ERDC MSRC

Major Shared Resource Center

HPC Modernization Program

From the Director's chair

While this is only my second newsletter as Director of the Engineer Research and Development Center Major Shared Resource Center (ERDC MSRC), it is my 10th year in the Center, which means I've been here as long as it has. In all that time there has been only one fundamental shift in the way we get the business of the MSRC done – the shift in the mid-90s from a primarily Government-owned, Government-operated organization to an organization staffed largely by an integration contractor led by the Government.

This was a big change aimed at bringing flexibility into the way the Centers were operated. The result was the four Centers we have now, each a major force in the provision of computational expertise and resources enabling the Department of Defense (DoD) warfighter mission.

That approach served us – and you, our users – very well. However, the passage of time, change in requirements, and continual evolution of the Government-contractor landscape brought us to the point that we needed to consider another fundamental shift in the way we get the business of the MSRC done.

On April 1, 2003, that shift was completed. The ERDC MSRC completely restructured its service contracts, moving from the large umbrella of a single integration contract to a constellation of contracts that provides clusters of expertise and functionality for the Center. The three major areas of these contracts are service delivery (system administration, technology planning, etc.), service support (help desk, computational science, scientific visualization, etc.), and maintenance.

Creating a service contract structure like this affords us a variety of critical abilities as we continue to strive to improve our service model. Most importantly, it will allow the ERDC MSRC to respond more flexibly to the changing demands of our user community, resulting ultimately in a higher level of service for our user community.

For us, this is a significant change that will be accompanied by the usual growing pains as we struggle to reshape how we get things done. For you, however, the mechanics of this change will be virtually invisible. It is our goal that the only effects you see are more services provided in the way you want them, when you want them.

As we move through this period of transition within the Center, I encourage you to continue to give us feedback about how we can help you more effectively. The Users Advocacy Group is a very effective way to get your input to us; we welcome and encourage you to respond individually to us as well. The only way to truly match what we provide to what you need is open, honest, continuous communication.

John West
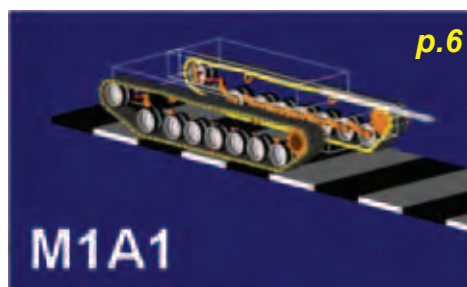Director, ERDC MSRC

About the Cover:
Seismic signature simulations for unattended ground sensor systems and numerical simulation of ground vehicle tracking systems using seismic signatures (see article, page 6). Cover design by the ERDC MSRC Scientific Visualization Center.

Features

Departments

"Army Newswatch" to Feature DoD Supercomputer Center at ERDC

By Rose J. Dykes

Soldiers Radio and Television reporter Hank Heusinkveld films John E. West in the ERDC Supercomputer Center.

"Army Newswatch," SRTV's premier television news program, showcases the Army as it conducts its many roles and missions in support of the Nation. It takes a comprehensive look at what is happening throughout the Army and focuses on the issues, the equipment, and the people that make the Army what it is today. This award-winning television newscast is a biweekly production.

Soldiers Radio and Television (SRTV) reporter Hank Heusinkveld visited the MSRC on October 24, 2002, and interviewed John E. West, Director, while walking through the Joint Computing Facility. The news feature on the MSRC will eventually air at the Pentagon, at worldwide Army installations, and on several hundred cable systems in the United States.

Other ERDC news to be featured along with that of the Supercomputer Center include ERDC as the 2002 Army Research and Development Organization of the Year, force protection and antiterrorism research and development, the TeleEngineering Operations Center, and the new Ship-Tow Simulator.

(Left to right) Wayne Stroupe, ERDC Public Affairs office, Hank Heusinkveld, SRTV, and John E. West, ERDC MSRC Director, visit before filming the MSRC news feature.

The ERDC MSRC welcomes comments and suggestions regarding *The Resource* and invites article submissions. Please send submissions to the following e-mail address:

msrchelp@erdc.hpc.mil

Users Advocacy Group – A Forum for DoD HPCMP Resource Users

By Rose J. Dykes

Dr. Stacy Howington, ERDC Coastal and Hydraulics Laboratory, is the newest member of the high-performance computing (HPC) Users Advisory Group (UAG). This group was formerly known as the Shared Resource Center Advisory Panel or SRCAP. The UAG mission has recently been changed as follows:

➢ Provides a forum for users of the DoD High Performance Computing Modernization Program's (HPCMP) resources to influence policies and practices of the Program.
➢ Facilitates the exchange of information between the user community and the HPCMP.
➢ Serves as an advocacy group for all HPCMP users.
➢ Advises the HPC Program Office on policy and operational matters related to the HPCMP.

The Army, Navy, and Air Force each appoint four people to represent them as their service members; one additional member is selected to represent other DoD agencies. The services are encouraged to appoint members who are active users in the HPCMP to best represent the user community. The members serve 2-year renewable terms.

Dr. Stacy Howington received his B.S. and M.S. degrees from Mississippi State University in 1983 and 1988, respectively, in civil engineering. In 1997, he received his Ph.D. in civil engineering from the University of Colorado at Boulder.

Dr. Howington works in the ERDC Coastal and Hydraulics Laboratory where he does modeling of fluid flow and constituent transport in groundwater and surface water systems. He has been associated with the Environmental Quality Modeling and Simulation and Climate/Weather/Ocean Modeling and Simulation Computational Technology Areas for several years.

Meetings are scheduled at least twice a year. Representatives from the Shared Resource Centers, although not members, have a standing invitation to attend the meetings. A user should contact one of the four representatives in his same service. If a user does not work for the Army, Navy, or Air Force, he should contact the representative from other DoD agencies. Users can always contact the Program Office to get the names of their service representatives. Appropriate issues for users to take to UAG members are ones that need to be brought before the entire Program for the good of the whole user community – not things such as a machine is not working as it should at a particular site.

The full list of HPC UAG members is found below.

