

AUTOMATIC TRACKING METHOD FOR A TAPE RECORDER

This invention relates to automatic tracking in a tape recorder.

5 In Figure 1 of the accompanying diagrammatic drawings, a block diagram of a general tracking control device in a video tape recorder (VTR) system is schematically illustrated, wherein a program contained in a system controller 6 generates tracking data TRDT to a servo 7 and then, the servo 7 provides a deck 1 with a capstan control signal CAP-CTL in accordance with the tracking data TRDT, so as to control the rotational speed of a capstan. Then, a head in the deck 1 picks up a tracking level indicative of the current tracking state according to the rotational speed of the capstan and provides the tracking level data to the system controller 6, thereby to sustain an optimized tracking level by comparing the instantaneous tracking levels with each other.

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Referring to Figures 2A to 2D of the accompanying diagrammatic drawings, there is shown a conventional automatic tracking method performed by the VTR system of Figure 1, which is disclosed in Korean Patent application No. 89-19419. According to this conventional method, the system controller 6 having an analog-to-digital converter therein executes the automatic tracking as shown in Figures 2A to 2D. However, when such an automatic tracking method is employed, on some occasions the system controller 6 may misrecognize a variation value of the tracking levels picked up by the head and/or may result in a mal-operation because the automatic tracking operation depends simply on a comparison of the tracking levels by means of the system controller 6. Therefore, occasionally, a noisy video signal may be misrecognized for a noise-free video signal particularly when

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a worn-out video tape is used, and thus the tracking level may be miscalculated, thereby resulting in deteriorated automatic tracking.

Preferred embodiments of the present invention aim to provide a method for detecting an optimized, accurate tracking level in a VTR system so as to sustain automatically a good picture quality.

Another aim is to provide an automatic tracking method for always sustaining a good picture quality in a VTR system, regardless of the condition of a video tape quality.

According to a first aspect of the present invention, there is provided an automatic tracking method comprising the steps of:

generating a plurality of first tracking data sets each having corresponding first digital tracking level values, and storing said first digital level values in a memory;

determining whether said first digital tracking level values are steadily increasing;

if said first digital tracking level values are steadily increasing, increasing repeatedly said tracking data by predetermined steps each having corresponding second digital tracking levels, storing the corresponding second digital tracking levels in the memory, and comparing a current digital tracking level value from said second digital tracking levels with a preceding tracking level value, so as to set the tracking data corresponding to said preceding tracking level value for output tracking data if said current digital tracking

level value from said second digital tracking levels is lower than said preceding tracking level value;

5 if said first digital tracking level values are not steadily increasing in said first tracking data generation step, generating a plurality of second tracking data sets each having corresponding third digital tracking levels, and storing the third digital tracking levels in a memory;

10 determining whether said third digital tracking level values are steadily increasing;

15 if said third digital tracking levels are steadily increasing in said second tracking data generation step, decreasing repeatedly said tracking data by predetermined steps each having corresponding fourth digital tracking levels, storing the corresponding fourth digital tracking levels in the memory, and comparing a current digital tracking level value from said fourth digital tracking levels with a preceding tracking level value, so as to set the tracking data corresponding to said preceding tracking level value for output tracking data if said current digital tracking level value from said fourth digital tracking levels is lower than said preceding tracking level value; and

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25 if said second digital tracking levels are not steadily increasing in said second tracking data generation step, comparing entire tracking level values stored in said memory in the preceding steps so as to detect therefrom the highest tracking level value and tracking data corresponding thereto, said detected tracking data being set for output tracking data.

According to another aspect of the present invention, there is provided an automatic tracking method for a tape recorder, the method comprising the steps of generating and applying a series of tracking data sets, measuring and storing the resultant tracking levels, monitoring variation of tracking level,
5 detecting therefrom a highest tracking level, and outputting corresponding tracking data to set said highest tracking level for output tracking data.

The invention extends also to a tape recorder (e.g. a video tape recorder) having a system controller adapted to perform an automatic tracking
10 method according to any of the preceding aspects of the invention.

For a better understanding of the invention and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying diagrammatic drawings, in which:
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Figure 1 is a block diagram of one example of a general tracking control device in a VTR system to which the present invention may be applied;

20 Figures 2A to 2D are flow charts of a conventional automatic tracking method as mentioned above;

Figures 3A to 3D are flow charts of one example of an automatic tracking method according to the present invention; and
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Figure 4 shows examples of tracking level curves with respect to tracking data, in a method as illustrated in Figures 3A to 3D.

With reference to Figures 3A to 3D, in steps 301 through 306, n (preset tracking data), $(n+4)$, $(n+8)$, $(n+12)$ and $(n+16)$ tracking data are sequentially generated by the system controller 6. For each tracking data, tracking level values S_1 , S_2 , S_3 , S_4 , and S_5 (see Figure 4) are consecutively stored in a memory after a lapse of 0.1 second, each time. Then, whether the tracking level values are in the order of $S_1 < S_2 < S_3 < S_4 < S_5$ is checked, so as to detect therefrom variation of the tracking level.

