

## CASE STUDY

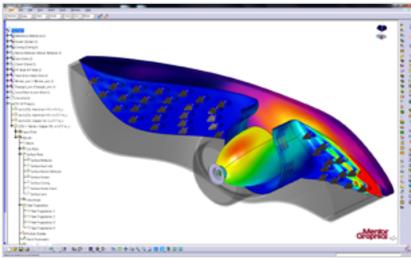
### Intel® Software Development Tools

Intel® Parallel Studio XE, Intel® VTune™ Amplifier XE,  
Intel® Threading Building Blocks



# Mentor Graphics Speeds Design Cycles with Intel® Software Tools

Thermal simulations get the performance boost for faster time to market



"We achieved a significant improvement of almost 2x even on one core by optimizing the code based on the information provided by Intel® VTune™ Amplifier XE. Good scalability resulted from the combination of Intel® Threading Building Blocks (Intel® TBB) and OpenMP\* parallelization techniques. We achieved more than 8x the performance of the previous version on 8 cores, and almost 11x the performance on 16 cores."

*-Alexey Andrianov,  
R&D Deputy Director,  
Mechanical Analysis Division,  
Mentor Graphics Corporation*

## OVERVIEW

Mentor Graphics specializes in electronic design automation software. Customers in diverse industries—including aerospace, automotive, electronics, general manufacturing, power generation, and sports performance—rely on Mentor Graphics solutions to conduct the sophisticated simulations necessary to develop electronic products faster and more cost-effectively. Mentor Graphics' Mechanical Analysis Division (formerly Flomerics) provides thermal simulation and analysis software to help eliminate mistakes, reduce costs, and accelerate and optimize designs involving heat transfer and fluid flow before physical prototypes are built.

Mentor Graphics' upfront analysis solutions include FloEFD\*—offering concurrent CAD-embedded CFD for 3D fluid flow and heat transfer analysis—and the FloTHERM® family of IC, PCB, and systems thermal simulation solutions.

## THE CHALLENGE

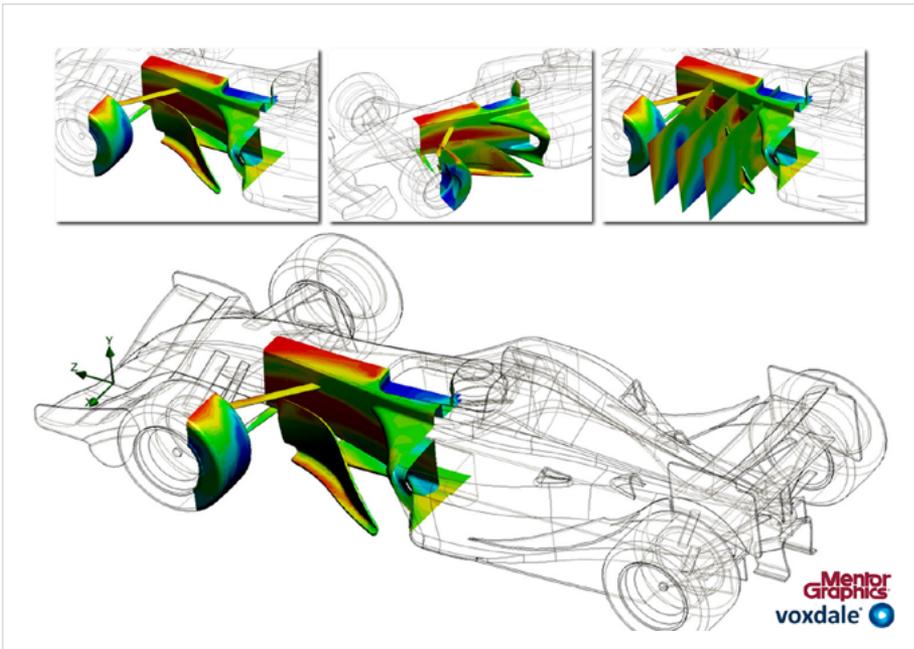
As products become increasingly complex, engineers need to simulate real-life conditions for more complicated designs. Processing speeds for very large problems can take a significant amount of time. Because all manufacturers are interested in reducing design cycles, any improvements which help speed up the process are highly valued by users. Mentor Graphics' experts strive to provide customers with the tools they need to simulate designs quickly and effortlessly.

Rewriting Mentor Graphics' legacy serial code into parallel code was a challenging task, requiring specialized expertise. Once parallelized, the code needed accurate and thorough debugging. In many cases the OpenMP\* pattern of fork-join-fork-join defined limitations for scalability which needed to be overcome. Finding and fixing bottlenecks was key for both serial and parallel code.

## THE SOLUTION

Mentor Graphics looked to Intel for the tools to increase parallelization, provide accurate debugging, reduce or eliminate bottlenecks, and accelerate overall software performance. In particular, it wanted to apply these benefits to mesh generation in the latest version of its FloEFD software.

