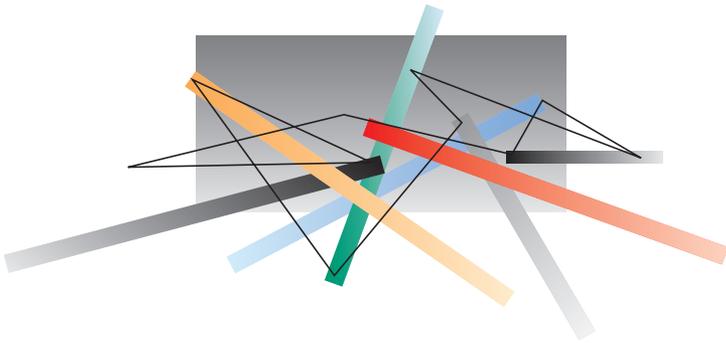


# **Coalition for Academic Scientific Computation**

# C A S C



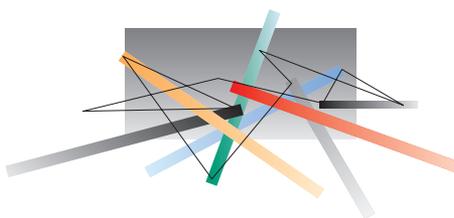
**Increasing Competitiveness and  
Safeguarding Our Nation Through  
High Performance Computation**

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**CASC** is an educational nonprofit 501(c)(3) organization founded in 1989, and at present includes 42 member institutions representing some of the nation's most forward thinking universities and computing centers. CASC is dedicated to enhancing use of the most advanced computing technology to increase national competitiveness, security, and economic growth, accelerate scientific discovery, and develop a diverse and well-prepared 21st century workforce.



The mission of the Coalition for Academic Scientific Computation (CASC) is to disseminate information about high performance computing and communications: provide information about the value of high performance computing and communications; offer recommendations to government and funding agencies; and facilitate information exchange within the academic scientific computation community.

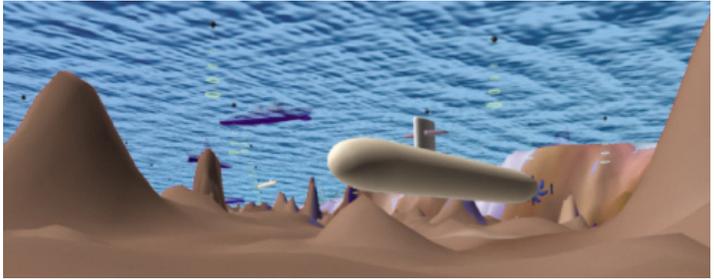
Coalition members complement traditional methods of laboratory and theoretical investigation by using high performance computers to simulate natural phenomena and environmental threats, handle and analyze data and create images – all at performance levels not available from smaller computers. By applying advanced technology, CASC members help extend the state of the art to achieve the scientific, technical, and information management breakthroughs that will keep the U.S. in the forefront of the 21st century information technology revolution. Public-private partnerships created with major corporations guarantee that cutting-edge technologies will be applied to real world challenges faced by industry and education. CASC members participate in research and development in education, healthcare, cybersecurity, bioinformatics, national security and the environment. This brochure features the activities of a number of CASC members in a few of these areas. It is not intended to incorporate all of the research that all of our members are doing in these and many other fields. More information about CASC members may be found on our website at <http://www.casc.org>.

## *Homeland Security and Cybersecurity Research*

**CASC** members are involved in a wide range of activities supporting the Federal government in its efforts to develop and improve security measures to combat terrorism, both physical and electronic. Program partners include the Department of Defense (DoD), the Department of Homeland Security, the National Security Agency and the Office of Naval Research.

CASC Members participate in the DoD's High Performance Computing Modernization Program (HPCMP), the Defense Threat Reduction Agency (DTRA), and host a variety of other government-sponsored programs. Researchers at CASC centers are working on ways to increase the effectiveness of the response to terrorist acts and reduce response time; improve incident management and detection; assess chemical, biological, radiological and nuclear threats; improve nationwide crisis communications systems; and simulate attacks to facilitate development of appropriate recovery strategies and policies.

The Air Force Research Laboratory at the Maui High Performance Computing Center includes a supercomputer dedicated to studying Theater



Display of actual bathymetry, contacts, buoy patterns and time-lapse sonar data are part of the research to augment TUSW graphical software.

Under Sea Warfare (TUSW). The system is used for computationally intensive simulations that allow researchers to analyze data gathered from underwater acoustic transmissions. The TUSW program will also integrate air reconnaissance assets into real-time operations, to be incorporated into the Naval Tactical Data System.

