

Description

Field of the invention

This invention relates to the evaluation of the quality of audio transfer characteristics for recording medium on which audio information is contained. Specifically, the invention contains both method and apparatus for evaluating the quality of information transfer in recording and playing back of a recording medium by determining the presence of a prescribed degree of similar information content on any two selected audio channels.

Description of the prior art

The art of performing a variety of audio and/or video tests on various electronic information handling devices is well known. It is an additionally well-known technique to perform certain audio and/or video tests upon virgin recording mediums such as magnetic tape in order to evaluate the characteristics of the tapes for purposes of quality assurance and for grading, i.e. for categorizing the quality as to grade of the tapes exiting a production line.

However, such tests for sample testing of blank tapes in a production run are performed for purposes of evaluating the magnetic characteristics of the medium only and are performed under ideal recording and playback conditions resulting in specifications for the medium *per se*.

Since the test procedures noted above are for evaluating the recording medium itself, there were heretofore no procedures known for evaluating a medium which had material prerecorded on it and for subsequently comparing the results of such evaluation with the evaluation of a duplicate copy recorded on another storage medium.

Further, prior art testing procedures have no means for sampling and evaluating audio information on a pre-recorded recording medium to determine a prescribed degree of similar information content on any two selected audio channels.

Brief summary of the invention

Consequently, it is an object of this invention to provide a method of, and means for, analyzing characteristics of a program of recorded information recorded on two information channels of recording medium by determining the presence of a prescribed degree of similar information content on both channels.

In its broadest aspect the invention provides a method of establishing the characteristics of a program of recorded analog audio signal information previously recorded on two channels of a recording medium, comprising the steps of:

sampling the amplitude of audio information contained on each of said two channels of the recorded program simultaneously;

comparing said amplitudes of said information sampled from one channel with said amplitudes of information occurring simultaneously with that sampled from the other channel; and

counting the number of times that the amplitudes of the samples from the two channels are within a prescribed percentage tolerance of one another to provide information regarding whether or not the signals on the two channels are substantially similar in informational content.

In the following discussion, the term "unit" in the phrase "unit evaluation" includes tapes, discs, audio records, electronic storage, various electronic circuits ranging from simple integrated circuits or printed circuit boards to macrosize amplifier or other complex information handling equipment.

Since this invention is exceptionally useful in the evaluation of videodiscs, a special form of the phrase "unit evaluation" will be used throughout this application, and thus, "disc evaluation" will refer to the analysis of information retrieved from a videodisc as compared with the analysis of the recording medium (generally tape) of which the information recorded on the disc is duplicative. Thus, "tape evaluation" will refer to evaluating the contents of a master tape, while "disc evaluation" will refer to the information retrieved from a replicated disc.

Another term used through this application is "signature". The term "signature" has been used in the prior art to designate a parameter listing against which devices being tested are compared.

The term "signature" as used in this application has a degree of identity or "personality" of the unit under test, insofar as the "signature" is comprised of a multiplicity of test parameters, each parameter having limits within which comparable measurements of the unit under test must fall. Accordingly, the "signature" as used with this invention is a practical, as opposed to theoretical, model against which all further units are compared.

Brief description of the drawings

The invention will be described in detail having reference to the appended drawings in which:

Figure 1 shows in block diagram form a complete audio/video quality monitoring system in which a common central controller cooperates with multiple interface subsystems and associated multiple audio/video test subsystems;

Figure 2 shows a modified version of Figure 1 in which, rather than having a central controller, the audio and video test subsystems communicate with and are under the control of an isolated and independent interface subsystem and controller;

Figure 3 is a more detailed block diagram of the audio/video quality monitoring system of Figure 1 showing the interrelationship between the central controller and one of the plurality of interface subsystems and its associated audio and video test subsystems;

Figure 4 is a block diagram showing a further breakdown of the audio test subsystem of Figure 3;

Figure 5 illustrates a representation of a length of video tape showing the position of lead-in, lead-out program material, and track locations for audio

and control and cue tracks;

Figure 6 shows, in the upper half thereof, a spacial representation of the placement of audio test tones at the lead-in and lead-out portion of a video tape or video disc, and in the bottom half thereof, a pictorial representation of the signals in the corresponding blocks of the top half of the figure;

Figure 7 shows, in block diagram form, the audio test tone generator logic for creating the audio test tones for placement on lead-in and lead-out of the video tape or video disc;

Figure 8 is a general block diagram illustration of the audio analysis logic portion of the audio test subsystem;

Figure 9 is a timing chart showing the relationship between the signals operative for carrying out the audio analysis.

Detailed description of the invention

The disclosure of the present description overlaps with the disclosure of the co-pending EP-application Nr. 82 108 473.8, 83111960.7 and 83111963.1.

Figure 1 shows a complete audio/video quality monitoring system utilizing a central controller 1 and a plurality of terminals each comprising an interface subsystem 3, an audio/video test subsystem 2, and the unit under test 4 connected to the audio/video test subsystem 2. The peripheral equipment associated with the central controller 1 comprises a memory unit 13, a keyboard 70, a data evaluation subsystem 19, and a data readout device or devices 64.

