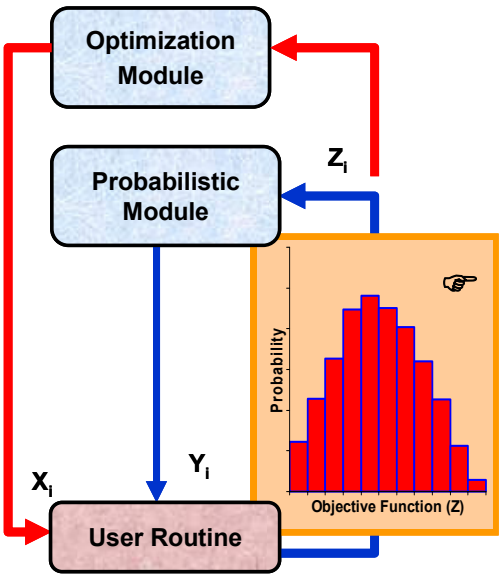
Scientific Computing Within the ORNL Modeling and Simulation Group: Numerical Physics

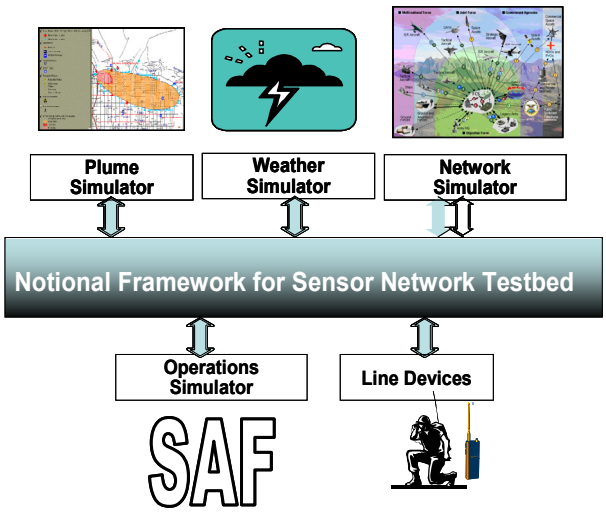
The ORNL Modeling and Simulation Group (MSG) develops sophisticated numerical solutions for a wide range of scientific, engineering, and operational applications. MSG's core competency is computational physics and engineering, and within this context we must frequently identify optimal solutions, quantify scientific and programmatic uncertainties, execute inverse problems, and/or develop new computing algorithms and solution software to support the complete range of ORNL research activities. These specialized software-development capabilities include but are not limited to the following.

- *Continuity Constraint Method* CFD algorithm for laminar flow of compressible fluids and its implementation into the MSG-developed general-purpose finite-element code ***PHI3D.***
- 2D WEIBELL stress model to predict constraint recovery due to biaxial loading and its impact on shallow-flaw fracture toughness.
- Solution algorithm for the solution of fractional-order partial differential equations and its application in fusion-plasma simulations.
- ***SuperCode*** software suite for conducting optimization and probabilistic analysis in support of systems design and programmatic decision-making for a wide range of DOE and DoD projects.
- Development of middleware software and design of wound ontology's for DARPA's Virtual Soldier Program.
- Development of scalable parallel-discrete-event-simulation algorithms and numerical engines for next generation high performance computing applications.

These applied scientific computing capabilities represent an extremely versatile modeling and simulation resource for a broad range of R&D, industrial, homeland defense, and military applications. We welcome the opportunity to discuss your potential applications and ways MSG can contribute to a solution.



MSG developed SuperCode for optimization & uncertainty analysis to support system design & programmatic decision making



MSG performed some of the most detailed Parallel-DES analyses to date of integrated plume, weather & communication models to quantify model-fidelity effects on sensor network operation

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