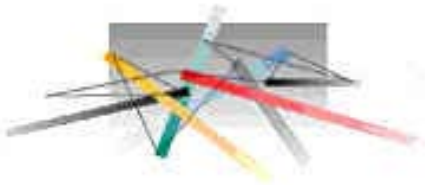
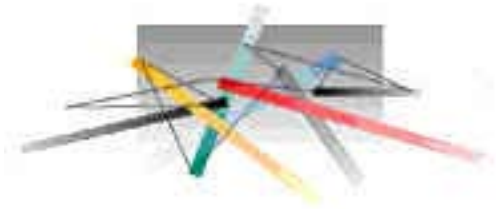
Coalition for Academic Scientific Computation

C A S C



Advancing High Performance Computation and Communication through Collaboration

CASC is a nonprofit organization of supercomputing centers and research universities that offer leading edge hardware, software, and expertise in high performance computing resources and "advanced visualization environments." Founded in 1989, CASC has grown into a national association representing 35 centers and programs in 22 states.



Working individually and together, 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 the 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 IT revolution.

Coalition members are involved in activities that foster major advances for virtually every element of society. The range of these efforts encompasses:

- Aiding in Homeland Security
- Accessing Information
- Improving Health Care
- Conducting Research
- Combating Cyber-Terrorism
- Enhancing Education
- Innovating in Design and Construction
- Understanding the Environment
- Preparing for Bio-Terrorism
- Advancing Bioinformatics

Aiding in Homeland Security

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.

- The National Center for Supercomputing Applications (NCSA) has developed the Multi-Sector Crisis Management Consortium (MSCMC) at the University of Illinois at Urbana-Champaign. The MSCMC uses cutting edge technology to mitigate and respond to crises of national security and national disasters. The Center employs crisis management objectives, which encourage partnerships, collaboration, and problem solving within the crisis management and disaster response communities and other economic and security sectors of society.

- Draco, a project of the University of Maryland, is an innovative technology that can revolutionize emergency response to national crises and regional disasters. It provides a secure and rapidly deployable network that immediately allows first responders at all levels to communicate with each other using voice, video and data. With a simple click on a PDA or pen computer screen, responders can note their location and connect by voice to any other responder or set of responders.

- The Maui High Performance Computing Center (MHPCC), managed by the University of Hawaii, is an allocated distributed center of the Department of Defense High Performance Computing Modernization Program (HPCMP), providing resources to researchers and an innovative environment for migrating projects from research to production. The Center is currently hosting the Airborne Laser Challenge Project II and six other HPCMP Challenges.

Accessing Information

CASC members are working to improve access to data so it can be found and manipulated, regardless of the user's location.

- The Pittsburgh Supercomputing Center's main computing resource is the National Science Foundation's Terascale Computing System. The system features six teraflops of processing power, and remarkable capabilities for large-scale data handling. In a collaborative project supported by NSF, Distributed Terascale Facilities are being built at two other CASC member institutions: the National Center for Supercomputing Applications and the San Diego Supercomputer Center. This project, known as the Teragrid, adds as partners the California Institute of Technology and Argonne National Laboratory. NSF's next step in terascale computing, the Extensible Terascale Facility (ETF), will be a scalable distributed computational grid based on the DTF and TCS. The ETF will enable researchers to conduct analyses at unprecedented scale, to merge multiple data resources seamlessly, and to advance discovery at the frontiers of science and engineering. Other CASC members will join in this effort in the coming years.

- Innovative information management is demonstrated in a virtual reality project for the arts conducted by Indiana University's high performance computing facility. At multiple remote sites linked by the Internet, participants use virtual reality goggles to "walk" through a fantasy environment filled with animated models, artwork, and audio. The experience is shared in each linked location as artists, graphic designers, teachers, musicians and others trigger the virtual "objects" to move and make sounds. Thus, technology created for the sciences has been adapted for use in the humanities, accessible to expert and novice users alike, regardless of physical ability, education, or culture.

Improving 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.

- The Ohio Supercomputer Center's Biomedical Applications Research Group has developed a working prototype system for the virtual simulation of temporal bone dissection. The system integrates technological advances to provide a safer and more cost effective way to learn fundamental techniques, and obviates the need for physical material in initial training. By increasing the realism and complexity of the representation, this project will advance training in surgical intervention, which remains a key element in improving the control of hearing and balance disorders and enhancing the health of many.

- East Carolina University's Telemedicine Program provides training in Technology for Homeland Security, in topics such as the Role of Health in Security; Situational Awareness; Distributed Medical Intelligence Concepts and Practices; Data Collection Technologies; Flexible Telecommunications; and Toolkits and Systems. The track is designed to provide an overview of the use of technology to increase homeland vigilance and to improve health care quality through the use of innovative, appropriate applications of health telematic practices and technologies.

Conducting Research

CASC members routinely use high performance computing in virtual laboratories to conduct research without regard to the researchers' physical location. Within these virtual settings, scientists and engineers can interact with colleagues, access instrumentation, share data and computational resources, and find information in digital libraries.

