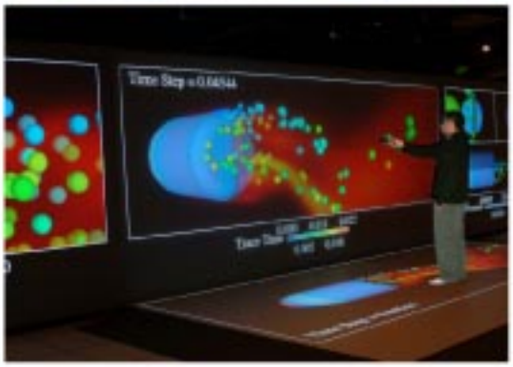
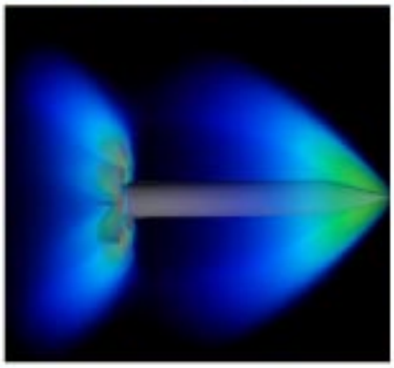
ARL MSRC

Army Research Laboratory Major Shared Resource Center

A Tradition of Innovation. The Attitude for Success.





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A Tradition of Innovation.

The Army Research Laboratory (ARL) has a deep, ingrained heritage of supporting U.S. warfighters. Our drive to creatively overcome obstacles and break new ground continues traditions started before World War II. Since 1943, the ARL (then known as the Ballistic Research Laboratory or BRL) has been at the vanguard of modern computing. Using the Bush Differential Analyzer, programmable calculators, and sheer brute force, the BRL provided ballistic calculations and firing tables that were vital to the Allied victory in World War II. In fact, the BRL at the Army's Aberdeen Proving Ground facility became the first permanent installation of what was fast becoming a strategic asset for battlefield computations and weapons development.

Our attitude for success comes from the tradition of teamwork and innovation that led to our leadership role in the development of the world's first general purpose, electronic digital computer. Conceived by a collaboration between BRL and the University of Pennsylvania, the Electronic Numerical Integrator And Computer (ENIAC) required only 30 seconds to compute a single trajectory. Manual calculations took almost 20 hours.

Over the next three decades, the BRL continued to collaborate with academic partners to design new computers that were the most powerful machines of their time. These included EDVAC, ORDVAC, BRLES I, and BRLESC II. In 1986, the BRL developed ASNET, the Army Supercomputer Network, which became one of the fastest and most secure networking infrastructures on the planet. In 1992, the Army Research Laboratory was established by combining the Ballistic Research Laboratory with other Army research activities. This multifaceted organization is staffed by talented multidisciplinary scientists, engineers, and visionaries who are dedicated to meeting and pushing the envelope on the computing requirements of DOD researchers.

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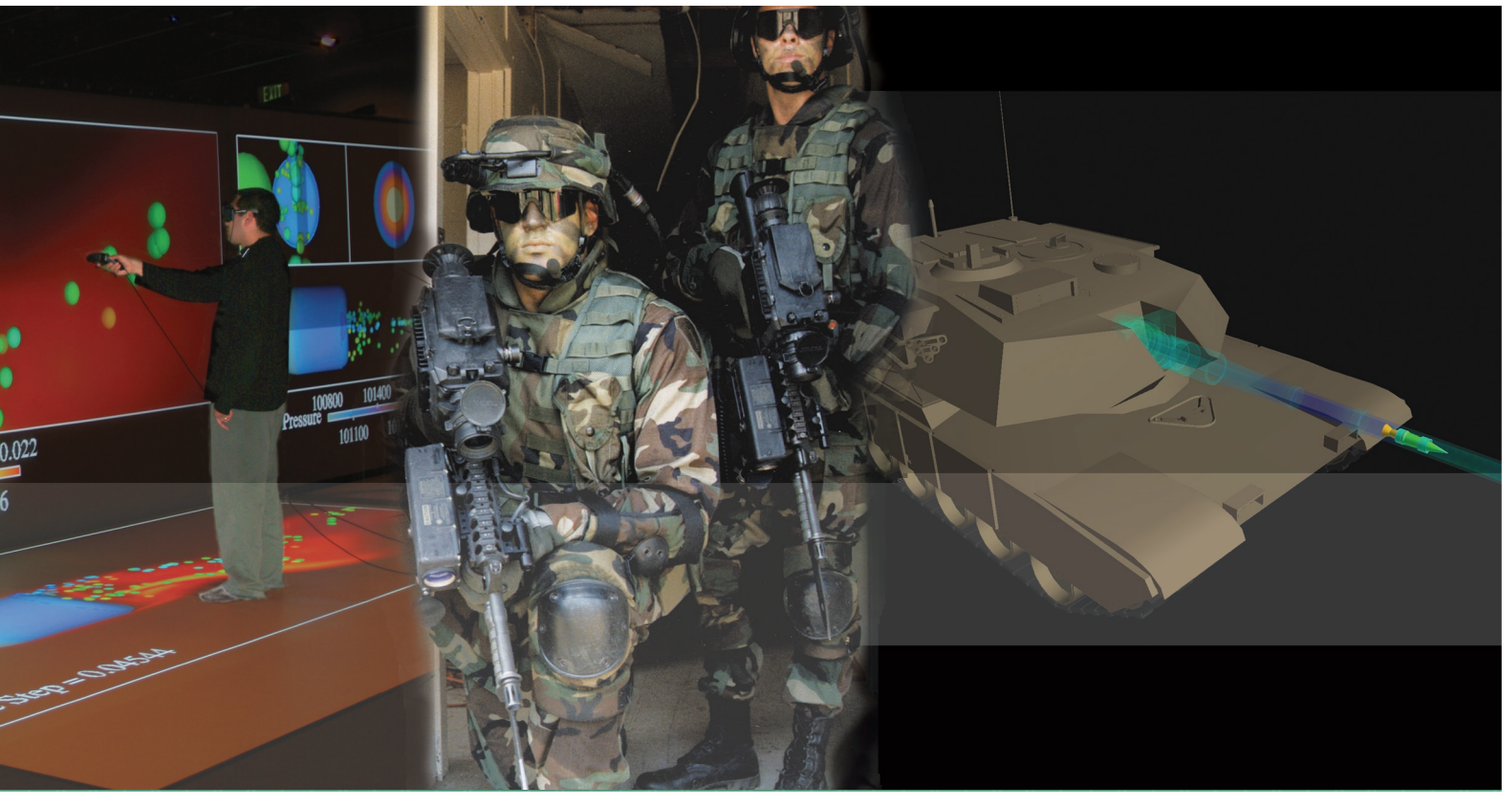