While Figure 1 shows a single central controller 1 with multiple interface subsystems 3, an alternative to such a "centralized" system is the arrangement of Figure 2 in which each interface subsystem 3 is inclusive of its own, perhaps less sophisticated, controller, and has its own memory unit 13, keyboard 70, and data readout devices 64. Figure 2 further shows a slightly more detailed communication link between the various components of the interface, test, and evaluation subsystems.

Figure 3 shows a greatly expanded version of the arrangement shown in Figure 1 with central controller 1 and its associated peripheral equipment connected with only a single interface subsystem 3, audio test subsystem 5, video test subsystem 7, and unit under test 4. To this point, the unit under test 4 has been treated as strictly a player-type unit capable of reproducing audio and video signals from a prerecorded tape or disc. The phrase "unit under test", however, carries with it, for the purposes of this application, a more complex arrangement comprised of a tape recorder/player 11, a disc player 9, and an audio and video selector 53 as shown within the unit under test block 4 in Figure 3. The disc player is capable of outputting both video and audio signals to the selector 53 on lines 147 and 151, respectively. Similarly, the tape recorder/player 11 outputs video on line 149, and audio on line 153. Later, it will be evident that the audio lines

151 and 153 carry two lines of audio for the purposes of accommodating a stereophonic or two channel signal.

Operation control, i.e., stop, play, reverse, fast forward, rewind, etc., is effected by operation control 117 in interface subsystem 3 via cable 133 shown in Figure 3 as a single line for simplifying the drawing. Operation control is also effective to select either audio channel, or both, and video from either the disc player 9 or tape recorder/player 11. Audio and video are thus outputted on lines 58 and 118, respectively, leaving the audio and video selector 53.

Tape position is outputted on the data channel output line of the tape player 11, and audio test tones are applied to the tape by tape recorder 11 as will be discussed in connection with more detailed figures later.

Having reference to Figures 3 and 4, the function of the audio test subsystem will now be described.

Upon receiving a customer's tape, a duplicate is made, and while the duplicate copy is properly termed a submaster, it is also referred to as a pre-mastering tape preparatory to producing a disc master. In any event, the first step in the process is to transfer the customer's program from the master tape to a submaster or pre-mastering tape. Simultaneously with the transferring of the video portion of the program to the pre-mastering tape, appropriate video test signals are inserted on lines 19 and 20 of the vertical interval. A timed sequence of audio test signals is recorded at a predetermined location on the lead-in and lead-out portions of the pre-mastering tape. The signals will be used to analyze the audio quality of the signals recorded on the tape and on the disc to be made from the tape. Details of the lead-in and lead-out audio testing will now be discussed.

In Figures 3 and 4, the data channel from the tape player 11 is outputted on line 34 and is sent to time code selector 51, a second input of which is a time code signal from time code register 116 as set up by the keyboard 70 via central controller 1. The operator thus rewinds the tape on recorder 11 to a position upstream of the start position for the test tones and sets the tape recorder into a recording mode through actuation of operation control 117 over line 133. When the time code on data channel line 34 matches the time code from register 116, the time code selector 51 sends an output compare signal to the audio controller 21 which then initiates, over line 30, test tone generator 49 to apply test tones to both channels 1 and 2 of tape recorder 11.

In a similar manner, after the test tones have been applied to the lead-in portion of the tape, the operator performs a high speed tape wind to a point corresponding to the end of the active program and enters a second beginning point for the test tones to occur, during lead-out of the tape, beginning at least 150 frames after the program end. Under control of central controller 1, when the operator permits the tape to resume normal speed prior to passing the end of active

program area, a match is again detected by time code selector 51 at at least 150 frames after the program end, the tape recorder is put into record mode, and the test tone generator 49 is enabled by audio controller 21 to deposit test tones on channels 1 and 2 of the tape recorded by tape recorder 11.

It is contemplated that the present invention can be utilized to insert audio test tones in between isolated program segments, as well as during lead-in and lead-out locations.

In any event, the method of characterizing the information transfer characteristics of the recording medium basically involves recording, and simultaneously making a first measurement of, known values of one or more test signals on the recording medium, followed by playing back the recording medium and making a second measurement of the recorded test signal or signals. In the manner of establishing a "signature" as a representation of the signal transfer characteristics, and unlike prior art procedures involving merely checking properties of the medium (e.g., magnetic properties of a video tape), deviation levels from the first measurement results are set up as prescribed tolerance limits for the aforementioned second measurement, and the results of the first measurement are compared with the results of the second measurement to determine if the second measurement results are within the prescribed tolerance limits established from the first measurement results.

When testing throughput devices (such as amplifiers, printed circuit boards, microelectronic chips, etc.), or in generally applying the present invention, analyzing the signal transferring characteristics of a signal processing unit can be accomplished by establishing an input signal of known content, measuring selected parameters of selected parts of such input signal, feeding that input signal to the signal processing unit, measuring the parameters of parts of the output signal from the signal processing unit corresponding to the similar selected parts of the input signal, and comparing the selected parameters of the input signal with the corresponding parameters of the output signal. Again, the tolerance limits for the measurement of parameters of the output signal are derived as deviation levels from the measurement of the corresponding parameters of the selected parts of the input signal.

