

METHOD TO DETERMINE ENCROACHMENT AT SPIN STAND

Field of the Invention

5 The present invention relates generally to the manufacture and testing of disc drives. More particularly, the present invention relates to a method of assessing encroachment.

Background of the Invention

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 A typical disc drive includes at least one head made up of a writer configured to record data to a disc surface and a reader to retrieve data from the disc surface. The disc surface is usually formatted with concentric tracks for data storage. When the disc is rotated, holding the writer at a more or less
15 fixed position adjacent to the disc surface allows the writer to write data along a track. To write to another track, the writer is repositioned at another radial position relative to the disc surface. Read operations involve similar positioning of the reader and rotation of the disc surface.

 It is generally found that as a writer writes data along one track, it will
20 at the same time have an erasure effect on the tracks immediately adjacent to that track, thereby creating erase bands that run alongside that track. Various techniques are used to measure erase band widths, of which the "747" test is but one example. The "747" test involves writing two tracks (a test track and a squeeze track) at different distances apart. For each squeeze track distance
25 apart, measurement of the off track capability is taken at the test track with a background noise presence. Plotting the off track capability against an increasingly closer squeeze track, the off track capability is observed to



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writing two tracks as a head travels in a substantially circumferential track-wise direction with respect to a disc, reading pre-erasure data from the disc as the head travels along a scan path, performing a direct current erase as the head travels between the two tracks in the track-wise direction, reading post-
5 erasure data from the disc as the head travels along the scan path, and extracting a measure of encroachment from the pre-erasure data and the post-erasure data. The head is set at a skew angle to the track-wise direction and the two tracks are defined as being an adjacent track distance apart. The scan path is in a cross-track direction that is substantially parallel to a radius of the
10 disc.

The measure of encroachment is given by $TSL \times TEW / BW$, and where TSL is a total signal loss, TEW is a total erasure width and BW is a baseline width. In addition, a relationship between the measure of encroachment and the adjacent track distance may be established.

15 In addition, there is provided a disc drive having at least one disc and at least one head operably connected to the at least one disc for writing data to and reading data from the at least one disc, and the at least one head has been assessed by the method described in the foregoing.

20 Thus, the present invention not only provides for the measurement of encroachment, it further allows for measurement of far track encroachment without the need for additional procedures or expensive modifications to currently available equipment. In this and other ways, the present invention provides practical improvement to the manufacturing process of disc drives as well as of disc drive components.

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Brief Description of the Drawings

FIG. 1 is an exploded perspective view of a disc drive.

FIG. 2 is a partial schematic illustration of a writer at a skewed condition relative to tracks on a disc, showing the geometric relations between the writer and the track pitch.

FIG. 3 is a functional block diagram of a spin stand.

5 FIG. 4, 5 and 6 is a flowchart illustrating a method according to an embodiment of the present invention.

FIG. 7 is a diagrammatic presentation of the position of tracks written in accordance with the method of FIG. 4.

10 FIG. 8 shows signal amplitude versus displacement plotted using data collected using the method of FIG. 4.

FIG. 9 shows a track profile of the head used in the method of FIG. 4.

FIG. 10 shows a signal amplitude versus displacement plot for another test configuration.

15 FIG. 11 shows encroachment impact versus adjacent track distance.

Detailed Description

Referring to FIG. 1, a disc drive 100 includes a base plate 102 and a
20 cover 104 forming an enclosure within which various components are assembled. A gasket 106 is sometimes provided for improving the seal between the cover 104 and the base plate 102. Mounted to the base plate 102 is a spindle motor 108 for rotating one or more discs 110 about an axis of rotation, each of which has at least one disc surface 112 formatted in
25 nominally concentric tracks 114 for data storage. Each disc 110 is defined by an outer diameter 113 (FIG. 3) and an inner diameter 115 (FIG. 3). One or more heads (designated generally here by 116 but to be understood to each include a writer 117 and a reader 118) are located at distal ends of one or more

suspensions 119 that are in turn supported by an actuator 120 that is also mounted to the base plate 102. Control circuitry, generally found on a printed circuit board 122 attached to the base plate 102 or affixed to the actuator 120, enables a voice coil motor 124 to control the rotational movement of the
5 actuator 120, and thereby bring the heads 116 into proximity with the disc surfaces 112 and locate the heads 116 at desired radial positions. Data and control signals are routed by a flex circuit 126 between the heads 116, the voice coil motor 124 and the printed circuit board 122.