The Attitude for Success.

Today, ARL is proud to partner with the DoD High Performance Computing Modernization Program Office (HPCMPO) to manage and operate one of its four Major Shared Resource Centers (MSRCs). As one of the world's most powerful computing sites, the ARL MSRC continues to deliver the latest in computational tools and innovative technology. Our computer simulations and models help technologists develop, test, and field weapon systems faster and more efficiently—shortening the entire acquisition process from research to production. ARL MSRC Team members are helping scientists develop more effective techniques for simulating combat environments, detecting munitions, and creating new armaments—to save lives on future battlefields.

As one of world's most powerful computing sites, the ARL MSRC uses world-class, high-performance computers (HPCs), cutting-edge applications, and expert staff scientists to help the United States maintain its technological and military supremacy. The Center offers a full spectrum of computational capabilities for the Department of Defense (DoD) Science and Technology and Test and Evaluation communities, including:

- Powerful parallel processors
- Comprehensive storage
- Close ties with academic partners
- Reliable high-speed networks
- Scientific visualization
- Advanced training
- A wide range of software
- Novel storage platforms
- Outstanding end-user care

Integrated Work Teams (IWT) are an integral part of the ARL MSRC. Each functional work group–from Applications Support and Networking to System Administration–is composed of government and contractor personnel working together to support DoD researchers.

Hardware

The right tools to get the job done

The ARL MSRC has the equipment, power, and infrastructure needed to support the most demanding DoD research and engineering projects. Part of the Center's mission is to support large-scale Challenge Projects that have extensive compatibility, computational, and storage requirements. Many of these complex assignments require millions of hours of scalable, parallel computational power to evaluate extremely large problem sets. The Center is skilled and experienced and ready for complex, 3-D scientific research projects that stretch across multiple computational technology areas. The Center is uniquely capable of handling computing projects for both capability and capacity computing.

The Center's Team members take pride in providing a heterogeneous suite of HPC architectures that get the job done faster, including:

- Clusters of symmetric multiprocessor (SMP) systems
- Non-Uniform Memory Access (NUMA) systems

The Center's suite of HPC platforms gives researchers a wide range of cutting-edge hardware. In addition to raw processing power, the Center employs balanced system configurations that deliver enough memory and I/O subsystems to support the most resource-intensive, high-performance parallel applications.

The Center also offers secure, high-speed networking and communications with state-of-the-art archival storage platforms. Advanced scientific visualization resources, 3-D immersive equipment, and an innovative multimedia production facility help researchers visually evaluate and present project results.

High Performance Computers—like the Linux NetworX Evolocity II (very top) and IBM and SGI machines (directly above)—are selected for power, speed, compatibility, and durability. They support hundreds of processors, large memories, high-performance disks, and networking technologies. These systems give the Center the capability to handle demanding projects and the capacity to store all of their associated files.

