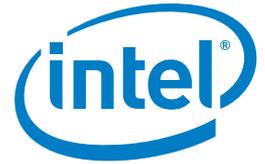


CASE STUDY

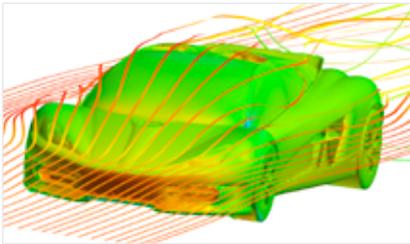
Intel® Software Development Tools

Intel® Fortran Compiler, Intel® C and C++ Compiler,
Intel® MPI Library, Intel® Trace Analyzer and Collector,
Intel® Cluster Ready



Altair and Intel Help Engineers to Analyze Complex Designs, Faster

Sophisticated simulation software breaks through performance barriers



"CFD simulations are notoriously computationally intensive. Along with robustness and accuracy, great parallel performance and scalability are keys for solving large CFD problems. These capabilities can be further realized with well-architected, high performance computing hardware such as Intel's—contributing to faster time-to-market."

— Farzin Shakib,
Vice President, CFD Technology,
Altair Engineering, Inc.

OVERVIEW

Working in collaboration with Intel's technical support team and utilizing key Intel® software development tools, Altair was able to improve performance, scalability, and time-to-results for AcuSolve®, a leading computer-aided engineering (CAE) application.

Altair specializes in simulation technology that helps clients analyze, simulate, visualize, and manage complex information. Altair's computational fluid dynamics (CFD) solution, AcuSolve, exemplifies the company's dedication to meeting the demands of intensive-design workloads.

AcuSolve is an industry-leading, general purpose, finite element-based CFD simulation software application within Altair's HyperWorks® suite of CAE products. HyperWorks is a simulation software platform for rapid design exploration and decision making. It provides a tightly integrated suite of best-in-class tools for all facets of the simulation process, including modeling, analysis, optimization, visualization, reporting, and collaborative knowledge management. Leveraging a revolutionary pay-per-usage licensing model, this comprehensive, open-architecture CAE solution can be used for linear and nonlinear structural analysis, structural optimization, computational fluid dynamics simulation, multiphysics simulation, and multibody dynamics applications.

Based on a sound mathematical foundation, AcuSolve is highly differentiated by its solution speed, parallel scalability, accuracy, and robustness, and is capable of efficiently solving complex and large scale industrial CFD problems.

THE CHALLENGE

Ever-increasing design complexity and shortened time-to-market requirements compel today's CFD software to tackle the largest problems with both efficiency and accuracy. At the same time, CFD solutions must support a high degree of parallel scalability.

THE SOLUTION

Altair's HyperWorks products take advantage of the high-performance capabilities and reliability in Intel® compilers and the Intel® MPI Library.

Key to improving an application's performance is understanding and profiling its behavior with powerful analysis tools. For this project, the technical support team at Intel helped Altair to diagnose one of the parallel bottlenecks in AcuSolve and to test the improved method. Intel® software development tools were used to help identify areas for improvement, resulting in an increase in performance and scalability.

Says Altair Vice President Farzin Shakib, "CFD simulations are notoriously computationally intensive. Along with robustness and accuracy, great parallel performance and scalability are keys for solving large CFD problems. These capabilities can be further realized with well-architected, high performance computing hardware such as Intel's—contributing to faster time-to-market."

