This case study was created as part of the free and voluntary UberCloud Experiment

Prediction of Barehull KRISO Containership Resistance in the Cloud

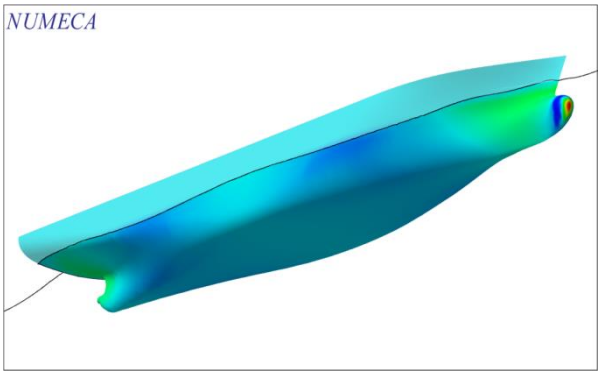
Use Case

In this project, we calculated the barehull resistance of the KRISO containership (KCS) in the cloud. The KRISO containership is a standard hull form frequently used as a benchmark case for computational fluid dynamics in the marine industry. Both basic hull form parameters and experimental results are available in published literature. Detailed information for the KCS test case is also available on the internet here:

https://www.nmri.go.jp/institutes/fluid_performance_evaluation/cfd_rd/cfdws05/

The purposes of this project were to become familiar with the mechanics of running a FINE/Marine simulation in an UberCloud container and to assess the performance of the available hardware compared to resources currently used by the end-user. The benchmark case was analyzed on local hardware, on virtual instances in the cloud, and on the bare-metal cloud solution offered by CPU 24/7 and UberCloud. All simulations were run using version 4 of Numeca's FINE/Marine software.

The cloud resource provider CPU 24/7 GmbH is a leading provider of CAE as a Service solutions for all application areas of industrial and academic /university research and development. Headquartered in Potsdam/Germany, CPU 24/7 develops and operates unique on demand services for High Performance Computing that are based on the latest globally accepted industry standards for hardware, software, and applications.



Setup

No challenges were experienced in downloading project files into the FINE/Marine container, running the simulation, or retrieving data. The remote desktop user interface was responsive without any significant delays. Logging into the system is simple and the Numeca software pre- installed in an UberCloud container runs without any user setup. The only user setup required is to adjust the display resolution.

THE TEAM

- ***End User and Team Expert*** – Justin M. Morgan, PE Principal, Ocean Engineering & Analysis, Glosten Inc.
- ***Software Provider*** – Aji Purwanto, Business Development Director, NUMECA
- ***Resource Provider*** – Richard Metzler, Software Engineer, CPU 24/7 GmbH
- ***Technology Experts*** – Hilal Zitouni Korkut and Fethican Coskuner, UberCloud Inc.

"A responsive graphical user interface, novel container technology, and an outstanding hardware performance make CPU 24/7 a viable alternative to local server acquisition and management."

PROCESS AND BENCHMARK RESULTS

The simulation was setup as a steady state solution, fixed in trim and heave to duplicate the conditions of the experimental data. The half model mesh contains 1.6 million cells. Simulation control variables in FINE/Marine were as follows:

300 time steps

Uniform time step = 5 sub-cycles, 8 non-linear iterations

The solution converges to a steady state resistance force within about 150 time steps; however, the simulation was allowed to run to completion on all platforms to provide a performance comparison.

The calculated total resistance coefficient for this model is 0.003574 compared to the experimental result of 0.00356, a 0.4% difference. Figure 1 illustrates the calculated wave field (top) compared to measured data (bottom).