Air Force

➢ Jerry Boatz (S&T), *Jerry.Boatz@edwards.af.mil*, (661) 275-5364
➢ Bonnie Heikkinen (T&E), *bonnie.heikkinen@arnold.af.mil*, (931) 454-7885
➢ John Martel (T&E), *john.martel@eglin.af.mil*, (850) 882-7898, Extension 3368
➢ Stephen Scherr (S&T), *Stephen.Scherr@wpafb.af.mil*, (937) 255-6686

Army

➢ Stacy Howington (S&T), *stacy.e.howington@erdc.usace.army.mil*, (601) 634-2939
➢ Michael J. Reil (T&E), *mreil@atc.army.mil*, (410) 278-9474
➢ Stephen Schraml (S&T), *stephen@arl.army.mil*, (410) 278-6556
➢ Jackie Steele (T&E), *jackie.steele@smdc.army.mil*, (256) 955-3917

Navy

➢ Joe Gorski (S&T), *gorskijj@nswccd.navy.mil*, (301) 227-1930
➢ Ed Neal (T&E), *NealER@navair.navy.mil*, (301) 757-1781
➢ Jeanie Osburn (S&T), *osburn@nrl.navy.mil*, (202) 767-3885
➢ Alan Wallcraft (S&T), *Alan.Wallcraft@nrlssc.navy.mil*, (228) 688-4813

Other

➢ Steve Finn (DTRA), *sf@sunmail.dtra.mil*, (310) 470-2335

NOTE: S&T (Science and Technology)
T&E (Test and Evaluation)
DTRA (Defense Threat Reduction Agency)

announcements ●●

Two CSC Employees at ERDC MSRC Honored for HPC Work

By Ginny Miller

Two Computer Sciences Corporation (CSC) employees were recognized by CSC for their contributions to the company's high-performance computing (HPC) efforts at the ERDC MSRC. Robert Scudamore, Vice President of CSC's HPC Center of Excellence, presented the awards November 18, 2002, during the 15th annual Supercomputing Conference (SC2002) in Baltimore, Maryland.

Carrie Mahood received CSC's High Performance Computing Outstanding New Employee Award. The award was in recognition of Mahood's immediate contributions to the Computational Science and Engineering (CS&E) group at the ERDC MSRC. Her work included a lead role involving testing and analysis on a project with the U.S. Army Corps of Engineers New Orleans District, as well as conducting multilevel parallel programming workshops at the Arctic Region Supercomputing Center in Fairbanks, Alaska, and SC2002.

Carrie Mahood of the CS&E group received CSC's Outstanding New Employee Award.

Mahood joined CSC in October 2001 as a computational scientist at the ERDC MSRC. She is a 1999 graduate of East Texas Baptist University in Marshall, Texas, where she earned a bachelor's degree in mathematics and computer science. Mahood graduated in August 2001 from Texas Tech University with a master of science in mathematics.

Robert Alter (left) received CSC's Technical Contribution Award. He is pictured with CS&E Director Dr. Bill Ward.

Scudamore also presented a Technical Contribution Award to Robert Alter in recognition of his continued contributions to the CS&E group as the resident expert of Message Passing Interface-Input/Output, for which he provided invaluable support to the Seismic Wave Propagation in Parallel Topography code.

Alter received a bachelor of science in mathematics from Boise State University in Idaho in 1977. He also received a bachelor of science in geophysics from Boise State University in 1983. A former high school mathematics teacher, Alter has worked as an exploration geophysicist for Amoco Oil Production Company and spent 14 years as an oceanographer at the Naval Oceanographic Office at Stennis Space Center. He joined CSC in December 2000.

upcoming events ●●●

2003 Users Group Conference – June 9-13, 2003, DoubleTree Hotel, Bellevue, Washington, hosted by the DoD High Performance Computing Modernization Program.

SC2003 Conference – "Igniting Innovation," November 15-21, 2003, Phoenix, Arizona.

MSRC Team Member Presents Seminar at USM

By Rose J. Dykes

Dr. Deborah Dent, Deputy Director of the Information Technology Laboratory (ITL), ERDC, and Dr. Fred Tracy, MSRC Team, ERDC, went to the campus of the University of Southern Mississippi (USM), Hattiesburg, Mississippi, on November 1, 2002, where Dr. Tracy presented a seminar entitled "Multi-Level Parallelism (MLP) – An Alternative Parallel Paradigm."

Dr. Fred Tracy presents a seminar at USM.

MLP is a new, lightweight approach to expressing the semantics of a parallel program where communication among processors is done through shared variables as in OpenMP rather than sends, receives, broadcasts, reductions, etc., as in Message Passing Interface.

The seminar was part of the class SC 740 Graduate Seminar taken by graduate students in the Program of Scientific Computing and related fields of study at USM. Approximately 20 students and faculty attended.

After the seminar, Drs. Dent and Tracy visited with faculty members and discussed plans for possibly working on joint projects and future visits to ITL. The Coordinator of the Program of Scientific Computing at USM is Dr. Joseph Kolibal.

IEEE Visualization 2002

By Paul Adams

Three team members of the ERDC MSRC Scientific Visualization Center, Paul Adams, Dr. Michael Stephens, and Richard Walters, attended IEEE Visualization 2002 on October 27 – November 1, 2002, in Boston, Massachusetts. Dr. Stephen Wolfram, a well-known scientist who received his Ph.D. in theoretical physics in 1979 at the age of 20, was the keynote speaker.

(Left to right) ERDC MSRC SVC *Lead Paul Adams and Dr. Michael Stephens and Richard Walters,* SVC *team members, attended* IEEE *Visualization 2002.*

In 1986 Dr. Wolfram created Mathematica, a technical computing tool for the scientific research community that is now used worldwide. *A New Kind of Science* is his latest book. In this book and in his keynote speech at the conference, Dr. Wolfram talked about cellular automata, which produce shaded images on grid patterns according to certain rules. He showed that incredible complexity can arise from simple systems and rules.

