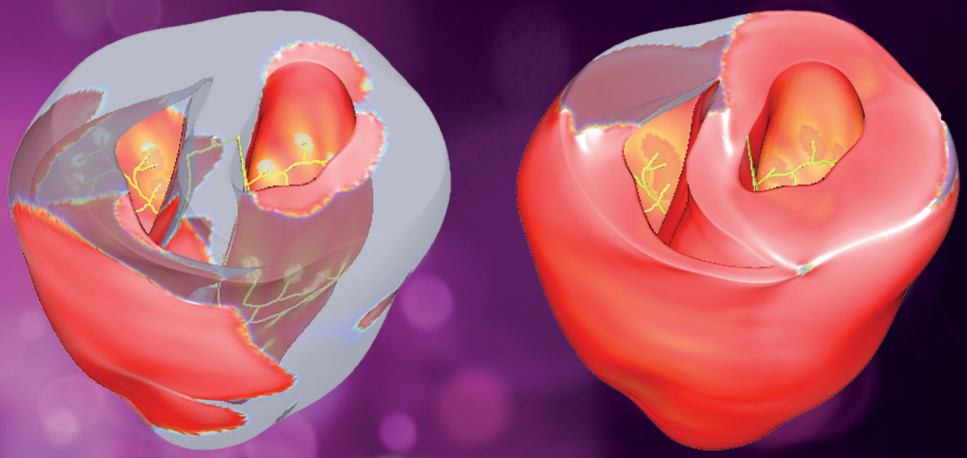
CASE STUDY Arm Forge gets to the heart of the matter at Institute of Biophysics, Medical University of Graz

arm FORGE

"The software developers in our group use Arm Forge on an almost daily basis, not only for finding and fixing errors but also in order to get a more profound insight into program execution and data states."



Medizinische Universität Graz

When Dr. Aurel Neic, postdoctoral researcher at the Institute of Biophysics, Medical University of Graz, and his team wanted to develop a simulation framework for the human heart, he turned, like so many scientific researchers, to the power of the supercomputer.

CHALLENGE

To advance and speed up important computational cardiology research, using the VSC-3 supercomputer, by quickly developing highly parallel numerical code which simulates the blood flow in a heart's ventricles and aorta, together with its associated management code.

SOLUTION

Arm Forge, a cross platform parallel code development suite providing a combined debugger (Arm DDT) and profiler (Arm MAP) for developers of high performance scientific codes which optimizes their time and the efficiency of their software.

Their goal is to simulate the electric, mechanic and haemodynamic (the forces associated with the flow of blood) phenomena in the heart in a coupled manner which requires a highly parallel numerical code, running on hundreds, if not thousands of CPU cores.

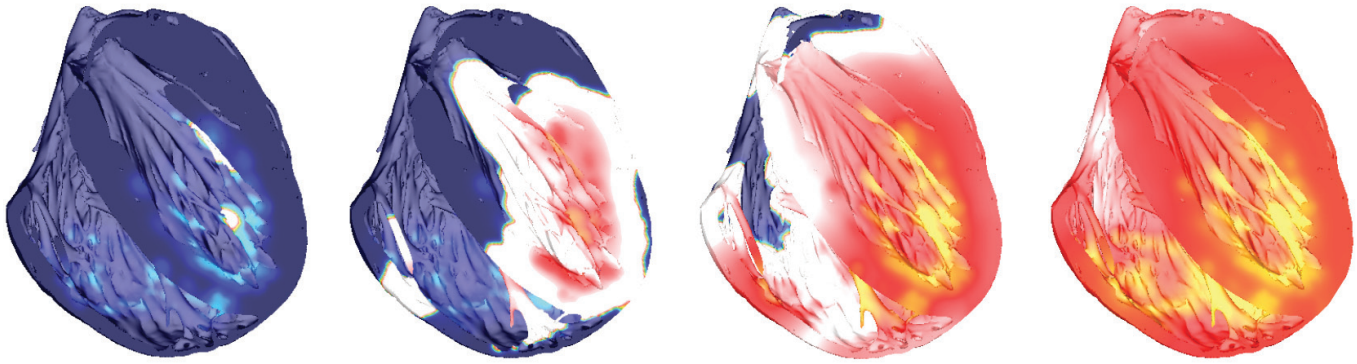
Dr Neic and his team were fortunate enough to be part of a group of eight universities who pooled resources in order to purchase the VSC-3 supercomputer. This supercomputer, located in the Science Centre of Vienna University, is made up of 2020 nodes, each with 16 processor cores – it has a computing power of more than 600 teraflops and can perform more than 600 trillion additions or multiplications in just one second. The collaboration means the universities involved can access a system that can hold its own against the top scientific supercomputers of the world.

