

MHPCC DSRC RESEARCH INITIATIVES

The MHPCC DSRC has expanded its science and research efforts into areas such as advanced imaging methodologies for space situational awareness and space object identification, advanced database design and optimization, data farming, high-fidelity radar analysis modeling and simulation, and novel compiler constructs that improve parallel software development productivity and performance. The MHPCC DSRC research staff has been awarded numerous research projects from the DoD High Performance Computing Modernization Program, Air Force Research Laboratories, National Geospatial-Intelligence Agency, United States Special Operations Command, Defense Intelligence Agency, Air Force Intelligence Analysis Agency, Office of Naval Research, and other government organizations. The MHPCC DSRC is also partnering with several agencies and local organizations on design, development and implementation of capabilities geared specifically to address the needs of the warfighter. Each of these research areas utilizes the advanced capabilities provided by MHPCC DSRC's professional staff, systems, networks, and engineering facilities.

MHPCC DSRC INITIATIVES

The MHPCC DSRC's Terascale High Performance Computing resources showcase a wide range of technologies that include a 9,216 compute core Dell PowerEdge M610 system (*Mana*) with a peak throughput of 103 TeraFLOPS (103 x 10¹² Floating Point Operations per second). The MHPCC DSRC offers an innovative environment for High Performance Computing applications. As one of the six DoD HPCMP DSRCs, the MHPCC DSRC participates in numerous HPCMP initiatives including: Storage Requirements Definition Team, Mass Storage Working Group, Consolidated Customer Assistance Center, Technology Assessment Community of Practice, the consolidated publication "HPC Insights", Outreach, and other collaborative initiatives.

HPCMP/MHPCC DSRC INTERN PROGRAMS

The MHPCC DSRC as a leader in High Performance Computing, offers summer internships for undergraduate students attending the DoD military academies and other universities to enhance their knowledge of computational methodologies in High Performance Computing. From 16 May – 25 August 2010, 19 undergraduate and graduate students were awarded research internships at the MHPCC DSRC. Programs supported by the MHPCC DSRC included HPCMP Military Academies, AFRL/RD Scholars Program, AF Technical Recruiting Internship Program (TRIP, ROTC), AFRL, University of Hawaii, HPCMP Joint Equal Opportunities for Minorities (JEOM), Akamai-Center for Adaptive Optics (CfAO), and the Maui Economic Development Board (MEDB). Universities represented were the U.S. Air Force Academy, U.S. Military Academy, Princeton University, University of Colorado, University of Kentucky, University of Wisconsin, University of Hawaii, and the Honolulu Business College. Research projects were individually designed for each intern and their major area of study. HPC was employed in each research effort. Project examples included modeling and simulation, image processing, algorithm development, computational fluid dynamics, space weather, visualization tools, and other HPC applications.



Front Row: (left to right), Viola Silva (University of Hawaii), Skip Williams (AFRL/RDSMA), Michael McMinn (University of Kentucky), and Tim Fram (University of Wisconsin)

Middle Row: Anna Cruickshank (USMA), Spenser McIntyre (USAFA), Marie Greene (AFRL/MHPCC), Daan Stevenson (University of Colorado), Herbert Harms (Princeton University), Tim Sinoga (University of Hawaii), and Gabriel Font-Rodriguez (USAFA Faculty)

Back Row: Jonathan Plyler (USAFA), Gene Bal (MHPCC/UH), Joseph Dratz (AFRL/MHPCC), Tom Ainscough (USAFA), and Neil Grigsby (USAFA)

The MHPCC DSRC is committed to providing the Department of Defense and other Government agencies with state-of-the-art scalable computing technologies and expert technical support services. As a recognized leader in the High Performance Computing community, the MHPCC DSRC is:

- A Center of the Air Force Research Laboratory's Directed Energy Directorate managed by the University of Hawaii
- A DoD Supercomputer Resource Center of the High Performance Computing Modernization Program
- A Center of Excellence in scalable computing, modeling and simulation, information analysis, large scale data management, and system integration
- Home to one of the most advanced state-of-the-art computational platforms in the world
- An anchor organization in Hawaii's growing science and technology community



MHPCC DSRC 2011

A Center of the Air Force Research Laboratory's Directed Energy Directorate
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AIR FORCE MAUI OPTICAL & SUPERCOMPUTING SITE

Located on Maui, Hawaii, the Air Force Maui Optical & Supercomputing Site (AMOS) is operated by the Air Force Research Laboratory's (AFRL) Directed Energy Directorate. AMOS is a center of excellence in electro-optical space surveillance and High Performance Computing (HPC). AMOS resources and facilities provide world-class national assets and advanced technologies for space control and Department of Defense (DoD) research. AMOS facilities include the Maui Space Surveillance System (MSSS) located on the summit of Haleakala at an altitude of 3,058 meters, the Maui High Performance Computing Center DoD Supercomputing Resource Center (MHPCC DSRC), Premier Place, and the Remote Maui Experimental Site. The MHPCC DSRC plays a leading role in the research, development, and implementation of remote sensing applications.