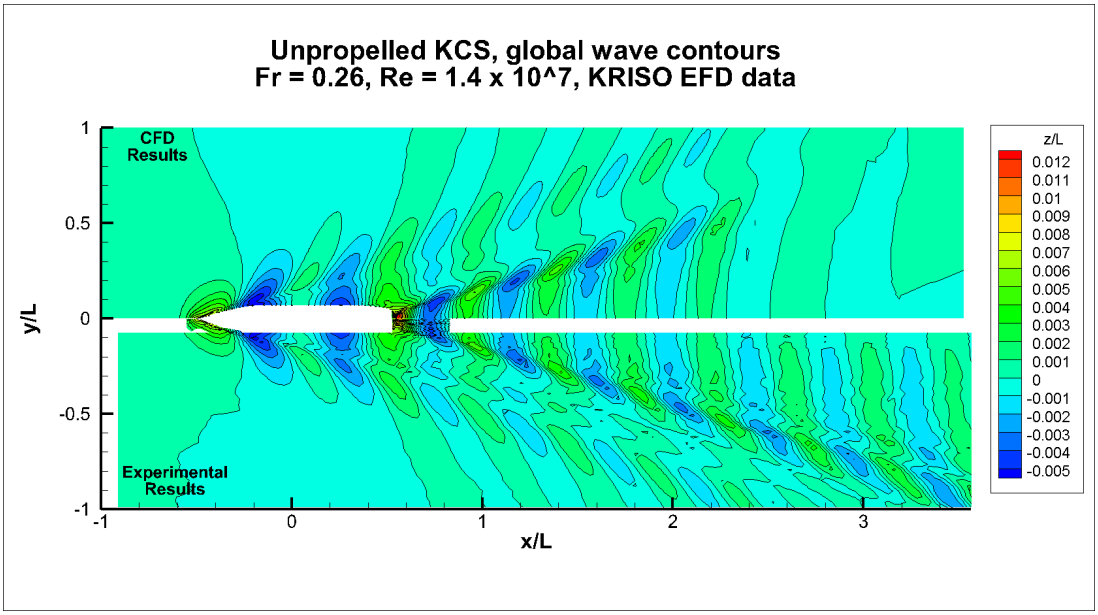


Figure 2: Comparison of experimental and calculated results.

The processors available through the UberCloud container provide a significant improvement in performance over local Glosten hardware and over virtual instances available through Amazon Web Services (AWS). The AWS compute instance used here is the third generation, c3.8xlarge. A fourth- generation compute instance is available on AWS with Intel Xeon CPU E5-2666 v3; however, setting up a new virtual instance was considered too costly for this project.

Platform	Processor	FINE/Marine	Cores	Time[hrs]
Local	Intel Xeon CPU E5645 @ 2.4 GHz x 2	v4.2	12	6.9
UberCloud	Intel Xeon CPU E5-2690 v3 @ 2.6 GHz x 16	v4.1	12	3.0
UberCloud	Intel Xeon CPU E5-2690 v3 @ 2.6 GHz x 16	v4.1	16	2.5
UberCloud	Intel Xeon CPU E5-2690 v3 @ 2.6 GHz x 16	v4.1	24	1.7
AWS	Intel Xeon CPU E5-2690 v3 @ 2.6 GHz x 16	v4.2	16	3.5
AWS	Intel Xeon CPU E5-2690 v3 @ 2.6 GHz x 16	v4.2	24	2.9

Figure 3: Performance comparison. The difference between v4.2 and v4.1 is only in patches not affecting performance.

BENEFITS AND LESSONS LEARNED

Benefits

This use case helped us understand the performance benefits offered by UberCloud and its partners. Glosten considers the UberCloud service to be a viable alternative to a local server upgrade. Additional benefits include the on-demand access and use of the software and hardware resources, a reduction in overhead required to manage virtual instances and to maintain software updates.

Conclusions

- We showed that the CPU 24/7 HPC bare-metal cloud solution provides performance advantages for Numeca FINE/Marine users who want to obtain higher throughput or analyze larger, more complex models.
- CPU 24/7 and UberCloud effectively eliminate the need to maintain in-house HPC expertise.
- The container approach provides immediate access to high performance clusters and application software without software or hardware setup delays.
- The browser-based user interface is simple, robust, and responsive.

UberCloud Application Containers for Numeca FINE™/Marine

UberCloud Containers are ready-to-execute packages of software. These packages are designed to deliver the tools that an engineer needs to complete his task in hand. In this experiment, the FINETM/Marine software has been pre-installed, configured, and tested, and were running on bare metal, without loss of performance. The software was ready to execute literally in an instant with no need to install software, deal with complex OS commands, or configure.

The UberCloud Container technology allows wide variety and selection for the engineers because the containers are portable from server to server, Cloud to Cloud. The Cloud operators or IT departments no longer need to limit the variety, since they no longer have to install, tune and maintain the underlying software. They can rely on the UberCloud Containers to cut through this complexity.

This technology also provides hardware abstraction, where the container is not tightly coupled with the server (the container and the software inside isn't installed on the server in the traditional sense). Abstraction between the hardware and software stacks provides the ease of use and agility that bare metal environments lack.

FOR MORE INFORMATION

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