In many disc drive configurations, the use of zone-bit recording and
10 other schemes to maximize the utilization of the disc surface requires the head 116 to be skewed with respect to the tracks 114 for much of the disc surface 112. FIG. 2 shows a writer 117 to include a top pole 130 that is separated from a notch 132 by a writer gap 134. In this example, the top pole length (TPL) 136 is designed to be 1.5 micrometer (μm) and the top pole write gap (TPWG) 138
15 is designed to be 0.35 μm . Supposing that the skew angle 140 of the writer 128 needs to be set at 18.28 degrees, relative to a tangent 142 of the track, and that the track pitch is about 17.2 micro-inch (μ''), it can be seen from equation (1) below that the writer 117 may be expected to have an influence across a width of about 1.1 tracks.

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$$(1.5\mu\text{m TPL}) * \sin(18.28 \text{ skew}) = 0.47\mu\text{m} = 18.8\mu'' = 1.1 \text{ tracks} \quad \text{--- (1)}$$

The magnetic field 152, 154, 156 from the edges 146, 148, 150 of the top pole 130 would extend further than the actual top pole and, as shown in equation
25 (2) below, would have a wider range of impact on adjacent tracks 158, 160, 162 beyond the track 164 at which the writer 117 is intended to be located.

$$(1.5\mu\text{m TPL}) * \sin(18.28 \text{ skew}) + 0.35\mu\text{m} / 2 * \cos(18.28 \text{ skew})$$

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$$= 0.63\mu\text{m} = 25.5\mu'' = 1.5 \text{ tracks} \quad \text{--- (2)}$$

In this example, the top corner 166 of the writer 117 may extend as much as one and a half tracks away from the writer gap 134. This would at least in part
5 account for the partial reversal of data in the tracks 160, 162 adjacent (or near to) the particular track 164 to which the writer 117 is writing, resulting in encroachment, or more specifically, encroachment at adjacent tracks.

In addition, it is found through the application of finite element modeling techniques that a stray magnetic field from the top corner 166 of the
10 writer 117 may be strong enough to partially encroach or erase data written on adjacent tracks 160, 162 and far adjacent tracks 168, 170. This occurrence is referred to as far track encroachment. That is to say, among the various factors that contribute towards encroachment (which would include encroachment at the adjacent tracks and far track encroachment) there is at least one factor that
15 is less predictable and not easily modeled. Embodiments of the present invention overcome this difficulty by providing a novel method for the measurement of encroachment.

A method 171 (FIG. 4) of determining encroachment in accordance with an embodiment of the present invention is described in the following in the
20 context of a spin stand 172, that is, at a stage of manufacture before the heads 116 are assembled to the rest of the components of the disc drive 100. A functional block diagram of a spin stand 172 such as one that may be used in conjunction with the present invention is shown in FIG. 3. A spin stand motor 174 allows for the mounting and rotation of a disc 110. A support 176 is
25 adapted for positioning an actuator 120 and suspension 119 assembly bearing a head 116 in proximity to the disc surface 112. A servo system 184 made up of a combination of hardware and software is used to eliminate thermal expansion effects of the suspension 119, the disc 110, and the spin stand

mechanical parts (such as support 176 and actuator 120). A user input module 180 allows a user to set parameters such as the speed of the spin stand motor 174. The user input module is operably connected to a controller 178 via circuitry 182. The controller 178 may incorporate part of the servo system 184.

5 Instructions to carry out a method of the present invention is embodied or carried in the controller 178, which may also be used to analyze the data collected and cause an output module 186 to provide the results of analysis to the user. Alternatively, the controller 178, the servo system 184, the output module 186, and the user input module 180 may be replaced by a host
10 computer system adapted to execute program instructions to perform a method 171 according to the present invention.

Referring to FIG. 4, the process 171 begins at step 200 where at the spin stand a skew angle is defined for the head under assessment at step 202. A larger skew angle 140 may be used when it is desired for the encroachment
15 impact to be enhanced to facilitate analysis. Alternatively, the skew angle 140 may be set according to the design requirements of the particular disc drive 100. Servo bursts required for guiding all subsequent head movement are written at step 204 for a chosen range, or for a chosen number of tracks, on the disc surface to provide reference points to help keep the head on-track in
20 subsequent operations. This may include the application of known servo systems 184 to compensate for thermal drift in the spin stand.