Other topics of interest at the conference included the following:

- ➢ Commodity-Based Cluster Visualization – How to manage and use scalable display walls.
- ➢ High-Quality Volume Graphics on Consumer PC Hardware – Using consumer graphics card for volume rendering.
- ➢ State of the Art in Data Representation for Visualization – Using signal processing to take laser-scanned data and reduce it to a manageable size.
- ➢ Out-of-Core Algorithms for Scientific Visualization – How to handle data sets that are larger than main memory.
- ➢ Interactive Rendering of Large Volume Data Sets – Using wavelet compression and Level-of-Detail to view data sets too large to be stored on a PC.
- ➢ Exploring Scalar Fields Using Critical Isovalues – Critical isovalues are those that are a minimum, saddle, or maximum. By creating a critical isovalue locating program, one can ensure not missing any important features. The listing of the critical isovalues can also be used to create transfer functions for volume rendering. However, with too many isovalues, the image can become cluttered.
- ➢ A New Object-Order Ray-Casting Method – The desire is to have a high-quality, interactive volume-rendering application. The four types of volume-rendering techniques in use today, their advantages, and their drawbacks were addressed. The presenter took the Shear Warp approach and improved its quality while also improving its performance by skipping empty and hidden regions. This method was then compared with the Volume Pro hardware volume-rendering board.

An HPC-Enabled Virtual Proving Ground for Seismic Unattended Ground Sensor Networks

By Dr. Mark L. Moran, Battlefield Seismic-Acoustic Sensors Program,
ERDC Cold Regions Research and Engineering Laboratory

Comprehensive, reliable, situation information is imperative for the success of light-armor, maneuver-dominated Future Combat System (FCS) operations. A core thrust of the Army Science and Technology program is directed toward developing an interlocking and overlapping network of ground, air, and national asset sensor systems with the aim of delivering a timely and detailed battlefield operational picture to commanders at all echelons. The ERDC Cold Regions Research and Engineering Laboratory's seismic signature simulation Challenge grant is supporting the development of a family of intelligent unattended ground sensors (UGS) including the UGS sensors in the U.S. Army Communication-Electronic Command Night Vision Laboratory's Networked Sensors for the Objective Force Advance Technology Demonstration, the FCS Intelligent Munition System, and the FCS Tactical Unattended Ground Sensor. These systems rely on seismic and acoustic sensors to detect, track, and classify a wide range of threat targets from heavy armored vehicles to dismounted infantry. Seismic signals are generated by targets via ground vibrations in complex ways that convey target-specific features useful for classification or identification. For example, the size and number of track blocks, the diameter and separation between wheels, or the resonance frequencies of the vehicles sprung mass are readily observable in sensor data. Seismic signals arriving at a sensor also interact with geologies having large material property contrasts. Tactically significant terrain includes large-scale physiographic features (such as forests, hills, passes, narrow valleys, or rivers), which is almost axiomatic. These complex battlefield environments are extremely difficult sensor settings. For example, a single impulsive force applied to the earth's surface often results in three to five distinct seismic wave fields all propagating along different ray-paths, with different amplitudes, different decay rates (in both space and time-frequency dimensions), different polarizations, and with propagation speeds that vary with frequency (i.e., strongly dispersive propagation). Moreover, all these seismic wave phases have complex interactions with topography and geologic discontinuities (reflections, refractions, diffractions, and mode conversions). However, it is by virtue of the signal interaction with geology that results in the over-the-hill, nonline-of-sight, sensing capabilities that are important to UGS systems.

By combining massively parallel HPC computational resources with state-of-the-art numerical methods, a "virtual proving ground" (VPG) has been developed for simulating the performance of networks of seismic UGS systems in realistically complex geologies. The resulting simulated data have been demonstrated to be indistinguishable from actual field data, even by subject matter experts. The seismic VPG capability has a wide number of applications that significantly
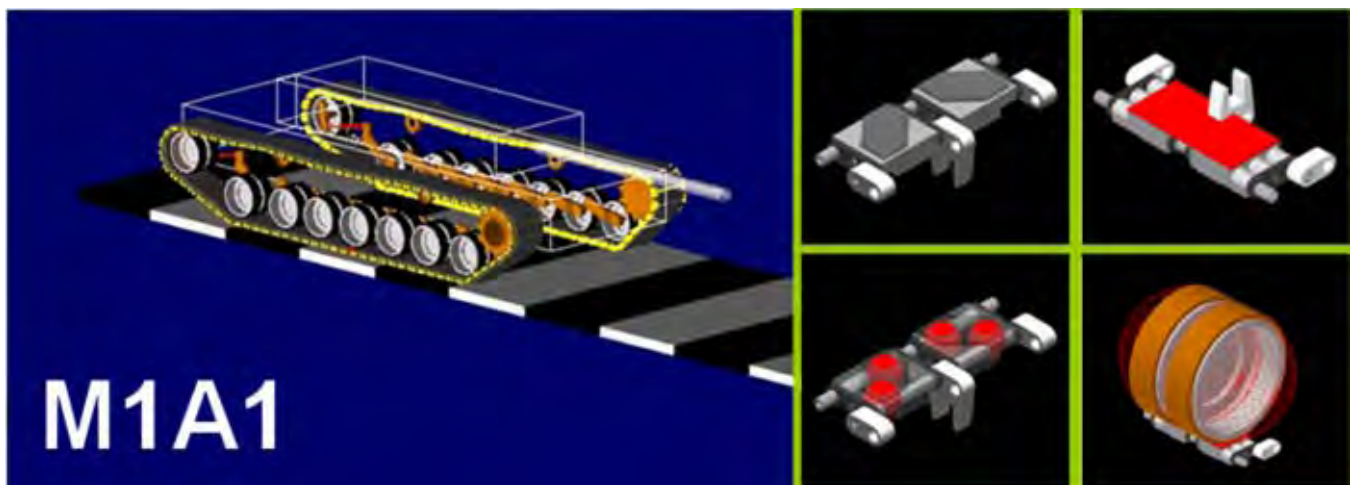

Figure 1. Examples of detail for the M1 main battle tank mechanical model. Other targets available include personnel, T-72, BMP-2, BTR-80, and the HMWVV. Convoys in any number or combination can also be modeled. The detailed mechanical models generate complex distributions of target-specific ground vibrations.

