



THôT Technologies, Inc.

Morphology, Flyability & Defects

Topography and its Effect on Fly Height Modulation
and Disk Defect Generation



***“The Effects of Disk Morphology on Flying-Height Modulation:
Experiment and Simulation”***

By Brian H. Thornton, D. B. Bogy, and C. S. Bhatia
University of California at Berkeley

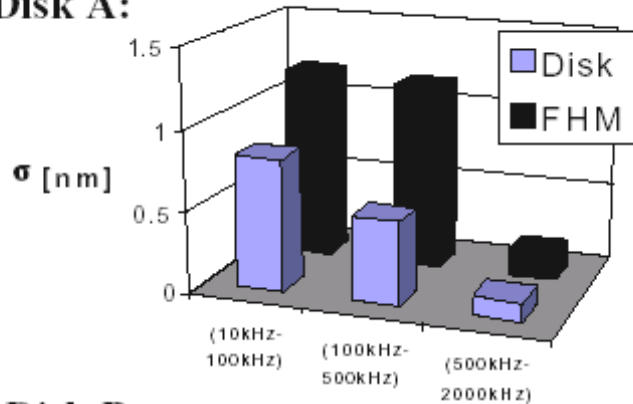
“.... depending on the slider ABS design and the disk morphology, this geometric FHM may be greater than the disk morphology....”

“.... It is obvious that a single number characterization of roughness or waviness is not sufficient to determine the quality of a disk with respect to FHM....”

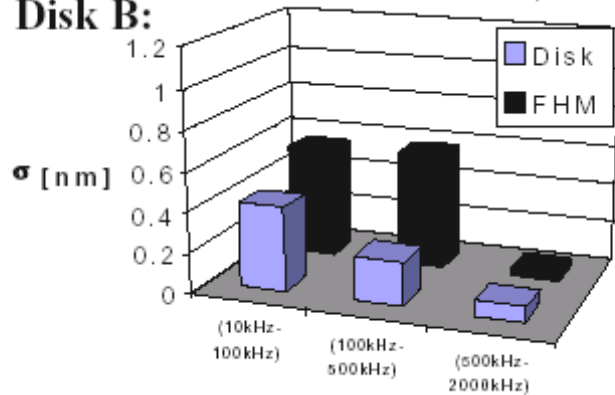
“.... A Thôt Technologies platform with the flyability option was the basic test stand....”



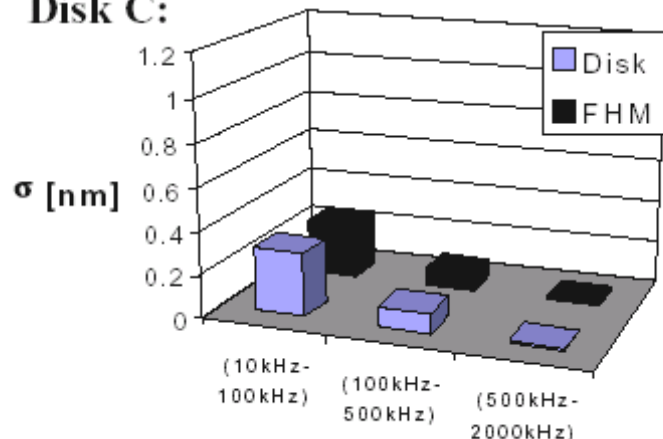
Disk A:



Disk B:



Disk C:

