Rotational Vibration Safeguard (RVS)

Seeing the future

Selected HGST hard drives now have an advanced Rotational Vibration Safeguard (RVS) that actually anticipates disturbances and counteracts them—maximizing performance in the most arduous conditions.

Do not disturb

One of the greatest hindrances to hard disk performance is vibration. Like a needle on a record, the disk drive's head must try to follow narrow data tracks in order to read (or write) information.

Physical disturbances can throw the head off-track and cause a delay while the actuator repositions it. This eventually has an impact on the hard drive's input/output performance. In modern, balanced hard drives, linear back-and-forth vibration barely affects the operation of the drive head. However, circular movements—rotational vibration—can cause serious disruption.

These problems are particularly acute in multi-drive systems, because drives tend to be installed alongside each other, in arrays. The vibration caused by the rotation and seek activities of nearby drives can affect the whole array, progressively disturbing the operation of each drive in the system. The drop in performance can be significant.

Feedback

Until recently, the conventional answer to this problem has been the use of a "feedback head position controller" (see Figure 1).

The drive head continually reads servo information on each track, to ensure that it is at the correct location. When the head moves off of the target track, the standard feedback controller generates a signal to reposition the head. After repositioning, the head must wait for the desired data to rotate around and be read by the head. This added delay results in an undesirable performance hit.

This feedback system is necessarily unsatisfactory—it can only correct the problem after it has arisen.

Fast forward

That's why HGST developed the Rotational Vibration Safeguard. Rather than rely on signals from the disk head, the RVS has its own vibration sensors placed at the edges of the hard disk (Figure 2.1) and on the edges of the drive circuit board (Figure 2.2). If these sensors feel a vibration rippling through the drive, they can feed forward a signal to

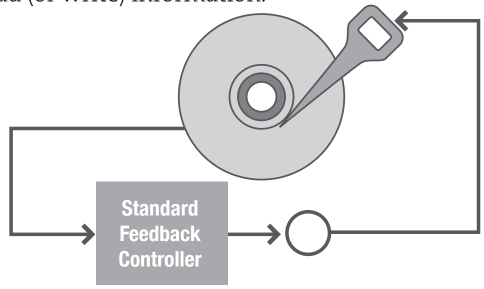

Figure 1: The standard feedback control system

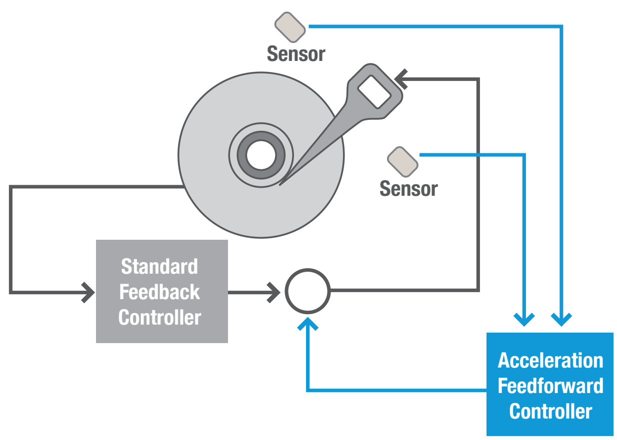

Figure 2.1: Standard feedback controller plus RVS

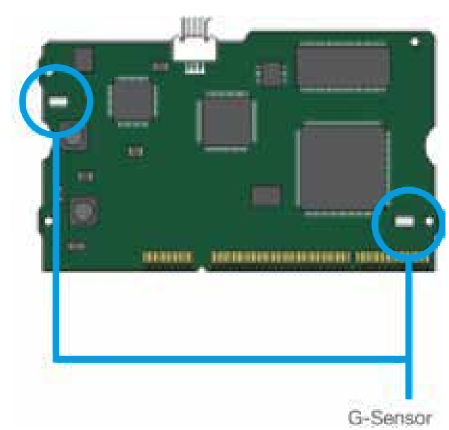

Figure 2.2: Drive circuit board with vibration sensors

the actuator that controls the head's position. The actuators then compensates for the disturbance, counteracting it with an equal and opposite force. In this way, the head is able to "ride" the vibration and stay on track.

More and more HGST hard drives use a combination of feedback and feed forward signals to minimize delays and ensure optimum performance.

The results

Because the actuator is warned in advance of any oncoming disruption, it can keep the drive head in a much more stable position.

Figure 3 shows the path followed by two drive heads after a small disturbance. The black line traces the position of a head that does not have the benefit of RVS—the disturbance results in large oscillations, long after the initial vibration has passed. The blue line shows how RVS is able to cancel out the effects of the disturbance. The oscillations here are much smaller, enabling the head to be in a position to read or write again much more quickly.

This, in turn, leads to a noticeable improvement in performance. The following bar charts (Figures 4.1 and 4.2) show how a system performs by simulating business and high-end machine operations. Testing was done using HGST's Deskstar 7K400 and VeriTest's Benchmark tests—WinBench Business and WinBench High-end. In each case tests were completed with and without RVS, under stable and vibrating conditions.

Figure 4.2—showing performance during vibration—is the most interesting. In the simulation, we shook the high-end machine so hard that, without RVS, it could only score 15% in our performance tests. However, the moment RVS was switched on, the score shot up to almost 70%. **In the business machine, the improvement was just as significant, boosting performance from 30% to almost 90%**.

These statistics confirm that HGST's RVS system constitutes a major step forward in hard drive technology. Unnecessary rotations of the disks are avoided and, by sensing vibrations before they hit, RVS gives users more reliable performance.

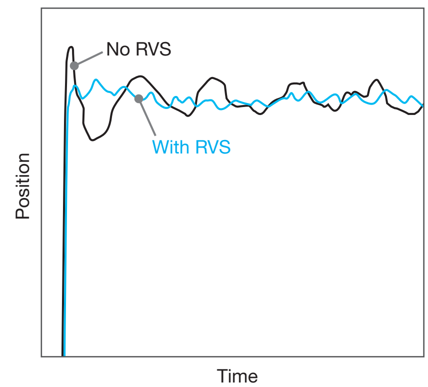

Figure 3: The path of a drive head after disturbance, with and without RVS

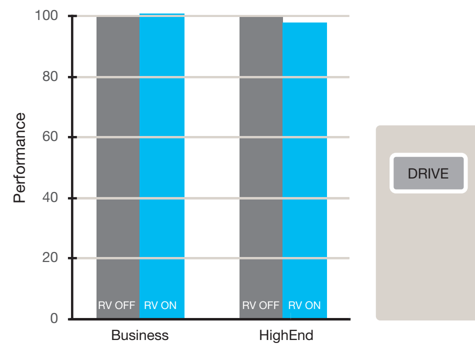

Figure 4.1: System level benchmark comparison with RVS enabled and disabled—NO SHAKER

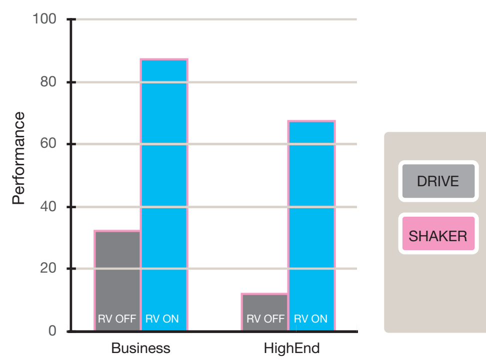

Figure 4.2: System level benchmark comparison with RVS enabled and disabled—WITH SHAKER

HGST
a Western Digital company

HGST, a Western Digital company
3403 Yerba Buena Road
San Jose, CA 95135 USA