accelerate the pace of UGS technology development, improve system reliability, and reduce overall costs. For example, using large-scale simulations, new methods for adapting networks of intelligent seismic UGS systems to their specific deployment environment have been developed and demonstrated, providing for robust all-weather target tracking performance. As another example, full wave field simulations with this level of fidelity can be used directly for system-specific engineering in the same manner as field data. In the early stages of system development, this saves many millions of dollars by reducing the number of field studies required to develop system algorithms and perform rigorous engineering trade studies to select the optimal sensor suite for a given application. Lastly, the simulated data will allow analysis and prediction of sensor network performance. For example, in complex terrains the HPC simulations have predicted that seismic sensors will perform better when placed at the top of hills or in deep ravines as opposed to flat alluvial soil deposits at the base of hills. This counter intuitive conclusion is explained by the HPC simulation results by noting that strong, interfering signal reflections are trapped in the alluvium whereas the tops of hills (with stiff rock cores) and deep ravines (near to water table) have geologies with generally higher velocity materials, which do not trap multiple reflected signals. HPC-supported computations of this nature are used to develop sensor performance prediction maps and sensor deployment doctrine under a wide variety of geologic conditions. This is important for maximizing information quality and coverage area for a fixed number of networked elements.
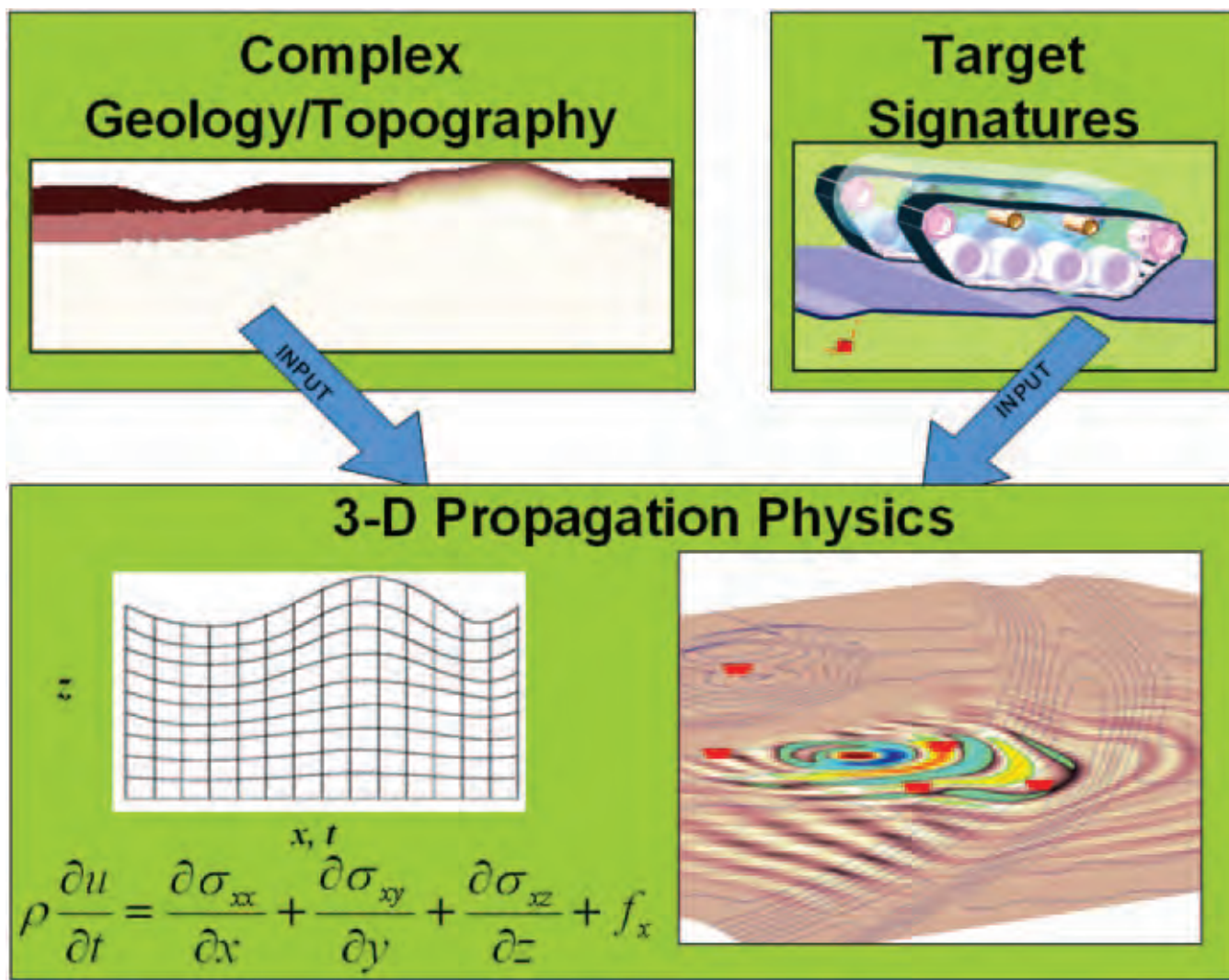

Figure 2. Iconic representation of the seismic virtual proving ground enabled by full exploitation of HPC facilities. The modeling approach uses realistic heterogeneous 3-D geology, soil attenuation, and topography as input along with signature ground vibrations. These inputs are applied to full wave field simulations resulting in simulated data that are indistinguishable from field data.

The approach combines a fully parallelized finite difference (FD) time domain, viscoelastic, seismic propagation model with dynamic mechanical system models in common use with the automobile industry for designing complex mechanical systems. The mechanical models provide target signature ground vibrations. To support material developers, computations are routinely run that can only be supported with HPC resources. For example, a roughly 1 km^2- by 200-m-thick model often has a grid mesh containing on the order of 10^8 nodes. Additionally, vehicles traveling at 30 to 40 km/hr often take 60 to 80 seconds or more to traverse these distances, leading to upwards of 200,000 time-steps. On Jim (ERDC's Cray T3E), a single model of this size may require 70 to 80k CPU-h. This is among the largest seismic FD simulations ever performed.

