

CASE STUDY

Programmable, Open-Architecture HyperWorks Helps Toshiba Design Smaller Hard Disk Drives to Meet Market Demand

TOSHIBA

Overview

Toshiba Digital Network Company, faced with increasing global competition in the hard disk drive (HDD) marketplace, set out to create an advantage through the redesign of their existing HDD product(s). To support this effort, Toshiba partnered with Altair Engineering to automate its design process. This was accomplished by leveraging HyperWorks powerful modeling, visualization and optimization software applications with Toshiba's proprietary solver for fluid dynamics. The specific goal was to optimize the air bearing surface (ABS) of the HDD's magnetic head slider. This unique product development process resulted in minimizing the flying height as much as possible while considering its stability. This, in turn, reduced the overall size of the HDD and increased its recording density. In addition, the new design was brought to market in significantly less time than with Toshiba's traditional design process.

Business Profile

Toshiba Digital Media Network Company – a key product company in Toshiba's Digital Products business domain – has wide-ranging expertise in advanced audio and visual products, which opens up new frontiers in home entertainment. Toshiba – a 130-year-old world leader in high technology – is a diversified manufacturer and marketer of advanced electronic and electrical products, spanning information and communications equipment and systems; Internet-based solutions and services; electronic components and materials; power systems; industrial and social infrastructure systems; and household appliances.

Challenge

Toshiba's goal was to reduce the physical size of the HDD, while increasing the recording density of the smaller disk. The HDD transfers data with the recording surface of the disk, using a chip approximately 1mm square called a magnetic head slider. The slider moves while keeping an approximately 10nm gap (flying height) above the disk, which is traveling at high speed. To increase the recording density of the HDD, the minimum flying height of the slider needs to be decreased. The flying height is determined by the pressure exerted on the ABS of the slider by the flow of air generated by the spinning disk. This pressure distribution is dependant upon the shape (groove depth) of the ABS. Toshiba's objective was to redesign the shape of the ABS to increase the stability, so to reduce the flying height of the slider.

“Altair worked closely with Toshiba to create dedicated macros for their software, which helped us efficiently design a new ABS shape for our HDD magnetic head slider. We met to our target for a reduced flying height, developed a more compact, high-performance product and saved significant time and money.”

Kan Takahashi
Specialist
Core Technology Center
TOSHIBA CORPORATION
Tokyo, Japan

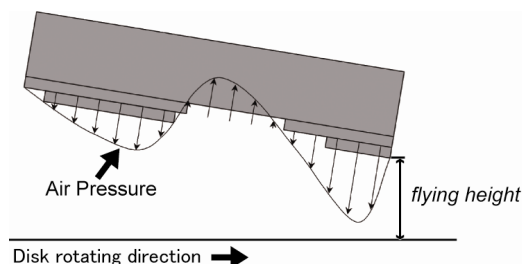


Figure 1. Pressure produced on the ABS of the Magnetic head slider due to disk rotation



Solution

The programmable, open-architecture design of the HyperWorks suite enabled Toshiba to integrate its proprietary fluid dynamics solver, used to calculate the flying height of the magnetic slide head, with HyperWorks. As a result, Toshiba leveraged HyperWorks advanced modeling, visualization and optimization technology with its proprietary software to efficiently re-design the ABS to meet the new flying height target. HyperWorks macros were also created to guide and automate Toshiba's established workflow processes.

- HyperMesh® pre-processing macros automated the creation of the input file for Toshiba's proprietary fluid dynamics solver. These macros included creating surfaces from nodal point data, auto-meshing, model export and bandwidth node renumbering.
- HyperStudy® shape optimization macros allowed Toshiba to quickly define design variables and to automate the conversion of results files from the fluid dynamics solver (such as flying height) to optimize the shape of the ABS with HyperStudy.
- HyperView® results visualization macros converted calculated pressure values from Toshiba's fluid dynamics solver to Altair's .h3d format. In this format, the results could then be visualized as an animated contour plot in HyperView. For time-history data, this allowed changes in the nodal point pressure values to be verified through the animation.

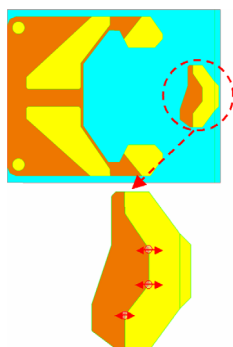


Figure 2. General model view (up) and enlarged view of ABS trailing pad (down)

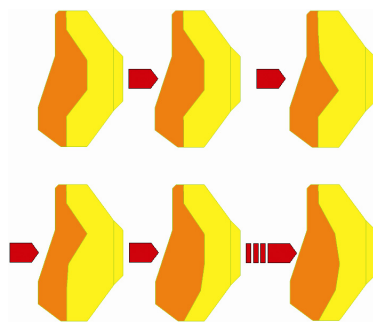


Figure 3. ABS trailing pad shape at each repetition time with HyperStudy

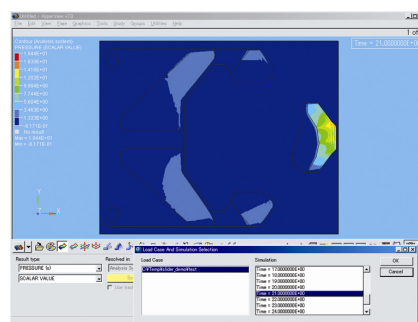


Figure 4. Display of nodal point pressure value with HyperView

Results

Collaboration with Altair to create customized macros for Toshiba's proprietary solver technology enabled the electronics company to use HyperWorks to automate its established workflow and take advantage of commercially supported modeling, optimization and visualization technology to meet its design objective. Tailored macros automated laborious engineering tasks and allowed users at all experience levels to achieve similar results. As a result of this automation, Toshiba saved 70 percent of the total time traditionally associated with the process. Most importantly, Toshiba could increase the stability and, in turn, reduce the flying height of the slider using HyperWorks.

Benefits

In the highly competitive electronics business, product success can often be measured in nanometers. Being able to increase HDD recording density is essential in creating the smaller, more compact electronic devices that appeal to today's discriminating buyers. This unique competitive advantage was achieved through an improved design process that was the result of the integration of Toshiba's proprietary solvers with Altair HyperWorks open-architecture product design and simulation software. This innovative application of simulation and optimization technology to create a competitive advantage represents the kind of advanced product development strategy on which Toshiba has built its reputation.

Altair HyperWorks

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