"AMOS is the leading electro-optical space surveillance research complex operated by the AFRL. AMOS includes the state-of-the-art Maui Space Surveillance Complex atop Haleakala, as well as *Mana*, one of the DoD's leading supercomputers located in Kihei. The AMOS mission is to research, develop, and transition to the warfighter cutting-edge space surveillance and high performance computing technologies for the Department of Defense. In addition, AMOS provides support to NASA, including satellite tracking, change detection, and anomaly resolution. With this unique blend of technology development and operational support along with the extraordinary men and women who support this mission, AMOS contributes to the Nation's defense on a daily basis."

Ms. Laura J. Ulibarri, Chief, Maui Space Surveillance Systems

MHPCC DSRC MISSION

"The Air Force Research Laboratory's MHPCC DSRC is an exceptional national asset, delivering leading-edge capabilities to researchers and warfighters worldwide. The MHPCC DoD Supercomputing Resource Center (MHPCC DSRC) provides extraordinary scientific and engineering expertise, state-of-the-art high bandwidth communications, and world-class parallel computing facilities. AMOS is a center of excellence in space situational awareness, optics research, and high performance computing, accelerating development and transition of advanced technologies into superior defense capabilities. As an integral part of AMOS, the MHPCC DSRC enjoys unparalleled access to the Pacific theater, and is an essential contributor in achieving mission success for the Air Force and the Department of Defense. Thanks to the steadfast support of the DoD High Performance Computing Program (HPCMP), and the Undersecretary of Defense for Acquisition, Technology and Logistics, the MHPCC DSRC is an invaluable resource today and will remain so well into the future."

Mr. David Morton, AFRL/MHPCC Director

"Technological superiority enables warfighting dominance. For two decades, High Performance Computing has powered breakthrough advancements in Research and Development for national defense. In partnership with the Department of Defense High Performance Computing Modernization Program, the Maui High Performance Computing Center remains ready to continue to accelerate technological advancements to secure our Nation's warfighting capability."

Mr. Eugene Bal III, MHPCC Executive Director, University of Hawaii

FOCUS AREAS

The MHPCC DSRC's *Mana* supercomputer is the cornerstone of the center's ongoing support for cutting-edge applications in the following areas:

Modeling and Simulation

- Computational Fluid Dynamics modeling supporting aircraft and ship design
- Force-on-Force battlefield simulations including semi-autonomous, adaptive combat models and model ensembles
- Modeling of environmental phenomena
- Modeling of chemical and biological agents
- Advances in weather modeling and weather prediction

Large Scale Data Management

- Large data model investigation including database design optimization, data mining, enterprise data warehousing, data fusion, operational data management, and archiving



Panoramic Survey Telescope and Rapid Response System (Pan-STARRS) is a planned array of astronomical cameras located at the MSSS on the summit of Haleakala at an altitude of 3,058 meters. Image processing and data storage is operated by the MHPCC DSRC.

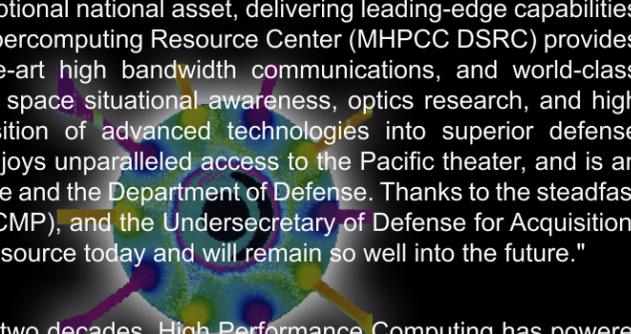


Image Processing and Information Analysis

- Enhancing the clarity of electro-optical, infrared, synthetic aperture radar, and multispectral sensor images
- Processing and analysis of multi-source data
- Development of data fusion and object identification methodologies

Systems and Software Integration

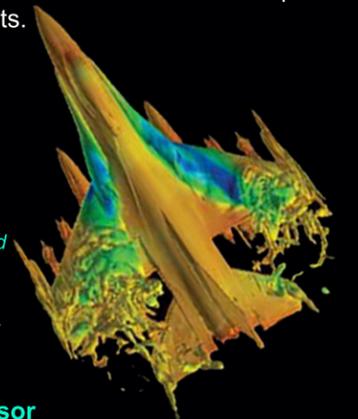
- Systems integration supporting multi-level classification, multi-platform environments and distributed access methodologies
- Software integration in High Performance Computing environments supporting research and operational applications

DOD HIGH PERFORMANCE COMPUTING MODERNIZATION PROGRAM

The DoD HPCMP mission is to deliver world-class commercial, high-end, high performance computational capability to the DoD's science and technology (S&T) and test and evaluation (T&E) communities, facilitating the rapid application of advanced technology into superior warfighting capabilities. The DoD HPCMP is a coordinated initiative to develop and subsequently sustain complete and balanced HPC environments based on user requirements.

