a multiplexer.

5. A circuit as claimed in claim 4, wherein the logic combination circuit comprises a plurality of AND gates for receiving outputs from said plurality of comparators and inverters, and a plurality of OR gates for receiving outputs from said AND gates and generating said selection signals.



6. A circuit as claimed in any of claims 2 to 5, wherein the pattern and motion detecting circuit includes a motion detector which comprises:

a frame memory for delaying said luminance signal by one frame;

a subtracter for subtracting the frame delayed luminance signal generated from the frame memory from the luminance signal input;

and absolute value circuit for converting the output of said subtracter to an absolute value; and

a motion signal processing circuit for processing the output from said absolute value circuit as said first control signal.

7. A circuit as claimed in any of claims 2 to 6, wherein the adaptive filters comprise:

first and second clock delay circuits coupled in series to the luminance signal;

a first horizontal delay circuit coupled to an input terminal of the luminance signal;

third and fourth clock delay circuits in series coupled to the output of said first horizontal delay circuit;

a second horizontal delay circuit coupled to said first horizontal delay circuit;

fifth and sixth clock delay circuits in series coupled to the output of said second horizontal delay circuit;

a horizontal filter connected to the outputs of said first horizontal delay circuit and said third and fourth clock delay circuits;

a vertical filter connected to the outputs of said first, third, and fifth clock delay circuits;

a horizontal-vertical filter connected to the outputs of said first and second horizontal delay circuits and to the outputs of said first through sixth clock delay circuits;

a multiplexer for selecting the output of said vertical, horizontal, and horizontal-vertical filters according to the output of said pattern detector;

a gain controller for receiving the output of a frame delay circuit which delays an input signal thereof by a frame unit; and

a mixer for combining a signal output from a gain controller with a signal output from a gain controller which controls the output of said multiplexer, according to the output of said motion detector.

8. Apparatus for encoding colour television signals, the apparatus being substantially as hereinbefore described with reference to Figures 2 to 9 of the accompanying drawings.

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9. A method of encoding colour television signals, the method being substantially as hereinbefore described with reference to Figures 2 to 9 of the accompanying drawings.