## Grid Computing

**CASC** members are working to improve access to data so it can be retrieved and manipulated, regardless of the user's location. The grid computing arena is of tremendous scientific and strategic importance.

Eight CASC Members are active participants in the National Science Foundation's Terascale Computing System, or "Teragrid". The system features six teraflops ( $10^{12}$  – one trillion point operations per second) of processing power, and remarkable capabilities for large-scale data handling, over a network that operates at 40 gigabits per second.

From its launch in 2001 with four sites, the TeraGrid now incorporates nine sites, and was granted an additional five year, \$150 million award from the National Science Foundation in 2005.



The network is being used to research critical events such as the impact of a 7.7 magnitude earthquake on the area surrounding the San Andreas Fault in Southern California. Preliminary data analysis shows directional effects larger than previously anticipated. TeraGrid machines are also involved in improving seismic modeling and reservoir simulation, to improve oil recovery efficiency. This research was carried out across hundreds of processors at multiple sites.

<http://www.teragrid.org>

## *Challenges in Education and Awareness*

**CASC** members are involved in a wide range of activities aimed at creating and improving educational programs that foster computer skills so that students can engage in the high-tech work force when they leave school. They also encourage superior students to consider future engineering and scientific careers, and teach computational skills to researchers whose backgrounds do not include computational methodology.

C A S C members are reaching out to young children early in their school careers, to try to spark an interest in the technology. The Advanced Visualization Laboratory



(AVL) at Indiana University demonstrated stereoscopic (3D) visualizations at the Marion County Public Library System in conjunction with the library's summer reading program. AVL set up demonstrations, running on the IU-invented "John-E-Box" in seven different library locations. By interesting schoolchildren (and their parents) in information technology, we hope to encourage children to pursue courses of study in high school and college that will lead to careers in advanced information technology.

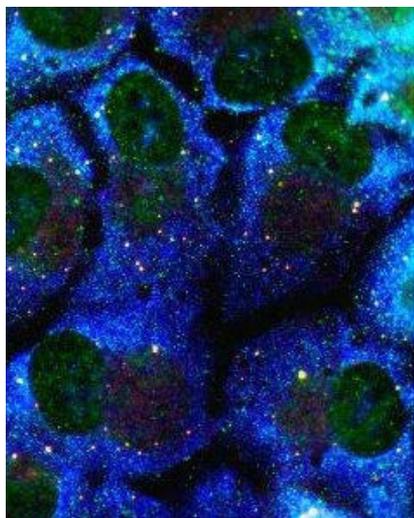
In 2005, CASC announced a new scholarship program for attendance at the IEEE/ACM SC '05 conference, designed to enable faculty members who are members of traditionally underserved groups, teaching at Minority-Serving Institutions, to attend this important conference. We hope that this will lead faculty members to encourage more students to consider careers in high performance computing.

## *Challenges in Health Care*

**CASC** members have been in the forefront of medical research, using supercomputers to expand knowledge, increase collaboration, and improve health care delivery. Today's medical providers already use videoconferencing (to interview or examine patients from hundreds of miles away), and computer-aided surgery with Internet-based video. Researchers use powerful computers for sophisticated analyses of huge amounts of information generated by advanced non-invasive imaging technology, such as CAT scans.

CASC members are instrumental in advancing the field of bio-informatics, including applications in Computational Chemistry, Functional Genomics, Neural Imaging (brain mapping), Pharmacogenetics, Proteomics and Structural Biology.

Researchers need new tools to understand the genetic, metabolic and clinical heterogeneity of diseases



Prostate cancer cells

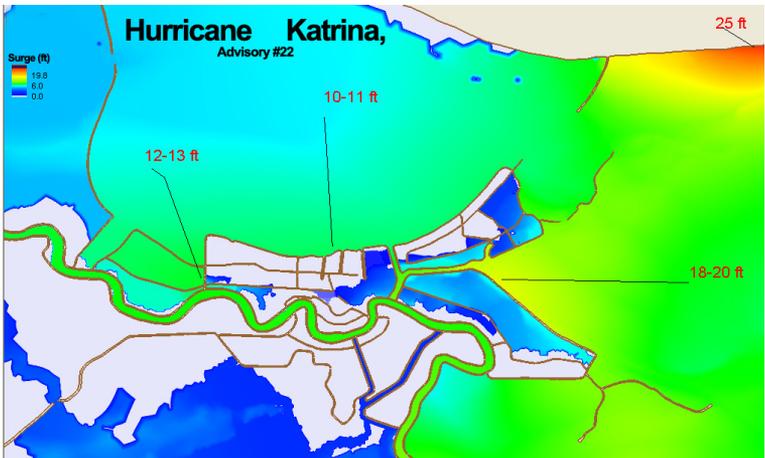
At the University of Michigan, the National Center for Integrative Biomedical Informatics (NCIBI) seeks to integrate genomic and molecular biology information into disease or biological models through the use of high performance computing. NCIBI will develop a framework of conceptual models, computational infrastructure and integrated knowledge repositories that are needed by modern scientists in order to make effective use of the wealth of data flowing from molecular biology and translational research. The NCIBI will focus on four driving biological problems – prostate cancer, bipolar depression, and type I and type II diabetes.

