Description

The present application relates to a hanging dot detector in a video signal processor which uses a comb filter to separate luminance and chrominance components from a composite video signal.

Under certain signal conditions the separation achieved by a comb filter is imperfect. Under these conditions, some color representative information appears in the comb filtered luminance signal; and some brightness representative information appears in the comb filtered chrominance signal (in addition to the vertical detail luminance information which appears there normally). The former phenomenon results in the display of a series of dots (known as hanging dots) at the frequency of the color subcarrier.

A one line delay comb filter achieves perfect separation when there is no change vertically between adjacent display lines. If there is a color change in the reproduced image between adjacent display lines, some color representative information is included in the comb filtered luminance signal. The extreme case occurs when on one line, the color representative information modulates the color subcarrier in such a manner that it has a given amplitude and phase and on the next line it has the same amplitude and phase, taking into account the normal 180° phase shift from line-to-line. In this case, all of the color representative information appears in the comb filtered luminance signal, and the comb filtered chrominance signal is zero. This condition is known as a complementary-color vertical transition.

Prior art hanging dot detectors have detected the presence of color representative information in the comb filtered luminance signal by calculating the cross-correlation between the comb filtered luminance and chrominance signals. United States Patent US-A-4,241,363 issued December 23, 1980 to Maeyama et al. is an example of such a hanging dot detector.

In these prior art hanging dot detectors, if a hanging dot condition is detected, the frequency composition of the comb filtered luminance signal coupled to the luminance processing channel is altered to eliminate the color representative information. The usual alteration is to provide a low pass filtered comb filtered luminance signal to the luminance processing channel during a hanging dot condition. Because the color representative information normally occupies the high frequency portion of the comb filtered luminance signal, this eliminates the color representative information. When no hanging dot condition is detected, then a full bandwidth luminance signal is coupled to the luminance processing channel.

These prior art cross-correlation hanging dot detectors, however, are sensitive to the magnitude of the color representative information in the comb filtered chrominance and luminance signals. That is, the output of such a detector varies with varying amplitudes of the color representative information in the respective comb filtered signals. It is desirable to have a hanging dot detector which is not magnitude dependent in this manner.

In accordance with the principles of the present invention, it is assumed that, if the phases of the signals in the frequency band normally occupied by color representative information in the comb filtered luminance and chrominance signals respectively change by the same amount over a given period of time, (i.e. the phases track each other) this is an indication of a hanging dot condition. Under such a condition, steps are taken to eliminate the color representative information from the comb filtered luminance signal.

If either comb filtered signal has a low amplitude, then the phase detection for that signal becomes less accurate and the control signal may be generated erroneously. Also, if the amplitudes are low, the hanging dots displayed are at so low a level as to be unobjectionable. In accordance with another aspect of the invention, the control signal is only generated if the amplitude of the signal in the frequency band normally occupied by color representative information is substantially non-zero in both the comb filtered luminance and chrominance signals.

In the complementary-color vertical transition condition, the amplitude of the comb filtered chrominance will be zero and all the color representative information will appear in the comb filtered luminance signal. Yet the hanging dots will be at the worst case, despite the zero amplitude of the comb filtered chrominance signal. In accordance with yet another aspect of the present invention, a complementary-color vertical transition is detected, and a proper control signal is generated. If the amplitude of the signal in the frequency band normally occupied by color representative information in the composite video signal is substantially non-zero, but the detected amplitude of the signal in the corresponding frequency band of the comb filtered chrominance signal is substantially zero, this indicates a complementary-color vertical transition. In this case, the control signal is generated despite the zero amplitude of the comb filtered chrominance signal.

The comb filtered luminance and chrominance phase angle signals track within a horizontal line so long as the color representative information changes relatively slowly. During a relatively fast transition, however, the tracking breaks down. The speed of transition which produces an anomaly is related to the bandwidth of the color representative

information. In accordance with yet another aspect of the present invention, when a hanging dot condition is detected, a control signal is generated which is extended in time sufficiently to be present during the transition periods before and after the detected condition.

Apparatus according to the present invention is embodied in a video signal processor including a comb filter, a luminance processing channel, and a signal coupling unit for coupling the comb filtered luminance signal to the luminance processing channel. The frequency composition of the comb filtered luminance signal coupled to the luminance processing channel is altered in response to a control signal which indicates a hanging dot condition. A hanging dot detector comprises a phase detector coupled to the comb filter. The phase detector produces at two outputs the detected phases of the signals in the frequency band normally occupied by color representative information in the comb filtered luminance and chrominance signals, respectively. A phase comparing means compares the changes over a given time period of the respective detected phases from the phase detector. A control signal generator generates the control signal in response to this comparison.

