OVERTURE AND RAPSODI: TOOLS FOR SET-UP AND SOLUTION OF PDE-BASED PROBLEMS IN COMPLEX MOVING GEOMETRY

D. L. Brown[a], **K. Chand**[a], **W.D. Henshaw**[a], **N.A. Petersson**[a] and **D. Quinlan**[a]

[a]Center for Applied Scientific Computing
Lawrence Livermore National Laboratory
Livermore, CA 94551
dlb@llnl.gov

The development and analysis of numerical methods that enable high-fidelity partial differential equation-based simulations involving complex, possibly moving geometry is an important element of the computational mathematics required to support the needs of applications within the Department of Energy. The **Overture** project in CASC support these needs through the development of finite difference and finite volume algorithms and software for the accurate solution of systems of partial differential equations (PDEs) in regions of complex geometry. The **Rapsodi** project supports this effort with the development of algorithms and software aimed at enhancing the ability to rapidly set up computational geometry for large-scale scientific simulations. Rapsodi is developing software for representing and generating information about complex geometries, including software for the rapid construction of overset (Chimera), mixed-element and embedded boundary (EB) Cartesian meshes starting with various types of geometry descriptions, including CAD data. Overture develops the algorithms and software for solving PDEs on the resulting 3D meshes.

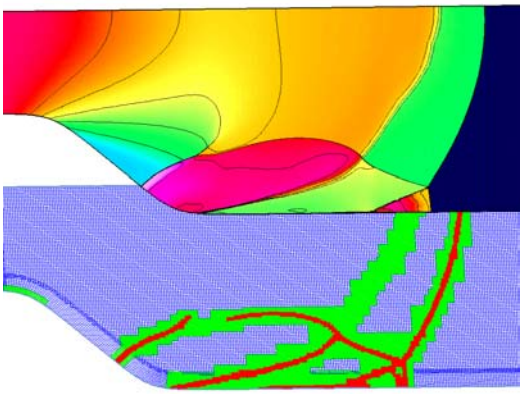

Figure 1. *A detonation wave calculation using adaptive overset mesh technology*

As part of the Overture project, we have developed a freely-distributed object-oriented code framework that supports the solution of partial differential equations on adaptively refined overset meshes[1]. The Overture Framework provides a portable, flexible software development environment for developing overset mesh applications that use finite difference or finite volume methods for discretization of the PDEs. It is implemented as a collection of C++ libraries that hide the details of the complex data structures that support the potentially large number of component meshes that form an overset mesh. Along with the Overture framework, we distribute mesh generation tools from the Rapsodi project that support CAD geometry cleanup and modification, and overset, mixed-element and EB Cartesian mesh generation. The *OverBlown* fluid flow solver is also included. OverBlown is a research code that solves incompressible and compressible flow problems on adaptive overset meshes using a variety of algorithms.

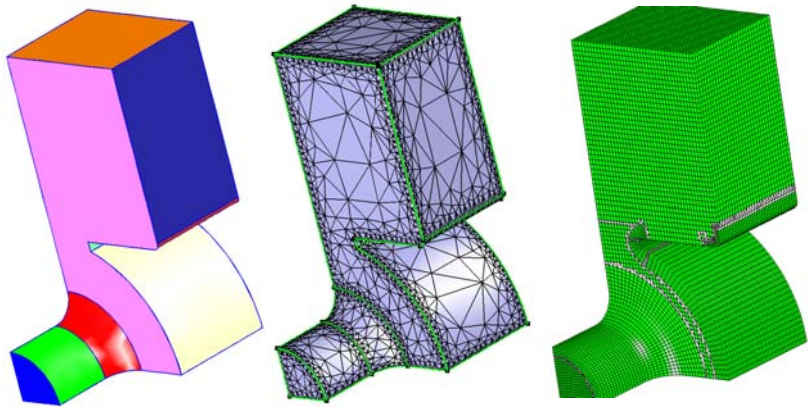

Figure 2. *Mixed-element mesh construction from CAD using Rapsodi tools*

References

[1] More information available at http://www.llnl.gov/casc/Overture/.

This work was performed under the auspices of the U.S. Department of Energy by University of California, Lawrence Livermore National Laboratory under Contract W-7405-Eng-48.