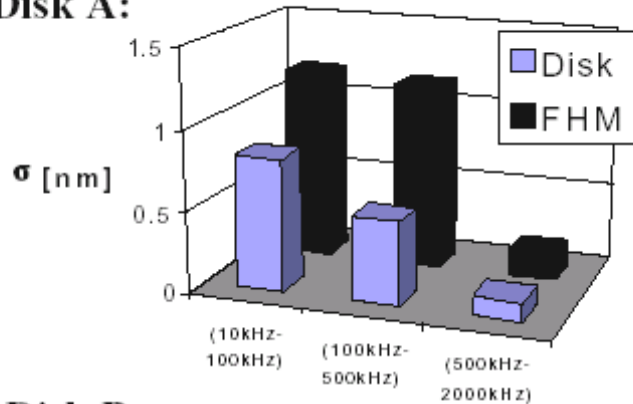


- FHM by Frequency over 3 Variations of Surface Morphology.
- Top to bottom: 50% reduction in surface morphology features from Disk A to Disk B and 50% from Disk B to Disk C.
 - Left to right: Filter settings corresponding to (left) waviness & u-waviness, (middle) n-waviness & macro-roughness and (right) roughness, u & n-roughness

From UC Berkeley paper by Thornton, et al.

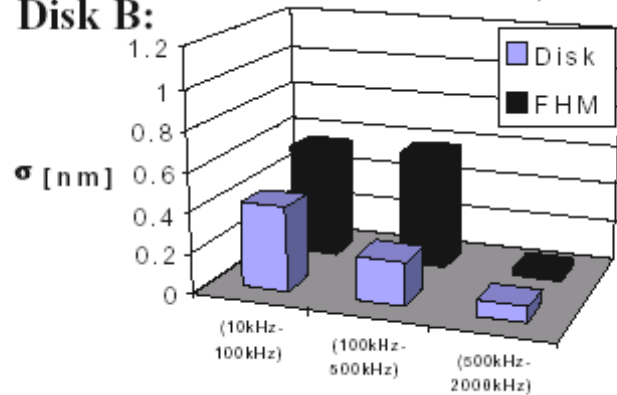


Disk A:



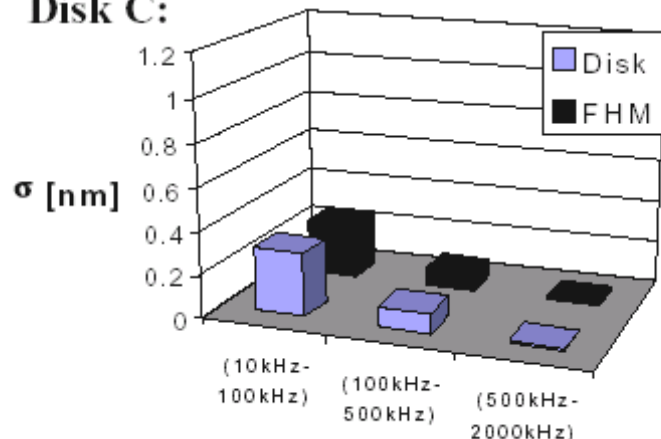
Note that the 50% reduction in surface morphology results in an even greater reduction in fly height modulation.

Disk B:



This effect is apparent across all three wavelengths.

Disk C:



It becomes obvious that reduced morphology drastically reduces fly height modulation.