The FD time domain seismic model has been extensively validated against other numerical models and in one-to-one comparisons with field data from the Smart Weapons Test Range, Yuma Proving Ground, Arizona. In these direct comparisons, excellent synthetic wave form agreement is shown with impulsive sources and moving tracked vehicle data including amplitude, attenuation rate, dispersion, and spectral decay. Such comprehensive agreement with field data has not been shown previously (with respect to dynamic seismic sources) and lends the needed validation to confidently apply the signature simulations to UGS system development.
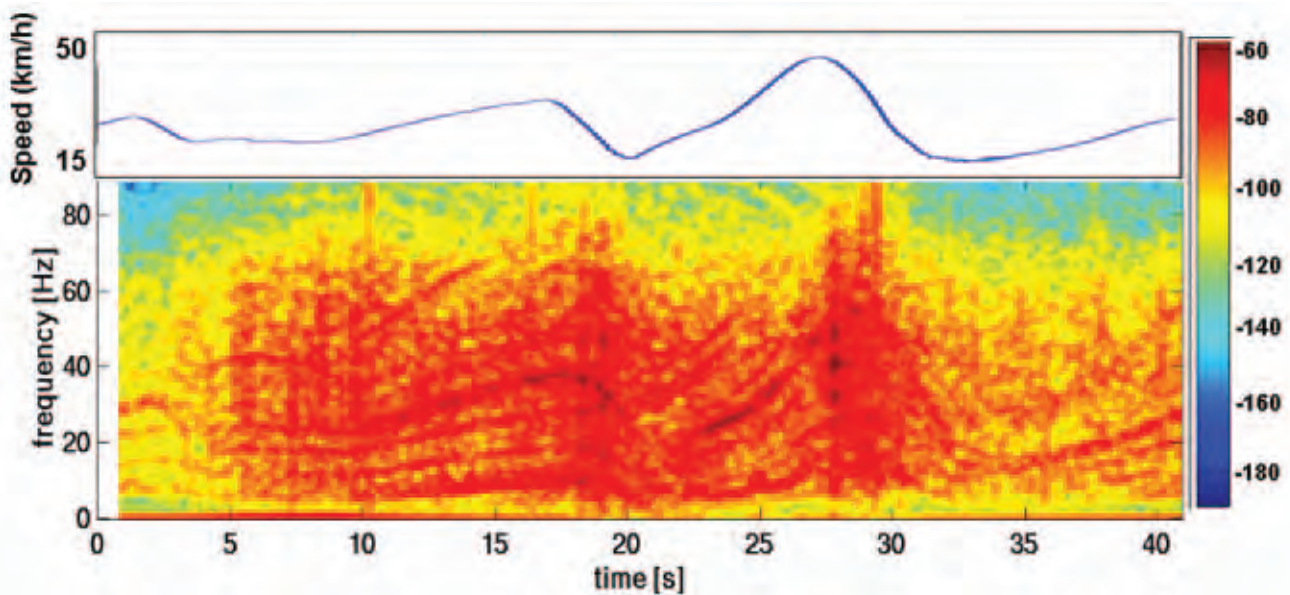

Figure 3. Spectrogram of synthetic seismic signature for a moving M1 vehicle. This result has all key target features observed in field data including correct spectral variation with target speed, correct absolute signal magnitude, and harmonics associated with track blocks, road wheels, and whole-body suspension resonances. Simulated data with this level of fidelity are nearly indistinguishable from actual field data and can be used directly for systems engineering.

SC2002
"From Terabytes to Insights"

By Ginny Miller

A record-breaking 7,200 people attended SC2002, the most successful show in the 15-year history of the annual HPC and networking Supercomputing Conference. The conference was held November 16-22 in historic Baltimore, Maryland.
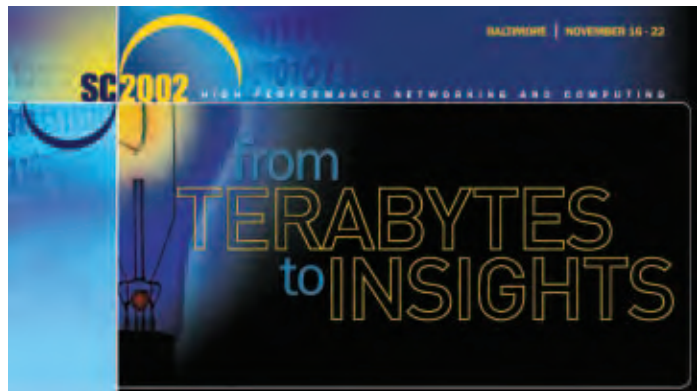
Following the theme "From Terabytes to Insights," SC2002 featured 223 exhibitors with displays covering nearly 2 acres at the Baltimore Convention Center. The Institute of Electrical and Electronics Engineers Computer Society and the Association for Computing Machinery sponsor the conference series, which celebrates achievements in HPC while looking to the future.

A number of ERDC MSRC personnel participated in SC2002, attending technical programs and supporting the HPCMP booth. Two members of the Computational Science and Engineering (CS&E) group presented a tutorial, while two members of the Scientific Visualization Center (SVC) and a former Programming Environment and Training (PET) intern gave demonstrations in both the HPCMP and SGI booths.

Dr. Tom Oppe and Carrie Mahood of CS&E presented a half-day tutorial at SC2002 entitled "Dual-Level Parallelism Techniques." In the tutorial, Oppe and Mahood discussed the motivation for using dual-level parallelism and gave attendees an introduction to OpenMP. They also shared case studies in dual-level parallelism as well as tools, quick guides, and references.

For the HPCMP booth, the ERDC MSRC SVC assembled a collection of applications for SC2002, including an interactive DVD highlighting the MSRC's contribution to Army and DoD missions through interviews with users. The MSRC Director, John West, also provided his view on the conference theme, "From Terabytes to Insights," as it relates to the DoD mission and the work of the MSRC.

A three-dimensional (3-D) interactive visualization application produced by former PET summer intern Kristin Stechschulte, senior scientific visualization specialist Tom Biddlecome, and SVC Lead Paul Adams was also shown at SC2002. The application investigates a time-history of Arctic Sea Ice thickness over the course of a year. The application was shown in both the HPCMP booth and the SGI booth through a technology partnership. In the SGI booth, a large audience viewed a 365-time-step (one for each day) version of the application, which was featured in an article in the *Baltimore Sun*.

