Computer-based simulation has become an essential tool, providing insights that often cannot be derived through experiment to inform design decisions or assess in-service assets.

At Lawrence Livermore National Laboratory (LLNL), we develop world-class simulation programs and the expert modeler/analysts who create and use them. This combination of sophisticated tools and skilled staff, supported by high-performance computing resources, provides state-of-the-art engineering solutions for our weapons, lasers, energy, and security programs.

Computational engineers at Lawrence Livermore focus most of their efforts on issues related to national security. By using computational methods to perform virtual testing, they gain insight into system responses for physical environments that may be too expensive or too difficult to physically test. Virtual testing also maximizes the total knowledge gained from experimental testing. For example, Laboratory engineers apply hydrostructural analysis codes to simulate physical events that last only a few microseconds to several hundred milliseconds and involve large material deformations, high strain rates, and strong shocks. By continually developing and improving computational methods, our engineers produce reliable data that enables them to confidently evaluate and make critical decisions concerning the Laboratory’s national security efforts.

Example Projects
- Simulating composite assembly design, leading to first-time testing success and rapid field deployment
- Developing advanced methodologies for blast–structure interaction
- Simulating novel additive manufacturing processes
- Simulating clean and efficient combustion to inform design of next-generation engines
- Predicting wind turbine power output, including realistic weather and terrain
- Using computational techniques to optimize electromagnetic structures such as photonic bandgap fibers
Expertise

• Structural response, including to extreme load environments
• Advanced material models for metal deformation
• Full-wave, high-accuracy electromagnetics
• Fluid dynamics and turbulence modeling
• Heat transfer
• Magnetohydrodynamics
• Uncertainty quantification
• Computational optimization

Sponsors and Collaborators

National Nuclear Security Administration
Department of Energy
Department of Defense
Department of Homeland Security
Bureau of Reclamation
Other Federal agencies
Private industry

Academic Alliances

Cornell University
University of California, Berkeley
University of California, Davis
Duke University
University of Illinois, Urbana-Champaign
Stanford University

Capability Leaders

Dr. Robert M. Ferencz 925-422-0571 ferencz1@llnl.gov
Bob is the Division Leader of the Computational Engineering Division at LLNL. He previously led the Methods Development Group responsible for LLNL’s suite of advanced, nonlinear structural mechanics codes. He serves on the American Society of Mechanical Engineers (ASME) Standards Subcommittee on Verification & Validation for Computational Solid Mechanics. He holds a Ph.D. in Mechanical Engineering from Stanford University.

Douglas R. Faux 925-423-9705 faux1@llnl.gov
Doug is the Section Leader for the Engineering Modeling Section in the Computational Engineering Division at LLNL. His expertise is in the application of multi-physics computational methods to model system response involving penetration mechanics, blast/structure interactions, and material failure and fragmentation. He holds a M.S. Degree from Purdue University.