

Alabama Supercomputing Authority
Huntsville, Alabama

Arctic Region Supercomputing Center
Fairbanks, Alaska

Arizona State University
Tempe, Arizona

Center for Advanced Computing Research
Caltech
Pasadena, California

Center for Computational Sciences
Lexington, Kentucky

Center for Computational Sciences
Oak Ridge, Tennessee

Center for Innovative Computer
Applications at Indiana University
Bloomington, Indiana

Center for Research on
Parallel Computation
Houston, Texas

Cornell Theory Center
Ithaca, New York

National Center for
Atmospheric Research
Boulder, Colorado

National Center for Supercomputing
Applications at UIUC
Champaign, Illinois

National Energy Research
Supercomputer Center
Livermore, California

National Supercomputer Center
for Energy and Environment
Las Vegas, Nevada

North Carolina Supercomputing
Center at MCNC
Research Triangle Park, North Carolina

Ohio Supercomputer Center
Columbus, Ohio

Pittsburgh Supercomputing Center
Pittsburgh, Pennsylvania

Purdue University
West Lafayette, Indiana

San Diego Supercomputer Center
San Diego, California

Supercomputer Computations
Research Institute
Tallahassee, Florida

System Network Computer Center
at Louisiana State University
Baton Rouge, Louisiana

Texas A & M University
Supercomputer Center
College Station, Texas

The Pennsylvania State University
University Park, Pennsylvania

University of Florida
Gainesville, Florida

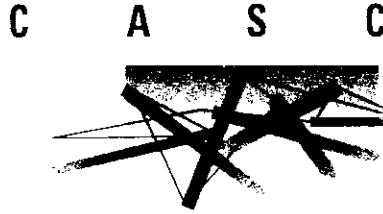
University of Georgia
Athens, Georgia

University of Maryland
College Park, Maryland

University of Texas at Austin
Computation Center
Austin, Texas

University of Utah
Salt Lake City, Utah

University of Wisconsin
Madison, Wisconsin



THE IMPACT OF HIGH PERFORMANCE COMPUTING ON AEROSPACE AND DEFENSE

The aerospace and defense industries have come to rely on the speed, power and precision of high performance computing to design, develop and manufacture the most advanced aeronautical and defense products in the world. To maintain this competitive edge and protect our interests at home and abroad, collaborations between the public and private sector in high tech R&D must remain a top priority.

The push for cost controls in these industries has made computer simulation a central component of product design and development. Defense applications frequently presage commercial use while commercial advances find their way into defense environments. Because of their unmatched expertise and resources, the national research labs and university-based supercomputing centers are called upon by industry and government to do this work.

DEFENSE APPLICATIONS -- The following are examples of defense-related products, developed using high performance computers at national laboratories under various DOD programs:

Weapons Tracking -- The Army's newest weapons tracking system, the Theater Missile Defense Ground-Based Radar, the first field deployable system to incorporate a massively parallel computer, can detect and track advanced weaponry like the Scud Missile at far longer distances than ever previously possible. This new system complements the highly successful Patriot missile with timely and accurate targeting. Massive parallelism has become a workable concept through the efforts of CASC member centers.

Reducing the Impact of Nuclear Accidents -- Massively parallel processing is improving the military's ability to predict, and control the effects of an accidental nuclear detonation. Computational analysis is used to assess the potential for "sympathetic" detonation of nearby warheads from the impact of debris generated by such an event.

Enhancing the Stealth -- The high tech Stealth fighter-bomber was the first aircraft ever to fly without building a full-scale assembled physical mockup. This was made possible by massively parallel processing, which enabled the rapid calculations required to simulate interactions between the electromagnetic spectrum and various aircraft design features.

AEROSPACE APPLICATIONS -- The following are examples of significant aerospace developments resulting from the federal investment in supercomputing research:

The Boeing 777 -- Boeing's much heralded new long-haul jetliner, slated for delivery in 1995, reaffirms U.S. leadership in the aircraft industry. Experts agree that manufacturing the 777 within acceptable cost and time constraints would have been impossible without supercomputer hardware and software developed at national labs under federal grant programs. Designed entirely with computational models, this plane is more streamlined, cost effective and fuel efficient than any built with physical mockups.

High Strength Steel -- An engineering team at Northwestern University has used supercomputers at the Pittsburgh Supercomputing Center to develop ultra high strength steel needed for such weight-critical applications as naval aircraft landing gear and bearings in the main engine turbo pumps of the space shuttle. By analyzing the composition of steel, they have identified the molecular mechanisms involved in impurity-induced brittleness, which is the cause of shattering in frigid conditions.

Wind Tunneling -- High performance computing has made it possible to create computational wind tunnels that replicate atmospheric conditions affecting aircraft in flight. This means that the viability and safety of new products can be tested more quickly, with increased accuracy, and at less cost than by building a physical prototype. Engineers from McDonnell Douglas, working at the San Diego Supercomputer Center, have further refined the process with a "Flow Analysis Software Tool Kit" that enables faster pre-selection of promising wind tunnel candidates. Limitations of the technology, however, mean that only sections of a plane, not any entire aircraft, can be tested at one time. High performance computers capable of full computational wind tunneling are still being developed.

Airplane Safety -- Researchers from the University of Dayton and Wright-Patterson Air Force Base are using Ohio Supercomputer Center facilities to simulate aircraft collisions with birds - a major cause of air disasters. This research, aimed at improving the design of aircraft windshields to withstand such events, has resulted in innovative manufacturing techniques to reduce the overall cost of producing aircraft windshields.

Minimizing Waste -- The Multi-disciplinary Analysis and Design Industrial Consortium (MADIC) brings together researchers from NASA, major aerospace companies, the Center for Research on Parallel Computation (CRPC), and other organizations to solve problems in aircraft development. One achievement has been creating computational templates that minimize waste in cutting sheet metal stock, a key material in building aircraft.