- The Access Grid continues to be developed by an alliance composed of broad sectors of society, including traditionally underrepresented groups. The goal is to make the tools and resources of emerging technologies accessible to all levels of learners and educators, and to forge a national computing infrastructure that will support the next wave of scientific discovery. Nineteen (19) CASC members participate in this program nationwide, ranging from Massachusetts to Hawaii and Alaska to Florida.

- The University of Florida is one of eight universities funded by the National Science Foundation to participate in the Middleware Initiative Testbed. Middleware components are software purposed to increase collaborative capabilities amongst peer groups. It is intended to provide a platform for academics and other groups to create effective virtual collaboration environments, as well as administrative applications. It is also meant to enable the seamless use of computer and storage resources across distributed domains, empowering individual scientists to analyze large volumes of data, perform high throughput simulations, and compute intensive scientific calculations.

Combating Cyber-Terrorism

CASC members use computer simulations to conduct research on basic and advanced computer security issues. The goal is not only the protection of vital national security data, but also the protection of our college and university networks, continuing the free flow of information and ideas without the fear of interference.

- SUNY-Buffalo's Center of Excellence in Information Systems Assurance Research and Education (CEISARE) is working on Intrusion Detection systems, in cooperation with the US National Security Agency. They are also developing e-commerce and Web assurance applications, as well as new approaches to Trusted Mobile Computing. Basic Measures include encryption, firewalls, intrusion detection and vulnerability testing.

- Purdue University's Center for Education and Research in Information Assurance and Security (CERIAS) is the world's foremost University center for multidisciplinary research and education in areas of information security. Key projects include Detecting Denial of Service Attacks and Online Security Communication about Credit Card Usage.

- The Pacific Institute for Computer Security (PICS) is a cooperatively funded research program within the San Diego Supercomputer Center (SDSC). PICS is a research-oriented operation which conducts and publishes leading-edge research into real-world computer and network security issues, with an emphasis on solutions grounded in practical reality. In addition to its technical work, PICS is at the forefront in recognizing the legal and policy implications of computer security and computer crime.

Enhancing Education

CASC members are involved in a 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), encourage superior students to consider future engineering and scientific careers, and teach computational skills to researchers whose backgrounds do not include computational methodology.

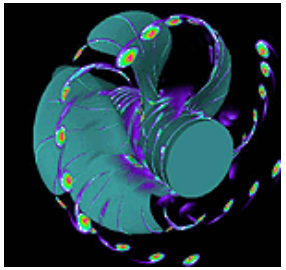
- The Arctic Region Supercomputing Center (ARSC) and the University of Alaska Fairbanks joined forces with the High Performance Computing Center at the University of New Mexico to initiate the first for-credit course in High Performance Computing, offered simultaneously in multiple locations via the Internet, during the fall semester of 2001. The course was designed to introduce students with research interests in the physical sciences to the concepts of parallel scientific computation, by focusing on the development of an intellectual and physical computing infrastructure.

- The University Corporation for Atmospheric Research (UCAR) runs an award winning, user-friendly Web site for general public use, known as Windows to the Universe. The site contains a rich array of documents – images, movies, animations, and data sets – that explore the Earth and space sciences, and the historical and cultural ties between science, exploration, and the human experience. Some four million users explored the site during the past year.

Innovating in Design and Construction

CASC members use computer simulations to create accurate representations of a structure's physical properties before it is built. These models allow designers, manufacturers, builders and end-users to participate in the process, offer feedback, and reduce the time and cost of engineering designs and analyses. The ability to predict long-term fatigue and failure in vital system parts may be of even greater benefit in decreasing design costs and possible accidents in the future.

- The San Diego Supercomputer Center was a major partner in a project to analyze the earthquake vulnerability of San Francisco's Golden Gate Bridge, and to design a seismic retrofit for the bridge and its approaches. This project, one of the most detailed computational analyses ever done on the structural integrity of a bridge, used modern engineering techniques to verify how to retrofit a structure built using older design and construction methods. The simulation included running earthquake scenarios with changing variables – some at one-and-a-half times the magnitude of any earthquake the bridge is likely to experience – to determine how the bridge would respond under different conditions.

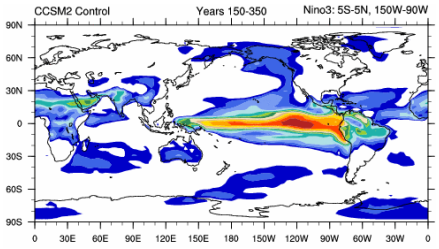


- The Engineering Research Center at Mississippi State University is studying aerodynamic optimization and improvement capabilities for turbine airfoil configurations. This will help turbine engine manufacturers achieve the Integrated High Performance Turbine Engine Technologies goals of increased thrust-to-weight ratio for future weapons systems and commercial applications. An aerodynamic shape design code has been developed which seeks to optimize a prescribed objective function, subject to various flow and geometric constraints, to evaluate candidate designs.

Understanding the Environment

CASC members are generating knowledge and understanding about such environmental concerns as water and air quality, and controlling the effects of toxic material. 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.