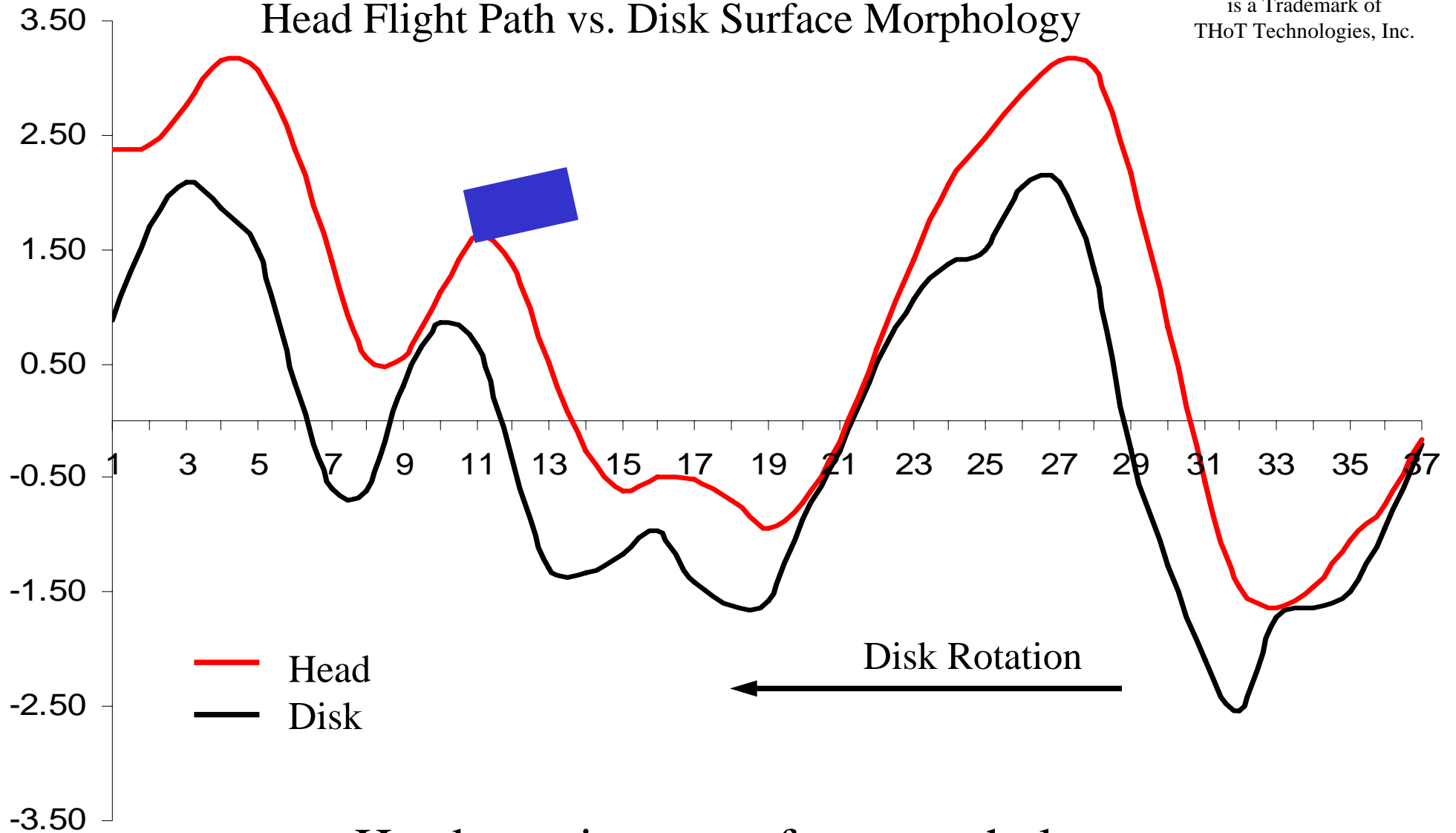
From UC Berkeley paper by Thornton, et al.



