Modeling & Simulation



NAS expertise in fundamental and applied modeling and simulation is essential to creating large-scale simulations supporting critical NASA engineering and design decisions. Our fundamental research advances numerical methods, algorithms, and code development for aeronautics research, while applied modeling enables large-scale numerical simulations in several important mission areas.

In support of NASA's project to design the heavy-lift Space Launch System, NAS computational fluid dynamics experts developed specialized software and performed thousands of simulations to analyze aerodynamic characteristics for proposed designs of this next-generation vehicle.

Supercomputing for Today and Tomorrow

The NAS approach to real-world supercomputing integrates the latest technology with multi-level security and 24x7 user support to provide a reliable and accessible computing experience.

This empowers our customers to meet their science and engineering goals while reducing cost, risk, and development time.

With our recent expansion to Pleiades just completed to meet near-term needs, we have begun evaluating next-generation technologies to address emerging customer requirements.

Together with our industry, university, and government partners, the NAS Division remains committed to supporting current and future Agency missions.

Contact Us
To learn more about how about our high-end computing resources and customizable services can impact your NASA science and engineering sponsored projects, please contact:

Rupak Biswas
NAS Division Chief
(650) 604-4411
rupak.biswas@nasa.gov

Bill Thigpen
NAS Systems & Engineering Branch Chief
(650) 604-1061
william.w.thigpen@nasa.gov

NAS High-End Computing Environment Facts

Pleiades
- Primary production system for all NASA mission directorates
- SGI ICE X cluster connected via InfiniBand in an 11D hypercube topology
- 126,720 cores (Intel Xeon quad-, six-, and eight-core processors)
- 1.75 petaflop/s peak; 1.24 petaflop/s sustained performance (June 2012)
- 233 terabytes total memory
- 64 nodes enhanced with Nvidia graphics processing units

hyperwall-2
- 128-screen, tiled LCD wall displays, processes, and shares data—can display a single image across all screens, or can display unique images in selected "cells"
- Custom Colfax International system connected to Pleiades via InfiniBand (over 100 gigabytes-per-second connectivity)
- 128 nodes; 2 quad-core (AMD Opteron 2354) processors per node
- 136 Nvidia Fermi GTX 480 processors
- 2 terabytes total system memory; 208 gigabytes GDDR5 graphics memory

Storage
- Online and archive systems to store and retrieve science and engineering results
- 2 SGI Altix 4700 mass storage systems
- 115-petabyte archival storage capacity
- 10-petabyte RAID disk capacity on floor; 17 petabytes of unique data on tape

Networks
- World's largest InfiniBand network, with over 65 miles of cabling connecting Pleiades, hyperwall-2, and storage systems
- Cisco Systems local area network, with 10-gigabit backbone supporting both 1G and 10G hosts
- 914 total active ports; 838 gigabit Ethernet ports, 76 10-gigabits-per-second Ethernet ports
- Maximum bandwidth: 1.6 terabytes per second

For the latest system updates see: http://www.nas.nasa.gov/hecc/resources/environment.html

NASA Advanced Supercomputing Division
NASA Ames Research Center
Mail Stop 258-6
Moffett Field, CA 94035-1000
Phone: (650) 604-4502
FAX: (650) 604-4377
www.nas.nasa.gov

NP-2010-12-02-ARC
Summer 2012

www.nasa.gov

National Aeronautics and Space Administration

NASA Advanced Supercomputing Division



NASA Advanced Supercomputing Division

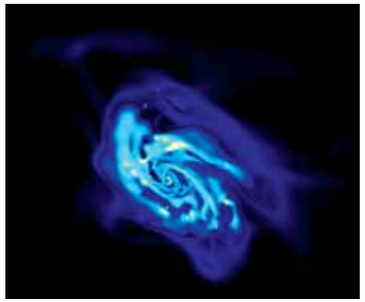
Delivering Powerful and Reliable Computing Solutions for NASA Missions

The NASA Advanced Supercomputing (NAS) Division at Ames Research Center is known worldwide for its innovation and expertise in high-end computing (HEC).

To help achieve exceptional performance and ground-breaking results for NASA's scientific and engineering users, we combine cutting-edge HEC technology and techniques with an emphasis on providing reliable, real-world production capability.