A method of analyzing the signal transfer characteristics of a signal processing unit will now be described in a slightly modified version than previously described, in that advantage is taken of an information storage device which can retain information gathered quickly from the unit under test and which can be accessed later for information analysis. In effect, the method involves establishing an input signal of known content, measuring selected parameters of selected parts of the input signal, storing the input measurement results to define a stored signature of the input signal comprising the selected para-

meters of selected parts of the input signal, feeding the input signal to the processing unit, measuring the parameters of parts of the output signal from the signal processing unit corresponding to selected parts of the input signal, and subsequently comparing the parameters of the output signal with the corresponding input signature parameters. When it is desirable to carry out the actual evaluation of the output signal measurements at a later time, the method of analyzing just described can be supplemented by a further step in the evaluation process. That is, before comparing the output signal measurement with the stored selected input signature parameters, the measurements of the output signal can also be stored to define a stored signature of the output signal comprising selected parameters of selected parts of the output signal, and the comparing step would then comprise comparing the stored output signal signature with the stored input signal signature. Reference is made to Figures 3 and 4 and the following discussion for an understanding of this aspect of the invention.

A 6734 head tone is recorded and retrieved from only one channel (e.g., channel 2 of a two channel audio program). This head tone identifies the beginning of the audio test tone sequence, and the audio on line 58 (Figure 3) or line 58-2 (Figure 4) from the audio and video selector 53 is routed to the 6734 tone detector 41. The output of 6734 detector 41 is routed over line 82 to the audio controller 21 which provides, under internal process control, all of the timing functions for the remainder of the audio test subsystem 5.

Audio controller 21 is enabled preparatory to the system recognizing the 6734 tone burst by the operator, through keyboard 70, central controller 1, and interface subsystem 3 by the sending of a request to the audio subsystem to load its internal acquisition program and to activate the audio test subsystem.

At the time audio test signals were generated and applied to the tape, a SMPTE start code is entered by the tape operator to indicate the start of active program as expressed in hours and minutes. Similarly, a SMPTE end code as entered by the tape operator indicates the end of active program as expressed in hours and minutes. Thus, upon command from the operator to perform tape or disc evaluation, the central controller 1, via interface subsystem 3, enables the audio controller 21 in the audio test subsystem 5 over line 18 with an "enable" signal.

The central controller then instructs the operator to rewind and start the tape or disc from the beginning. The central controller sends the SMPTE start code minus 25 seconds to the interface subsystem 3 and loads it into time code registers 74. In the same manner as previously described with depositing the test tone sequence to the pre-mastering tape, time code selector 51 alerts the audio controller 21 over line 76 that lead-in of the tape or disc is being read. With the audio controller 21 now enabled, detection of the 6734 tone burst initiates the action of audio

controller 21 to perform its timing sequences for the various analyzing functions of the audio test subsystem over line 30. One of the output control signals over line 30 is a control and trigger signal routed to the multiprogrammer 23. Upon receipt of the control and trigger signal, multiprogrammer 23 digitizes the segmented audio test tones on line 58, stores the digitized version of the test tones in memory, and under control of the audio controller 21, converts a selected segment of the audio test tones to a continuous analog representation and sends such representation over line 46 to audio signal analyzer 25 for general analysis, and to audio spectrum analyzer 27 for spectrum analysis of the lead-in and lead-out test tones. Direct audio on line 58 from the audio/video selector 53 is routed to an active program spectrum analyzer 43 and a mono/non-mono signal check 62, the former performing spectrum analysis of selected portions of the active program material, and the latter making a determination as to whether or not the two audio signals on the two audio channels of the playback audio are substantially the same or different, thereby indicating that the audio portion of the program is either monophonic or non-monophonic. The term "stereo" is not used in describing the function of the signal check block 62, since the invention is equally suited for analyzing audio signals on the two channels in the form of monophonic, stereophonic, or totally separate audio tracks.

The outputs of each of the signal analysis blocks of the audio test subsystem are routed to a data evaluation subsystem 19 which, under instructions from the operator through central controller 1 compares the audio analysis results with standards, i.e., performs a signature comparison, and outputs the results of the evaluation onto a printer 15 or visual display 17.

With specific reference to Figure 3, the video from audio and video selector 53 over line 118 is routed to the video test subsystem 7, the video signal being converted from analog to digital form by A/D converter 123, the digitized version being stored in digital memory 124 and selectively processed or analyzed in video processor 125. The output of video processor 125 is thus a video "signature" of the recovered video signal, is outputted over line 126 to the data evaluation subsystem 19, and the thus obtained output "signature" is compared with a stored signature in the data evaluation subsystem 19, the results of which is printed on printer 15 and/or displayed at display station 17.

Program start and end signals on line 76 and evaluate start on line 78 all from code or frame number selector 51, enable audio controller 21 to initiate and periodically check active audio as a result of decoding frame time codes from the vertical interval of the video received from the audio/video selector 53 on line 118.

For purposes of illustration and to insure consistency of terminology used in this specification with that normally used and accepted in the art, references made to Figure 5 which shows a

schematic representation of a length of video tape containing a lead-in portion, a lead-out portion, and a program material portion sandwiched therebetween. Assuming tape motion is to the right in Figure 5, the beginning of the tape 55 has a lead-in portion 57, a test tone zone 59 on the lead-in portion, and a guard portion 65 of lead-in, all followed by the program material portion 67. The test tone zone 59 on lead-in is comprised of two tracks of audio test tones, track 1 being represented by numeral 61 and track 2 by numeral 63.