Software & Customer Service

Fuel for solutions

The ARL MSRC supports DoD scientists and engineers with state-of-the-art programming tools and multi-platform system software. Online documentation is available for most installed applications. The Center's Help Desk, the Applications Support Team, and Programming Environment and Training (PET) representatives located here can answer questions, optimize software, provide help with scripts, provide assistance in interfacing with the queuing systems, and maintain COTS software applications on all systems.

Comprehensive tools include Grid generation programs, flow solver software, mathematical libraries, and parallel programming tools (MPI and OpenMP). Debugging tools, such as Totalview and Vampir, are readily available to users. Postprocessing software is available for scientific visualization services. And, of course, the Center supports a wide variety of system software and the major programming languages, including C, C^{++} and Fortran.

A complete list of the Center's software is available on www.arl.hpc.mil. Software applications are listed in the High Performance Computing Modernization Office Program's website, www.hpcmo.hpc.mil. The Center constantly reevaluates its software suites and are always open to suggestions for new applications.

Customer Service

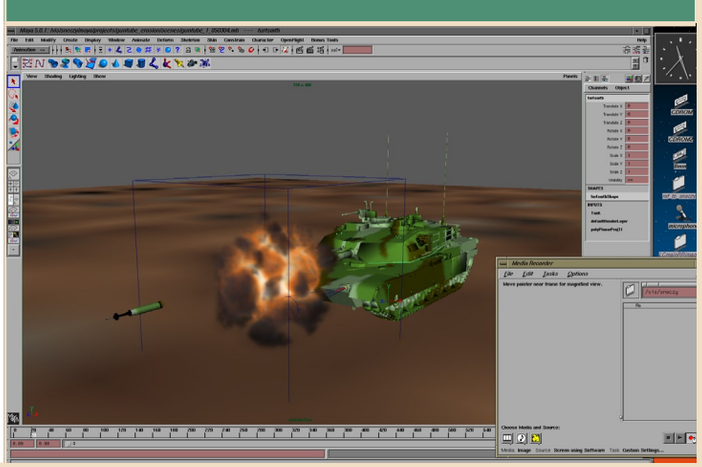
Our Customer Service Team has created a comprehensive resource and information center for current and prospective users. This group delivers a full range of customer care, support, and out-of-the-box thinking. These proactive professionals help researchers get started, answer questions, and try to prevent problems before they can occur. They also install Computational Technology Areas software, provide programming environment support and technical reference materials, and can suggest ways to optimize code and use peripherals.

The Customer Service Team will do whatever it takes to make a project successful.

As a result, the Team is the first place new customers turn to for in-depth information about the Center's resources and capabilities. Team members can help newcomers submit security forms, request an account, and start working. The Team is carefully trained in a multitude of diagnostic skills–from computer accounts and software applications to secure computing. Team members are on duty Monday to Friday, from 8 a.m. to 6 p.m. (EST), and will respond quickly to any after-hours emergency.

Contact the Customer Service Team by phone, fax, e-mail, or Internet. For general assistance, call the ARL MSRC help desk toll-free at 1-800-275-1552 or 410-278-1700/6933. E-mail msrchlep@arl.army.mil.

The ARL MSRC Team utilizes both COTS and in-house software tools to address basic and advance computational problems. Moreover, professional 3-D rendering software like Maya 5.0 (seen below) is used by the Scientific Visualization Team to explore, define and present the results of HPC computations. The Center is continually reevaluating its software suites.



Network & System Administration

Security, accuracy, and speed

The ARL MSRC has the infrastructure to handle large and small computer projects. Our low-latency, high-bandwidth networks support multiple Gigabit-class technologies for flexible, high-speed data transfers. High-capacity mass storage systems with petabyte-level scalability ensure that information is protected and readily available. Backup power generation systems, battery-based UPS, and dual-chilled water systems provide clean, stable power and a controlled environment—ensuring the Center stays up and running.

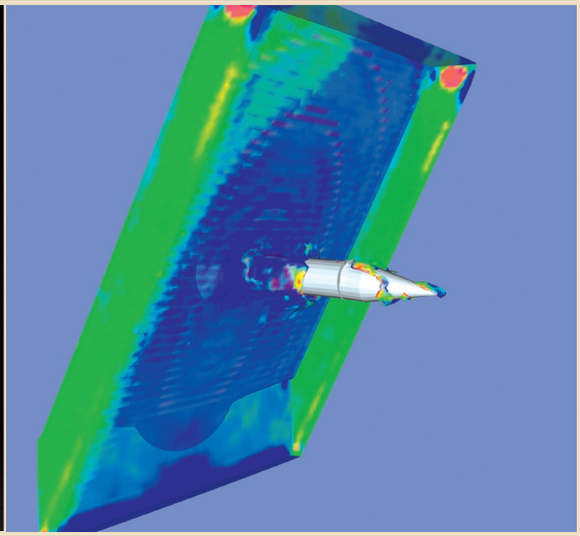
The Center's networking Team provides local and remote customers with full engineering and security support, including router configuration and encryption management. The Center's computational resources use Defense Research and Engineering Network (DREN) to connect to other DoD centers and the user community. Our computational environment is interconnected by Gigabit Ethernet at very fast speeds.