## Challenges in the Environment

**CASC** members are generating knowledge and understanding about such environmental concerns as water and air quality, and controlling the effects of toxic materials. Supercomputers are used to create accurate models of regional climate systems, ecosystems, and population trends. These models provide valuable data to scientists and policy makers so that they can make decisions about reducing environmental impact, adapting to changes in climate, or dealing with public safety.

Beginning in 2003, Louisiana State University's Hurricane Center began modeling the effects of a category 5 hurricane on the city of New Orleans and its low-lying surrounding area. Using high performance computing, the Hurricane Center developed an extremely detailed map of New Orleans. Armed with the knowledge of how far and how fast the water in the inlets would rise, state and local officials would know the "worst-case scenario" if a major storm were to hit, and be better able to plan evacuations and cleanup.

In the case of south Louisiana, a breach of the levees would trap the flood water on the wrong

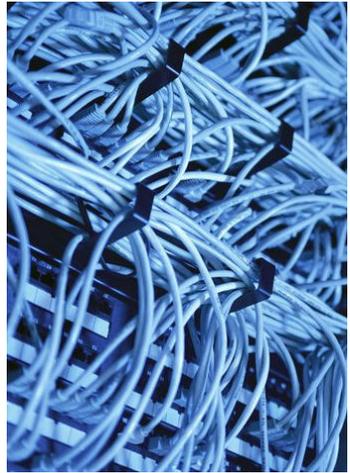


side of the bank once the bayous and rivers receded. The hurricane center accurately predicted that if the surge were to overtake the city's levees, it could take weeks to pump the water out.

## *Challenges in Safety and Security*

**CASC** members are working on improving the real-time detection of natural and man-made threats, as well as the response time to these threats for both government and civilian organizations. In addition, the supercomputer centers are involved in the development of high confidence infrastructure control systems, to mitigate any threats to the nation's vital communications networks.

Collaborators from eight universities around the country, including four CASC members, will form the new Team for Research in Ubiquitous Secure Technology (TRUST), funded by the National Science Foundation. Led by the University of California, Berkeley, the TRUST center is expected to receive nearly \$19 million over five years. Researchers have set their sights on developing new technologies that will radically transform the ability of organizations - from private software vendors to local and federal agencies - to design, build and operate trustworthy information systems that control critical infrastructure. In addition to simply protecting networks from attacks, they will begin to develop ways to keep systems running properly even when intrusions occur - a concept known as "degrading gracefully under attack."





## *Industry Partnerships*

**CASC** members have formed partnerships with major industry leaders, in the areas of parallel computing, wireless technology, interactivity among operating systems, financial data analysis, and infrastructure development. Corporations such as IBM, Motorola, Sun Microsystems, and Microsoft have donated equipment and funding to these and other research areas, to advance state of the art technologies and systems and educate the next generation of scientists.

The Ohio Supercomputer Center (OSC) and the federal government (DOE, DoD) are making substantial investments in the new Springfield Advanced Technology Research Park (ATRP). This park has already attracted companies such as Lexis-Nexis and is expected to attract more from across the US. Blue Collar Computing, a new OSC initiative, enables advanced manufacturing and other industries to tap into OSC's high performance computing resources and expertise. High performance computing and networking are critical elements of this strategy to turn the "rust belt" into a hub for US-based manufacturing of high-end goods and services again.

The goal of the NCSA Private Sector Program (PSP) is to partner with leading-edge companies to guarantee that NCSA's cutting-edge technology development will be applied to real-world challenges faced by industry. Working with NCSA, companies have reaped the benefits of access to technological breakthroughs before their competition. The PSP is a doorway for business—leading to the emerging technologies and computing innovations developed at NCSA. PSP partners have included Allstate, Caterpillar, Inc., Motorola, Boeing, IBM and SAIC.