In symmetrical fashion, following the program material portion 67, a lead-out guard portion 65 precedes test tone zone 59 comprised of audio track 1 shown at 61, audio track 2 shown at 63, and lead-out portions 57 extending to the end of the tape.

The dotted line at 66 represents a control track for use in synchronizing the tape drive of the tape recorder upon playback, among other things, and a cue track 68 upon which can be recorded a variety of signals, including time code frame numbers, editing data, additional audio, etc.

Referring to Figure 6, in order to have a known measurable set of standards upon which to qualify audio signals, a segmented signal train of appropriate test signals is recorded on both the lead-in and lead-out areas of the pre-mastering tape. In a preferred embodiment of the invention, audio test tones are recorded on both audio channels of the tape and occupy 12 vertical frame times in corresponding areas on both of the audio channels as represented by the vertical dotted lines in Figure 6. Preceding the 12 frames of test tones, on channel 2, is the 6734 test tone location signal.

The top half of Figure 6 schematically shows the two audio channels 61 and 63 with a literal designation of the type of signal contained in each frame time period of each audio channel. The bottom half of Figure 6 is a drawing of the approximate waveforms of the signals identified in the upper half of Figure 6.

When the contents of the first segment of the audio test tone train is analyzed, phase, amplitude, signal-to-noise, and harmonic distortion measurements are taken. Since the two channels contain, for the durations of segments 2 and 3, one kilohertz on one channel simultaneously with DC (i.e., no signal) on the other channel, cross talk measurements from one channel to the other are taken during segments 2 and 3.

During segments 4 and 7, each channel contains a DC level, and thus noise level measurements are taken during these time slots.

A prescribed summation of 60HZ and 7KHZ tones is contained on segments 5 and 6, and when analyzed with appropriate test equipment indicate the intermodulation distortion level through the recording and playback process.

Finally, segments 8-12 contain audio tones continuously sweeping through a wide range of frequencies, i.e., from 20HZ to 20KHZ, and the

analysis of the recovered test tones in this area reflect the frequency response of the transfer characteristics.

For the purpose of this invention, the contribution to the electronics involved in the recording/playback process is considered negligible.

Turning now to Figure 7, a schematic diagram is shown which produces the audio test tones. A test tone generator and multiplexer 49 contains a plurality of function generators including a 6734 generator 73, a 1KHZ tone generator 75, a 60HZ tone generator 77, a 7KHZ tone generator 79, a sweep generator 81, and a DC source 83.

In the test tone recording process, upon command from the keyboard operator, an enabling signal over line 18 is routed to audio controller 21. The tape is rewound and put into play condition, whereupon the SMPTE code derived by the central controller 1 is loaded into lead-in location register 87 and sent over line 86 to comparator 91. As the tape progress in its play mode, a position detector 85 reads the SMPTE time code off the data channel tape recorder 11 and sends the detected position information over line 84 also to comparator 91. After enabling of the audio controller 21, the controller 21 interrogates comparator 91 for detection of correspondence between the present position detected by position detector 85 and the predetermined point at which lead-in test tone signals are to be applied, the latter location information taken from lead-in location register 87. When a comparison is found, an output of the comparator 91 over line 28 initiates the subsequent multiplexing action under control of audio controller 21. Basically, audio controller 21, over line 72, selectively, and at a video vertical repetition rate, enables one or two of the function generators feeding multiplexer 71. Multiplexer 71 then sums the outputs of the selected function generators, and outputs the desired combinations shown in Figure 6 over lines 76 and 78 to be routed to the input channels 1 and 2 of tape recorder 11.

Simultaneously with detection of the compare signal on line 28, audio controller 21 outputs a record enable signal on line 80 to tape recorder 11 in order to change the recorder from the play to the record mode so that the audio test tones will be deposited, in the fashion shown in Figure 6, on the separate audio channels.

Control of forward, reverse, play, and stop motions of the tape recorder 11 are effectuated under control of audio controller 21 over the lines in cable 133. Not shown in Figure 7 are communication links between the central controller 1, interface subsystem 3, and the audio test subsystem 5 which communicate the operator's keyboard commands to the audio controller for effectuating the various motion functions of the tape recorder 11. These are typical control communication paths which can be implemented in a variety of known ways.

A general block diagram of the audio analysis logic is shown in Figure 8. In the manner described in connection with Figure 3, both a disc

player 9 and a tape recorder/player 11 are shown connected to an audio selector 53 (the audio portion of audio and video selector 53) the two audio outputs of disc player 9 being carried by line 32, while the two channels out of the tape player 11 are carried by line 16. Channels 1 and 2 audio out of the audio selector 53 are carried on lines 58-1 (channel 1) and 58-2 (channel 2). It will be noted that only channel 2 audio is sent to the 6734 detector 41, consistent with the waveforms shown in Figure 6. The audio on line 58-1 enters A/D converter 37, is digitized thereby and sent over line 36 to the digitized test tones memory 33 for storage. Under command of the audio controller 21, a control and trigger signal on line 30 is effective to cause recirculate control 99-1 to recirculate a selected test tone segment in the digitized memory 33 and output that selected tone segment in a continuous manner over line 38 to D/A converter 39. The continuous representation of the selected test tone is then routed over line 46 to the audio signal analyzer 25 and lead-in/lead-out spectrum analyzer 27 as described briefly earlier. The outputs of the two analyzers 25 and 27 are routed over lines 48 and 50 to audio analysis memory 47. The memory unit 45 thereof has information written into it by memory write gates 44 which receive outputs from multiplexer 42 in a timed manner under control of audio controller 21 over line 30. Thus, all inputs to the multiplexer 42 are sequentially acted upon to be stored in memory unit 45 for later evaluation by the evaluation subsystem.