If the tracking levels are increasing such as $S_1 < S_2 < S_3 < S_4 < S_5$, the tracking data are also increased by the system controller 6 by $(n+4k)$, where $k = 5, 6, 7, \dots, 20$, and then a current tracking level detected according thereto is compared with a preceding tracking level. As a result, if the current tracking level is lower than the preceding tracking level, then the preceding tracking data is set for the output tracking data (see steps 308 through 319).

However, if the tracking level values decrease such as $S_1 > S_2 > S_3 > S_4 > S_5$ in the step 307, then $(n-4)$, $(n-8)$, $(n-12)$, and $(n-16)$ tracking data are generated in sequence. For each tracking data, the tracking level values S_6 , S_7 , S_8 , and S_9 are stored in the memory after a lapse of 0.1 second, each time. Thereafter, whether the tracking level values are in the order of $S_6 < S_7 < S_8 < S_9$ is checked, so as to detect therefrom variation of the tracking level (see steps 320 through 326).

Thereafter, if the tracking level increases such as $S_6 < S_7 < S_8 < S_9$, the tracking data are decreased by the system controller 6 by $(n-4k)$, where $k = 5, 6, 7, \dots, 20$, and then the current tracking level detected according thereto is compared with a preceding tracking level. As a result, if the

current tracking level is lower than the preceding tracking level, then the preceding tracking data is set for the output tracking data (see steps 327 through 339').

5 However, if the tracking level values decrease such as $S_6 > S_7 > S_8 > S_9$ in the step 326, then the highest tracking level out of the tracking level values S_1 through S_9 each from the memory is set for the output tracking data (see the steps 339 and 340).

10 Referring to Figure 4, showing tracking level values with respect to the respective tracking data, a reference "A" represents the highest tracking level value, detected during the steps 308 through 319; a reference "B" represents the highest tracking level value, detected during the steps 327 through 339'; and a reference "C" represents the highest tracking level value, detected
15 during the steps 339 through 340.

Referring back to Figures 1 to 4, an example of operation of an embodiment of the present invention will now be described in more detail.

20 With respect to the steps 301 to 306, the system controller 6 sets a variable k to zero in the step 301, and generates $n+k$ initial preset tracking data in the step 302. In this case, the $n+k$ ($=n$, since $k=0$) preset tracking data is supplied to the servo 7 together with a clock CK. Then, the servo 7 generates a capstan control signal CAP-CTL to the deck 1 according to the
25 tracking data so as to control the capstan. As a result, the capstan in the deck 1 rotates to run the tapes and at the same time, a signal is read out from the tapes. Being very weak, this signal is preliminarily amplified by a preamplifier 2. Of various signals, the only signals required for tracking

control are selected by means of a peaking process and amplified, up to or over 1V, by an amplifier 4. These amplified signals are integrated by the integrator 5. The integrated signals are the tracking level and are applied to the analog-to-digital converter in the system controller 6, thereby to generate
5 a digital tracking level value S_1 ($k=0$; $S_{(4+k)/4} = S_1$).

0.1 second after the generation of n tracking data in the step 302, the system controller 6 stores the tracking level value S_1 into the memory. Consecutively, the system controller 6 checks whether the variable k is equal
10 to 16 in the step 305. In this case, however, since the variable k is zero, the system controller 6 proceeds to the step 306.

In the meantime, the system controller 6 generates the next $n+k$ tracking data and then, after the lapse of 0.1 second therefrom, stores in the
15 memory, the tracking level value S_2 ($k=4$; $S_{(4+k)/4} = S_2$) for the $n+4$ tracking data.

In the above way, the system controller 6 repeats the steps 302 through 306 so as to generate the digital tracking level values S_1, S_2, S_3, S_4, S_5 for the
20 respective $n, n+4, n+8, n+12, n+16$ tracking data, the above digital tracking level values being stored in the memory sequentially. In the meantime, if the variable k reaches sixteen (i.e. $k=16$), the system controller 6 will proceed to the step 307 and analyze the tracking level values S_1, S_2, S_3, S_4, S_5 to determine whether they are in the order of $S_1 < S_2 < S_3 < S_4 <$
25 S_5 . If the tracking level values are increasing as such, the system controller 6 proceeds to the step 308.

During the steps 308 through 319, if the tracking level values for the respective tracking data increasing sequentially by four steps are decreasing at a certain point, as shown with reference to curve 401 of Figure 4, the system controller 6 determines, as the highest tracking level value, the tracking data preceding the current tracking data. This procedure has been expanded with respect to that of the prior art so that the tracking level may be more precisely determined.