For Dr Neic and the team working on the project, the ability to simulate the workings of the human heart brings a wealth of exciting possibilities to medical science. In the human heart, electrical, mechanical and hemodynamic phenomena take place at different spatial (the where) and temporal (the when) scales. Cardiac electrics are driven by ionic processes at cell level, which lead to electrical phenomena at tissue level (the conduction of currents).

DEVELOPING AND DEBUGGING

The research group develops a simulation framework called the Cardiac Arrythmia Research Package (CARP). The team uses Arm Forge to assist in developing and debugging the highly parallel numerical code and its associated management code.

arm



“Before using Arm Forge, we had problems debugging simulations that used more processes than the amount supported by a desktop machine, around eight to 12,” says Dr Neic. “Since our software routinely operates on process counts between 64 and 1024 processes, with benchmarks ranging up to 16,000 processes, we could not debug our code in the most relevant parallel execution scenarios.”

“Our software routinely operates on process counts between 64 and 1024 processes”

Without a parallel debugger they could only try to reproduce the error occurring on high process counts, on lower process counts where they had the tools to debug the code. Alternatively they could introduce a very fine-grained logging of the program state in order to find the error without debugging. Neither offered a viable solution and both were extremely time consuming, with a low success rate. So the team turned to Arm Forge.

PINPOINT FAILURES QUICKLY WITH DDT

Arm Forge provides a linux C, C++ and Fortran debugger (Arm DDT), designed to handle complex software projects. Arm DDT can swiftly solve problems such as which parts of the code are using most memory, show if there are memory leaks and whether your programme is deallocating.

With Arm DDT, developers can pinpoint failures quickly which is vital for researchers like the team at Graz. Faulty results can lead to faulty designs – and costly corrections later. Arm DDT gives a view of every process in a parallel job, showing exactly what lines of code are being executed so software issues can be quickly resolved.

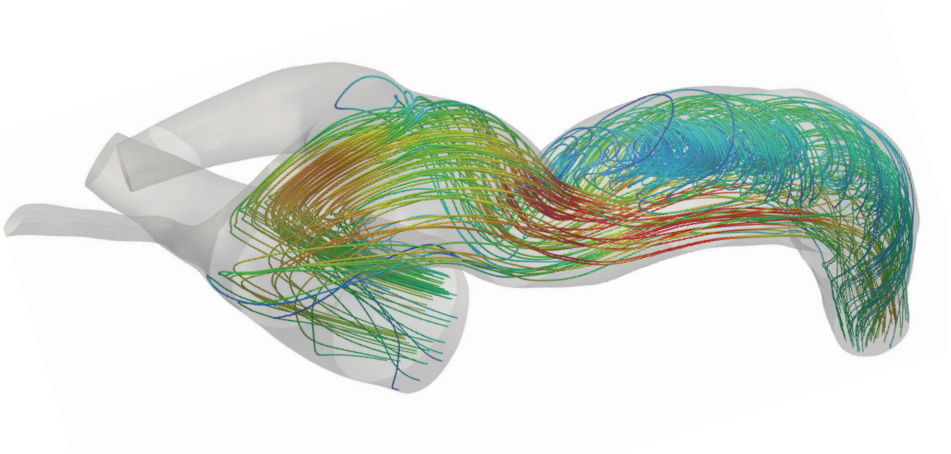
“Since acquiring Arm Forge, the software developers in our group have begun using DDT on an almost daily basis,” says Dr Neic. “Not only for finding and fixing errors but also in order to get a more profound insight into program execution and data states. This is because DDT offers tools beyond the core debugging functionality, for example, allowing a statistical analysis of data arrays.”

SPOT PERFORMANCE ISSUES EASILY WITH MAP

the Arm Forge development tool suite also includes the Arm MAP performance profiler. Thanks to the success of Arm DDT, the researchers at Graz have started to use Arm MAP for profiling too, allowing them to look deep into the performance of their code. Dr. Neic and his team have found Arm MAP to be incredibly straightforward and intuitive. With the interface giving an immediate overview of what their application is doing they can spot performance issues easily and make changes quickly, speeding up research and getting more work done.

“Arm DDT is an excellent product and we knew Arm MAP would be just as clear and simple”

“We chose Arm Forge because Arm DDT is an excellent product and we knew Arm MAP would be just as clear and simple. Together they have helped eliminate costly errors and allowed us to optimize our time. We are excited by the possibilities of what our research could bring and couldn’t be happier with Arm for helping us get there.”



arm

Arm Limited, Fulbourn Road, Cambridge, CB1 9NJ