In the drawings:

FIGURE 1 is a block diagram of a video signal processor embodying a hanging dot detector according to the present invention;

FIGURE 2 is a block diagram of a portion of a phase and amplitude detector which may be used in the hanging dot detectors illustrated in FIGURES 1, 5 and 7;

FIGURE 3 is a block diagram of a phase comparator which may be used in the hanging dot detectors illustrated in FIGURES 1, 5 and 7;

FIGURE 4 is a block diagram of a control signal generator which may be used in the hanging dot detector illustrated in FIGURE 1;

FIGURE 5 is a block diagram of a video signal processor embodying a hanging dot detector according to another aspect of the present invention;

FIGURE 6 is a diagram partially in block form and partially in logic schematic form of a control signal generator which may be used in the hanging dot detector illustrated in FIGURE 5;

FIGURE 7 is a block diagram of a video signal processor embodying a hanging dot detector according to yet another aspect of the present invention; and

FIGURE 8 is a diagram partially in block form and partially in logic schematic form of a control signal generator which may be used in the hanging dot detector illustrated in FIGURE 7.

FIGURE 1 illustrates a video signal processor embodying a magnitude independent hanging dot detector in accordance with the present invention. A composite video signal source (not shown), such as the front end of a standard color television receiver, supplies a composite video signal to terminal 5. Terminal 5 is coupled to an interline comb filter 10. The comb filter 10 produces comb filtered luminance, Y, and chrominance, C, signals. The comb filtered luminance and chrominance signals are coupled to a phase detector 20. Phase detector 20 produces respective signals $\angle Y$ and $\angle C$ representing the phases of the signals in the band of frequencies normally occupied by the color representative information in the comb filtered luminance and chrominance signals. The respective phases $\angle Y$ and $\angle C$ are coupled to a phase comparator 30. Phase comparator 30 produces a signal representing a comparison of the changes over a given time period of the comb filtered luminance phase $\angle Y$ and chrominance phase $\angle C$.

The signal from phase comparator 30 is coupled to control signal generator 40. The control signal generator produces a control signal responsive to the comparison. This control signal is coupled to a control input of a signal coupling unit 50. Signal coupling unit 50 has a signal input which is coupled to comb filter 10 to receive the comb filtered luminance signal Y. The signal output of signal coupling circuit 50 is coupled to luminance processing channel 60.

Signal coupling unit 50 includes an adjustable filter which alters the frequency composition of the comb filtered luminance signal Y in response to the control signal. An example of such a signal coupling unit is described in U.S. Patent US-A-4,149,181 entitled "Signal-Dependent Chrominance Subcarrier Filtering Circuit" issued April 10, 1979 to Burdick et al. In this U.S. Patent, the comb-filtered luminance signal is provided to two subchannels. A band-reject filter is in one subchannel and only a matching delay in the other. The band-reject filter provides a greater amount of attenuation to the chrominance frequencies than to those below them. In the presence of a detected hanging dot condition, the band-reject filtered comb filtered luminance signal is coupled to the luminance processing channel. Otherwise, the unfiltered comb filtered luminance signal, from the other subchannel, is coupled to the luminance processing channel.

Control signal generator 40 will generate the control signal in response to the comparison of the phase changes over the given time period. If the phases are tracking, then a comparison of the changes over the given time period will indicate substantial equality, otherwise inequality will be indicated. If the phase changes are equal, the control signal is sent to the signal coupling circuit 50. Signal coupling circuit 50 then eliminates the color representative information from the comb filtered

luminance signal.

FIGURE 2 illustrates a portion of a phase detector 20 which may be used in the video signal processor illustrated in FIGURE 1. The portion illustrated processes the comb filtered luminance signal Y and produces a signal ∠Y representing the phase of that signal. A similar portion processes the comb filtered chrominance signal and produces a signal representing the phase of that signal. These two circuits together make up the phase comparator 20 of FIGURE 1.

In FIGURE 2, the comb filtered luminance signal from comb filter 10 of FIGURE 1 is coupled to a bandpass filter 22. The bandpass filter 22 passes the band of frequencies which contain color representative information in the presence of a vertical transition. The output of the bandpass filter 22 is supplied to a color signal demodulator 24. Color signal demodulator 24 produces a pair of base color signals which in combination form basis vectors from which the phase angle of the color representative information may be derived. The color signal demodulator 24 in the illustrated embodiment operates on samples taken at four times the subcarrier frequency and produces a pair of orthogonal color difference signals, I and Q. (In another embodiment, (R-Y) and (B-Y) or any other pair of orthogonal color difference signals may be generated, or samples taken at three times the subcarrier frequency may generate the base signals.)

The I and Q signals are supplied to phase angle calculator 25. Phase angle calculator 25 calculates the phase angle of the resultant of the orthogonal color difference signals with respect to some given axis. In the NTSC system, the given axis is sometimes taken as the -(B-Y) axis, which is supplied by the burst component of the composite video signal. The output ∠Y of phase angle calculator 25 is supplied to phase comparator 30 of FIGURE 1. (The components of FIGURE 2 illustrated in phantom will be described below.)