- Scientists have just completed a 1,000-year run of a powerful new climate system model on a supercomputer at the U.S. Department of Energy's National Energy Research Scientific Computing Center (NERSC) at Lawrence Berkeley National Laboratory. Accurately predicting global climate change demands complex and comprehensive computer simulation codes, the fastest supercomputers available and the ability to run those simulations long enough to model century after century of the global climate.



- A consortium of investigators at Purdue University has achieved preeminence in environmental monitoring at the farm, forest, and watershed, on urban, regional, national and global scales. Faculty researchers affiliated with more than ten institutes and departments at Purdue are collaborating in this project, including the Environmental Science and Engineering Institute (ESEI), Department of Forestry and Resource Management, Department of Earth & Atmospheric Sciences, the Laboratory for Applications of Remote Sensing (LARS), and Information Technology at Purdue's (ITaP) emerging Purdue Terrestrial Observatory (PTO).

Preparing for Bio-Terrorism

CASC members conduct research into the prevention of, preparation for, and response to bioterrorism. Biological Terrorism is defined as the use or threatened use of biological or biologically related toxins against civilians, with the objective of causing illness, death or fear.

- The Pittsburgh Supercomputing Center supports the BioMedical Security Institute (BMSI), which is charged with advancing our capability to detect, analyze, prevent and respond to acts of terrorism and natural events involving biological agents. The BMSI is a collaboration between Carnegie Mellon University and the University of Pittsburgh.

- Researchers at Cornell University are using their background experience in large-scale epidemiological studies to study questions associated with the deliberate release of biological agents such as small pox or influenza into the populace using transportation systems. They are using high-performance computing to simulate outbreaks of epidemics in large networks to identify worst-case scenarios, to aide in policy and planning.

Figure 1: Flow regimes within and around urban terrain

- At Texas Tech University, researchers are performing modeling and simulation experiments of chemical and biological operations in urban terrains. This project will include the toxicity impact on soldiers and civilians, as well as behavioral and physiological responses to such an attack, in order to improve the operational effectiveness of soldiers and Marines through the integration of advanced technologies and associated tactics, techniques and procedures.

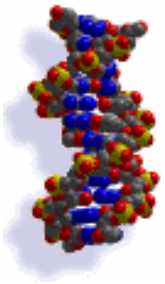
Advancing Bioinformatics

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,

- The Buffalo Center of Excellence in Bioinformatics, in partnership with biotechnology, computing and engineering industry partners, seeks to combine computational science and high-throughput experimental biology to enable the development of new medical treatments. The Center is developing and exploiting state-of-the-art algorithms for data acquisition, storage, management, and transmission, as well as utilizing innovative parallel and grid computing techniques.

- The North Carolina Bioinformatics Grid, established in December 2000, seeks to facilitate collaboration among the state's researchers and educators in genomics, proteomics, and bioinformatics education, research, and development. The North Carolina Supercomputer Center and the North Carolina Research and Education Network provide the base infrastructure for the Bio-Grid.

- Computational Chemistry research will soon be carried out on a Terascale level, due to the ever-increasing quantities of data required for research in this field. At the University of Kentucky, Bioinformatics studies are carried out using software programs that utilize data parallelization techniques to automate the splitting of query databases into smaller chunks, which are then spread out over the cluster nodes' local disks for querying.



Federal Partnerships

CASC members develop partnerships with federal government entities to meet important national goals. A representative list appears below.

Federal Departments and Agencies

U.S. Department of Agriculture
U.S. Department of Defense
U.S. Department of Education
U.S. Department of Energy
U.S. Department of Transportation
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

Federal Programs

Air Force Laser Challenge Project
Advanced Simulation and Computing Program (ASCI)
Adventures in Supercomputing
Defense Modernization Program
Digital Library Initiative
Distributed Terascale Facility & Extensible Terascale Facility (at NSF)
Genomes to Life (GTL)
Human Genome Project
Information Technology Research Program (at NSF)
Minority Science Scholars Program
NASA Information Power Grid
National Middleware Initiative (at NSF)
Partnerships for Advanced Computational Infrastructure (PACI)
Scientific Discovery through Advanced Computing (SciDAC)

Federal Task Forces and Committees

Internet Engineering Task Force (ITEF)
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 Research, California Institute of Technology, Pasadena CA
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 Utah, Salt Lake City UT
Center for Parallel Computing, University of Michigan, Ann Arbor MI
Computational Science and Information Technology, Florida State University, Tallahassee FL
Computer and Information Technology Institute, Rice University, Houston TX
Cornell Theory Center, Ithaca NY
East Carolina University, Greeneville NC
High Performance Computing Education and Research, University of New Mexico, Albuquerque NM
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
North Carolina Supercomputing Center at MCNC, Research Triangle Park NC
Northeastern University, Boston MA
Oak Ridge National Laboratory Center for Computational Sciences, Oak Ridge TN
Ohio Supercomputer Center, Columbus OH
The Pennsylvania State University, University Park PA
Pittsburgh Supercomputing Center, Pittsburgh PA
Purdue University, West Lafayette IN
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 Southern California Information Sciences Institute, Marina del Rey CA

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Use CASC logo

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