From detonation to diapers: Los Alamos computer codes at core of advanced manufacturing tools

July 27 2011

Computational tools developed at Los Alamos National Laboratory to help ensure the reliability of the nation's nuclear weapons deterrent in the absence of testing are helping industry giants ensure the reliability of their manufacturing processes.

These specialized computer codes are now available to U.S. industry as part of President Barack Obama's recently announced advanced manufacturing initiative, designed to help make American companies more competitive and create new jobs.

Under a Cooperative Research and Development Agreement, LANL and Procter & Gamble have been collaborating for about two decades to incorporate computational technologies developed for national security into cutting-edge tools for advanced manufacturing. Among results of the collaboration, Los Alamos researchers and P&G engineers enlisted computer codes developed to model the flow, transport, and interaction of fluids and particles to help design a more efficient diaper manufacturing process. Further collaboration using Los Alamos statistical modeling tools led to creation of a comprehensive system, called Reliability Technology, that helped P&G reduce interruptions to production lines—saving the company billions of dollars in the process.

The Reliability Technology method is owned by Procter and Gamble and provides the ability to analyze failure modes of all components of the

production line. The beauty of Reliability Technology is its ability to "learn and adapt" when provided with data from actual production runs.

The Reliability Technology method has allowed P&G to remain competitive in U.S. manufacturing, helping the company design highly advanced manufacturing plants that employ skilled workers who use this cutting-edge technology to their advantage. With the help of Ernst & Young, P&G will make this innovative system available to other industries.

The computer codes used for predictive fluid modeling are part of the Los Alamos Computational Fluid Dynamics Library (CFDLib)—a software package that includes traditional and state-of-the-art computer modeling codes developed to solve problems related to the dynamic behavior of materials, particularly multiphase fluid flow in simple or complex geometries. Basic methodologies behind the codes date from the 1950s to the present, including many of the most recent developments found in the computational fluid dynamics literature, a significant number of which are unavailable in commercial software packages.

Common types of behaviors the codes can model are, for example, rain falling through the air, the transport of coal slurry through piping, or the initial mixing of coffee and milk. Physics models built into the codes include equations of state for non-ideal compressible materials, species diffusion within materials, and heat transport and exchange within, or among, materials. Consequently, the codes can be used to increase fundamental design confidence, reduce material costs, and reduce the time to market.

Use of the CFD library will require a significant level of knowledge in computational fluid dynamics. The code is intended for end-user problem solving and is not licensed for resale and redistribution. It

comes with no user support by Los Alamos; however, there is a broad-based user and applications knowledge community that can be tapped, and Procter and Gamble offers at no cost a front-end script to ease integration into innovation work practices.

Los Alamos's Technology Transfer Office is working on a mechanism to release the CFDLib as well as P&G's proprietary wrapper that allows industry users to more simply set software parameters.

"We are pleased to see that the problem solving methodologies developed at Los Alamos National Laboratory to help ensure the reliability of the nation's nuclear weapons stockpile are being used to help ensure the reliability and competitiveness of American manufacturing," said Terry Wallace, Principal Associate Director for Science, Technology and Engineering at LANL. "It is gratifying to know that our multidisciplinary science can serve the nation in so many ways."

Provided by DOE/Los Alamos National Laboratory