Systems Administration personnel provide 24-hour-a-day support of the Center's resources. The Team works with the Integration Team to configure new systems for benchmark testing and configures new systems into the production baseline. Responsibilities include:

- Monitoring systems for performance and system security.
- Performing system upgrades and installs and verifying updates that do not impact user jobs.
- Monitoring the queuing system and ensuring the systems are kept at optimal usage.
- Working with Tier 1 and 2 support to resolve user issues and with the operations staff to ensure proper disaster recovery measures (system backups) are created and available.

Network services and system administration personnel keep networks up and running 24 hours a day. Extremely reliable, high-performance equipment offers extensive data storage and archiving and delivers the bandwidth local and remote users require. Robust security measures keep data safe and protect the network infrastructure against unauthorized access, component damage, and denial of service attacks.

Scientific Visualization



The Scientific Visualization Team develops techniques for exploiting HPC technology, promote the use of SciVis within DoD, and make visualization technology available to DoD researchers. (Right) A visualization of the XM1002 TPCSDS-T 120mm training cartridge interacting with an aluminum plate.

See the results

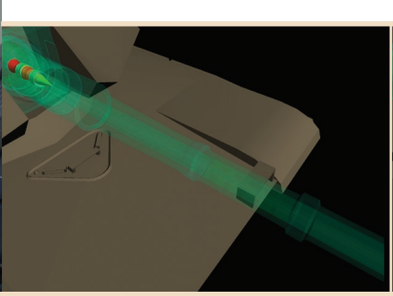
The ARL MSRC Scientific Visualization Laboratory houses a comprehensive suite of software tools that are supported by a wide variety of high-end workstations, visualization servers, and a fully functional video/multimedia production facility. Large-format, 3-D stereoscopic display systems integrated with 3-D sound and infrasound allow natural and intuitive interactions with multidimensional computational models.

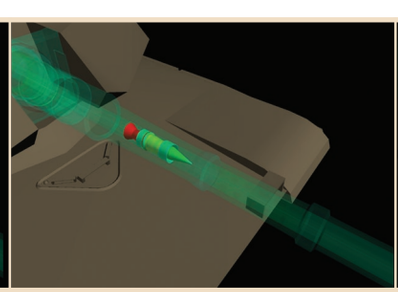
Scientific Visualization serves as a key technology by providing researchers with ways to explore, define, and present the results of HPC computations. Computer simulations are becoming more sophisticated, which results in corresponding increases in data file sizes. Technologists can get insight into complex problems by reducing these large quantities of data into images and animation that they can manipulate and analyze.

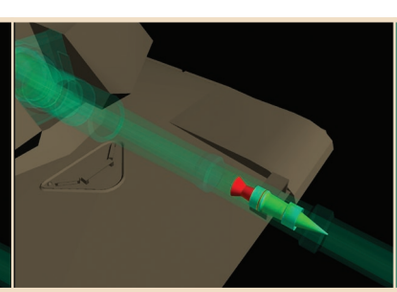
Scientific Visualization not only helps scientists understand the results of their research, but also serves as a tool to explain and promote a particular science or technology to a broader audience in unique and nontraditional ways. Scientific Visualization offers new techniques, both visual and auditory, that can make presentations more understandable to nontechnical audiences.

The Center's Scientific Visualization Team has led the way in visualization services since it was established in 1991. The group is staffed by talented, multidisciplinary computer scientists, engineers, and artists who are dedicated to providing comprehensive solutions. Team members continually strive to combine HPC computations, analysis, and visualization into one seamless, easy-to-use environment.

To learn more about Scientific Visualization, visit www.arl.hpc.mil or e-mail vis@arl.army.mil.







This training cartridge visualization of the tactical M830A1 MPAT-T cartridge replicates the configuration of the M830A1 with cone stabilized and discards sabot projectile.

Programming Environment and Training (PET)

Assisting the user in the HPC environment
The Programming Environment and Training (PET) activity is responsible for gathering and deploying the best ideas, algorithms, and software tools emerging from the national High Performance Computing (HPC) community into the DoD user community.

Technical support is through the Functional Area Points of Contact (FAPOCs) and their teams of on-site personnel, who are proficient in the 10 computational technology and five cross-cutting areas. The Functional Area teams serve as liaison/brokers among users and academia, industry, and other government agencies–helping to improve the computational environment and knowledge base.

Support for the functional areas involves the knowledge and technology transfer of computer modeling applications and computational algorithms, methods, and tools into the user community. The five cross-cuttings areas are Enabling Technologies; Computational Environments; Collaborative and Distance Learning Technologies; Education Outreach and Training Coordination; and Online Knowledge Center.