Occupying a 30- by 30-ft space in the Research area of the exhibit floor, the HPCMP booth featured other high-tech displays that invited visitors to stop by and learn about the Program. An interactive video kiosk described DoD program initiatives, while other displays showed how the DoD uses high-performance information technologies to deliver science to the warfighter. Applied science demonstrations from each of the MSRCs and consolidated Distributed Centers further illustrated how HPC applications and resources are successfully used in research. Visitors were also treated to free luggage tags.

In addition to the HPCMP booth, other exhibits at SC2002 represented technology companies, leading-edge start-ups, research centers, Government laboratories, and universities. Other events at SC2002 included panel discussions, Birds-of-a-Feather sessions, and an awards program recognizing the highest achievements in the field.

Speakers in the SC2002 technical program addressed key technical, policy, and real-world application issues of HPC. Speakers included National Science Foundation Director Rita Colwell, who delivered the keynote address, and Tetsuya Sato, director-general of the Earth Simulator Center in Yokohama, Japan, home of the world's fastest supercomputer.

SC2003, "Igniting Innovation," will be November 15-21 in Phoenix, Arizona. For more information, go to *www.sc-conference.org/sc2003*.

Dr. Paul Bennett (foreground) listens as Carrie Mahood and Dr. Tom Oppe lead a tutorial at SC2002.

Paul Adams shows a visualization application of Arctic Sea Ice thickness in the SGI booth at SC2002.

An interactive DVD highlighting the MSRC's contribution to Army and DoD missions is displayed at the HPCMP booth at SC2002.

Dr. Tom Oppe of the ERDC MSRC (center) and Denice Brown of the Army Research Laboratory MSRC make luggage tags for a visitor to the HPCMP booth at SC2002.

Former PET intern Kristin Stechschulte (seated) demonstrates a 3-D interactive visualization application to Paul Adams (center) and Tom Biddlecome (right) before the HPCMP booth at SC2002 officially opened to visitors.

Bobby Hunter (left) learns about the Cray X1 at SC2002.

John West (far right) visits with other SC2002 attendees at the HPCMP booth.

Dr. Fred Tracy (left) and Bobby Hunter attend a technical program at SC2002.

Cray Henry (center) visits with other SC2002 attendees at the HPCMP booth.

Morris Ramsey (left) and Dr. Dan Duffy (center) work the HPCMP booth with Dr. George Heburn of the Naval Oceanographic Office MSRC.

PET Highlights

By Dr. Wayne Mastin

The Programming Environment and Training (PET) initiative of the DoD HPCMP completed the second year of its current contract on 31 May 2003. The ERDC MSRC hosts one of four components of PET. The PET team at ERDC is available to assist all HPC users. Onsite resources in the DoD Computational Technology Areas (CTAs) are Dr. Richard Weed for Computational Structural Mechanics (CSM) and Dr. Nathan Prewitt for Computational Fluid Dynamics (CFD), both with Mississippi State University. Also onsite are Dr. Phu Luong for Climate/Weather/Ocean Modeling and Simulation (CWO) and Dr. Jeff Hensley for Environmental Quality Modeling and Simulation (EQM). Assistance in other CTAs is available from PET university faculty and onsite CTA leads at other DoD facilities.

Information about the PET program is available on the Online Knowledge Center (OKC) at *https://okc.erdc. hpc.mil/*. The OKC resides at ERDC, but provides information on all components of PET. Users can find information about training, funded projects, and reports and presentations from the PET team. The OKC also contains descriptions and contact information for all of the technical areas supported under the PET program.

The ERDC component of PET coordinates training offered at all DoD sites. Since training resumed under the new PET structure in January 2002, more than 100 training courses and workshops have been delivered to DoD users at sites throughout the country. This has included training offered by members of the PET university team, the onsite staff, and software vendors. In March of this year, PET training at ERDC moved into the remodeled Information Technology Laboratory (ITL) collaboratorium. The new facilities have audio/video and computer resources for training on HPC technology. The collaboratorium also houses an Access Grid node and Webcasting capabilities for broadcasting training to remote users. Users who have a requirement for training are encouraged to register their need with their project leader or Service/Agency Approval Authority so that their training needs for the upcoming fiscal year can be entered into the HPCMP Requirements Questionaire.

Lesa Nelson (far right), OKC PET technologist, conducts a training session for training coordinators from ERDC and other MSRC sites on using the OKC to administer registration for PET courses offered at their sites.

A highlight of this past year's activities was the PET Technical Review held on the campus of Clark Atlanta University on 3-6 February. Dr. Leslie Perkins, HPCMP lead for PET and the Common High Performance Computing Software Support Initiative (CHSSI), kicked off the meeting with a review of the CHSSI portfolios and identified potential PET and CHSSI collaboration. University leads for all of the technical areas supported by PET gave presentations on their accomplishments during the first year and a half of the current program. There were more than 100 in attendance including the PET contractor and Government leadership, HPCMP officials, DoD CTA leads, and others in the DoD user community. The review concluded with a meeting of the PET Joint Technical Council to discuss directions for future PET activities, especially in multidisciplinary fields.

Looking toward the summer, the PET program will again be involved with student programs aimed at exposing college students to careers in HPC. The Jackson State University (JSU) HPC Summer Institute will again be held and will include a site visit to ERDC and a tour of the MSRC. The success of the JSU institute is recognized across the PET program and will serve as a model for a similar institute to be held for the first time this summer at Central State University in Wilberforce, Ohio. The ERDC MSRC will also host summer interns for a 10-week tour of duty this summer. The interns will work side-by-side with their mentors to gain experience in using the tools and techniques of HPC to solve large-scale problems in computational science and engineering.

A highlight of this past year's activities was the PET Technical Review held on the campus of Clark Atlanta University on 3-6 February.

Shown (left to right) at the PET Technical Review are Professor Shahrouz Aliabadi, Clark Atlanta University, Professor Bharat Soni, University of Alabama, Birmingham, Dr. Stan Ahalt, Ohio State University, Professor Mary Wheeler, University of Texas, Austin, and Dr. David Littlefield, University of Texas.

PET Technical Review attendees shown (left to right) are Dr. Andy Mark, Army Research Laboratory, Bob Athow, PET Technical Advisor – Component 3, and Professor Shahrouz Aliabadi, Clark Atlanta University.