At step 206, the head is used to perform a whole track direct current (DC) band erase on a disc surface to create a clean area for the following operations. Next, a left track and a right track are written at a predetermined
25 write current and for the same periodic frequency pattern at steps 208, 210.

Referring now to FIG. 7, the left track 250 and the right track 252 are written so that they are separated by an adjacent track distance 254, measured from the center of the left track 250 and the center of the right track 252. The

left track 250 is written in a track-wise direction 261 and the right track 252 has been similarly written in the track-wise direction 261.

Varying the adjacent track distance 254 each time the process 171 is carried out would allow the user to determine the encroachment impact at
5 different distances away from the writer. The adjacent track distance 254 may vary from values smaller than the track pitch to values larger than the track pitch, and as large as the spin stand 172 would allow. By setting a relatively large value for the adjacent track distance 254, for example, one that is larger than the track pitch, far track encroachment can be characterized. The adjacent
10 track distance 254 also determines the severity of the interference 258, 260 between a center track 256, the left track 250 and the right track 252. Therefore, using a shorter adjacent track distance 254 may aid the user by magnifying the encroachment impact and thus facilitate easier study of the phenomenon.

In step 212 (FIG. 4), the reader 118 is next made to travel along a scan
15 path 268 in a cross-track direction 262. The cross-track direction 262 is a direction substantially parallel to a radius of the disc surface 110. Specifically, the reader 118 intermittently senses signals from the disc surface 112 as it travels from a start point 264, continues across the entire width of the left track 250, bridges the spacing 270 between the right edge of the left track 250 and
20 the left edge of the right track 252, continues across the entire width of the right track 252, and coming to a stop at an end point 266. The signals sensed by the reader 118 are stored as a set of pre-erasure data. Preferably, the signals are processed through a built-in narrow-band filter in the controller 178 of the spin stand 172 to eliminate harmonics and other noise.

25 The process 171 then continues to an intense direct current (DC) erase operation 214 (FIG. 5) with the writer 117 in a central position of the spacing 270 or approximately at a mid-point of the adjacent track distance 254. In other words, the writer 117 is positioned so that it is substantially equidistant from

the left track 250 and the right track 252. In this operation 214, the writer 117 travels in the track-wise direction 261 while writing a relatively strong direct current to the center track 256, for one or more than one revolution of the disc 110, and preferably for several revolutions of the disc 110. To enhance the encroachment effects, the intense DC erase operation 214 may be carried out with a stronger DC current. As described herein, this and other parameters may be chosen in various combinations.

The reader 118 is next made to travel in the same scan path 268 to obtain a set of post-erasure data in step 216. For example, if the pre-erasure data was collected with the reader 118 traveling away from the outer diameter 113 (FIG. 3) of the disc towards the inner diameter 115 (FIG. 3) of the disc, the post-erasure data is also collected with the reader 118 traveling away from the outer diameter 113 of the disc and towards the inner diameter 115 of the disc. In this frame of reference, it would be understood that, compared to the right track 252, the left track 250 would be the one nearer the outer diameter 113 of the disc.

In an alternative frame of reference where the reader 118 is made to travel away from the inner diameter 115 of the disc and towards the outer diameter 113 of the disc in collecting the pre-erasure data, the left track 250 would be understood to be that nearer to the inner diameter 115, compared to the right track 252. In such a set-up, the reader 118 will travel away from the inner diameter 115 of the disc and towards the outer diameter 113 of the disc when collecting the post-erasure data.

More specifically, and making reference again to FIG. 7, in collecting the set of post-erasure data in step 216, the reader 118 is made to travel from the same start point 264 as that used in collecting the pre-erasure data, and is then made to pass over the entire width of the left track 250, cross the spacing 270, traverse the entire width of the right track 252, and to come to a stop at

the same end point 266. The signals sensed by the reader 118 in this reading step 216 is stored as a set of post-erasure data. Preferably, the step size of the movement of the reader 118 in the reading step 216, that is the intervals at which the reader 118 senses signals from the disc surface 112, is also set to be the same as that used in the reading of the pre-erasure data in the reading step 212, such that data is collected from similar locations before and after the intense DC erase operation 214.