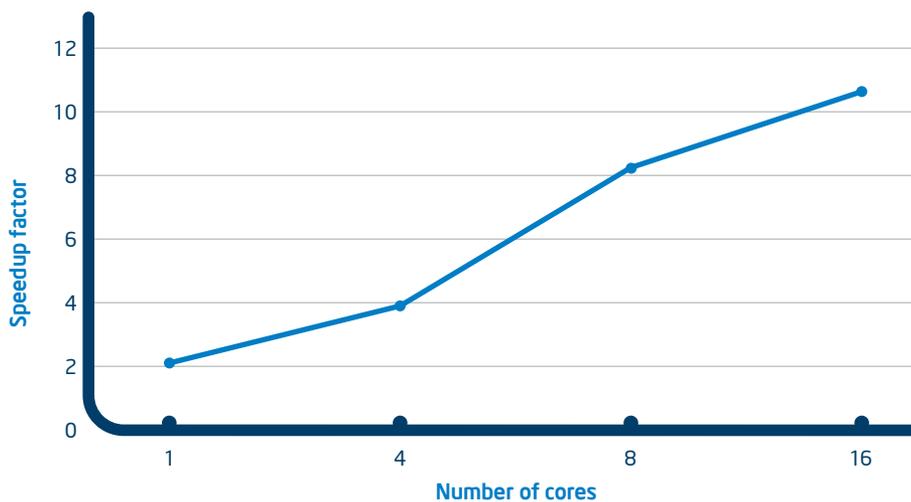
Along with its parallel programming tools, Intel provided timely technical support and access to training to shorten the learning curve. Says Alexey Andrianov, R&D deputy director of Mentor Graphics' mechanical analysis division, "Intel helped us to use Intel® Parallel Studio XE, which opened new opportunities for further improving performance of our EFD based products. As a result, we were able to obtain the best performance out of the hardware, in turn, enabling our customers to further shorten their design cycles."



## About Intel® Software Development Tools

Intel has been providing standards-driven tools for developers in the high performance computing industry for more than 25 years. Its industry-leading tools include Fortran, C, and C++ Compilers, as well as 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® Threading Building Blocks provide developers the tools needed to build applications for today and scale forward to tomorrow.

## Meshing Speed Up v13 vs v12



**Figure 1.** Average meshing time comparison between version 12 (serial code) and version 13 (parallel and optimized)

## RESULTS

Mentor Graphics achieved a significant improvement of nearly 2x even on one core through code optimization based on the insight provided by Intel® VTune™ Amplifier XE. Good scalability resulted from a combination of Intel® Threading Building Blocks (Intel® TBB) and OpenMP\* parallelization techniques. **More than 8x the performance of the previous version was achieved on 8 cores, and up to 11x the performance on 16 cores.**

Bottlenecks were overcome in memory allocation with the use of the Intel TBB library. Utilization of `tbb::task` concept allowed Mentor Graphics to parallelize complex algorithms in a way that had not been possible with the OpenMP paradigm. Intel VTune Amplifier XE offered an excellent tool for analysis of both parallel and serial code efficiency.

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R&D Deputy Director,  
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## KEY FINDINGS

- Nearly 2x improvement even on one core
- More than 8x performance gain on 8 cores
- Up to 11x performance gain on 16 cores
- Increased scalability
- Eliminated bottlenecks in memory allocation
- Parallelization of complex algorithms

## Conclusion

Mentor Graphics utilized Intel® software tools and parallelization methodologies to optimize its core products for complex simulations, resulting in improved accuracy and significantly increased performance. These benefits will have a direct impact on customers using Mentor Graphics' industry-leading thermal simulation software products, supporting faster time to market and accelerating the pace of innovation.

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

Explore Mentor Graphics simulation software solutions at: [www.mentor.com/mechanical](http://www.mentor.com/mechanical)

## MENTOR GRAPHICS SIMULATION SOFTWARE

**FloEFD\*** software is a full-featured 3D Computational Fluid Dynamics (CFD) simulation solution and enables users to analyze and optimize complex fluid flow and heat transfer effects on designs directly inside the preferred mechanical CAD (MCAD) environment. The award-winning FloEFD software is embedded in a range of commercial MCAD software products, including Creo\*, CATIA V5\*, and Siemens NX\*. The FloEFD software is based on EFD technology, which enables Concurrent CFD. As a result, design engineers can conduct upfront CFD analysis throughout the product's lifecycle, thus reducing design times by orders of magnitude compared to traditional methods and products. Concurrent CFD can reduce simulation time by up to 75 percent in comparison to traditional CFD tools. It enables users to optimize product performance and reliability, while reducing physical prototyping and development costs without time or material penalties.

**FloTHERM XT\*** is a unique 3D thermal simulation solution created for use during all stages of the electronics design process—from conceptual design to manufacturing—improving product quality, reliability, and time to market. FloTHERM XT is the industry's first integrated Mechanical Design Automation (MDA) and Electronics Design Automation (EDA) electronics cooling simulation solution to dramatically shorten the process. This electronics cooling simulation solution enables earlier virtual prototyping, fewer design iterations, and advanced "what-if" analysis for improved product quality and faster time-to-market benefits. Combining the electronics cooling DNA from FloTHERM thermal analysis software and Concurrent CFD technology from the FloEFD product, FloTHERM XT offers the power and performance to solve complex electronics systems design problems.



For more information regarding performance and optimization choices in Intel® software products, visit <http://software.intel.com/en-us/articles/optimization-notice>.

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