Flyability TM

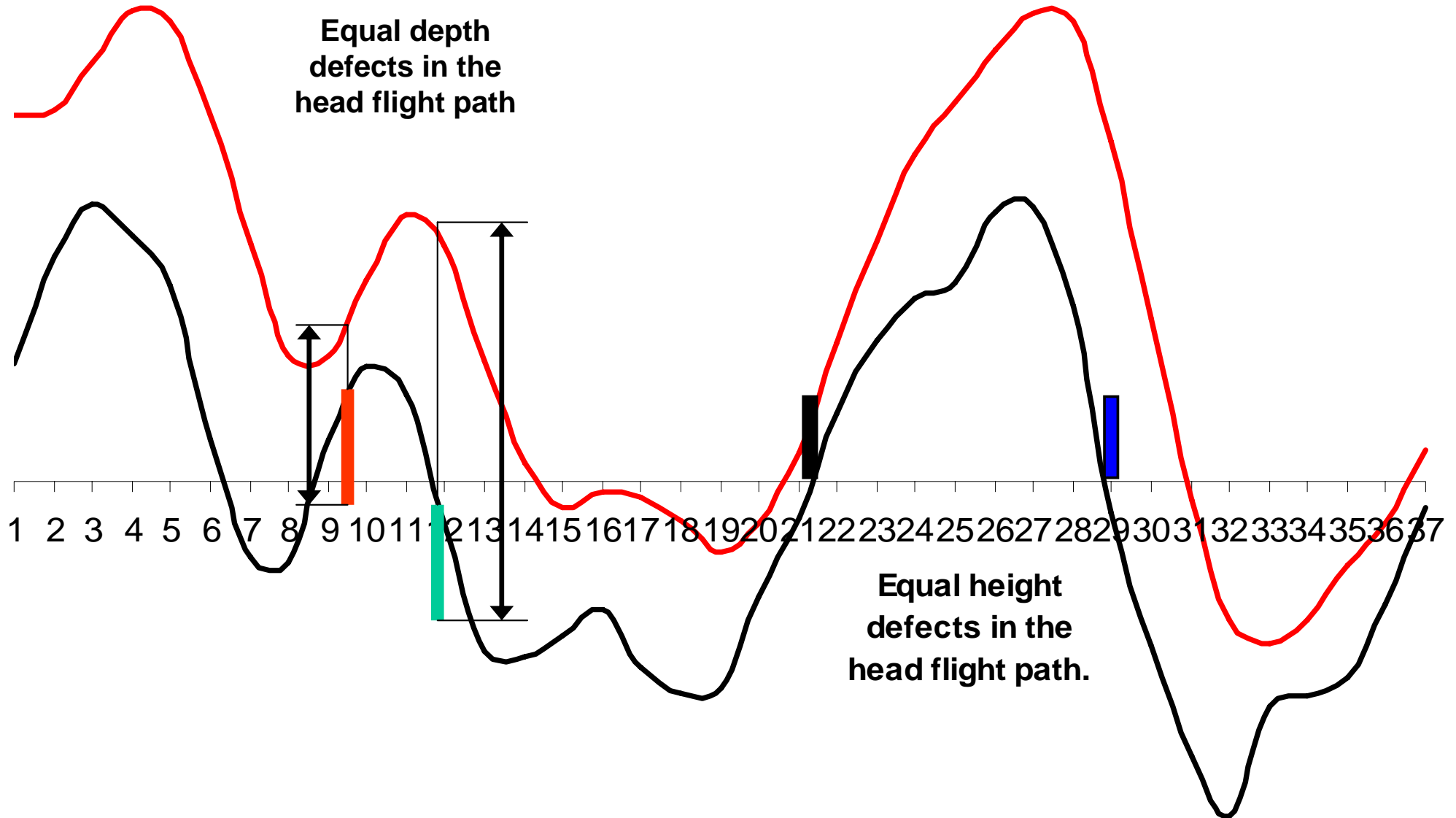
Flyability
is a Trademark of
THoT Technologies, Inc.

Head Flight Path vs. Disk Surface Morphology



Head reaction to surface morphology

(Tests performed on the same model as the tool supplied to U.C. Berkeley)