An exemplary I, Q orthogonal color difference signal demodulator which may be used as the demodulator 24 of FIGURE 2 is described in U.S. Patent 4,415,918 entitled "Digital Color Television Signal Demodulator" issued Nov. 15, 1983 to Henry G. Lewis, Jr. An exemplary phase angle calculator which may be used as the phase angle calculator of FIGURE 2 is described in U.S. Patent US-A-4,523,221 entitled "TV Receiver Circuitry for Performing Chroma Gain, Auto-Flesh Control and the Matrixing of I and Q Signals to (R-Y), (B-Y) and (G-Y) Signals" issued June 11, 1985 to Danny Chin et al.

FIGURE 3 illustrates a phase comparator 30 which may be used in the video signal processor of FIGURE 1. The comb filtered luminance ∠Y and chrominance ∠C phase angle signals from phase detector 20 are supplied to circuits 32 and 34 respectively which calculate the magnitude of the changes in phase of the respective signals over a given time period. The comb filtered luminance phase angle signal ∠Y is coupled to a delay circuit 3222 and one input of a subtractor 3224. The output of delay circuit 3222 is coupled to another input of subtractor 3224. Delay circuit 3222 and subtractor 3224 in combination form a circuit 322 for calculating the difference in phase of the comb filtered luminance phase angle signal at times separated by the time period of the delay introduced by delay circuit 3222. An exemplary time period could be the period of the color subcarrier, which has a frequency of 3.58 MHz in an NTSC system. The output of subtractor 3224 is supplied to a magnitude generator 324. Magnitude generator 324 calculates the magnitude of the change in the phase angle over the given period of time.

In a similar manner, the comb filtered chrominance phase angle signal ∠C is processed by circuitry 342 which calculates the difference in phase of the input signal at times differing by the given time period. The phase comparator 342 comprises delay circuit 3422 and subtractor 3424. Magnitude generator 344 receives the change in phase angle from phase comparator 342 and generates the magnitude of the change of phase over the given time period.

The output of circuitry 32 (from magnitude generator 324) is coupled to one input of a subtractor 36. The output of circuitry 34 (from magnitude generator 344) is coupled to another input of subtractor 36. The output of subtractor 36 is an indication of the difference between the magnitudes of change over the given time period of the comb filtered luminance ∠Y and chrominance ∠C phase angle signals. If this difference is zero, the two comb filtered phase angle signals changed by the same amount over the given time period, i.e. the phases tracked each other. Such a result indicates the presence of color representative information in the comb filtered luminance signal Y resulting in a hanging dot condition. The larger the difference, the less a hanging dot condition is indicated. The output of subtractor 36 is coupled to control signal generator 40 of FIGURE 1.

FIGURE 4 illustrates a control signal generator 40 for use in the video signal processor of FIGURE 1. The comparison signal from phase comparator 30 is applied to one input of comparator 42. A threshold level generator 44 is coupled to another input terminal of comparator 42. Comparator 42 and threshold level source 44 in combination form a threshold detector 46. The output of the threshold detector 46 is supplied to a pulse stretcher 48. The output of pulse stretcher 48 is coupled to signal

coupling unit 50 of FIGURE 1.

If the level of the phase change comparison is less than the threshold level supplied by threshold level generator 44, comparator 42 causes pulse stretcher 48 to generate the control signal, indicating a hanging dot condition. As discussed above, the nearer the comparison signal to zero, the more likely that a hanging dot condition exists. The threshold level can, thus, be adjusted for optimum performance.

Pulse stretcher 48 expands the time period of the control signal so that it is of sufficient width to be present during transitions before and after the detected hanging dot condition. An example of such a pulse stretcher is described in U.S. Patent US-A-4,001,496 entitled "Defect Detection and Compensation Apparatus for Use in an FM Signal Translating System" issued January 4, 1977 to Clemens et al. See particularly the switch control signal generator 40 illustrated in FIGURE 1 and described in the associated text of this patent. Signal coupler 50 of FIGURE 1 has circuitry which operates in conjunction with pulse stretcher 48 to properly align the stretched pulse with the comb filtered luminance signal.

FIGURE 5 illustrates a video signal processor embodying another aspect of the hanging dot detector. Those elements of FIGURE 5 which are similar to those of FIGURE 1, are indicated by the same reference numbers and operate in the same manner. Such elements will not be discussed in detail below.

The hanging dot detector illustrated in FIGURE 5 will generate a control signal in a similar manner as that in FIGURE 1, but only if the amplitudes of the portions of the color representative information in the comb filtered luminance and chrominance signal are both substantially non-zero. As discussed above, if the magnitude $|Y|$, $|C|$, of the color representative information in either the comb filtered luminance or chrominance are too small, then the detected phase angles $\angle Y$ or $\angle C$ have a lower accuracy. In addition, if the magnitudes are small, the deleterious effect is not large enough to be objectionable. Thus, the correction circuitry need not be activated, possibly erroneously, in such a situation.