The analysis of the appropriate locations during lead-in and lead-out for recovering audio test tones to be analyzed is controlled by outputting a signal on line 28 from comparator 91 when the appropriate frame numbers during lead-in and lead-out have been detected. Whether the audio test subsystem is analyzing the tape or the disc, present position data is received over lines 34 and 118, respectively, by position detector 85. The present position is then routed over line 84 to comparators 95 and 91. Comparators 95 and 91 operate in similar manners, i.e., a desired tape or disc position is contained in location registers, and the contents of such registers is compared with the present position data to enable the audio controller 21 at coincidence thereof. In Figure 8, the two comparators 91 and 95 are shown separately, since they perform slightly different functions in carrying out the audio analyses.

That is, comparator 95 makes a comparison of the time code contained in the video information of the active program material so as to identify program start, program end, and various points along the program material content at which active audio and/or video tests are to be carried out. On the other hand, since there is no video contained in the lead-in and lead-out portions of a tape or disc, comparator 91 must rely upon SMPTE time code detection from either the data channel out or audio out signals of the tape and disc player.

After lead-in analysis has been accomplished,

the audio test subsystem proceeds to analyze active audio program material at predetermined time intervals during the active programming. Comparator 95 is thus provided with present position data from the vertical interval of the video signal, and location register 109, when matched with present position, outputs a program start signal to the audio controller 21 to ready the audio controller for subsequent active program analysis control. At the first predetermined location in the active program wherein audio is to be analyzed, location register 111 will have a position location match with present position from position detector 85, and comparator 95 will output an evaluate start signal over line 78 to audio controller 21. Control then of two additional audio analysis functions of the audio test subsystem commences under control of audio controller 21 over the control line generally designated at 30 in Figure 8.

The audio from both channels of the playback device exiting audio selector 53 enters active program two channel spectrum analyzer 43. Analyzer 43 contains two analyzer arrays, one for each of the audio channels. Since the audio to be analyzed during active program material is continuous, it is not necessary to digitize and recirculate audio segments in the multiprogrammer 23 as was necessary with the short segment duration test tones of the lead-in and lead-out portions of the tape or disc. Accordingly, the audio entering spectrum analyzer 43 is selected audio direct from the playback devices. Both arrays 113 and 115 of the spectrum analyzer 43 operate in identical fashion, i.e., a 45 second audio waveform from each audio channel is acquired and transformed into two frequency spectrum of 128 separate frequency points for each channel. Point spacing is in 200HZ increments, and each value analyzed at each point is expressed in decibels. The frequency spectrum for each sample represents a unique audio "print", and the 128 points for each channel have their values contained on lines 56 and 60, respectively, and these values are multiplexed with the other analyzer signals in multiplexer 42, and ultimately stored in memory unit 45.

Another part of the "signature", and therefore another input to multiplexer 42, is a signal on line 54 indicating whether or not the audio portion of the program is monophonic or non-monophonic. The signal is developed in the mono/non-mono signal check block 62. Channel 1 and channel 2 audio are received by block 62 over lines 58-1 and 58-2, respectively, these two signals being compared with each other in amplitude comparator 105. Mono/non-mono testing is performed at intervals throughout the active programs areas of the tape or disc. Each test consists of 65,536 measurements, the measurements being spaced one millisecond apart.

Block 62 illustrates a preferred embodiment of the mono/non-mono check in which the amplitudes of the two audio channels are continuously compared in comparator 105 with the

difference between the two audio channels being outputted on line 84. If the amplitudes are within 5% of each other, threshold detector 107 does not react to the signal on line 84, there is no output on line 86, and a 1KHZ clock 103 is applied over line 88 to the mono/non-mono counter 101. Without an input on line 86, i.e. the amplitudes of the audio on both audio channels are within 5% of one another, counter 101 is incremented by 1 count. One millisecond later, as determined by the pulse recurrent rate of 1KHZ clock 103, counter 101 is again incremented if the amplitudes are again within 5% of one another. This procedure continues in like manner until the measured amplitudes between the two audio channels are greater than 5% in difference, at which time threshold detector 107 outputs a step waveform on line 86 to inhibit counter 101 from incrementing one count. As a result, after counter 101 permits 65,536 clock pulses to increment or not increment the counter, the accumulated count is sent over line 54 to multiplexer 42 and stored in memory unit 45 by memory write gate 44 to become a part of the "signature" for the unit tested.

Obviously, in the printout of the analysis performed by the audio test subsystem, the greater the number count on line 54, i.e. the closer the accumulated count is to 65,536, the more definite it is that the two audio signals on the two audio channels are the same, i.e. the audio program is monophonic.