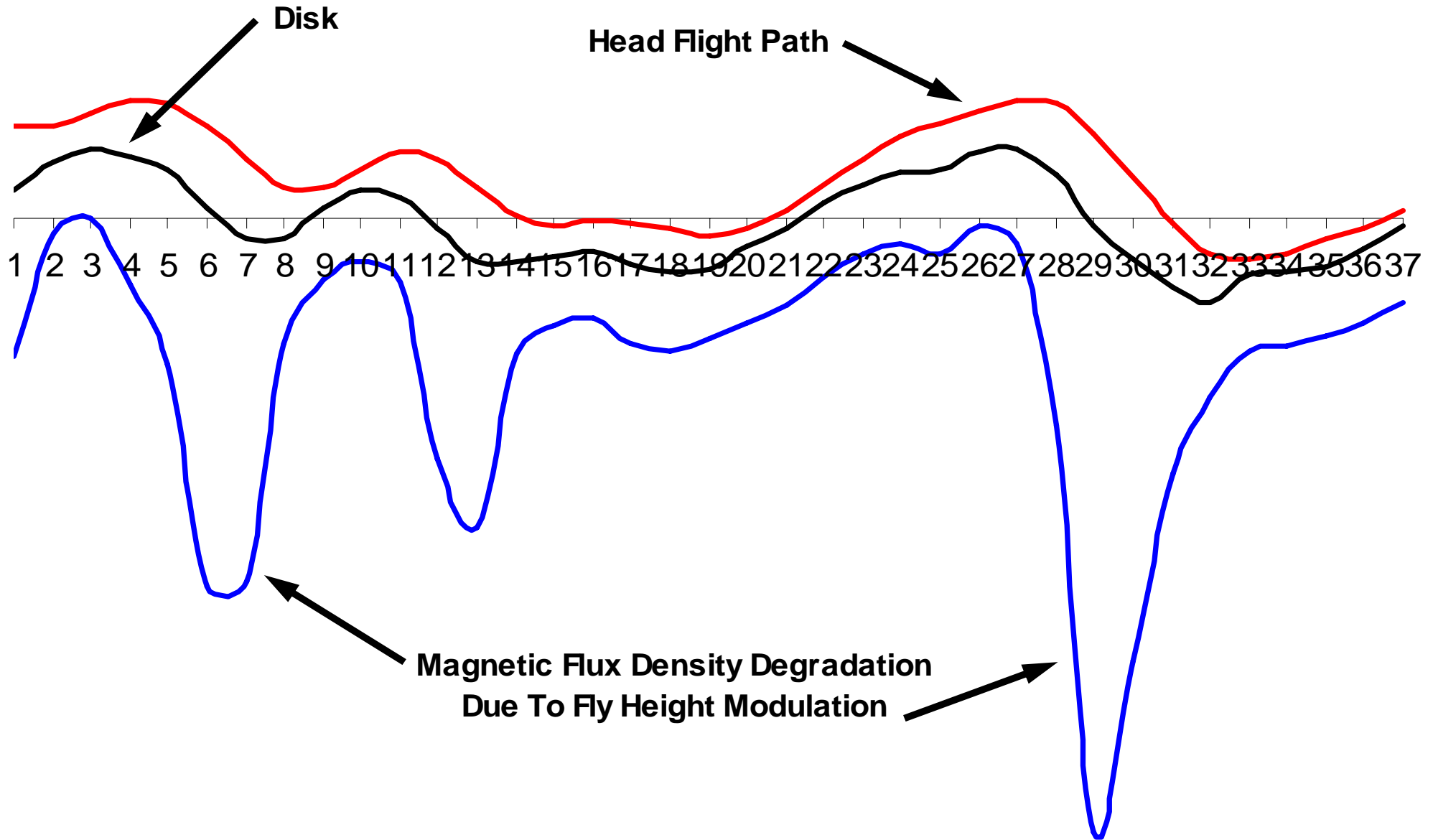




Physical defects for glide and burnish as well as certification now become dependent on fly height modulation.

