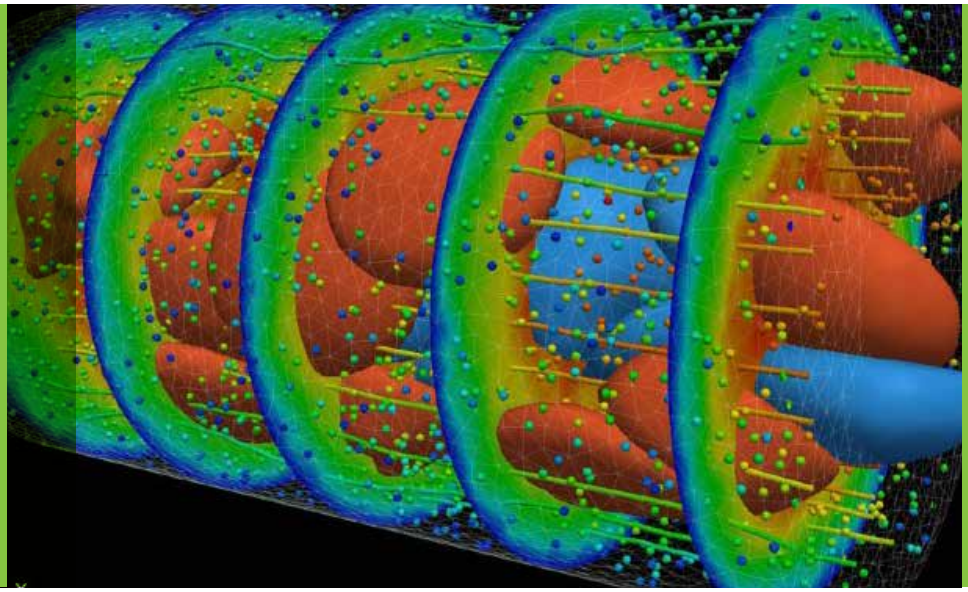
Argonne NATIONAL LABORATORY

DEFINING THE FUTURE

Providing intellectual and technical leadership in the computing sciences — applied mathematics, computer science, and computational science



Research on multiscale blood flow models — a flow of healthy (red) and diseased (blue) blood cells simulated with a dissipative particle dynamics method

SIGNATURE SOFTWARE

- MPICH
- Nek5000
- PETSc
- ADIC
- PVFS
- Globus Toolkit
- Swift
- TAO
- Model Coupling Toolkit
- ROMIO
- MG-RAST
- ADLB
- Argobots
- MINOTAUR

www.mcs.anl.gov/software

From basic research in such core areas as optimization, partial differential equations, and system software for extreme-scale computing to exploration of new technologies such as bioinformatics, MCS researchers have a common goal: providing the tools and technology needed to tackle challenging science and engineering problems of critical importance in the 21st century.

As we move toward the exascale, we are not only exploring new algorithms, programming models, and advanced visualization technologies, we are also defining the future — including exascale software architecture and exascale storage architecture.

Essential to this research is access to leadership-class computers such as the Blue Gene/Q and Argonne's next-generation computer Aurora, as well as collaborations with universities, industry, and other research institutions worldwide.

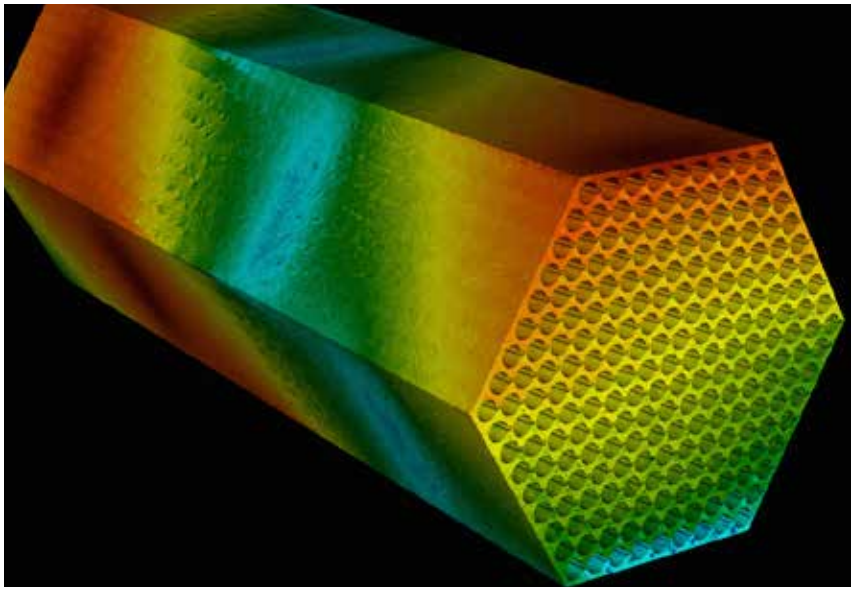
RESEARCH AREAS

Researchers in the Mathematics and Computer Science Division attack complex problems in four key scientific areas important to our nation:

- **Extreme Computing:** developing new system and run-time technologies for future extreme-scale computers that handle the massive scale, increased failure rate, and power management needs of these systems.
- **Data-Intensive Science:** formulating novel techniques for managing, storing, and visualizing the enormous amounts of data produced by leadership-class computers and large experimental facilities.
- **Applied Mathematics:** developing new algorithms and libraries for exploiting high-performance computing in targeted applications.
- **Science & Engineering Applications:** working with scientists and engineers to apply our advanced algorithms and software tools to challenging problems of national interest.

R&D 100 AWARD-WINNING SOFTWARE

- **MPICH:** providing a high-performance, widely portable implementation of the Message Passing Interface standard
- **Globus Online:** enabling large quantities of information to be moved reliably, efficiently, and securely worldwide
- **Globus Toolkit:** enabling the secure, scalable, and coordinated use of resources in dynamic, multi-institutional "virtual organizations"
- **PETSc:** providing a suite of codes for solving large-scale problems modeled by partial differential equations



Simulation of coolant flow in a 217-pin wire-wrapped subassembly on the Argonne Leadership Computing Facility

The Array of Things will provide real-time, location-based data about Chicago's environment, infrastructure, and activity to researchers and the public.

EXCITING NEW INITIATIVES

With the aim of enabling breakthroughs in science and engineering, we collaborate with the scientific community on solving problems critical to the national interest, including the following:

- **Array of Things (AoT)**, using a network of interactive sensors to collect data on Chicago's environment and infrastructure and help create solutions to problems such as pollutants.
- **Scientific Data Management, Analysis (SDAV), and Visualization Institute**, providing application scientists with state-of-the-art tools and technologies for analyzing the enormous amounts of data generated by large-scale simulations
- **Accelerated Climate Modeling for Energy (ACME)**, developing and applying the most complete, leading-edge climate and Earth system models to challenging climate-change research imperatives.
- **Urban Center for Computation and Data (UrbanCCD)**, applying advanced computational techniques to the design of smarter cities.
- **Center for Exascale Simulation of Advanced Reactors (CESAR)**, pursuing a codesign effort involving algorithmic development, performance modeling, and simulation critical to the field of nuclear energy.
- **Multifaceted Mathematics Center for Complex Energy Systems (M2ACS)**, tackling the long-term mathematical challenges arising in complex electrical energy systems.

Research Areas:
- Extreme Computing
- Data-Intensive Science
- Applied Mathematics
- Science & Engineering Applications

2015 Details:
Budget: $38.3M
Regular Staff: 90
Postdocs: 30
Interns, coops, predocs: 72
Joint Appointments / Visitors: 41

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U.S. DEPARTMENT OF ENERGY
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