In the step 307, if the tracking level values are not increasing, then the system controller 6 proceeds to the step 320 and sets a variable L to four (i.e. $L=4$). In the meanwhile, the system controller 6 generates n-L (i.e. n-4) tracking data in the step 321 and stores in the memory a digital tracking level value $S_{(20+L)/4}$ (i.e. S_6) for the digital tracking data n-4, in the step 323. In practice, the tracking level value S_6 is produced such that a tracking envelope signal output from the head in the deck 1 is processed through the preamplifier 2, peaking circuit 3, amplifier 4, integrator 5, and analog-to-digital converter in the system controller 6. Thereafter, whether the variable L is equal to sixteen (i.e. $L=16$) is checked in the step 324. As a result, if the variable L is not equal to sixteen, the system controller 6 proceeds to the step 325, so as to increase the variable L by four and to repeat the above steps 321 to 324. In this way, the system controller 6 generates n-4, n-8, n-12 and n-16 tracking data and stores the digital tracking level values S_6 , S_7 , S_8 and S_9 for the above respective tracking data. In the meantime, if the tracking level values are in the order of $S_6 < S_7 < S_8 < S_9$, the system controller 6 proceeds to the step 327.

In the steps 327 to 339', if the tracking level values for the respective tracking data decreasing sequentially by four steps are decreasing at a certain

point, as shown with reference to curve 402 of Figure 4, the system controller 6 determines, as the highest tracking level value, the tracking data preceding the current tracking level value. In this way, the system controller 6 compares the tracking level values, thereby to determine the highest tracking level. Then, the system controller 6 sets the output tracking data to the digital data corresponding to the above highest digital tracking level value, thereby always sustaining an optimized tracking condition.

However, in the step 326, if the tracking level values are not in the order of $S_6 < S_7 < S_8 < S_9$, then the system controller 6 proceeds to the step 339 to compare the tracking level values $S_1 - S_9$ stored in the memory in the above steps so as to detect therefrom the highest tracking level value. In the step 340, the system controller 6 sets the tracking data corresponding to the above highest tracking level value for the output tracking data.

A particular feature of the above-described method are the steps 339 and 340 in which the highest tracking level value can be detected even though the tracking level values are irregularly changed as shown with reference to curves 403 and 404 of Figure 4.

The above-described examples of the present invention monitors the variation of the tracking level so as always to detect therefrom the highest tracking level. Then, the tracking data corresponding to the highest tracking level value is set for the output tracking data, thereby always sustaining the best optimized tracking condition.

CLAIMS

1. An automatic tracking method comprising the steps of:

5 generating a plurality of first tracking data sets each having corresponding first digital tracking level values, and storing said first digital level values in a memory;

10 determining whether said first digital tracking level values are steadily increasing;

if said first digital tracking level values are steadily increasing, increasing repeatedly said tracking data by predetermined steps each having corresponding second digital tracking levels, storing the corresponding second
15 digital tracking levels in the memory, and comparing a current digital tracking level value from said second digital tracking levels with a preceding tracking level value, so as to set the tracking data corresponding to said preceding tracking level value for output tracking data if said current digital tracking level value from said second digital tracking levels is lower than said
20 preceding tracking level value;

if said first digital tracking level values are not steadily increasing in said first tracking data generation step, generating a plurality of second tracking data sets each having corresponding third digital tracking levels, and
25 storing the third digital tracking levels in a memory;

determining whether said third digital tracking level values are steadily increasing;



if said third digital tracking levels are steadily increasing in said second tracking data generation step, decreasing repeatedly said tracking data by predetermined steps each having corresponding fourth digital tracking levels, storing the corresponding fourth digital tracking levels in the memory, and
5 comparing a current digital tracking level value from said fourth digital tracking levels with a preceding tracking level value, so as to set the tracking data corresponding to said preceding tracking level value for output tracking data if said current digital tracking level value from said fourth digital tracking levels is lower than said preceding tracking level value; and

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if said second digital tracking levels are not steadily increasing in said second tracking data generation step, comparing entire tracking level values stored in said memory in the preceding steps so as to detect therefrom the highest tracking level value and tracking data corresponding thereto, said
15 detected tracking data being set for output tracking data.

2. An automatic tracking method for a tape recorder, the method comprising the steps of generating and applying a series of tracking data sets, measuring and storing the resultant tracking levels, monitoring variation of
20 tracking level, detecting therefrom a highest tracking level, and outputting corresponding tracking data to set said highest tracking level for output tracking data.

3. A method substantially as hereinbefore described with reference to
25 Figures 3A to 3D of the accompanying drawings.

4. A tape recorder having a system controller adapted to perform an automatic tracking method according to any of the preceding claims.



5. A tape recorder according to claim 4, being a video tape recorder.



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