An alternate implementation of the mono/non-mono check block 62 is represented by the dotted line 88' from 1KHZ clock 103 to amplitude comparator 105. In this embodiment, the amplitude of the audio on the two channels 58-1 and 58-2 are not compared continuously, but rather are compared under the gating action of the 1KHZ clock, that is, a comparison is made every millisecond. Comparator 105 is then arranged such that, when the amplitudes of the signals of the two audio input lines 58-1 and 58-2 are within 5% of one another, an output pulse is routed to threshold detector 107 along line 84. The output of threshold detector 107 is then a step when the amplitudes on the two audio channels are within 5% of one another and DC when the amplitudes are greater than 5% of one another. Since comparator 105 is clocked at a 1KHZ rate, the maximum frequency step signal out of threshold detector 107 is also 1KHZ, and when a stereophonic or non-monophonic program is being and counter 101 is incremented fewer times. Again, assuming that amplitude comparisons are made in comparator 105 65,536 times, this embodiment of the mono/non-mono signal check merely counts the number of times that the amplitudes of the samples from the two audio channels are within a prescribed percentage tolerance of one another (5%) to provide information regarding whether or not the signals on the two channels are substantially similar in informational content.

Figure 9 shows an "evaluate start" pulse at the

beginning of program material, and as a result, the count from counter 101 (Figure 8) begins to be accumulated. Waveform 100a shows a plurality of counts occurring at a 1KHZ rate, and assuming that a theoretical monophonic signal has been recorded in both audio channels 1 and 2, most, or all of the 65,536 samplings are shown to exist, thereby indicating the presence of a monophonic program on the two audio channels. On the other hand, waveform 100b illustrates the effect of acquiring and analyzing a non-monophonic audio program on the two channels, and only occasional 1KHZ pulses are present to be accumulated, and the scarcity of counter pulses will accumulate, after 65,536 seconds, to a small number indicating the existence of a non-monophonic program on the two audio channels. It should be appreciated that, due to spacial limitations, the pulses indicated at 102a and 102b of waveforms 100a and 100b, respectively, are only schematic representations of the actual waveforms when viewed on an oscilloscope.

Audio controller 21, over line 80, creates waveform 104 having "save accumulated count and clear counter" pulses 106 applied to mono/non-mono counter 101 so as to output the accumulated count over line 54 to be analyzed by audio analysis memory 47, having reference again to Figure 8.

Claims

1. A method of establishing the characteristics of a program of recorded analog audio signal information previously recorded on two channels of a recording medium, comprising the steps of:
sampling the amplitude of audio information contained on each of said two channels of the recorded program simultaneously;

comparing said amplitudes of said information sampled from one channel with said amplitudes of information occurring simultaneously with that sampled from the other channel; and

counting the number of times that the amplitudes of the samples from the two channels are within a prescribed percentage tolerance of one another to provide information regarding whether or not the signals on the two channels are substantially similar in informational content.

2. The method as claimed in Claim 1, wherein said comparing step includes:

continuously comparing the amplitude of information from one of said channels with that of the other of said channels;

clocking at regular intervals the comparison results between the two channels of information; and

wherein said counting step includes:

counting the successful comparisons for which the two channels of information are within said prescribed percentage tolerance; and

outputting a total tabulation of the number of counts, whereby after a fixed number of comparisons, the number of successful counts gives an indication as to whether or not the signals on the

two channels are substantially similar in information content.

3. Apparatus for establishing the characteristics of a program of recorded analog audio signal information previously recorded on two channels of a recording medium, comprising:

means (53) for sampling the amplitude of audio information contained on both channels of the recorded program simultaneously;

comparison means (105, 107) for comparing said amplitudes of said sampled information from one channel with said amplitudes of sampled information occurring simultaneously with and sampled from the other channel; and

a counter (101) for counting the number of times that the amplitudes of the samples from the two channels are within a prescribed percentage tolerance of one another to provide information regarding whether or not the signals on the two channels are substantially similar in informational content.

4. The apparatus as claimed in Claim 3, wherein said comparison means (105, 107) includes:

means for continuously comparing the amplitude of information from one of said channels with that of the other of said channels; and

timing means (103) for clocking at regular intervals the comparison results between the two channels of information; and

said counter includes:

means (101) for counting the successful comparisons for which the two channels of information are within said prescribed percentage tolerance;

output means for outputting a total tabulation of the number of counts; and

means for indicating, after a fixed number of comparisons, the number of successful counts, thereby indicating as to whether or not the signals on the two channels are substantially similar in informational content.

Patentansprüche

1. Ein Verfahren zur Ermittlung der Kenndaten eines Programms aus aufgezeichneter Analog-Audiosignalsinformation, die früher auf zwei Kanälen eines Aufzeichnungsmediums aufgezeichnet wurde, in dem die Schritte enthalten sind:

gleichzeitiges Abtasten der Amplitude der Audioninformation, die auf jedem der beiden Kanäle des aufgezeichneten Programms enthalten ist;

Vergleichen der Amplituden der Information, die in einem Kanal abgetastet wurde, mit den Informationsamplituden, die gleichzeitig mit denen auftreten, die im anderen Kanal abgetastet wurden; und

