# HDDs with Better Heat Dissipation Systems Designed for Search Engines Servers

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**Abstract**

The usage of search engines such as *Google*, *Yahoo* and *Bing* for information seeking is inevitable and important for our daily lives. *Google* claims that users conduct over a billion searches a day, not including numerous downloads and queries. These search engines have hard disk drives (HDDs) as their core part for data storage. HDDs operating on average 7,200 rotation per minute (rpm) are the norm. However, high-end HDDs meant for fast responses and feedbacks require higher rotational speed and higher track density. These type of HDDs simultaneously need smart countermeasures for excessive heat rise; HDDs' flow-induced vibration (FIV) such as arm vibrations and disk flutters, without increasing its power consumptions. Gigantic search engines or even cloud computing servers used in nowadays smart computing actually involve numerous HDDs to store these data and information for our convenience. By decreasing the heat generated by these vital core parts of the servers; the HDDs, the authors aim at a lesser energy consumption HDD. Out of the total energy consumed by these servers, only 40 to 45 percent are being used for operation. The remaining energy is consumed for cooling the server and database systems. In this paper, the authors propose a new actuator arm with a better window that will improve the heat dissipation of the HDDs system. The HDD's actuator arm is designed using *AutoDesk* and exported to *Comsol Multiphysics* for numerical simulation. Each arm has a large windowed area for a better dissipation of heat generated due to air frictions. Another improvement that the authors proposed is by designing a novel S-shaped arm to promote better air flow. This will eventually lead to less heat generating HDDs meant for search engines servers of the internet.

***Keywords*:** hard disk drives, actuator arms, flow induced vibrations, thermal management, energy savings

## I. INTRODUCTION

In this paper, the behavior of the air flow inside an HDD with the consideration of a bigger window and a novel S-shaped design arm actuator is studied.

Higher disk rotation in an HDD would inevitably attract unnecessary vibrations to the moving parts in the HDD; such as the actuator arm and platter disk, due to the high-speed airflow inside the HDD's compartment. Past researches have shown that in order to improve the performance of HDDs, it is imperative to increase its rotational speed while maintaining its dynamic stiffnesses [1]. However, higher rotational speed will induce vibrations [2], high internal pressure [3] and excessive unnecessary heat which will eventually require tremendous heat loss management to maintain the performance and life span of these HDDs. These vibrations were proven to be able to be decreased by using spoilers to disturb the air flow inside these high revolutionary speed HDDs [3], [4]. Other findings also show that introducing unique compartment designs that can disturb the air flow will improve the performance of a HDD [5], [6].

The heat however, can be reduced by considering its aerodynamic factors. In aiming for improvements of the aerodynamic functions of these vital parts of HDDs, the frontal area can be decreased and this would reduce the drag force in between these parts. Since the drag force is the most significant factor contributing towards air frictional heat generation on the moving parts of the HDDs with high revolutionary speed, the aerodynamic and thermodynamic properties improvement of the mechanical parts of the HDD has been chosen for the study in this paper. The countermeasures are to introduce a better and appropriately designed window on the actuator arm integrated with an S-shaped design on the actuator arm.

In this paper, designs based on disassembled conventional commercialized HDD designs were compared with an improved S-shaped windowed HDD arm. These designs were numerically verified, aerodynamically and thermodynamically. These

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