These snapshots of current projects highlight different aspects of our integrated approach to providing custom supercomputing solutions to users across all NASA mission directorates.





End-to-End Network Support

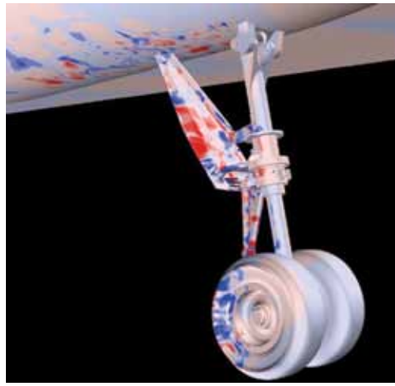
NAS network engineers provide custom, end-to-end support services that help users efficiently transfer their massive datasets, often many terabytes in size. The outcome: more computational runs, reduced time-to-solution, and faster turnaround of scientific results.

This image of the "cosmic web" is from an unprecedented Bolshoi simulation, which models the role of dark matter in galaxy formation. Using NAS' automated network flow-monitoring tool, our experts discovered and helped resolve a remote network bottleneck, improving data transfer speeds by 600% for astrophysicists at New Mexico State University.

Scientific Visualization

The NAS visualization environment connects Pleiades to our locally developed hyperwall-2 system via high-speed InfiniBand, forming a unique heterogeneous cluster enabling concurrent visualization, through which scientists can view simulation results in real time.

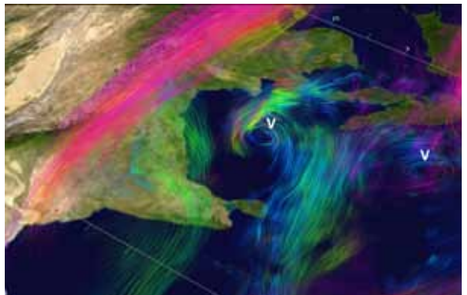
With significant support from our "vis" specialists, researchers on NASA Langley Research Center's Airframe Noise Team discovered new features in simulations of the complex flowfield around the nose landing gear of a jet aircraft. This new information can be used in future designs to reduce takeoff and landing noise near airports.



Real-World Supercomputing

Using Pleiades, our production supercomputer, research scientists supporting NASA's Earth Science Technology Office produced cutting-edge simulations of 2008's Cyclone Nargis. By improving the understanding of tropical storm genesis and intensification, their work may help save lives and property from future storms.

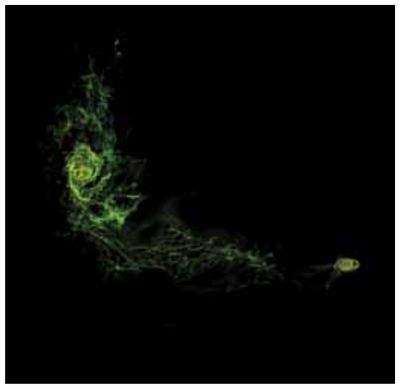
In the last year, we have continued to expand Pleiades, which now delivers 1.24 petaflop/s sustained performance. Even though these ground-breaking cyclone simulations used thousands of processors, Pleiades' enhanced capacity allowed many other mission-critical jobs to run at the same time.



Creative Storage Solutions

Our mass storage capacity, currently encompassing 115 petabytes (PB) of tape and 10 PB of on-floor disk, is expected to grow by 400% over the next three years to meet user needs. In addition, NAS provides custom filesystems and training to help users manage their massive datasets more efficiently.

For example, an astronomer at Princeton University created a simulation of two galaxies merging, which used hundreds of terabytes of data storage. NAS support saved the user countless hours of data transfer and retrieval time.



Code Performance Optimization

NAS code performance experts provide a variety of troubleshooting, porting, and optimization services—ranging from basic to comprehensive—which are designed to enhance researchers' productivity and ensure that they obtain accurate results in less time.

Extensive code-building and troubleshooting by NAS experts for scientists supporting NASA's Explorer Program were key to producing the largest 3D hybrid simulations of Earth's magnetosphere to date. This led to new discoveries about how space weather affects both our planet and critical elements of global infrastructure, such as communications satellites.

