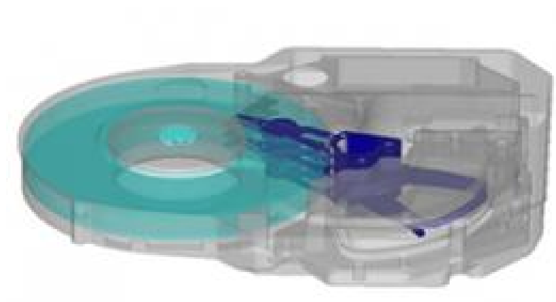
Fluid dynamics simulations aim to better predict how air circulating in a hard disk drive

August 2 2012



Engineers rely on sophisticated simulation software to understand how air and other fluids flow over objects like an airplane wing or a golf ball. The software typically maps the air and object to a three-dimensional array (mesh) of small cells and iteratively calculates the forces in each cell over a series of time steps. Such simulations would be useful for predicting the effects of air flow on moving parts of a spinning hard disk drive — a critical step in the testing of new designs. Unfortunately, parts moving at high frequencies are notoriously difficult to simulate because they are shifted by a few nanometers only.

Ningyu Liu and co-workers at the A*STAR Data Storage Institute have now made an important step towards solving this problem. They developed a program that can accurately simulate the force of air acting on the actuator assembly (the arm that suspends the read/write head over the spinning magnetic disk in a hard disk drive) and determine the amplitude of the assembly's vibration. The program is unique in that it uses fluid dynamics to describe the interaction between the read/write arm and the air surrounding it.

In a hard disk drive (see image), the read/write head moves quickly back and forth over the magnetic disk, which rotates at up to tens of thousands of revolutions per minute. In high-density hard disk drives, however, the distance between the read/write head and the disk (the "flying height") may only be a few nanometers — or even less for compact, high-storage disks of the future.

"Variation in the amplitude of vibration can have a critical impact on the performance of hard disk drives, even if the difference is on the sub-nanometer scale," says Liu.

To improve fluid dynamics simulations and better predict how air, which is sealed inside the hard disk drive and driven into circulation by the rotating disks, affects the vibration of the arm suspending the read/write head, Liu and his co-workers described the space right around the arm as a continuous vibrating surface, or boundary, instead of breaking it into many cells. They tested their simulations by comparing them to measurements of arm vibrations in a home-built simplified hard disk drive.

Liu and his colleagues showed that simulations that do not include the vibrating boundary underestimate or overestimate the amplitude of the vibrating arm by as much as 40%. They are now in the process of performing similar simulations on smaller and thinner disk drives, which, according to Liu, "require a huge computer resource."

More information: Liu, N. et al. A new fluid structure coupling approach for high frequency/small deformation engineering application. IEEE Transactions on Magnetics 47, 1886–1889 (2011). dx.doi.org/10.1109/TMAG.2011.2141120

Provided by Agency for Science, Technology and Research (A*STAR), Singapore

Citation: Fluid dynamics simulations aim to better predict how air circulating in a hard disk drive (2012, August 2) retrieved 25 April 2024 from https://phys.org/news/2012-08-fluid-dynamics-simulations-aim-air.html