The overall PET program oversight is coordinated by the PET Program Director, Dr. Leslie Perkins, at the HPCMPO, and four government Component Area COTRs. In addition, four contractor Component Area POCs are responsible for management of each of their assigned functional areas, as well as any cross-functional area collaboration and projects. The Functional Area POCs for Component Area 4 at the ARL MSRC are:

• Computational Chemistry and Materials Science (CCM); Anthony Rollet, Carnegie Mellon University, e-mail: rollet@andrew.cmu.edu and Nick Nystrom, Pittsburgh Supercomputing Center, e-mail: nystrom@psc.edu.
• Computational Electromagnetics and Acoustics (CEA); Jianming Jin, University of Illinois at Urbana-Champaign, e-mail: j-jin1@uiuc.edu and Charbel Farhat, Stanford University, cfarhat@stanford.edu.
• Computational Electronics and Nanoelectronics (CEN): Stephen Goodnick, Arizona State University, e-mail: stephen.goodnick@asu.edu
• Collaborative and Distance Learning Technologies (CDLT): Jeffrey Huskamp, University of Maryland College Park, e-mail: jhuskamp@umd.edu.

The PET intern program, which was created in 1998, pairs undergraduate and graduate students with DoD scientists and engineers to work on real-world projects. This program is one of many PET initiatives that have promoted training within the Center and its users.

For more information on the Component Area 4 PET program, contact Dixie Hisley at 410-278-9156, e-mail: hisley@arl.army.mil or Dr. Vincent Natoli at 410-278-9284, e-mail: vnatoli@arl.army.mil.

For more information on the PET program and Functional Area POCs, visit www.hpcmo.hpc.mil/Htdocs/PET/index.html.

Getting Started

Getting an account

The application process is complicated and can seem overwhelming, but when it's all over, you will have access to some of the world's most powerful machines. Below is a synopsis of the account application process. For additional information, visit http://www.arl.hpc.mil/userservices/newuser.html.

If you have any questions, call the ARL MSRC Help Desk toll-free at 1-800-275-1552 or locally at 410-278-1700 or e-mail msrchelp@arl.army.mil. An experienced user support representative will take you through the procedures step-by-step.

I. Apply for an Information Environment (IE) account: Go to https://ieapp.erdc.hpc.mil/info/home.do. To complete the IE Account application form, you must provide your (refer to https://ieapp.erdc.hpc.mil/info/IEAppProc.html for the detailed definition of these fields).

- Name, title, and position.
- Mailing address (no P.O. boxes) and phone and fax numbers.
- E-mail address.
- HPCMPO organization.
- Citizenship status (alien registration number and expiration date, where applicable).
- Government employee status.
- (For non-government employees) Government Point of Contact (POC), POC contact information, contract number, and contract expiration date.
- Organization hierarchy and position (optional)
- National Agency Check (NAC) status, if known
- Preferred User ID (optional, where permitted)
- Preferred Login Shell (optional, where permitted)

That information will be forwarded for approval or rejection.

II. Upon approval for a HPC account: Once you have been approved for a HPC account, your Principal Investigator (PI), or Service/Agency Approval Authority (S/AAA) will assign you to one or more projects on specific HPC machines. If you are a non-U.S. citizen, your PI needs to complete and fax a Section IV form for each project you have access to. You will also need to send the ARL MSRC a Visit Request.

III. Send us your signed Section III: We will send new users a SecurID Card and a Kerberos principal. All users will also receive a Section III form that must be signed and faxed back before accounts can be activated.

IV. Upon receipt of all requirements: Your accounts will be activated, and you will be mailed instructions on how to utilize your newly accessible resources. Until all of the requirements are met, you and the persons associated with your account will receive weekly e-mail reminders with a list of items that need to be completed before account activation.

V. ARL MSRC New User Tutorial: Learn how to compute at the ARL MSRC by taking our interactive, web-based, New User Tutorial. Spending some time up front learning about our local configurations, our queuing systems, our file systems, what your job scripts should do, how to report problems, etc. will save you considerable time in the long run.

The ARL MSRC User Services Team can be reached by trouble ticket web form, e-mail, or phone. Team members are on duty Monday through Friday, 8 a.m.-6 p.m. EST. After regular duty hours, the Operations staff handles the Help Desk phone calls. User Services monitors e-mail and trouble ticket web forms to ensure urgent problems are handled expeditiously. Users with emergencies are encouraged to use the Help Desk phone number after hours to ensure the swiftest handling of their situation.

To contact the Help Desk:

- Visit the ARL MSRC web page at www.arl.hpc.mil/userservices/index.html to fill out a Trouble ticket. (Click the "Submit a New Help Desk Ticket.")
- E-mail msrchelp@arl.army.mil.
- Call 1-800-275-1552/1-410-278-1700.
- Fax 1-410-278-7961.

CONTACT US

Let us demonstrate our attitude for success.