In FIGURE 5, the comb filtered luminance Y and chrominance C signals from comb filter 10 are applied to a phase and amplitude detector 70. The luminance $\angle Y$ and chrominance $\angle C$ phase angle signals are coupled to the phase comparator 30. The luminance $|Y|$ and chrominance $|C|$ amplitude signals are coupled to a non-zero amplitude detector 80. Non-zero amplitude detector 80 produces a signal indicating that the comb filtered luminance $|Y|$ and chrominance $|C|$ amplitude signals are both substantially non-zero.

The outputs of the phase comparator 30 and the non-zero amplitude detector 80 are coupled to the control signal generator 90. Control signal generator 90 generates a control signal in response to non-zero amplitudes detected by non-zero amplitude detector 80 and the output of phase comparator 30.

The signal from control signal generator 90 is supplied as a control signal to signal coupling unit 50 which, in response to the control signal, eliminates a color representative information from the comb filtered luminance signal Y before it is supplied to the luminance processing channel 60.

Referring again to FIGURE 2, the portion of the figure illustrated in phantom provides a signal representing the magnitude $|Y|$ of color representative information in the comb filtered luminance signal Y. The orthogonal color difference signals I and Q are supplied to magnitude calculator 72. The above-mentioned U.S. Patent US-A-4,523,221 issued to Chin et al. describes an exemplary magnitude calculator which may be used as the magnitude calculator 72 in FIGURE 2. As described above, a similar circuit is coupled to process the comb filtered chrominance signal C and produce the comb filtered chrominance amplitude $|C|$ signal.

FIGURE 6 illustrates a non-zero amplitude detector 80 and control signal generator 90 for use in the video signal processor illustrated in FIGURE 5. Elements similar to those in the control signal generator 40 of FIGURE 1 have the same reference numbers and operate in the same manner.

The comb filtered chrominance amplitude signal $|C|$ from phase and amplitude detector 70 is coupled to one input of a comparator 822. A threshold level supply 824 is coupled to another input of comparator 822. Comparator 822 and threshold level source 824 in combination form a threshold detector 82.

The comb filtered luminance amplitude signal $|Y|$ from phase and amplitude detector 70 is coupled to one input of comparator 842. A threshold level source 844 is coupled to another input of comparator 842. Comparator 842 and threshold level source 844 in combination form a threshold detector 84.

The outputs of threshold detectors 82 and 84 are coupled to respective input terminals of AND gate 86. The output of AND gate 86 is the output of non-zero amplitude detector 80.

The outputs of threshold detectors 82 and 84 are '1' only if the level of the comb filtered chrominance $|C|$ and luminance $|Y|$ amplitude signals respectively are greater than the level supplied by threshold level sources 824 and 844 respectively. The outputs are '0' otherwise. The output of AND gate 86, thus, is a '1' only if the comb filtered luminance $|Y|$ and chrominance $|C|$ amplitude signal

levels are both greater than their respective threshold levels. As discussed above, in this situation, the phase angles detected will be more accurate and the hanging dots will be more noticeable.

The output of threshold detector 46, which operates in the manner described above in reference to FIGURE 4, is coupled to one input of an AND gate 94. The output of non-zero amplitude detector 80 (from AND gate 86) is coupled to another input of AND gate 94. The output of AND gate 94 is coupled to a pulse stretcher 48. Threshold detector 46, AND gate 94 and pulse stretcher 48 in combination form control signal generator 90.

If the phases are tracking each other, the output of threshold detector 46 is a '1'. If the amplitudes are at a high enough level (indicated by a '1' from AND gate 86) and the phases are tracking (indicated by a '1' from threshold detector 46), the output of AND gate 94 is '1'. If the output of AND gate 94 is '1', this indicates a hanging dot situation. The frequency composition of the comb filtered luminance signal is altered in that case to eliminate the color representative information, as discussed above. When the output of AND gate 94 is '1', pulse stretcher 48 produces a stretched pulse for the reasons discussed above in the description of FIGURE 4. The output of signal stretcher 48 is supplied to the signal coupling unit 50 of FIGURE 5.

FIGURE 7 illustrates a video signal processor embodying a hanging dot detector according to yet another aspect of the present invention. Those elements of FIGURE 7 which are similar to those of FIGURES 1 and 5 are indicated by the same reference numbers and operate in the same manner.

In FIGURE 7, the control signal generator 110 receives signals from phase angle comparator 30 and non-zero amplitude detector 80, as in FIGURE 5. In addition, control signal generator 110 receives signals from the chrominance amplitude |C| output of the phase and amplitude detector 70 and a chrominance detector 100.

