



## Success Brief

Intel® Developer Products

Intel® HPC tools

Manufacturing and Industrial



“This breakthrough delivers the missing link for CAE-driven design in vehicle safety. This, combined with our new hybrid solver approach, has enabled us to eliminate the turnaround time bottleneck inherent to virtual crash testing. Now, multidisciplinary optimization for crash, durability, and NVH will be able to provide valuable input to the design process.”

Dr. Uwe Schramm  
CTO for HyperWorks  
Altair Engineering, Inc.

# Creating a new standard in virtual crash testing

**Altair advances frontal crash simulation with help from Intel® Software Development products.**

Company	Altair Engineering, Inc. 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 1,300 employees, Altair has offices throughout North America, South America, Europe, and Asia/Pacific. With a 25-year track record for product design, advanced engineering software, and cloud computing technologies, Altair consistently delivers a competitive advantage to customers in a broad range of industries. Built on a foundation of design optimization, performance data management, and process automation, HyperWorks is an enterprise simulation solution for rapid design exploration and decision making. To learn more, please visit <a href="http://www.altair.com">www.altair.com</a> and <a href="http://www.altairhyperworks.com">www.altairhyperworks.com</a> .
Mission	Deliver the first simulation code to solve a full vehicle frontal crash simulation with more than 1 million elements in less than five minutes.
Product	RADIOSS is a next-generation finite element analysis (FEA) solver for linear and non-linear simulations. It can be used to simulate structures, fluids, fluid-structure interaction, sheet metal stamping, and mechanical systems. This robust, multidisciplinary solution allows manufacturers to maximize durability, noise and vibration performance, crashworthiness, safety, and manufacturability of designs in order to bring innovative products to market faster.
Challenge	Use state-of-the-art hybrid programming mixing different parallelization techniques to achieve more scalability and deliver optimal performance for very large number of processors.
Results	The five-minute goal was successfully exceeded (294s achieved using 1024 cores [128 MPI x 8 OpenMP*]) and overall performance has been increased by 10x.
Impact	Altair improved customer satisfaction by exceeding customer performance and timeline requirements.



## Intel® Software Development Products

Intel® high-performance computing (HPC) products are designed specifically for software developers using the C++ or Fortran programming languages.

Leveraging leading multicore compilers, libraries, and cluster tools, Intel HPC products give you everything you need to build, debug, tune, and optimize Windows\*, Linux\*, and Mac OS\* X-based applications.

With Intel's powerful HPC tools, you can speed development of reliable threaded applications from desktop to device, enabling you to innovate, optimize end-user experiences, and pull more from the latest Intel® multicore processors.

### A complete, end-to-end solution

Intel HPC tools work together to support the entire development lifecycle.

### Build: Develop for intensive computing

Intel® Professional Edition Compilers  
Intel® Threading Building Blocks  
Intel® Integrated Performance Primitives  
Intel® Math Kernel Library

### Correct: Find errors

Intel® Thread Checker

### Optimize: Tune your app

Intel® VTune™ Performance Analyzer

### Cluster: Implement cluster apps

Intel® Thread Profiler  
Intel® Cluster Toolkit  
Intel® Cluster Toolkit Compiler Edition  
Intel® Trace Analyzer and Collector  
Intel® MPI Library  
Intel® Cluster Ready

To enjoy a free 30-day evaluation of Intel® HPC products, visit the Intel® Evaluation Center: [www.intel.com/software/products/eval](http://www.intel.com/software/products/eval).

## Challenge: Why Altair's products benefit from utilizing parallelism

Virtual crash tests are one of the most time-consuming tasks in the automotive development process. Altair wished to demonstrate the feasibility of a new analysis process that drastically reduces the simulation time needed for virtual crash testing. In terms of the product lifecycle, it sought to reduce both prototyping costs and time to market—two key competitive advantages for Altair customers.

Massively parallel programming enables very good scalability using domain decomposition techniques and an MPI communication library; such scalability tends to decrease as the number of processors increases and the amount of data to compute decreases.

Altair used state-of-the-art hybrid programming mixing different parallelization techniques (MPI and OpenMP) to achieve more scalability and deliver optimal performance at very large number of processors. To accomplish its goal, Altair leveraged the optimization made possible by Intel® compilers, libraries, and tools to sustain the required efficiency. There exists no real alternative to achieve the necessary level of performance.

## Results

The five-minute goal was successfully exceeded (294s achieved using 1024 cores [128 MPI x 8 OpenMP]) and overall performance was increased by 10x. As a result of hybrid programming, scalability of the code demonstrated up to 1024 cores. In addition, a new numerical algorithm, called Advance Mass Scaling (AMS), decreased computational costs.

Altair enjoyed improved customer satisfaction by exceeding current customer performance and timeline requirements by enabling faster evaluate design variant evaluations and less time-consuming design sensitivity and robustness analysis. For the market, this advancement can be considered a disruptive approach by cutting simulation time from the hours previously required to minutes, making possible new processes and advancements in virtual crash testing such as finer meshes, integration of better material laws with rupture, optimizations, and scatterings, etc. By decreasing the delay of virtual crash testing, both time to market and costs can be drastically decreased.

## How Intel® Software Development products assisted

To meet its speed, scalability, and performance objectives, Altair incorporated a range of Intel Software Development tools, including the following:

- Intel® compilers
- Intel® VTune™ Performance Analyzer
- Intel® Cluster Toolkit
- Intel® Trace Analyzer and Collector
- Intel® MPI Library

Altair and Intel were also able to leverage the Intel® Xeon® processor 5500 series-based clusters and deliver substantial performance improvement for crash simulations. This improvement will have long-term benefits for the industry.

Finally, Intel provided technical help for running and optimization, access to computing resources, and marketing support.

## Optimization Notice

Intel® compilers, associated libraries and associated development tools may include or utilize options that optimize for instruction sets that are available in both Intel® and non-Intel microprocessors (for example SIMD instruction sets), but do not optimize equally for non-Intel microprocessors. In addition, certain compiler options for Intel compilers, including some that are not specific to Intel micro-architecture, are reserved for Intel microprocessors. For a detailed description of Intel compiler options, including the instruction sets and specific microprocessors they implicate, please refer to the “Intel® Compiler User and Reference Guides” under “Compiler Options.” Many library routines that are part of Intel® compiler products are more highly optimized for Intel microprocessors than for other microprocessors. While the compilers and libraries in Intel® compiler products offer optimizations for both Intel and Intel-compatible microprocessors, depending on the options you select, your code and other factors, you likely will get extra performance on Intel microprocessors.

Intel® compilers, associated libraries and associated development tools may or may not optimize to the same degree for non-Intel microprocessors for optimizations that are not unique to Intel microprocessors. These optimizations include Intel® Streaming SIMD Extensions 2 (Intel® SSE2), Intel® Streaming SIMD Extensions 3 (Intel® SSE3), and Supplemental Streaming SIMD Extensions 3 (Intel® SSSE3) instruction sets and other optimizations. Intel does not guarantee the availability, functionality, or effectiveness of any optimization on microprocessors not manufactured by Intel. Microprocessor-dependent optimizations in this product are intended for use with Intel microprocessors.

While Intel believes our compilers and libraries are excellent choices to assist in obtaining the best performance on Intel® and non-Intel microprocessors, Intel recommends that you evaluate other compilers and libraries to determine which best meet your requirements. We hope to win your business by striving to offer the best performance of any compiler or library; please let us know if you find we do not.

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