Zählen der Häufigkeit, mit der die Amplituden der Abtastwerte von beiden Kanälen innerhalb eines vorbestimmten Toleranzbereichs voneinander liegen, um Information zu erzeugen, die angibt, ob die Signale auf beiden Kanälen im



beginning of program material, and as a result, the count from counter 101 (Figure 8) begins to be accumulated. Waveform 100a shows a plurality of counts occurring at a 1KHZ rate, and assuming that a theoretical monophonic signal has been recorded in both audio channels 1 and 2, most, or all of the 65,536 samplings are shown to exist, thereby indicating the presence of a monophonic program on the two audio channels. On the other hand, waveform 100b illustrates the effect of acquiring and analyzing a non-monophonic audio program on the two channels, and only occasional 1KHZ pulses are present to be accumulated, and the scarcity of counter pulses will accumulate, after 65,536 seconds, to a small number indicating the existence of a non-monophonic program on the two audio channels. It should be appreciated that, due to spacial limitations, the pulses indicated at 102a and 102b of waveforms 100a and 100b, respectively, are only schematic representations of the actual waveforms when viewed on an oscilloscope.

Audio controller 21, over line 80, creates waveform 104 having "save accumulated count and clear counter" pulses 106 applied to mono/non-mono counter 101 so as to output the accumulated count over line 54 to be analyzed by audio analysis memory 47, having reference again to Figure 8.

Claims

1. A method of establishing the characteristics of a program of recorded analog audio signal information previously recorded on two channels of a recording medium, comprising the steps of:
sampling the amplitude of audio information contained on each of said two channels of the recorded program simultaneously;

comparing said amplitudes of said information sampled from one channel with said amplitudes of information occurring simultaneously with that sampled from the other channel; and

counting the number of times that the amplitudes of the samples from the two channels are within a prescribed percentage tolerance of one another to provide information regarding whether or not the signals on the two channels are substantially similar in informational content.

2. The method as claimed in Claim 1, wherein said comparing step includes:

continuously comparing the amplitude of information from one of said channels with that of the other of said channels;

clocking at regular intervals the comparison results between the two channels of information; and

wherein said counting step includes:

counting the successful comparisons for which the two channels of information are within said prescribed percentage tolerance; and

outputting a total tabulation of the number of counts, whereby after a fixed number of comparisons, the number of successful counts gives an indication as to whether or not the signals on the

two channels are substantially similar in information content.

3. Apparatus for establishing the characteristics of a program of recorded analog audio signal information previously recorded on two channels of a recording medium, comprising:

means (53) for sampling the amplitude of audio information contained on both channels of the recorded program simultaneously;

comparison means (105, 107) for comparing said amplitudes of said sampled information from one channel with said amplitudes of sampled information occurring simultaneously with and sampled from the other channel; and

a counter (101) for counting the number of times that the amplitudes of the samples from the two channels are within a prescribed percentage tolerance of one another to provide information regarding whether or not the signals on the two channels are substantially similar in informational content.

4. The apparatus as claimed in Claim 3, wherein said comparison means (105, 107) includes:

means for continuously comparing the amplitude of information from one of said channels with that of the other of said channels; and

timing means (103) for clocking at regular intervals the comparison results between the two channels of information; and

said counter includes:

means (101) for counting the successful comparisons for which the two channels of information are within said prescribed percentage tolerance;

output means for outputting a total tabulation of the number of counts; and

means for indicating, after a fixed number of comparisons, the number of successful counts, thereby indicating as to whether or not the signals on the two channels are substantially similar in informational content.

Patentansprüche

1. Ein Verfahren zur Ermittlung der Kenndaten eines Programms aus aufgezeichneter Analog-Audiosignalsinformation, die früher auf zwei Kanälen eines Aufzeichnungsmediums aufgezeichnet wurde, in dem die Schritte enthalten sind:

gleichzeitiges Abtasten der Amplitude der Audioninformation, die auf jedem der beiden Kanäle des aufgezeichneten Programms enthalten ist;

Vergleichen der Amplituden der Information, die in einem Kanal abgetastet wurde, mit den Informationsamplituden, die gleichzeitig mit denen auftreten, die im anderen Kanal abgetastet wurden; und

Zählen der Häufigkeit, mit der die Amplituden der Abtastwerte von beiden Kanälen innerhalb eines vorbestimmten Toleranzbereichs voneinander liegen, um Information zu erzeugen, die abgibt, ob die Signale auf beiden Kanälen im



Informationsgehalt im wesentlichen ähnlich sind oder nicht.

2. Das Verfahren nach Anspruch 1, in dem der Vergleichsschritt enthält:

laufendes Vergleichen der Informationsamplitude von einem der Kanäle mit der des anderen Kanals;

Takten der Vergleichsergebnisse zwischen beiden Informationskanälen in regelmäßigen Zeitintervallen; und

in dem der Zählschritt enthält:

Zählen der erfolgreichen Vergleiche, bei denen die beiden Informationskanäle innerhalb des vorgeschriebenen Prozenttoleranzbereichs liegen; und

Ausgeben einer Gesamttabelle der Anzahl von Zählungen, so daß nach einer festen Anzahl von Vergleichen die Anzahl der erfolgreichen Zählungen einen Hinweis darauf gibt, ob die Signale auf beiden Kanälen im Informationsgehalt im wesentlichen ähnlich sind oder nicht.