Building on Previous Strategies to Create a Synthetic Application of Benchmarking

By Dr. Paul M. Bennett

Dr. Paul Bennett

In the Fall 2002 issue of *The Resource*, Carrie Mahood presented a technology update describing the efforts of the Computational Science and Engineering (CS&E) group toward creation of a synthetic application code included in the Technology Insertion 2003 (TI-03) benchmark suite. The behavior of the synthetic application code SynNLOM led the CS&E group to reconsider the problem of creating such a code, and this article summarizes those efforts.

There are several reasons for creating a synthetic application of benchmarking. Current high-performance numerical research drives the creation of more complicated models and larger codes, which in turn leads to the acquisition of increasingly larger and more complicated high-performance computers possessing a variety of strengths and capabilities. The current and preferred future capabilities of these computers are evaluated by using popular codes as benchmarks, chosen according to Computational Technology Area (CTA). Unfortunately, many of the codes are difficult to obtain because of licensing or security issues. Regardless of how easy or difficult they are to obtain, however, the most popular codes are frequently highly tuned to make maximum use of specific architecture capabilities, resulting in complicated codes with many higher level, vendor-specific language extensions. Such codes can be difficult to compile and validate, making the benchmarking process time-consuming and less efficient.

A synthetic application code solves the problems of portability, availability, and ease of use. It will use standard conforming coding practices, making use of freely available routines, and not solve any specific physical problem. The objective is to mimic the target research code's performance on any given machine. In this project, standard Fortran 90 is used to write the main calling routine and to write the module interfaces to the numerical routines, though the numerical routines are written in both Fortran 77 and Fortran 90. The numerical routines are either from Netlib or else homegrown, and consist of seven strictly computational routines, one mixed communication/computation routine, and 15 strictly communication routines. For this study, NLOM is the target research code, and habu, an IBM Power3 distributed-memory machine at the Naval Oceanographic Office MSRC, was used to generate the data. Data dimensions, loop lengths, and the numbers of times to call each routine are specified as input parameters so that the same synthetic applica-tion code can be used to mimic other research codes, such as COBALT or NAMD, by merely changing the input parameters.

NLOM uses a domain decomposition to distribute the data among the participating processes, so the work W performed by each process should scale as $W = W_o + W_s/P$, where W_o is the overhead, assumed to be constant regardless of the number P of processes, and W_s is the portion that scales perfectly. The idea is to fix the work size for each module at a reasonably small value, and then change the number of calls to each module depending on the number of processes. If the communication pattern of NLOM is also matched in some sense, then the hope is that the execution times should be the same, allowing the synthetic application code to serve as the benchmark for NLOM.

The procedure is to fix the input data dimensions and loop lengths judiciously and then find the numbers or metrics specifying how the synthetic modules use habu. Although a much wider variety of suitable metrics is available, the metrics in this study are the number of floating-point operations, number of branches completed, and the numbers of loads and stores between memory and central processing unit (CPU) register for integer and real data types. Using the same compiler settings, the same metric values are obtained for NLOM, and the problem is then to find how many times to call each module in order for the synthetic application to have the same metric values at the end of execution as NLOM does.

Since the work performed by each process in each module is fixed per call, the problem is naturally set up as a least squares constrained optimization problem $Ax = b$, where the components of b are the four metric values above evaluated at each of several different numbers of processes. Thus, if the metric values for NLOM are measured at 56, 168, and 336 processes, then b possesses 12 components. The components of A are the metric values of the modules, with each row consisting of the same metric values across all synthetic modules. The components of x are the number of times each module must be called, in order of overhead term W_o and scaling term W_s, in order to match NLOM's performance at 56, 168, and 336 processes. The constraint is that the components of the unknown x take strictly nonnegative values.

Figure 1 compares the work performed, exclusive of Message Passing Interface (MPI) communication, for NLOM, the least-squares solution x, and the synthetic application code. The values are computed or measured at 56, 168, and 336 processes. To find the work exclusive of communication, PAPI calls counting the numbers of floating-point operations, branches completed, and loads and stores completed are inserted into NLOM and the synthetic application code at the beginning and end of parallel execution. Using PMPI, PAPI calls are also inserted before and after every MPI communication. The code is then compiled using the same compiler settings as in the original NLOM benchmark. After execution, the PAPI values within the MPI calls are subtracted from the total PAPI values to give estimates of the four metric values for NLOM and the synthetic benchmark exclusive of MPI communication. By visual inspection, it is clear that for NLOM, the above procedure gives good simulation by the synthetic application code in the four metrics used.

The communication behavior according to communication type, length of message, and number of occurrences was measured for NLOM. The message lengths are averaged into short, medium, and long messages, and the numbers of times each should be transmitted for each type of communication are found. These numbers specify the numbers of times the corresponding communications should occur in the synthetic application code, so the synthetic application should match NLOM in the total number and average length of messages sent.

Figure 2 presents the numbers and lengths of the corresponding communications as they were initialized in synBmk. S, M, and L denote messages of short, medium, and long length, respectively, and bcast denotes a broadcast. NN-send denotes a point-to-point exchange of a message with the nearest neighbor, and N-send denotes an exchange with a process that is a near neighbor. Near neighbors are chosen up to a distance of four processes away by using a uniform random number generator. R-send denotes an exchange of a message with a remote processor at least four processes away. In all cases of point-to-point communications, each process receives exactly one message
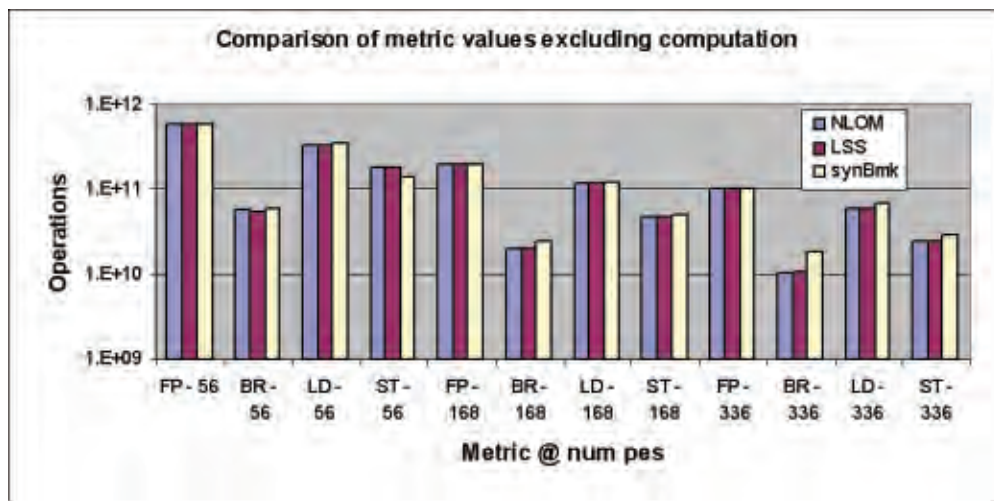