Through carrying out the steps generally designated by 217 in FIG. 5, the pre-erasure data and the post-erasure data is analyzed to extract a measure of encroachment. The set of pre-erasure data and the set of post-erasure data are plotted on the same x-axis 280 of displacement with respect to the start point in the cross-track direction and the same y-axis 282 of signal amplitude, as shown in FIG. 8. A pre-erasure track profile 300 derived from the set of pre-erasure data shows, for increasing displacement, a signal of increasing amplitude coming to a pre-erasure maximum left peak amplitude 302 at a left track displacement 342, followed by a decrease in amplitude, after which the signal again increases to a pre-erasure maximum right peak amplitude 304 at a right track displacement 344. The spacing 270 between the left track 250 and the right track 252 accounts for a valley in the pre-erasure track profile 300.

The post-erasure track profile 310 derived from the set of post-erasure data shows the signal amplitude to initially increase with displacement in a manner similar to the pre-erasure track profile 300, but to have a post-erasure maximum left peak amplitude 312 before the signal amplitude decreases. The post-erasure track profile 310 then increases again to a post-erasure maximum right peak amplitude 314. In this example, the post-erasure maximum left peak amplitude 312 is less than the pre-erasure maximum left peak amplitude 302, and the post-erasure maximum right peak amplitude 314 is less than the pre-erasure maximum right peak amplitude 304.

FIG. 10 shows a case where the adjacent track distance 254 had been defined to be significantly wider than the track pitch. The post-erasure track profile 426 may not show a significant difference from the pre-erasure track profile 424 when plotted against a similar set of y-axis of amplitude 422 and x-axis of displacement 420. It may be desired in such a situation to vary the parameters described above so as to facilitate measurement of encroachment. For example, the process 171 may be repeated with a shorter adjacent track distance 254.

Turning back to FIGS. 7 and 8, the process 217 preferably includes a step 218 of checking that the pre-erasure track profile 300 and the post-erasure track profile 310 overlap sufficiently. For example, the far left slope 356 of the pre-erasure track profile 300 should preferably generally coincide with the far left slope 366 of the post-erasure track profile 310, and the far right slope 358 of the pre-erasure track profile 300 should preferably generally coincide with the far right slope 368 of the post-erasure track profile 310. If the extent of overlap is deemed insufficient and appears to be indicative of poor servo control, the process 171 is preferably repeated with improved servo control at the spin stand 172.

Alternatively, if the far slopes 356, 358 of the pre-erasure track profile 300 and the far slopes 366, 368 of the post-erasure track profile 310 do not overlap, the user may choose to re-define the scan path 268 so that the start point 264 and the end point 266 are further away from the center track 256.

Known linear regression techniques are then applied to obtain regression lines 372, 373, 375, 378 along the substantially linear portions of the pre-erasure track profile 300 and to obtain regression lines 382, 383, 385, 388 along the substantially linear portions of the post-erasure track profile 310. If it is found in step 220 that the regression lines do not sufficiently match the substantially linear portions of the pre-erasure track profile and post-erasure

track profile, the process 171 is preferably repeated to obtain at least one new set of pre-erasure data and post-erasure data.

Continuing to step 222 of FIG. 5, the displacement of the left track center 392 is taken to be the mid-point between the regression line 372 and the regression line 373 where the signal amplitude is about half the pre-erasure maximum left peak amplitude 302. Similarly, the displacement of the right track center 394 is taken to be the mid-point between the regression line 375 and the regression line 378 where the signal amplitude is about half the pre-erasure maximum right peak amplitude 304. The difference between the displacement of the right track center 394 and the displacement of the left track center 392 is taken to represent the adjacent track distance 254.

Alternatively, the adjacent track distance 254 may be taken to be the difference between the right track displacement 344 and the left track displacement 342.

A left amplitude loss 332 can be read by taking the difference between the pre-erasure maximum left peak amplitude 302 and a post-erasure left amplitude 322 at the left track displacement 342. The post-erasure track profile 310 here shows noticeable signal amplitude loss at the left track 250 and the right track 252, partly because the spacing 270 is narrower than the track width 257. Similarly, a right amplitude loss 334 can be read by taking the difference between the pre-erasure maximum right peak amplitude 304 and a post-erasure right amplitude 324 at the right track displacement 344. A total signal loss (TSL) is defined by the sum of the left amplitude loss 332 and the right amplitude loss 334.