Chrominance detector 100 receives at its input the composite video signal from terminal 5 and produces at its output a signal indicating the presence of signals in the frequency band normally occupied by color representative information. Chrominance detector 100 could, for example, include a bandpass filter for passing only the frequencies normally containing color representative information; an envelope detector coupled to the output of the bandpass filter and the threshold detector coupled to the output of the envelope detector.

If the level of the signal detected by the envelope detector exceeds the threshold level in the threshold detector, then the output of the threshold detector is '1' and is '0' otherwise. The output of the threshold detector is the output of the chrominance detector 100.

Control signal generator 110 generates a control signal in response to non-zero comb filtered luminance |Y| and chrominance |C| amplitude signals and tracking of the comb filtered chrominance $\angle C$ and luminance $\angle Y$ phase angle signals, as in FIGURE 5. In addition, the control signal generator 110 generates a control signal if the comb filtered chrominance amplitude signal |C| is substantially zero but the level of the signal in the band of frequencies normally occupied by the color representative information in the composite video signal is non-zero. The latter set of conditions indicates a complementary-color vertical transition. In either of these cases, color representative information in the comb filtered luminance signal is eliminated by the signal coupling unit 50.

FIGURE 8 illustrates a non-zero amplitude detector 80 and control signal generator 110 which may be used in the video signal processor of FIGURE 7. Elements in FIGURE 8 which are similar to those of FIGURES 4 and 6 have the same reference numbers and operate in the same manner.

As in FIGURE 6, the output of AND gate 94 is a '1' if the comb filtered luminance |Y| and chrominance |C| amplitude signals are both greater than respective given thresholds and the comb filtered chrominance $\angle C$ and luminance $\angle Y$ phase signals are tracking. The output of AND gate 94 is coupled to one input of an OR gate 1106.

The signal indicating a non-zero amplitude of color representative information in the composite video signal from chrominance detector 100 is coupled to one input of an AND gate 1104. An inverter 1102 is coupled to the output of threshold detector 82. The output of inverter 1102 is coupled to another input of AND gate 1104. The output of AND gate 1104 is coupled to another input of OR gate 1106. The output of OR gate 1106 is coupled to signal stretcher 48. The output of signal stretcher 48 is the control signal supplied to signal coupling unit 50.

The output of inverter 1102 is a '1' only if the comb filtered chrominance amplitude signal |C| is less than a given threshold, as indicated by a '0' output from threshold detector 82. The output of chrominance detector 100 is a '1' when the signals in the frequency band normally containing color representative information in the composite video signal is substantially non-zero. The output of AND gate 1104 will, therefore, be a '1' in a complementary-color vertical transition condition. The output of OR gate 1106 is a '1' in either a complementary-color vertical transition condition, or in the non-zero amplitude and phase tracking con-

dition and causes signal stretcher 48 to generate a stretched control signal. Such a detector will properly detect both types of hanging dot situations and the signal coupling unit 50 will properly condition the comb filtered luminance signal Y under those conditions.

It should be understood that, although the embodiments illustrated utilized digital circuitry, the invention may be embodied in either continuous or sampled data signal processors. Sampled data signal processors embodying the invention may be either analog or digital implementations.

Claims

1. In a video signal processor including a comb filter (10) for producing comb filtered luminance (Y) and chrominance (C) signals, a luminance processing channel (60), and means for coupling said comb filtered luminance signal (Y) to said luminance processing channel including means (50) for altering the frequency composition of said comb filtered luminance signal in response to a control signal; a hanging dot detector characterized by:

phase detecting means (20) coupled to said comb filter for detecting the respective phase angles (<Y, <C) of the signals in the frequency band normally occupied by color representative information in said comb filtered luminance and chrominance signals;

means (30) for comparing the magnitude of changes over a given time period of said respective comb filtered phase angle signals; and

means (40) coupled to said phase comparing means for generating said control signal in response to said comparison.

2. The hanging dot detector of Claim 1, wherein said phase detecting means (20) comprises:

respective bandpass filters (22) responsive to said comb filtered chrominance and luminance signals for passing those frequencies normally occupied by color respresentative information;

respective demodulators (24) coupled to said respective bandpass filters; and

respective phase angle calculating means (25) responsive to signals recovered by said demodulators.

3. The hanging dot detector of Claim 1, wherein said phase change comparing means (30) comprises:

respective means (32, 34) for calculating the magnitude of changes of said respective phases over a given time period; and

a subtractor (36) coupled to said respective calculating means for generating the difference between said respective magnitudes of phase changes.

4. The hanging dot detector of Claim 3, wherein said change magnitude calculating means (32,34) comprises:

respective means (322, 342) for comparing said respective phases at times differing by said given time period; and respective means (324,344) for generating a signal representing the magnitude of the result of said comparison.

5. The hanging dot detector of Claim 4, wherein said respective phase comparing means comprises:

respective delay circuits (3222, 3422) responsive to said respective phases for delaying the input signal by said given time period; and

respective subtractors (3224, 3424) each having a first input responsive to said respective phases, a second input coupled to receive said respective delayed phases, and an output for producing said comparison of said respective phases.