We are dedicated to providing DoD researchers with the best possible service and continue to offer high-performance computing solutions that feature accelerated hardware, comprehensive software applications, flexible networking infrastructure, dynamic visualizations, and outstanding customer care. If you are connected to the Department of Defense community, put our resources to work for you.

Please visit **http://www.arl.hpc.mil** for additional information about the ARL MSRC or call **410-278-9277**. Current or prospective users should contact the User Services help desk toll-free at **1-800-275-1552** or **410-278-1700/6933**. Send faxes to **410-278-7961** or e-mail **msrchelp@arl.army.mil**.

About the Outreach Team

This brochure is one of many informational and promotional products the ARL MSRC Outreach Team produces to ensure the Center is visible to DoD, government agencies, and the HPC and academic communities. By participating in numerous military and civilian HPC conferences throughout the year, the Outreach Team supports efforts to recruit both classified and unclassified users, reaching to all parts of DoD where MSRC resources can be used. For more information, e-mail the Outreach Team at **outreach@arl.army.mil.**

Welcome to the Army Research Lab (ARL) Major Shared Resource Center (MSRC)

As one of the most powerful computing sites in the world, the ARL MSRC's state-of-the-art, High Performance Computing (HPC) resources help the U.S. stay strong. Our mission is to evaluate, acquire, develop, operate, and manage high performance computers and networks. ARL MSRC supercomputers support and empower DOD scientists and engineers in their Research & Development (R&D), Science & Technology (S&T), and Testing & Evaluation (T&E) efforts. The ARL MSRC strives to continually improve existing computational techniques, methodologies, and infrastructure—to look beyond the box and develop more effective ways of doing business.

The ARL MSRC is a critical force in the DOD scientific and engineering communities. The Center's high performance computers—combined with advanced technology and the dedication of government-contractor integrated work teams—support a computational environment that helps solve complex, coupled, three-dimensional, time-dependent, scientific problems that encompass multiple computational technology areas. Our Center has consistently proven that it excels in processing large Challenge jobs that require hundreds of hours of scalable computations. Proactive work teams keep systems running at maximum efficiency and provide researchers with outstanding technical support and training.

High performance computing processors and systems work together in parallel to handle the most complex computations. Their speed, robust performance, and capability make our HPCs ideal for modeling and simulations in scientific and engineering environments—for research, product design, and development.

HPC systems save time and money by accelerating the design process. It is significantly faster and less expensive to experiment with systems computational before building prototypes and making test runs. The accelerated production cycle means new systems can be deployed faster. This provides warfighters with the best technology and weapons systems available and gives them more time to train—enhancing their readiness and potentially saving U.S. lives.

Warfighters on the front lines increasingly depend on technology to successfully carry out U.S. foreign policy. The ARL MSRC is helping researchers push the boundaries of scientific knowledge. Scientists have used the results of computations made on the ARL MSRC computers to develop the tools that ultimately help the military conduct its missions more effectively. Some of the breakthroughs that were derived from ARL MSRC resources have enhanced soldier survivability, developed smart projectiles and missiles, and enabled munitions to impact on targets with greater accuracy and force.

The ARL MSRC management team and staff are ready, willing, and able to satisfy your HPC requirements. We are eager to take on new challenges and have a vast array of organizational experience, computational tools, and cutting-edge applications at your disposal. The ARL MSRC has what it takes to get the job done—*a tradition of innovation and the attitude for success.*

Please contact us today for additional information or if you would like to discuss how to put the Center to work for you. Call our help desk at **1-800-275-1552** or **410-278-1700/6933**, or e-mail **msrchelp@arl.army.mil.**

Mr. Charles J. Nietubicz,
Chief, High Performance Computing Division and Director of the ARL MSRC

Dr. R. Prabhakaran
Raytheon Program Manager for the ARL MSRC

ARL MSRC Hardware

(As of September 2004)

IBM

1 - 2304-Processor eServer 1350 Cluster
- 2304 – 2.2 GHz AMD Opteron processors
- 3456 GB memory
- 60 TB RAID disk
- 10 peak TeraFlops total

1 – 768-Processor eServer p690 System
- 768 – 1.3 GHz Power4-based RS/6000 processors
- 768 GB memory
- Dual plane Colony switch
- 7 TB RAID disk
- 4 peak TeraFlops total

1 – 128-Processor eServer p690 System
- 128 – 1.7 GHz Power4-based RS/6000 processors
- 224 GB memory
- Federation switch
- 7 TB RAID disk
- 870 peak GigaFlops total

1 – 1024-Processor Power3 RS/6000 SP System
- 1024 – 375 MHz Power3 RS/6000 processors
- 1024 GB memory
- 16-way Colony switch
- 5 TB RAID disk
- 1.5 peak TeraFlops total

1 – 256-Processor eServer p690 System
- 256 – 375 MHz Power3 RS/6000 processors
- 192 GB memory
- 16-way Colony switch
- 2.3 TB RAID disk
- 384 peak GigaFlops total