3. Einrichtung zur Ermittlung der Kenndaten eines Programms aufgezeichneter Analog-Audiosignalinformation, die auf zwei Kanälen eines Aufzeichnungsmediums früher aufgezeichnet wurde, in der enthalten sind:

Vorrichtung (53) zum gleichzeitigen Abtasten der Amplitude der Audioinformation, die in beiden Kanälen das aufgezeichnete Programm enthalten ist;

Vergleichsvorrichtungen (105, 107) zum Vergleichen der Amplituden der abgetasteten Information von einem Kanal mit den Amplituden der abgetasteten Information die gleichzeitig bei der Abtastung des anderen Kanals auftreten; und

ein Zähler (101) zum Zählen der Häufigkeit, mit der die Amplituden der Abtastwerte von beiden Kanälen innerhalb eines vorbestimmten Prozenttoleranzbereichs voneinander liegen, um Information zu erzeugen, die angibt, ob die Signale auf beiden Kanälen im Informationsgehalt im wesentlichen ähnlich sind oder nicht.

4. Die Einrichtung nach Anspruch 3, bei der die Vergleichsvorrichtungen (105, 107) enthalten:

Vorrichtungen zum laufenden Vergleich der Informationsamplitude eines Kanals mit der des anderen Kanals; und

Zeitgebervorrichtungen (103) zum Takten der Vergleichsergebnisse zwischen den beiden Informationskanälen zu regelmäßigen Zeitintervallen; und

bei der der Zähler enthält:

Vorrichtungen (101) zum Zählen der erfolgreichen Vergleiche, bei denen die beiden Informationskanäle innerhalb des vorgeschriebenen Prozenttoleranzbereichs liegen;

Ausgabevorrichtungen zum Ausgeben einer Gesamttabelle der Anzahl von Zählungen; und

Vorrichtungen zur Anzeige der Anzahl erfolgreicher Zählungen nach einer festen Anzahl von Vergleichen, um damit anzuzeigen, ob die Signale auf beiden Kanälen im Informationsgehalt im wesentlichen ähnlich sind oder nicht.

Revendications

1. Un procédé d'établir les caractéristiques d'un programme d'information d'un signal audio analogique enregistré préalablement enregistré sur deux canaux d'un milieu d'enregistrement, comprenant les étapes de:

échantillonner l'amplitude de l'information audio contenue dans chacun desdits deux canaux du programme enregistré simultanément;

comparer lesdites amplitudes de ladite information échantillonnée d'un canal auxdites amplitudes de l'information se produisant simultanément avec celles échantillonnées de l'autre canal; et

compter le nombre de fois que les amplitudes des échantillons des deux canaux sont dans une tolérance de pourcentage prescrite de l'un de l'autre pour produire une information considérant si oui ou non les signaux sur les deux canaux sont sensiblement similaires en contenu d'information.

2. Le procédé selon la revendication 1, où l'étape précitée de comparaison comprend:

comparer continuellement l'amplitude d'information de l'un des canaux précités avec celle de l'autre desdits canaux;

cadencer à des intervalles réguliers les résultats de comparaison entre les deux canaux d'information; et

où l'étape précitée de comptage comprend:

compter les comparaisons couronnées de succès pour lesquelles les deux canaux d'information sont à l'intérieur de la tolérance de pourcentage prescrite précitée; et

produire un tableau total du nombre de comptes, ainsi après un nombre fixe de comparaisons le nombre de comptes couronnés de succès donne une indication si oui ou non les signaux sur les deux canaux sont sensiblement similaires en contenu d'information.

3. Dispositif pour établir les caractéristiques d'un programme d'information d'un signal audio analogique enregistré préalablement enregistré sur deux canaux d'un milieu d'enregistrement, comprenant:

un moyen (53) pour échantillonner l'amplitude de l'information audio contenue dans les deux canaux du programme enregistré simultanément;

un moyen de comparaison (105, 107) pour comparer lesdites amplitudes de ladite information échantillonnée d'un canal aux amplitudes de l'information échantillonnée se produisant simultanément avec et échantillonnée de l'autre canal; et

un compteur (101) pour compter le nombre de fois que les amplitudes des échantillons des deux canaux sont à l'intérieur d'une tolérance de pourcentage prescrite de l'un de l'autre pour produire une information considérant si oui ou non les signaux sur les deux canaux sont sensiblement similaires en contenu d'information.

4. Dispositif selon la revendication 3, où le moyen de comparaison précité (105, 107) comprend:



17

0 113 425

18

un moyen pour comparer continuellement l'amplitude d'information de l'un des canaux précités avec celle de l'autre des canaux précités; et

un moyen de temporisation (103) pour cadencer à des intervalles réguliers les résultats de comparaison entre les deux canaux d'information; et

le compteur précité comprend:

un moyen (101) pour compter les comparaisons

couronnées de succès pour lesquelles les deux canaux d'information sont à l'intérieur de la tolérance de pourcentage prescrite précitée;

un moyen de sortie pour produire une table totale du nombre de comptes; et

un moyen pour indiquer, après un nombre fixe de comparaisons, le nombre de compte couronnés de succès, indiquant ainsi si oui ou non les signaux sur les deux canaux sont sensiblement similaires en contenu d'information.

15

20

25

30

35

40

45

50

55

60

65

10