Boosting Memory Capacity with SSDs

Solid-state drives are a cost-effective way to add fast memory to workstations.

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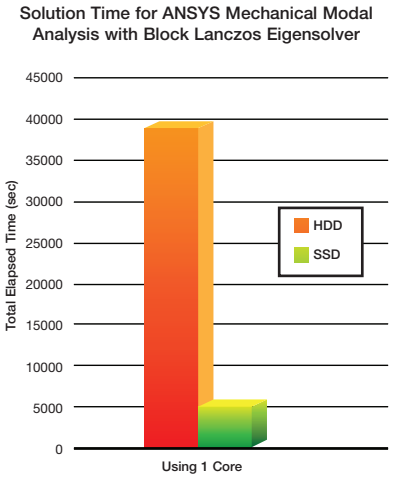
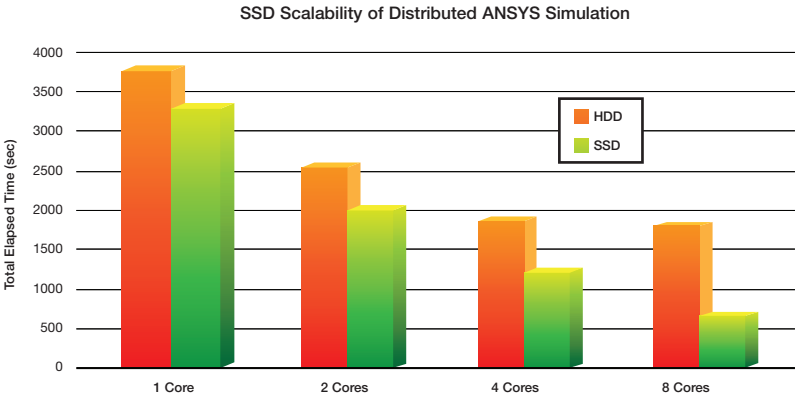
One of the main factors limiting the size of simulations that can be run on a workstation is the amount of physical memory (or RAM) available on the machine. More RAM can be added, but only so many slots are available on the machine, and high-capacity RAM is relatively expensive.

To help alleviate this difficulty, equation solvers often utilize vacant space on the hard disk drive (HDD) — the spinning media that provides a fairly inexpensive means for long-term storage of large amounts of data. A 250-gigabyte (GB) hard drive — about as small as you can get these days — can be purchased for only about $50 (U.S.), for example. The drawback is an order-of-magnitude speed penalty, with the relatively slow input/output (I/O) speed of the HDD generally below 100 MB/second often resulting in significantly longer run times.



For this study, approximately 1 million degrees of freedom (DOF) were analyzed for 200 frequencies. Elapsed times are compared for simulations on a workstation having two file systems: one with four SCSI 15k rpm hard disk drives, another with four Intel® X25-E 64GB SATA SSDs.



Considerable I/O was performed in an analysis requiring about 30 GB of disk space to run the ANSYS distributed sparse solver on a workstation containing only 24 GB of RAM. The reduced seek times for the SSD significantly improved I/O performance, thus helping to shorten solution time as more cores are involved.

This is where relatively inexpensive solid-state drives (SSDs) with minimal seek times in reading files can be utilized to dramatically quicken solution times — particularly with simulations involving high levels of I/O to be performed. While expensive relative to HDDs, SSDs are considerably faster than HDDs and are approximately two to three times less expensive than RAM for the same number of gigabytes. SSDs also offer several other advantages over HDDs, such as no noise and high mechanical reliability due to the lack of moving parts — although SSDs do consume more electricity than HDDs and have a useful life limited by the number of times data can be written and rewritten at a given location.

Using SSDs with software from ANSYS is fairly straightforward. Once the working directory for the software is set to the SSD file system, all I/O requests done by the software will then utilize the SSD. The recommended configuration for multiple drives is RAID-0 (redundant array of independent disks), which distributes data equally among them.

In ANSYS Mechanical software, solutions involving the sparse solver, distributed sparse solver or block Lanczos eigensolver running in the out-of-core memory mode typically perform the most amount of I/O and, therefore, see the most benefit from SSDs. In one such modal analysis, transferring 3 terabytes (TB) of data to and from the disk took nearly 40,000 seconds on a HDD versus about 5,000 seconds using SSDs — both in a RAID-0 configuration. In another case, a turbine analysis with the ANSYS distributed sparse solver requiring large amounts of I/O on an eight-core workstation was completed in less than 600 seconds with SSDs compared to more than 1,700 seconds on an HDD. For this simulation, each Distributed ANSYS process had to read/write its own set of files, resulting in a considerable number of I/O requests to be performed during solution. ■