CASE STUDY: Convergent Science ignites combustion simulation performance with Allinea Forge

CHALLENGE
Developing faster and more capable software to meet the growing demands of their clients for precision and performance.

SOLUTION
Allinea Forge, the development tool suite for debugging, profiling and optimizing high performance software.

RESULTS
Convergent Science’s clients are producing higher quality engine simulations faster than ever

“With Allinea Forge we increased our performance scaling, enabling our clients to run much more efficiently on hundreds of processors.”

Convergent Science is a world leader in internal combustion engine (ICE) simulation. With its primary clients based within the automotive industry, it is a major player in this specialized market.

The speed and capability of its CONVERGE computational fluid dynamics (CFD) software is vital to the company’s success, but developing high performance software to take advantage of the size of today’s systems and to meet customer demands is challenging.

Identifying bugs and performance issues was inefficient with their previous methods.

Joshua Strodtbeck, Senior Research Engineer at Convergent Science, explains, “Our immediate problem was not being able to debug efficiently in parallel and that led us to explore Allinea Forge. Now we are also using it extensively to improve our software performance.”

Allinea Forge, the industry standard development tool suite for high performance computing, combines the powerful debugging and profiling tools Allinea DDT and Allinea MAP to provide everything needed to debug, profile and optimize software.

Increasing Performance
Convergent Science is saving development time and has increased the performance of CONVERGE, which in turn has allowed the company to stay ahead of the competition by adding value and generating results for their customers.

Strodtbeck explains: “When we originally designed our software, the market we were targeting rarely ran on more than eight processors.
Now the market demand is for much larger scales of computing. Allinea MAP has proven to be an excellent tool for identifying the bottlenecks in our programmes and assessing the validity of different high performance computing strategies.

**From Two Hours down to Four Seconds**

“It’s had a huge payoff. I took one of our standard cases and ran it through MAP and could see all the bottlenecks. I knew right away where to start chasing things down.”

“MAP breaks performance down in a nice visual way, detailing which routine is costly and why.”

“In one area, MAP highlighted a huge spike in the network code as a problem, detailed why and showed how much time it was spending in MPI transfer.”

“We nailed down how to do that bit in a different way and brought the time down from two hours to four seconds!”

**Accelerating development**

Strodtbeck believes Allinea Forge’s integration of the profiler MAP and debugger DDT helps them to handle the complexity of their software and identify problems much more quickly. The combination of MAP and DDT gives a deeper insight into the cause of the bottlenecks.

In one case, he adds, “Using DDT and breakpoints I looked at the floating point calculations and found why some of the routines were taking a very long time to reach the barrier. A particular routine did not cause a bottleneck until we reached a large number of processors due to non-linear scaling. The way MAP shows which specific lines occupy the most execution time allowed us to quickly identify not just the problematic function, but the specific loop within it.”

“At the end of a project the first thing I do is run it in DDT. Using the tool proactively helps me find and solve problems much more quickly than when I used to debug reactively.”

**Higher Quality Simulations Faster**

Convergent Science’s clients are also benefiting from Allinea’s tools. Clients are achieving faster simulations and increased resolution, which lead to faster time to market and other competitive advantages in the marketplace.

Strodtbeck added, “We’ve increased our performance scaling, which enables our clients to run jobs much more efficiently on hundreds of processors.”

“We’re pushing CONVERGE to have as few bottlenecks as possible so that how you want to use your power is up to you. For an engine cylinder, we typically recommend keeping the simulation at approximately 2 million nodes (points). With our improved performance scaling, however, you can go up to 20 million nodes if you want, and you can run a huge simulation in a much shorter time.”

It’s evident that you need to be firing on all cylinders to stay ahead in the world of ICE and CFD, and with Allinea Forge, Convergent Science has ensured it is sparks ahead of the competition.