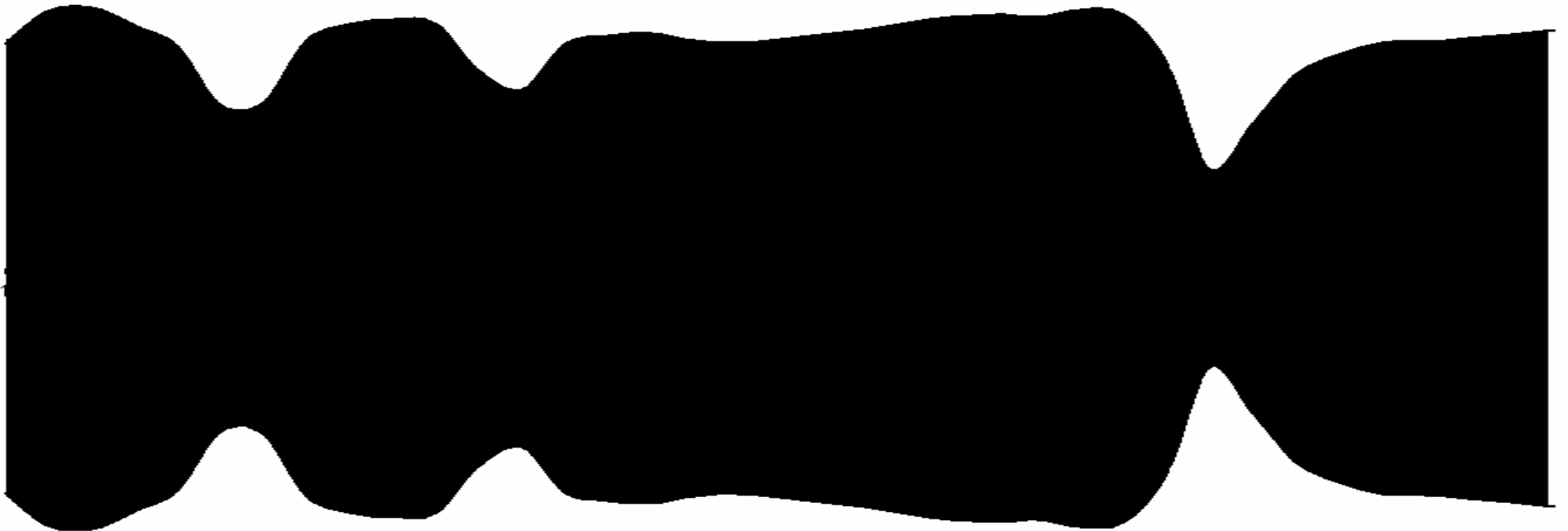
Clamping distortions and dynamic flutter can change the surface topography and dynamically modify the fly height modulation.

The only reliable method of insuring that fly height modulation does not interfere with glide and certification testing is to reduce or remove the underlying cause, excessive topographical features in the wavelengths that cause FHM





Read-back signal variations due to fly height modulation
(assuming that the magnetic quality has no variation).



Certification defects become dependent on magnetic flux density which varies greatly with fly height modulation.



Isolated and smaller defects are becoming critical to the disk manufacturing process for Perpendicular Magnetic Recording.

As the heads fly closer to the surface, the surface morphology becomes critical to controlling the Fly Height Modulation.