The difference in the displacement between regression line 373 and regression line 383 when the signal amplitude of the pre-erasure track profile 300 is about half of the pre-erasure maximum left peak amplitude 302 is referred to as the left erasure width 393. The difference in the displacement

between regression line 385 and regression line 375 when the signal amplitude of the pre-erasure track profile 300 is about half of the pre-erasure maximum right peak amplitude 304 is referred to as the right erasure width 395. A total erasure width (TEW) is defined as the sum of the left erasure width 393 and
5 the right erasure width 395.

Using methods familiar to a person of ordinary skill in the relevant art and therefore not described here in detail, a standard track profile measurement is taken of the head 116 under assessment to obtain a baseline width 402. The standard track profile 400, plotted against a y-axis of
10 amplitude 416 and x-axis of displacement 414 in FIG. 9, shows how the baseline width (BW) 402 is taken to be the sum of the writer width 404 and the read head width 406, 408 with measurements taken from regression lines 410, 412 fitted to the slopes of the standard track profile 400.

According to embodiments of the present invention, encroachment, or
15 encroachment impact, is characterized by multiplying the product of the total signal loss (TSL) and the total erasure width (TEW), and factored by the baseline width (BW) in step 224. This relationship can be expressed as in equation (3) below:

$$20 \quad \text{Encroachment Impact} = \text{TSL} \times \text{TEW} / \text{BW} \quad \text{--- (3)}$$

Referring to FIG. 6, the process 171 of assessing encroachment is repeated for different adjacent track distances in process step 226. The process
25 171 may be completed 230 by establishing the relationship between encroachment and the adjacent track distance 228. One way of doing so is to plot the various encroachment impact values, obtained using the above-described operations, with respect to different adjacent track distances in a

graph 434 as shown in the FIG. 11. The relationship curves 436, 438, 440, 442, 444 depict a spectrum that reveals the change of the encroachment with respect to the adjacent track distances. By reading the encroachment impact (y-axis) 430 with reference to the adjacent track distances (x-axis) 432, 5 encroachment at the adjacent tracks and beyond the adjacent tracks can be quantified.

In addition, the graph 434 of FIG. 11 provides a method of checking for any outlying point in a particular test procedure, as well as providing a more effective and more reliable method for future assessment of encroachment 10 because the user can rely on a combination of multiple test data points to make future cut-off judgments. If the encroachment impact is found to be larger than the maximum tolerable encroachment impact 446 within a desired range 448 of adjacent track distances for a particular configuration of a disc drive 100, the head can be identified and rejected or, if practicable, reworked 15 to reduce the fringing effect of the head and thereby reduce the negative impact on the overall performance of the disc drive 100. In this and other ways, the present invention provides practical improvement to the manufacturing process of disc drives and disc drive components.

Furthermore, the graph 434 provides a way of determining the extent to 20 which adjacent track distances can be reduced before severe encroachment is encountered.

As an option, a method 171 of the present invention may be embodied in a computer program that when executed achieves useful and practical results such as that described in the foregoing.

25 It can thus be seen that the present invention not only provides for the measurement of encroachment, it allows for measurement of far track encroachment without the need for additional procedures or expensive modifications to currently available equipment. In addition to the various

advantages already discussed, the present invention also facilitates the study of encroachment by enabling the user to easily aggravate or emphasize encroachment so that the impact of encroachment is severe enough for easier study.

5 Alternatively, embodiments of the present invention may be described as follows.

Embodiments of the present invention provide a method 171 for determining encroachment at spin stand 172. The method 171 involves steps of writing 208, 210 two tracks 250, 252 as a head 116 travels in a substantially
10 circumferential track-wise direction 261 with respect to a disc 110, reading 212 pre-erasure data from the disc 110 as the head 116 travels along a scan path 268, performing 214 a direct current erase as the head 116 travels between the two tracks 250, 252 in the track-wise direction 261, reading 216 post-erasure data from the disc 110 as the head 116 travels along the scan path 268, and
15 extracting 217 a measure of encroachment from the pre-erasure data and the post-erasure data. The head 116 is set at a skew angle 140 to the track-wise direction 261 and the two tracks 250, 252 are defined as being an adjacent track distance 254 apart. The scan path 268 is in a cross-track direction 262 that is substantially parallel to a radius of the disc 110.