Linux Networx

1 – 2048-Processor Evolocity II Cluster
- 2048 – 3.4 GHz Intel XEON processors
- 4096 GB memory

- 50 TB RAID disk
- 14 peak TeraFlops total

1 – 256-Processor Evolocity II Cluster
- 256 – 3.06 GHz Intel XEON processors
- 256 GB memory
- 8 TB RAID disk
- 1.5 peak TeraFlops total

STK

2 – Storage Silos
- 10,402 Total Slots
- 1198 TB peak storage capacity total
- 10 – StorageTek 9840 Drives
- 10 – StorageTek 9940 Tape Drives

1 – Storage Silo
- 5496 Total Slots
- 1073 TB peak storage capacity total
- 10 – StorageTek 9840 Drives
- 8 – StorageTek 9940 Tape Drives

SGI

1 – 256-Processor Altix 3700
- 256 – 1.5 GHz Intel Itanium2 processors
- 512 GB memory
- 20 TB RAID disk
- 1.5 peak TeraFlops total

1 – 16-Processor Altix 3700
- 16 – 1.4 GHz Intel Itanium2 processors
- 16 GB memory
- 2 TB RAID disk
- 96 peak GigaFlops total

1 – 512-Processor Origin 3800
- 512 – 400 MHz R12k processors
- 384 GB memory
- 5 TB RAID disk
- 410 peak GigaFlops total

1 – 256-Processor Origin 3800
- 256 – 400 MHz R12k processors
- 128 GB memory
- 2.2 TB RAID disk
- 204 peak GigaFlops total

1 – 32-Processor Origin 2000
- 32 – 300 MHz R12k processors
- 32 GB memory
- 540 GB RAID disk
- 19.2 peak GigaFlops total

Sun

Fire 15000 Server System
- 16 – 1.05 GHz UltraSparc3 processors
- 16 GB memory
- 28 TB RAID disk

Dual Enterprise 6800 Server System
- 12 – 750 MHz UltraSparc2 processors
- 12 GB memory
- 3 TB RAID disk

Scientific Visualization:

1 – SGI Onyx3
- 24 – 500 MHz processors
- 24 GB memory
- 3 “Infinite Reality 3” graphic pipes

1 – SGI Onyx2
- 16 – 500 MHz processors
- 19 GB memory
- 3 “Infinite Reality 3” graphic pipes

1 – SGI Onyx2
- 16 – 500 MHz processors
- 32 GB memory
- 3 “Infinite Reality 2” graphic pipes

1 – SGI Onyx2
- 16 – 300 MHz processors
- 16 GB memory
- 1 “Infinite Reality 2” graphic pipes

1 – SGI Onyx2
- 16 – 250 MHz processors
- 32 GB memory
- 3 “Infinite Reality 3” graphic pipes

1 – SGI Onyx2
- 8 – 250 MHz processors
- 6 GB memory
- 1 “Infinite Reality 2” graphic pipes

ARL MSRC Software

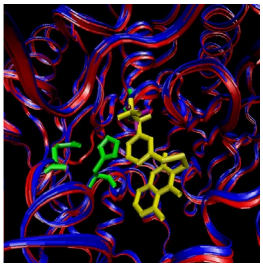
(As of September 2004)

ARL MSRC offers a variety of third-party applications for the Computational Technology Areas (CTAs) in which we operate. For more information about software availability, please see the list at **www.arl.hpc.mil**, contact the help desk at **msrchelp@arl.army.mil**, or the PET CTA Lead in your area of science. For software released through the HPCMPO, check out the software listing at **www.hpcmo.hpc.mil**.

Online documentation is available in Postscript, PDF, or HTML formats in the "docs" subdirectory of the respective software install directory. In addition, information on environmental variables and installation specific to the ARL MSRC site is provided in the ARL.README file in each software installation directory. Users should read the ARL.README file first before using the software. Licensed codes are installed in /usr/cta on each machine and are maintained and supported in-house.

General suggestions about software or requests for new CTA software packages should be sent to **sw-iwt@arl.army.mil**. User requests are first evaluated by PET CTA Leads. Their recommendations are then forwarded to the ARL MSRC Configuration Control Board for final approval.

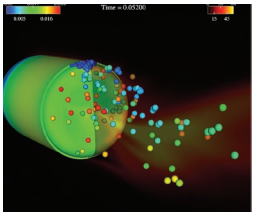
CCM—Computational Chemistry and Material Sciences CTA:
Research tools used to predict basic properties of new chemical species and materials. CCM helps the DOD develop high-performance materials for electronics, optical computing, advanced sensors, aircraft, rocket engines, and lasers.



ACES II
Amber
Crystal98
Gaussian G98
MELDF
VASP

ADF
Cerius
GAMESS
Gaussview
Mopac
wien97

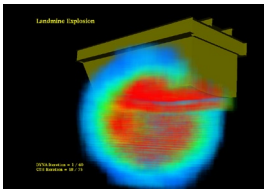
CFD Computational Fluid Dynamics CTA:
Numerical equations accurately describing fluid and gas motion. Applications include calculating atmospheric re-entry, advanced power systems, and weapons effects.