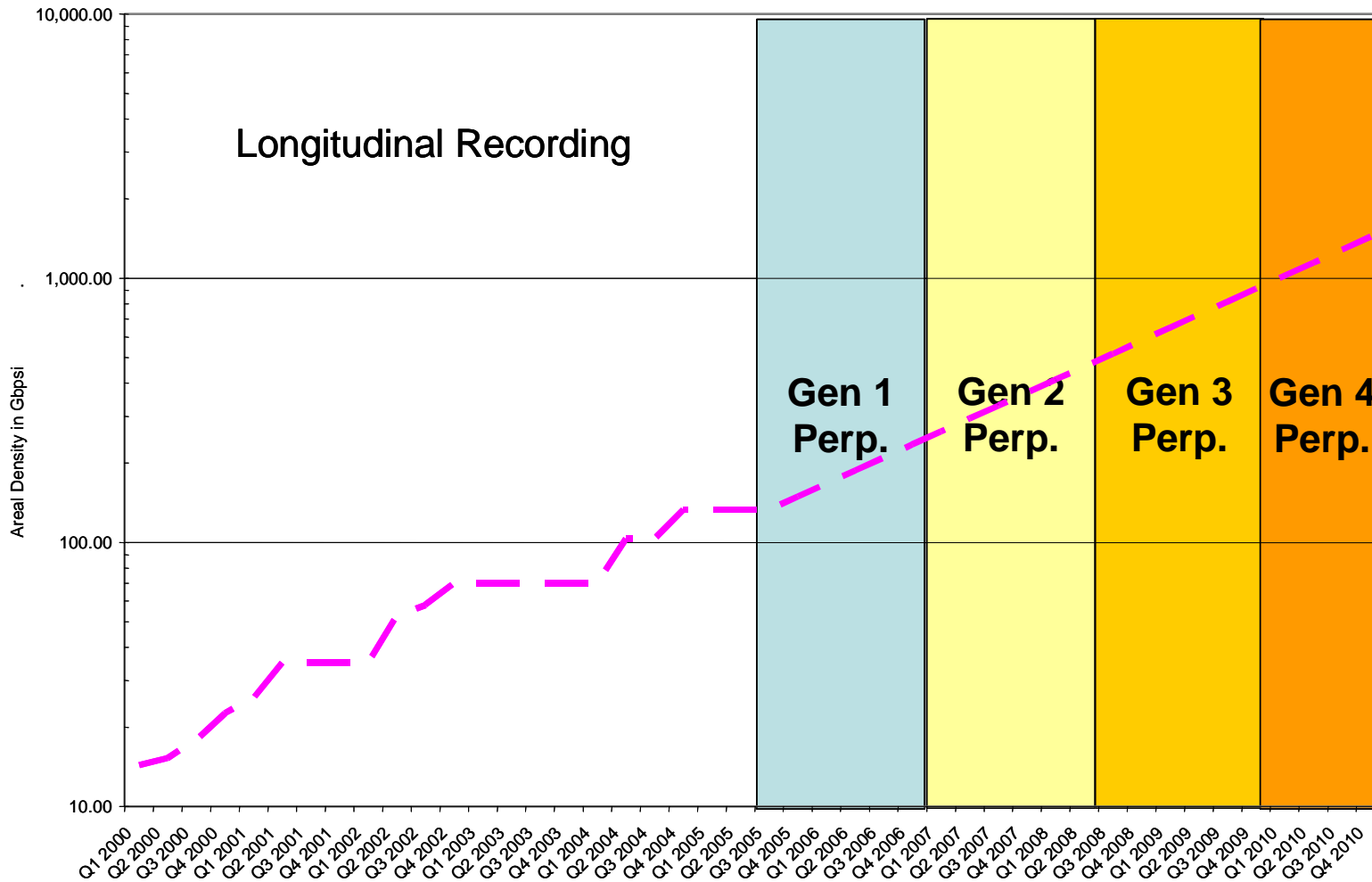
Fly Height Modulation introduces extreme variations in read and write signal strength.

Signal strength variations create erroneous and soft errors



Projected Perpendicular Recording Product Announcement Generations

HDD Product





Perpendicular Recording Product Announcement Generations

- Generation 1: 1st generation PMR media and heads.
- Generation 2: 2nd generation PMR media and heads (**lower flying height**).
- Generation 3: 3rd generation PMR media and heads. May also include discrete tracks on disk or dual actuator suspensions.
- Generation 4: 4th generation PMR media and heads (**near contact recording**). May also include HAMR.



Summary:

PMR media is going to require very low fly height modulation.

Fly height modulation is a product of micro-waviness, nano-waviness and macro-roughness.

To control these features the polishing, cleaning and texturing processes will require extreme close monitoring and feedback.

High resolution, repeatability, flexibility and measurement control will be needed.



Conclusion:

Morphology control is necessary for defect control.

The THoT tool provides:

High speed, dual sided tests.

Full surface scans.

User adjustable wavelength measurements.

PSD (Power Spectral Density) analysis.

Extreme resolution.

Very wide measurement bandwidth.

Tool-to-tool, site-to-site calibration and correlation