20 The method 171 further includes writing 208, 210 the two tracks 250, 252 using the same write current and write frequency. The method 171 is preferably implemented with the head 116 reading data at substantially similar intervals for both reading steps 212, 216. Preferably, the direct current erase process 214 is carried out for more than one revolution of the disc 110.

25 The extracting step 217 may involve plotting a pre-erasure track profile 300 based on the pre-erasure data against a set of axes 280, 282 and plotting a post-erasure track profile 310 based on the post-erasure data against the set of axes 280, 282, and comparing 222 the pre-erasure track profile with the post-erasure

track profile. The method 171 may also include performing 222 linear regression on the pre-erasure track profile 300 to obtain at least one pre-erasure regression fit line 372, 373, 375, 378 and, if the pre-erasure regression fit line does not substantially match a corresponding slope of the pre-erasure track profile 300, new pre-erasure data and post-erasure data is obtained. 5 Similarly, the method 171 may also include performing 222 linear regression on the post-erasure track profile 310 to obtain at least one post-erasure regression fit line 382, 383, 385, 388 and, if the post-erasure regression fit line does not substantially match a corresponding slope of the post-erasure track profile 310, new pre-erasure data and new post-erasure data is obtained. New pre-erasure data and new post-erasure data may also be obtained if the pre-erasure track profile 300 and the post-erasure track profile 310 do not sufficiently overlap. The new pre-erasure data and the new post-erasure data are preferably obtained after defining at least one new value for one or more of the following parameters: the skew angle of the head 140, the adjacent track distance 254 and the scan path 268. 10 15

The measure of encroachment is given by $TSL \times TEW / BW$, and where TSL is a total signal loss, TEW is a total erasure width and BW is a baseline width 224. In addition, a relationship between the measure of encroachment and the adjacent track distance may be established 226, 228. 20

In addition, there is provided a disc drive 100 having at least one disc 110 and at least one head 116 operably connected to the at least one disc 110 for writing data to and reading data from the at least one disc 110, and the at least one head 116 has been assessed by the method 171 described in the foregoing. 25

It is to be understood that even though numerous characteristics and advantages of various embodiments of the present invention have been set forth in the foregoing description, together with details of the structure and

function of various embodiments of the invention, this disclosure is illustrative only, and changes may be made in detail, especially in matters of structure and arrangement of parts within the principles of the present invention to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed. For example, although the preferred embodiment described herein is directed to a method carried out at a spin stand, it will be understood by a person skilled in the art to utilize another configuration of equipment to perform the method, without departing from the scope of the present invention.

Claims

What is claimed is:

- 5 1. A method for determining encroachment at spin stand, the method comprising:
 - (a) writing two tracks as a head travels in a substantially circumferential track-wise direction with respect to a disc, the head being at a skew angle to the track-wise direction and the two tracks being an adjacent
10 track distance apart;
 - (b) reading pre-erasure data from the disc as the head travels along a scan path, the scan path being in a cross-track direction that is substantially parallel to a radius of the disc;
 - (c) performing a direct current erase as the head travels between the
15 two tracks in the track-wise direction;
 - (d) reading post-erasure data from the disc as the head travels along the scan path; and
 - (e) extracting a measure of encroachment from the pre-erasure data and the post-erasure data.
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2. The method of claim 1 wherein the writing step (a) further includes writing the two tracks using a same write current and write frequency.
3. The method of claim 1 wherein the reading step (b) and the reading step (d)
25 are carried out with the head reading data at substantially similar intervals.
4. The method of claim 1 wherein the step (c) of performing a direct current erase is carried out for more than one revolution of the disc.

5. The method of claim 1 wherein the extracting step (e) further comprises:

(f) plotting a pre-erasure track profile based on the pre-erasure data against a set of axes;

5 (g) plotting a post-erasure track profile based on the post-erasure data against the set of axes; and

(h) comparing the pre-erasure track profile with the post-erasure track profile.

10 6. The method of claim 5 further comprising:

(i) performing linear regression on the pre-erasure track profile to obtain at least one pre-erasure regression fit line;

(j) if the pre-erasure regression fit line does not substantially match a corresponding slope of the pre-erasure track profile, obtaining new pre-

15 erasure data and post-erasure data;

(k) performing linear regression on the post-erasure track profile to obtain at least one post-erasure regression fit line; and

(l) if the post-erasure regression fit line does not substantially match a corresponding slope of the post-erasure track profile, obtaining new pre-

20 erasure data and new post-erasure data.

