



# TUNING COMPUTE PERFORMANCE

## NANYANG TECHNOLOGICAL UNIVERSITY TARGETS I/O BOTTLENECKS TO SPEED UP RESEARCH

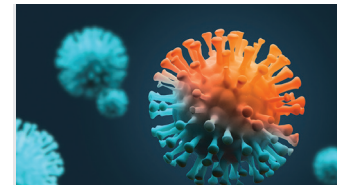
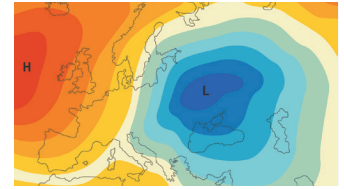
### About the Customer

Nanyang Technological University (NTU) Singapore is a research-intensive public institution that supports around 33,000 students and 10,000 staff in engineering, science, business and humanities, arts, social sciences, and medicine. NTU is one of the world's most prestigious universities and it's among the oldest in Singapore, with the nation's largest campus at nearly 500 acres. NTU's High Performance Computing Centre (HPCC) was established in 2010 to support the university's large-scale and data-intensive computing needs, and the need for resources continues to grow.



Altair delivered what we want from I/O profiling and even more. The data in Mistral is very clearly presented. By using the metrics we have gathered with Mistral we can identify the applications suited for the cloud and what runs best on-premises. This is important when planning our hybrid cloud environment.

Melvin Soh Hwee Jin,  
Senior Assistant Director,  
High Performance Computing  
Centre, Centre for IT  
Services, NTU



### Their Challenge

With more than 4,500 CPU cores, 40 NVIDIA Tesla GPGPU cards, 2,700TB storage, 100GB InfiniBand interconnect, and 40G/100G Ethernet backbone with technical support, HPCC churned out nearly **19 million core CPU-hours and nearly 300,000 GPU-hours** in 2021 to enable more than 160 NTU researchers. The HPCC digital community has grown to nearly 800 NTU members, and as its ranks continue to increase, the number of HPC and AI applications is growing rapidly. HPCC's small, four-engineer team turned to Altair for cutting-edge tools to help support their growing user community and evaluate scaling up to a hybrid cloud environment. They needed job-level insights to understand runtime issues; metrics on I/O, CPU, and memory to identify bottlenecks; and the ability to detect problematic applications and rogue jobs with bad I/O patterns that could overload shared storage. The HPCC team would **translate these insights into informed business intelligence**.

The HPCC team at Nanyang Technological University Singapore uses Mistral to tune and optimize their high-performance computing.

### Our Solution

The HPCC team deployed Altair Mistral™ to profile application I/O and **determine the most efficient options to optimize HPC** at NTU. Performance for the popular Gaussian chemistry application was measured with three different types of storage: local NVMe, tier 1 scale-out all-flash NAS, and tier 2 scale-out NAS with SSD/HDD. Mistral measured the application's job-run characteristics based on several parameters including read and write counts, read and write bytes, memory usage, processing time, and I/O latency. The metrics revealed the strengths and weaknesses of each type of storage. Local NVMe was fastest, completing the job in 32,208s. Tier 2 scale-out NAS with SSD/HDD finished second with 34,326s, and last was tier 1 scale-out all-flash NAS at 40,746s. This matched the results of read bandwidth, indicating that mean read performance is the bottleneck for this application. With I/O profiling using Mistral, NTU's HPCC team can now find the best-fitted nodes for application requirements and determine the **most affordable, best-performing storage** for different application types — and know which are best-suited for cloud vs. on-premises infrastructure.

### Results

As computing capacity and resources expand, benchmarking applications and hardware becomes critical to **ensure the best return on investment**. Using Mistral, the HPCC team at NTU Singapore determined that a hybrid architecture with different storage media and a good L3 cache could be more performant and cost-effective than focusing only on a single storage medium, especially if the OS can utilize the various strengths of each medium. They'll continue to collect metrics for additional applications and perform more tuning and optimization to support education and research. The HPCC team is happy with Mistral's results and with Altair. "A good product is not just good software, but more importantly a good supporting engineering team," says Melvin Soh Hwee Jin, Senior Assistant Director, High Performance Computing Centre, Centre for IT Services at NTU. "**Altair has raised the bar on what is truly personal and professional support for customers.**"