6. The hanging dot detector of Claim 1, wherein said control signal generating means (40) comprises:

a threshold detector (42) coupled to said phase comparator for producing a signal having a first state when the input signal is less than a given threshold, and a second state other wise; and

a signal stretcher (48) coupled to said threshold detector for producing said control signal as an output.

7. The hanging dot detector of any preceding claim, also including:

amplitude detecting means (70,80) coupled to said comb filter for detecting the respective amplitudes of the signals in the frequency band normally occupied by color representative information in said comb filtered luminance and chrominance signals; and

means (86, 94) for rendering said control signal generating means (90) responsive to said detected amplitudes in such manner as to enable control signal generation by said generating means when both of said detected amplitudes are non-zero.

dition and causes signal stretcher 48 to generate a stretched control signal. Such a detector will properly detect both types of hanging dot situations and the signal coupling unit 50 will properly condition the comb filtered luminance signal Y under those conditions.

It should be understood that, although the embodiments illustrated utilized digital circuitry, the invention may be embodied in either continuous or sampled data signal processors. Sampled data signal processors embodying the invention may be either analog or digital implementations.

Claims

1. In a video signal processor including a comb filter (10) for producing comb filtered luminance (Y) and chrominance (C) signals, a luminance processing channel (60), and means for coupling said comb filtered luminance signal (Y) to said luminance processing channel including means (50) for altering the frequency composition of said comb filtered luminance signal in response to a control signal; a hanging dot detector characterized by:

phase detecting means (20) coupled to said comb filter for detecting the respective phase angles (<Y, <C) of the signals in the frequency band normally occupied by color representative information in said comb filtered luminance and chrominance signals;

means (30) for comparing the magnitude of changes over a given time period of said respective comb filtered phase angle signals; and

means (40) coupled to said phase comparing means for generating said control signal in response to said comparison.

2. The hanging dot detector of Claim 1, wherein said phase detecting means (20) comprises:

respective bandpass filters (22) responsive to said comb filtered chrominance and luminance signals for passing those frequencies normally occupied by color respresentative information;

respective demodulators (24) coupled to said respective bandpass filters; and

respective phase angle calculating means (25) responsive to signals recovered by said demodulators.

3. The hanging dot detector of Claim 1, wherein said phase change comparing means (30) comprises:

respective means (32, 34) for calculating the magnitude of changes of said respective phases over a given time period; and

a subtractor (36) coupled to said respective calculating means for generating the difference between said respective magnitudes of phase changes.

4. The hanging dot detector of Claim 3, wherein said change magnitude calculating means (32,34) comprises:

respective means (322, 342) for comparing said respective phases at times differing by said given time period; and respective means (324,344) for generating a signal representing the magnitude of the result of said comparison.

5. The hanging dot detector of Claim 4, wherein said respective phase comparing means comprises:

respective delay circuits (3222, 3422) responsive to said respective phases for delaying the input signal by said given time period; and

respective subtractors (3224, 3424) each having a first input responsive to said respective phases, a second input coupled to receive said respective delayed phases, and an output for producing said comparison of said respective phases.

6. The hanging dot detector of Claim 1, wherein said control signal generating means (40) comprises:

a threshold detector (42) coupled to said phase comparator for producing a signal having a first state when the input signal is less than a given threshold, and a second state other wise; and

a signal stretcher (48) coupled to said threshold detector for producing said control signal as an output.

7. The hanging dot detector of any preceding claim, also including:

amplitude detecting means (70,80) coupled to said comb filter for detecting the respective amplitudes of the signals in the frequency band normally occupied by color representative information in said comb filtered luminance and chrominance signals; and

means (86, 94) for rendering said control signal generating means (90) responsive to said detected amplitudes in such manner as to enable control signal generation by said generating means when both of said detected amplitudes are non-zero.

* C L M S *

8. The hanging dot detector of claim 7 also including:

means (100), responsive to the input to said comb filter (10), for detecting the presence of components therein exhibiting those frequencies normally occupied by color representative information; and additional means (1102, 1104, 1106) responsive to the simultaneous detection of such component presence and the detection of a substantially zero amplitude with respect to said comb filtered chrominance signals by said amplitude detecting means, for enabling control signal generation by said generating means.

Revendications

1. Dans un processeur de signaux vidéo comprenant un filtre en peigne (10) pour produire des signaux de luminance (Y) et de chrominance (C) filtrés en peigne, un canal de traitement de luminance (60), et un moyen pour coupler le signal de luminance filtré en peigne (Y) au canal de traitement de luminance comportant un moyen (50) pour modifier la composition en fréquences du signal de luminance filtré en peigne en réponse à un signal de commande; un détecteur de points pendants caractérisé par :

un moyen de détection de phase (20) couplé audit filtre en peigne pour détecter les déphasages respectifs (<Y, <C) des signaux dans la bande de fréquences normalement occupée par l'information représentative de couleur dans les signaux de luminance et de chrominance filtrés en peigne;

un moyen (30) pour comparer la grandeur des changements sur une période de temps donnée des signaux déphasés filtrés en peigne respectifs; et

un moyen (40) couplé au moyen de comparaison de phase pour produire le signal de commande en réponse à ladite comparaison.