Grid Generation
Gridgen
Overgrid
Cart3D
Muses
Hypermesh
Gridpro
Kiva
MARG

Flow Solvers
Cobalt
FAST3D
Fluent
GASP
Icemcfd
METACOMP/CFD++
Overflow
Wind

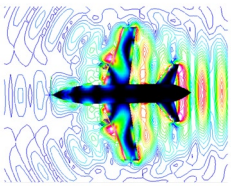
CSM—Computational Structural Mechanics CTA:
High-resolution, multidimensional modeling of materials and structures. DOD applications include coupled field problems, structural analysis, total weapon simulation, weapon system lethality/survivability, and propulsion systems.



Abaqus
CTH
LS-DYNA3D

ANSYS
Cubit
Msc/Patran

CEA–Computational Electromagnetics and Acoustics CTA:
High-resolution, multidimensional solutions of Maxwell's equations and acoustic wave equations in solids, liquids and gases. DoD applications include calculating electromagnetic fields and signatures, acoustics fields, seismic fields and acoustic shock waves.



FISC
Xpatch

Tempus

IMT—Integrated Modeling and Test Environments CTA:
Multidisciplinary computational methods using modeling and simulation tools and real-time techniques to test weapon components, subsystems, and systems in virtual operating environments.

ISIGHT
MATLAB
Pro/Engineer

PRG—Programming Tools:
Provide easy access to applications that facilitate the parallelization of users' codes and enhance code performance.

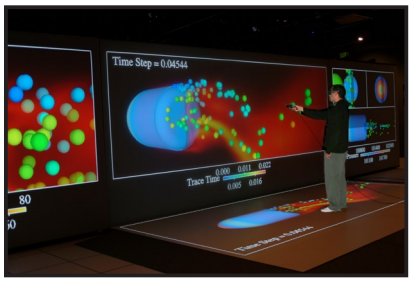
Interfaces:
NetCDF
PST

Debugging Tools:
KAI ASSURE, GUIDE, and KCC compiler
Pdbx (IBM)
SGI dbx
SGI Workshop Debugger
TotalView

Mathematical Libraries:
ESSL (IBM)
LAPACK
MASS (IBM)
Numerical Algorithms Group (NAG)
PESSL (IBM)
PETSc
ScaLAPACK
SGI complib (includes BLAS, EISPACK, LINPACK, LAPACK)
SGI libfastm (fast transcendental library)
SGI/Cray Scientific Library (SCSL)
SPRNG

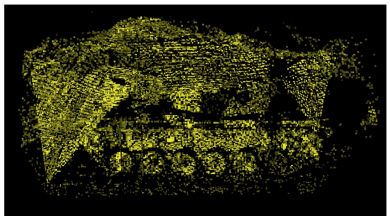
Parallel Programming:
MPI
Open MP
Pthreads
PCA Automatic Parallelization
PVM
SGI PFA

Profiling Tools:
CaseVision (cvpav)
KAI ASSURE, GUIDE, and KCC compiler
Libhpm (IBM)
PAPI
Parallel analyzer (cvpav)
Perfex
SGI process activity reporter (par)
Speedshop
TAU
Vampir
VampirTrace
XProfiler (IBM)



SCI—Scientific Visualization:
Evolving methodology allows scientists to analyze, interpret, and present the results of their computational research in visual forms that include multidimensional, animated depictions of their data.

Alias/wavefront Maya
AVS
AVS/Express
Cave Libraries
ICE – Interactive Computing Environment (locally developed)
Ensight/Ensight Gold
FAST
FieldView
Fluent
Gridgen
IDL
Lightwave
Mathematica
MATLAB
Nasadig
NCAR Graphics
NDGM (locally developed)
Pandemonium
Presto
Pro-Engineer
PV-Wave
Tecplot
Vis5d
vtk



SIP—Signal and Image Processing CTA:
Extracts, sorts, and interprets useful information from sensor outputs in real time. DOD applications include surveillance, reconnaissance, intelligence, communications, avionics, smart munitions, and electronic warfare.

MATLAB
RTExpress
XPatch
VisiGuest

System Software

IBM Power3 RS6000/SP Systems
AIX 5.1
LoadLeveler
C
C++
MPcc
MPCC
MPXLF
XLF

IBM Power4 P-Series 690/SP Systems
AIX 5.2
LoadLeveler
C
C++
MPcc
MPCC
MPXLF
XLF

SGI Origin 3000 Systems
IRIX 6.5.9
C
C++
FORTRAN 77
FORTRAN 90
Global Arrays
IDL

Linux NetworX EV2 system
Red Hat Enterprise Linux 3.0
Intel compilers (C++/FORTRAN)
Portland Group compilers (C/FORTRAN)

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