7. The method of claim 5 further comprising obtaining new pre-erasure data and new post-erasure data if the pre-erasure track profile and the post-erasure track profile do not sufficiently overlap.

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8. The method of claim 7 wherein the new pre-erasure data and the new post-erasure data are obtained after defining at least one new value for at least one

parameter chosen from the group consisting of the skew angle of the head, the adjacent track distance and the scan path.

9. The method of claim 1 wherein the measure of encroachment is given by
5 TSL x TEW / BW, and wherein TSL is a total signal loss, TEW is a total erasure width and BW is a baseline width.

10. The method of claim 9 further comprising establishing a relationship
10 between the measure of encroachment and the adjacent track distance.

11. A disc drive comprising:
at least one disc;
at least one head operably connected to the at least one disc for writing
data to and reading data from the at least one disc, wherein the at least one
15 head has been assessed by the method of claim 1.

12. A spin stand comprising:
a disc having at least one disc surface formatted with tracks running in
a substantially circumferential track-wise direction; and
20 a head operably coupled to the disc, the head being configured to write data to the tracks and to read data from the tracks, wherein the spin stand is configured to perform an assessment comprising:
(a) writing two tracks as the head travels in a substantially
circumferential track-wise direction with respect to the disc, the head being at
25 a skew angle to the track-wise direction and the two tracks being an adjacent track distance apart;

(b) reading pre-erasure data from the disc as the head travels along a scan path, the scan path being in a cross-track direction that is substantially parallel to a radius of the disc;

5 (c) performing a direct current erase as the head travels between the two tracks in the track-wise direction;

(d) reading post-erasure data from the disc as the head travels along the scan path; and

(e) extracting a measure of encroachment from the pre-erasure data and the post-erasure data.

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13. The spin stand of claim 12 wherein the assessment further includes, in the writing step (a), writing the two tracks using a same write current and write frequency.

15 14. The spin stand of claim 12 wherein the assessment further includes the head reading data at substantially similar intervals in both the reading step (b) and the reading step (d).

20 15. The spin stand of claim 12 wherein the assessment further includes, in the step (c) of performing a direct current erase, carrying out the direct current erase for more than one revolution of the disc.

16. The spin stand of claim 12 wherein the extracting step (e) further includes:

25 (f) plotting a pre-erasure track profile based on the pre-erasure data against a set of axes;

(g) plotting a post-erasure track profile based on the post-erasure data against the set of axes; and

(h) comparing the pre-erasure track profile with the post-erasure track profile.

17. The spin stand of claim 16 wherein the extracting step (e) further includes:

- 5 (i) performing linear regression on the pre-erasure track profile to obtain at least one pre-erasure regression fit line;
- (j) if the pre-erasure regression fit line does not substantially match a corresponding slope of the pre-erasure track profile, obtaining new pre-erasure data and post-erasure data;
- 10 (k) performing linear regression on the post-erasure track profile to obtain at least one post-erasure regression fit line; and
- (l) if the post-erasure regression fit line does not substantially match a corresponding slope of the post-erasure track profile, obtaining new pre-erasure data and new post-erasure data.

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18. The spin stand of claim 16 wherein the assessment further comprises obtaining new pre-erasure data and new post-erasure data if the pre-erasure track profile and the post-erasure track profile do not sufficiently overlap.

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19. The spin stand of claim 18 wherein the assessment further comprises obtaining the new pre-erasure data and the new post-erasure data after defining at least one new value for at least one parameter chosen from the group consisting of the skew angle of the head, the adjacent track distance and the scan path.

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20. The spin stand of claim 12 wherein the measure of encroachment is given by $TSL \times TEW / BW$, and wherein TSL is a total signal loss, TEW is a total erasure width and BW is a baseline width.

21. The spin stand of claim 20 wherein the assessment further comprises establishing a relationship between the measure of encroachment and the adjacent track distance.

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22. A spin stand comprising:

a disc;

a head operably coupled to the disc, the head being configured to write data to the disc and to read data from the disc; and

10 means for determining encroachment characteristics of the head.