Improved Performance

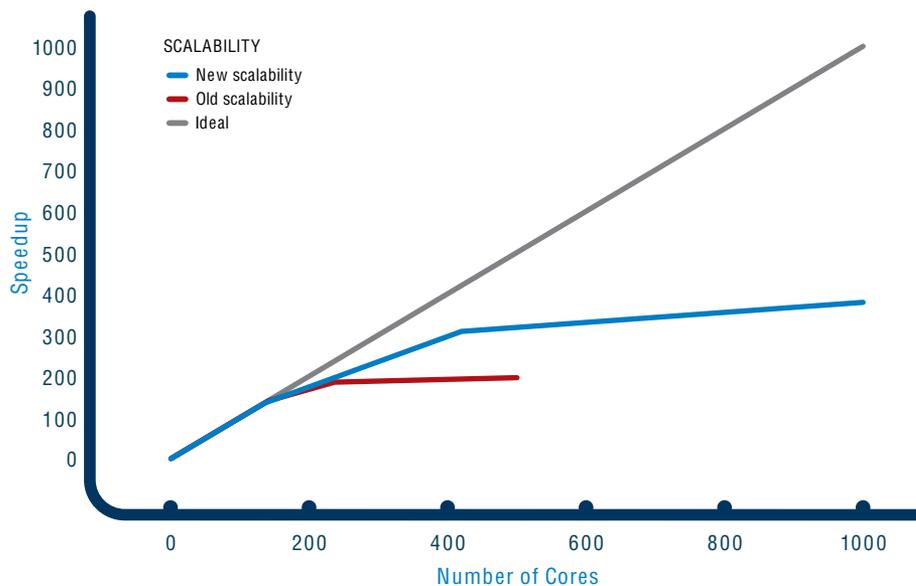
Maintaining high performance at higher core counts is critical for AcuSolve to compete in the CFD market. Thanks to the Intel® mpitune utility—delivered as a part of the Intel MPI Library—Altair engineers were able to fine-tune AcuSolve's parallel algorithms. This helped to increase the parallel performance beyond 500 processors.

Improved Scalability

Intel also collaborated with the AcuSolve team to improve the scalability of AcuSolve on a 13M-node customer wind tunnel test case. With the Intel® Trace Analyzer and Collector, Intel was able to diagnose a bottleneck and achieve a 30 percent performance gain using a different setting in collective communications. Subsequently, the AcuSolve team used Intel mpitune to automatically find the best settings in collective communications tailored to the customer's cluster. Using mpitune in addition to a few other changes in the parallel core of AcuSolve, resulted in significant improvements to the parallel efficiency of the code.

As an example, the parallel scalability for the simulation of air around a car that previously could scale only up to 500 cores is now extended to 1000 cores. Further testing is underway to explore scaling beyond 1000 cores.

New AcuSolve Scalability on 13m Nodes Test Case



	Number of Cores	Finite Element Nodes	Speedup
NACA0012 Airfoil - Steady	72	97,636	1.82x
Road Sign - ALE	240	1,818,405	1.37x
Wind Turbine Rotor - Steady	240	4,571,720	1.66x
Wind Turbine FSI - Steady	240	7,593,941	1.59x
Rotor - Sliding Mesh	120	4,983,066	1.22x
F1 Race Car - Steady	240	4,803,366	1.44x
Sedan Model - Unsteady	240	10,876,592	1.17x

Table 1

Altair found that the integration of mpitune within the solver was relatively straightforward and is now shipping the Intel® MPI tuner with AcuSolve. It can be invoked automatically by the user while performing a CFD simulation. It's simple to use, so AcuSolve users do not need any advanced skills to perform the tuning.

AcuSolve was measured for speedup due to improvement of parallel efficiency for a variety of engineering applications. Table 1 summarizes the demonstrated improvements for these applications.

End User Advantage

With the latest version of AcuSolve, CFD users are able to tackle bigger challenges and solve problems in a shorter time frame. In addition, maximum parallel performance can now be achieved using the built-in Intel mpitune utility for targeted problems on specific cluster configurations.

Conclusion

Highly differentiated through speed, robustness, and accuracy, Altair's AcuSolve has achieved a premier brand status within the CFD market space. Thanks to the improvements made possible with the help of Intel software development tools and support, Altair is confident that it will continue to deliver high-quality, scalable simulation products.

About Intel® Software Development Tools

Intel has been providing standards-driven tools for developers in the high performance computing industry for over 25 years. These include industry-leading Intel® Fortran, C, and C++ compilers, and performance profiling and analysis tools, such as Intel® VTune™ Amplifier XE, Intel® Inspector XE, and Intel® Trace Analyzer and Collector. Performance libraries and programming models, such as Intel® MPI library, Intel® Math Kernel Library, Intel® Cilk™ Plus, and Intel® TBB provide developers the tools needed to build applications for today and scale forward for tomorrow.

Learn more about Intel® software development tools at <http://software.intel.com/en-us/intel-sdp-home/>.

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Altair empowers client innovation and decision making through technology that optimizes the analysis, management, and visualization of business and engineering information. Privately held, with more than 1,500 employees, Altair has offices throughout North America, South America, Europe, and Asia Pacific. With a 26-year track record for high-end software for engineering and computing, enterprise analytics solutions, and innovative product design and development, Altair consistently delivers a competitive advantage to customers in a broad range of industries.

To learn more about Altair, please visit www.altair.com or www.simulatetoinnovate.com.



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