2. Le détecteur de points pendants de la revendication 1, où le moyen de détection de phase (20) précité comprend :

des filtres passe-bande respectifs (22) répondant aux signaux de chrominance et de luminance filtrés en peigne précités pour laisser passer les fréquences normalement occupées par l'information représentative de couleur;

des démodulateurs respectifs (24) couplés auxdits filtres passe-bande respectifs; et

des moyens de calcul de déphasage respectifs (25) répondant aux signaux restitués par lesdits démodulateurs.

3. Le détecteur de points pendants de la revendication 1, où le moyen de comparaison de changement de phase précité (30) comprend :

des moyens respectifs (32, 34) pour calculer la grandeur de changements des phases respectives précitées sur une période de temps donnée; et

un soustracteur (36) couplé aux moyens calculateurs respectifs pour produire la différence entre lesdites grandeurs respectives des changements de phase.

4. Le détecteur de points pendants de la revendication 3, où le moyen de calcul de grandeur de changement (32, 34) comprend :

des moyens respectifs (322, 342) pour comparer les phases respectives précitées à des périodes différentes de la période de temps donnée précitée; et des moyens respectifs (324, 344) pour produire un signal représentant la grandeur du résultat de la comparaison précitée.

5. Le détecteur de points pendants de la revendicaiton 4, où les moyens de comparaison de phase respectifs précités comprennent :

des circuits à retard respectifs (3222, 3424) répondant aux phases respectives précitées pour retarder le signal d'entrée de la période de temps donnée précitée; et

des soustracteurs respectifs (3224, 3424) ayant chacun une première entrée répondant aux phases respectives précitées, une seconde entrée reliée pour recevoir les phases retardées respectives précitées, et une sortie pour produire la comparaison précitée des phases respectives.

6. Le détecteur de points pendants de la revendication 1 , où le moyen générateur de signaux de commande précité (40) comprend :

un détecteur de seuil (42) couplé au comparateur de phase précité pour produire un signal ayant un premier état lorsque le signal d'entrée est inférieur à un niveau donné, et un second état autrement; et

un circuit d'expansion de signaux (48) couplé au détecteur de seuil pour produire le signal de commande comme une sortie.

7. Le détecteur de points pendants de n'importe quelle des revendications précédentes, comprenant également :

un moyen de détection d'amplitude (70, 80) couplé au filtre en peigne précité pour

* C L M S *

détecter les amplitudes respectives des signaux dans la bande de fréquences normalement occupée par l'information représentative de couleur dans les signaux de luminance et de chromiannce filtrés en peigne; et

un moyen (86, 94) pour rendre le moyen de production de signaux de commande (90) sensible aux amplitudes détectées précitées d'une manière à permettre la production du signal de commande par le moyen de production lorsque les deux amplitudes détectées ne sont pas nulles.

8. Le détecteur de points pendants de la revendication 7, comprenant également :

un moyen (100), répondant à l'entrée du filtre en peigne précité (10), pour détecter la présence de composantes dans celui-ci présentant les fréquences normalement occupées par l'information représentative de couleur; et un moyen additionnel (1102, 1104, 1106) répondant à la détection simultanée d'une telle présence de composantes et la détection d'une amplitude sensiblement nulle par rapport aux signaux de chrominance filtrés en peigne par le moyen de détection d'amplitude, pour permettre la production d'un signal de commande par le moyen de production précité.

Ansprüche

1. Punktstörungsdetektor in einem Videosignal-Prozessor, der ein Kammfilter (10) zum Erzeugen eines kammgefilterten Leuchtdichtesignals (Y) und Farbartsignales (C), einen Leuchtdichtesignal-Verarbeitungskanal (60), und eine Anordnung zum Koppeln des kammgefilterten Leuchtdichtesignals (Y) an den Leuchtdichtesignal-Verarbeitungskanal einschließlich einer Anordnung (50) zum Ändern der Frequenzzusammensetzung des kammgefilterten Leuchtdichtesignals als Reaktion auf ein Steuersignal, **gekennzeichnet durch**

eine Phasendetektoranordnung (20), die mit dem Kammfilter gekoppelt ist, um die jeweiligen Phasenwinkel (<Y,<C) der Signale im Frequenzband, das normalerweise von der Farbe repräsentierenden Information im kammgefilterten Leuchtdichtesignal und Farbartsignal eingenommen wird, zu demodulieren;

eine Anordnung (30) zum Vergleichen der Größe von Änderungen der jeweiligen kammgefilterten Phasenwinkelsignale über eine vorgegebene Zeitspanne; und

eine Anordnung (40), die mit der Phasenvergleicheranordnung gekoppelt ist, um das Steuersignal als Reaktion auf den Vergleich zu erzeugen.

