

Research team improves code to benefit industrial engineers

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The Ohio Supercomputer Center's (OSC) Karen Tomko, Ph.D., and the University of Illinois/Urbana's Robert Dodds, Ph.D., recently wrapped up a project that will greatly enhance the simulation capabilities of manufacturing engineers.

Tomko and Dodds were co-principal investigators on the Intel Parallel Computer Center project, a two-year project with the goal of [code](#) modernizing WARP3D, an open-source code used by engineers to optimize the robotic welding process for heavy equipment. It is a code used in industry, government laboratories and academia for 3-D nonlinear analysis of solids using finite elements.

The Intel PCC program provides funding to universities, institutions, and research labs to modernize key community codes used across a wide range of disciplines to run on current state-of-the-art parallel architectures. The primary focus is to modernize applications to increase parallelism and scalability through optimizations that leverage cores, caches, threads, and vector capabilities of microprocessors and coprocessors.

"It was definitely an interesting project because WARP3D was developed as a research code but it has very practical applications in industry, so that makes it more rewarding," said Tomko, director of research software applications at OSC. "It's going to do more than just produce a research paper. It's going to help people designing heavy equipment, it will be used by industry engineers, in the energy and other

sectors working with large structures."

The code modernization project was a collaborative effort of Tomko and Dodds, a code developer and professor emeritus at the University of Illinois/Urbana, along with OSC's Samuel Khuvis, Ph.D., scientific applications engineer, and Jeremy Nicklas, Ph.D., web and interface app engineer.

"This was a project I was interested in for two reasons," Dodds said. "It was an opportunity to continue working with the OSC applications group, with Karen and her staff, as well as the interactions we were going to have with the Intel technical people. It was also an opportunity to re-examine the key parts of our code, to improve performance and reliability."

The major goal and accomplishment of the project was improving the code so it could run on multiple nodes on a supercomputer using Message Passing Interface (MPI), a portable message-passing system that functions on a wide variety of parallel computers.

"We've enabled larger, more complex models to be simulated," Tomko said. "Users can use the same input files whether they're running on two nodes, four nodes or eight nodes, and that was not the case when we got started."

The ability to solve larger problems is a major benefit to companies such as Caterpillar and EMC2, with which Dodds works closely on manufacturing research and development. These code improvements will help Caterpillar and other heavy machinery companies optimize their welding simulations.

"The interest is to predict the deformations of these large components caused by the robotic welding process," Dodds said. "It's a fairly severe

computational challenge.

"In terms of the efficiency of the code and reliability of the code, we can solve significantly larger numbers than we were able to handle before. It gives us confidence going forward that it can be used in simulations for manufacturing design, but also for defect assessment of existing components."

Because this code is open source, it offers a major benefit to smaller and mid-sized companies, according to Dodds.

"The technology transfer aspect of this is absolutely crucial," he said. "As soon as you get away from the largest companies, the ability to access the technical expertise needed to improve on a trial-and-error method of manufacturing design, as opposed to a simulation-based design becomes a huge challenge quickly as you downscale in size of companies. Having facilities like OSC, where companies can go for support and using open sourced software, is absolutely critical."

The code has already been used by a mix of academic, industry, and government labs all over the world, with thousands of downloads in the past year.

Provided by Ohio Supercomputer Center

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