MHPCC is a DSRC of the HPCMP, providing High Performance Computing resources to the DoD HPCMP community. The MHPCC DSRC allocates more than 70,000,000 hours to the HPCMP annually. Currently the MHPCC DSRC is host to eleven of the HPCMP Challenge Projects. These research projects are dedicated to support high priority DoD research efforts. The Challenge Projects hosted at the MHPCC DSRC use HPC to design energetic ionic materials, simulate aircraft flow, model high power lasers, enhance microwave capabilities, investigate complex aerodynamics phenomena, model air/ship integration, evaluate new sonar capabilities, and enhance HPC storage and memory.

Computational methods for accurately determining static and dynamic stability and control characteristics of fighter aircraft with various weapons configurations are being explored. These methods are being successfully applied to the F-16C and the F-22. The image on the right is from an F-16 Small Diameter Bomb (SDB) flight test wind-up-turn-prescribed-motion simulation.



HPCMP Challenge Projects

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- Virtual Prototyping of Directed Energy Weapons..... Air Force Research Laboratory
- Design of Energetic Ionic Liquids..... Air Force Research Laboratory
- Aero-optical Distortions in Directed Energy Applications and Their Mitigation Using Feedback Flow Control..... United States Air Force Academy
- Environmental Fate and Transport of Energetic Materials Army Research Laboratory
- Understanding and Designing Complex Ferroelectrics and Multiferroics from First Principles..... Office of Naval Research
- Stability and Control Test and Evaluation Process Improvement Through Judicious Use of HPC Simulations..... Air Force SEEK EAGLE Office
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HPCMP Software Institute

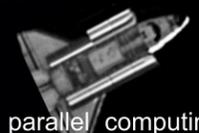
The MHPCC DSRC is tasked to support the DoD HPCMP's High Performance Computing Software Applications Institute (HSAI) program. One of nine HSAI programs that were initially competitively awarded by the Office of the Secretary of Defense (OSD) beginning in FY05, HSAI for Space Situational Awareness (HSAI-SSA) provides breakthrough capabilities by developing and transitioning HPC software applications. Emerging SSA challenges require supercomputing – and HSAI-SSA is providing new capabilities by combining supercomputing expertise and software optimization; world-class researchers from AFRL and its partners; and the experience of the HSAI-SSA stakeholders and SES/Flag-level Board of Directors. A recent success example is new image enhancement processing software that has been placed into daily use by key DoD organizations and other customers. Beginning in FY10, annual funding and oversight of HSAI-SSA transferred from the DoD HPCMP to the AFRL Directed Energy Directorate (AFRL/RD). HSAI-SSA work and MHPCC DSRC tasking is focused on advanced astrodynamics, space object image enhancement processing, non-resolvable space object characterization, data integration, and High Performance Computing.



DIRECTED TECHNICAL TASKS

The MHPCC DSRC offers a state-of-the-art computing environment with large-scale parallel computing platforms, terabytes of disk and on-line tape storage, and a high-speed communications infrastructure that connects directly to the Defense Research and Engineering Network (DREN) and other proprietary networks. The MHPCC DSRC is committed to the Nation's technological pre-eminence by advancing critical enabling technologies and expertise in High Performance Computing through application focus areas.

To ensure technological supremacy and to foster the flow of technology into warfighting systems, the MHPCC DSRC conducts research and development oriented Directed Technical Tasks for the DoD and other government organizations. Engineering capabilities at the MHPCC DSRC include: High Performance Computing and distributed processing technology, large scale data management technology, scalable computing technology, modeling and simulation support, software systems and network architecture development and integration, data visualization, advanced prototyping, operational and user support, web-based management systems, and comprehensive program management.



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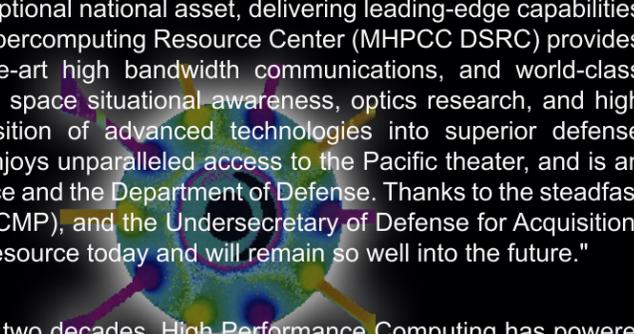


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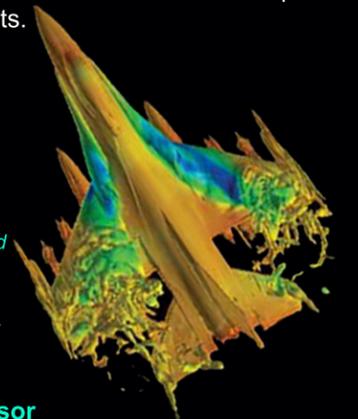


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