2. Punktstörungsdetektor nach Anspruch 1, **dadurch gekennzeichnet**, daß die Phasendetektoranordnung (20)

entsprechende Bandpaßfilter (22) für das kammgefilterte Farbartsignal und Leuchtdichtesignal, welche nur diejenigen Frequenzen durchlassen, die normalerweise von der für die Farbe repräsentativen Information eingenommen werden;

entsprechende Demodulatoren (24), die jeweils mit einem entsprechenden Bandpaßfilter gekoppelt sind; und

entsprechende Phasenwinkel-Rechneranordnungen (25), welche auf die durch die Demodulatoren wiedergewonnenen Signale ansprechen,

enthält.

3. Punktstörungsdetektor nach Anspruch 1, **dadurch gekennzeichnet**, daß die Phasenänderungsvergleicheranordnung (30)

entsprechende Einrichtungen (32, 34) zum Errechnen der Größe der Änderungen der jeweiligen Phasen über eine vorgegebene Zeitspanne; und

einen Subtrahierer (36), der mit den jeweiligen Rechneranordnungen gekoppelt ist, um die Differenz zwischen den jeweiligen Größen der Phasenänderungen zu bilden, enthält.

4. Punktstörungsdetektor nach Anspruch 3, **dadurch gekennzeichnet**, daß die Größenänderungsrechneranordnung (32, 34)

entsprechende Einrichtungen (322, 342) zum Vergleichen der jeweiligen Phasen zu Zeiten, die sich um die vorgegebene Zeitspanne unterscheiden, und entsprechende Einrichtungen (324, 344) zum Erzeugen eines Signals, welches die Größe des Resultats des Vergleiches darstellt, enthält.

5. Punktstörungsdetektor nach Anspruch 4, **dadurch gekennzeichnet**, daß die Vergleichereinrichtung für die jeweiligen Phasen

entsprechende, auf die jeweiligen Phasen reagierende Verzögerungsschaltungen (3222, 3422) zum Verzögern des Eingangssignals um die vorgegebene Zeitspanne, und

entsprechende Subtrahierer (3224, 3424), die jeweils einen ersten, auf die entsprechenden Phasen ansprechenden Eingang, einen für den Empfang der entsprechenden verzögerten Phasen geschalteten zweiten Eingang und einen Ausgang zum Erzeugen des Vergleichs der jeweiligen Phasen aufweisen,

enthält.

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6. Punktstörungsdetektor nach Anspruch 1, **dadurch gekennzeichnet**, daß die Steuersignalerzeugungsanordnung (40)

einen Schwellenwertdetektor (42), der mit dem Phasenvergleicher gekoppelt ist, um ein Signal zu erzeugen, das einen ersten Zustand aufweist, wenn das Eingangssignal kleiner als ein vorgegebener Schwellenwert ist, und sonst einen zweiten Zustand, und

einen Signaldehner (48), der mit dem Schwellenwertdetektor gekoppelt ist, um das Steuersignal als Ausgangssignal zu erzeugen, enthält.

7. Punktstörungsdetektor nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet**, daß er weiterhin

eine Amplitudendetektoranordnung (70, 80), die mit dem Kammfilter gekoppelt ist, um die jeweiligen Amplituden der Signale im Frequenzband, das normalerweise von der Farbe repräsentierenden Information eingenommen wird, im kammgefilterten Leuchtdichtesignal und Farbartsignal zu erfassen, und

eine Einrichtung (86, 94), um die Steuersignalerzeugungsanordnung (90) auf die erfaßten Amplituden derart reaktionsfähig zu machen, daß die Steuersignalerzeugung durch die Erzeugungsanordnung ermöglicht wird, wenn beide erfaßten Amplituden ungleich null sind, enthält.

8. Punktstörungsdetektor nach Anspruch 7, **dadurch gekennzeichnet**, daß er weiterhin eine auf das Eingangssignal des Kammfilters (10) reagierende Einrichtung (100) enthält, um in diesem das Vorhandensein von Komponenten feststellen, die diejenigen Frequenzen aufweisen, die normalerweise von der Farbe repräsentierenden Information eingenommen werden, und eine zusätzliche Einrichtung (1102, 1104, 1106), die auf die gleichzeitige Feststellung des Vorhandenseins solcher Komponenten und die Feststellung durch die Amplituden-Detektoreinrichtung, daß die Amplitude bezüglich der kammgefilterten Farbartsignale im wesentlichen null ist, um die Steuersignalerzeugung durch die Erzeugungsanordnung zu ermöglichen.

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