MBA Students at East Carolina University now have access to MineSet software, which analyzes high volumes of financial data, thanks to a grant from SGI. The program is housed on a server at the supercomputer center, which easily handles the large data sets, allowing the students to analyze trends and examine economic structures, as well as supporting the study of artificial intelligence in finance and economics.

## ***Government & Industry Partnerships***

**CASC** members develop partnerships with federal government entities and private industry leaders to meet important national goals. A representative list appears below.

### **Federal Departments and Agencies**

U.S. Department of Defense  
U.S. Department of Education  
U.S. Department of Energy  
U.S. Department of Homeland  
Security  
Environmental Protection Agency  
National Aeronautics and Space  
Administration  
National Institutes of Health  
National Library of Medicine  
National Nuclear Security  
Administration  
National Oceanic and  
Atmospheric Administration  
National Science Foundation

### **Industry Partnerships**

- Allstate
- Boeing
- Caterpillar
- Ericsson
- Handspring
- IBM
- Intel
- Microsoft
- Motorola
- SAIC
- SGI
- Sun Microsystems
- Unisys

### **Federal Task Forces and Committees**

Internet Engineering Task Force (IETF)  
NSF Computer Information Sciences and Engineering (CISE)  
Advisory Committee  
Presidential Information Technology Advisory Committee (PITAC)

## ***CASC Members***

Arctic Region Supercomputing Center, Fairbanks AK

Arizona State University, Tempe AZ

Boston University Center for Computational Science, Boston MA

Center for Advanced Computing, University of Michigan, Ann Arbor MI

Center for Advanced Computing Research, California Institute of  
Technology, Pasadena CA

Center for Computation & Technology, Louisiana State University, Baton  
Rouge LA

Center for Computational Research, University at Buffalo, Buffalo NY

Center for Computational Sciences, University of Kentucky, Lexington KY

Center for High Performance Computing, University of New Mexico,  
Albuquerque NM

Center for High Performance Computing, University of Utah, Salt Lake  
City, UT

Computer and Information Technology Institute, Rice University,  
Houston TX

Cornell Theory Center, Ithaca NY

East Carolina University, Greenville NC

Florida State University School of Computational Science and Information  
Technology, Tallahassee, FL

Georgia Institute of Technology, Atlanta GA

Indiana University, Bloomington IN

Maui High Performance Computing Center, University of Hawaii,  
Manoa HI

Mississippi State University, Mississippi State MS

National Center for Atmospheric Research, Boulder CO

National Center for Supercomputing Applications, University of Illinois  
Urbana-Champaign, Champaign IL

National Energy Research Scientific Computing Center, Berkeley CA

National Supercomputing Center for Energy and the Environment,  
University of Nevada Las Vegas, Las Vegas NV

NDSU Center for High Performance Computing, North Dakota State  
University, Fargo ND

Northeastern University, Boston MA

## *CASC Members*

Oak Ridge National Laboratory Center for Computational Sciences,  
Oak Ridge TN

Ohio Supercomputer Center, Columbus OH

OU Supercomputing Center for Education and Research, University of  
Oklahoma, Norman OK

Pacific Northwest National Laboratory, Richland, WA

The Pennsylvania State University, University Park PA

Pittsburgh Supercomputing Center, Pittsburgh PA

Purdue University, West Lafayette IN

The Renaissance Computing Institute, University of North Carolina, Chapel  
Hill NC

Rochester Institute of Technology, Rochester NY

San Diego Supercomputer Center, San Diego CA

Texas A&M University Supercomputer Center, College Station TX

Texas Advanced Computing Center, University of Texas, Austin TX

Texas Learning and Computation Center, The University of Houston,  
Houston TX

Texas Tech University, Lubbock TX

University of Florida, Gainesville FL

University of Iowa, Iowa City IA

University of Southern California Information Sciences Institute,  
Marina del Rey CA

Virginia Tech Terascale Computing Facility, Blacksburg, VA

## *CASC Officers:*

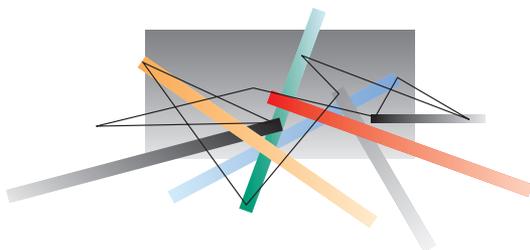
**Chair:** Dr. Frank Williams, Arctic Region Supercomputing Center

**Vice Chair:** Dr. Craig Stewart, Indiana University

**Secretary/Treasurer:** Dr. Richard Pritchard, Ohio Supercomputer  
Center



# CASC



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