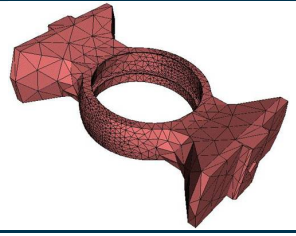
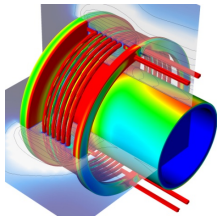
FASTMath – Frameworks, Algorithms, and Scalable Technologies for Mathematics

FASTMath is a SciDAC Applied Mathematics Institute funded by the U.S. Department of Energy (DOE). The institute will develop and deploy scalable mathematical algorithms and software tools for reliable simulation of complex physical phenomena and will collaborate with DOE domain scientists to ensure the usefulness and applicability of FASTMath technologies.






As the complexity of computer architectures and the range of physical phenomena that can be numerically simulated for important DOE applications continue to grow, application scientists have two fundamental challenges to overcome.

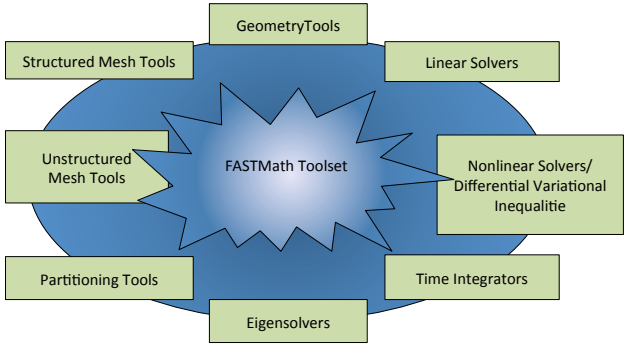
First, they must continue to improve the quality of their simulations by increasing accuracy and fidelity of the solution and improving the robustness and reliability of both their software and their algorithms. Second, they must adapt their computations to make effective use of the high-end computing facilities being acquired by DOE over the next five years.

This challenge will necessitate million-way parallelism and implementations that are efficient on many-/multi-core nodes. The FASTMath SciDAC Institute will help DOE application scientists address both of these challenges by focusing on the interactions among mathematical algorithms, software design, and computer architectures. Key to addressing the first challenge is a thorough understanding of application needs, and the FASTMath team has a strong and proven track record of doing just this.

FASTMath encompasses three broad topical areas

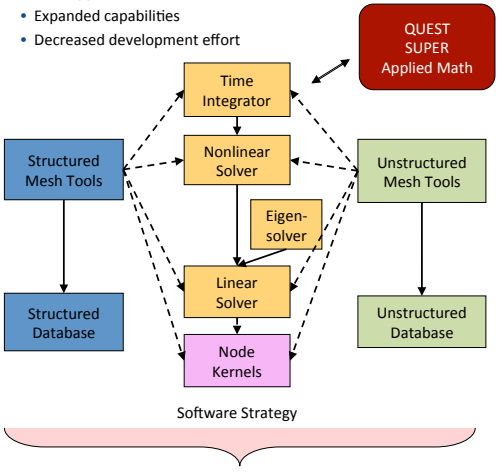
Tools for problem discretization	Solution of algebraic systems	High-level integrated capabilities
▪ Structured grid technologies ▪ Unstructured grid technologies ▪ Adaptive mesh refinement ▪ Complex geometry ▪ High-order discretizations ▪ Particle methods ▪ Time integration	▪ Iterative solution of linear systems ▪ Direct solution of linear systems ▪ Nonlinear systems ▪ Eigensystems ▪ Differential Variational Inequalities	▪ Adaptivity through the software stack ▪ Coupling different solution algorithms ▪ Coupling different physical domains

FASTMath brings a spectrum of software tools to the SciDAC Program



FASTMath Integrated Capabilities

- **As we provide integration between the core technology areas, science applications will benefit from**
  - Expanded capabilities
  - Decreased development effort



- **Development efforts for expandedcapability integration**:
  - Adaptivity through the software stack
  - Common linear system fill interface
  - Architecture-aware compute node kernels
  - Unified software strategy

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FASTMath SciDAC Institute

Lori Diachin (Director), Lawrence Livermore National Laboratory (diachin2@llnl.gov)
Phil Colella, Lawrence Berkeley National Laboratory (pcolella@lbl.gov)
Esmond Ng, Lawrence Berkeley National Laboratory (egng@lbl.gov)
Andy Salinger, Sandia National Laboratories (agsalin@sandia.gov)
Mark Shephard, Rensselaer Polytechnic Institute (shephard@scorec.rpi.edu)
Barry Smith, Argonne National Laboratory (bsmith@mcs.anl.gov)

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