Figure 1. Metric values exclusive of communication for NLOM, least-squares approximation (LSS), and synthetic application code (synBmk). The abbreviations FP, BR, LD, and ST stand for floating-point operations, branches completed, loads to register completed, and stores from register completed. The integers following each abbreviation are the numbers of processors used in the benchmark, so FP – 56 means the floating-point operations observed on 56 processors.

Figure 2. Communication calls in synBmk listed by type (one of broadcast, gather, send to the nearest neighbor, send to a near neighbor, or send to a remote processor) and length (short, medium, or long)
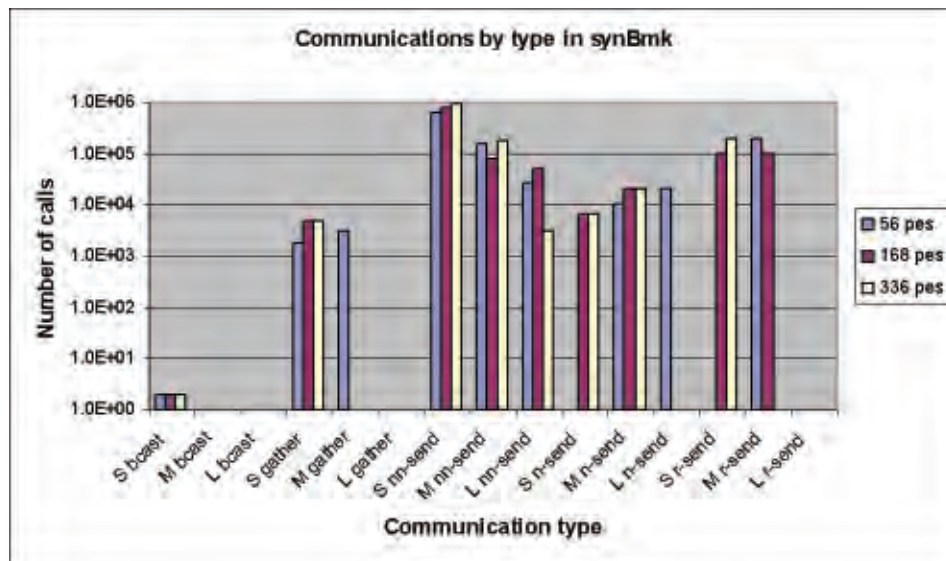
and sends exactly one message. The source of the received message is not necessarily the destination of the sent message, so processor B may receive a message from A but send to C. MPI library calls were used for all global and point-to-point communications.

These specifications for the global and point-to-point communications gave a count of the total number of messages communicated. Figure 3 presents a comparison between NLOM and synBmk of the total counts of messages performed. The numbers of communications performed by synBmk are taken from a representative process and are close in value to the average counts for NLOM.

Finally, in Figure 4, the timings observed on habu for NLOM are presented and compared with the timings for synBmk. The timings for synBmk are larger by 44, 88, and 44 percent at 56, 168, and 336 processors, respectively, than those observed for NLOM in the TI-03 benchmarking activity. Since NLOM and synBmk have such close metric values for execution excluding

communication, as shown in Figure 1, the difference in timings is due to differences in the global and point-to-point communications between the two codes. Research on synBmk's communication algorithms is currently being conducted to reduce its timings to within 20 percent of NLOM's.

In summary, by following the above procedure, it is possible to write a flexible synthetic application code that matches NLOM in the numbers of floating-point operations, branch instructions completed, loads to register completed, and stores from register completed. It is possible to do this and match NLOM in the numbers, lengths, and types of communication performed. Without optimizing the communication, however, the execution time might not closely match NLOM's performance. The procedure should generalize well, favorably demonstrating the use of synthetic application codes for benchmarking in place of more complicated, less portable, proprietary, or classified codes.

Figure 3. Total numbers of messages performed by NLOM and synBmk. Global communications, such as broadcasts and gathers, are counted as the total number of participating processes.
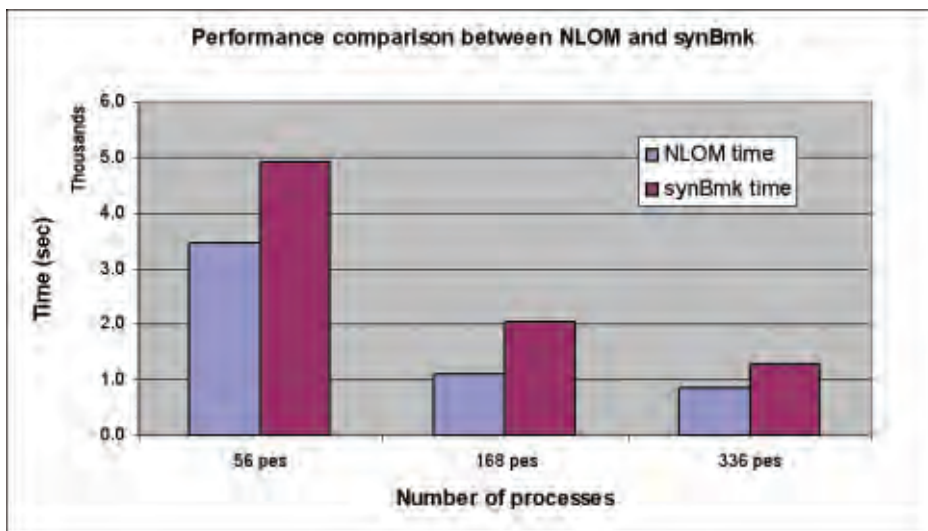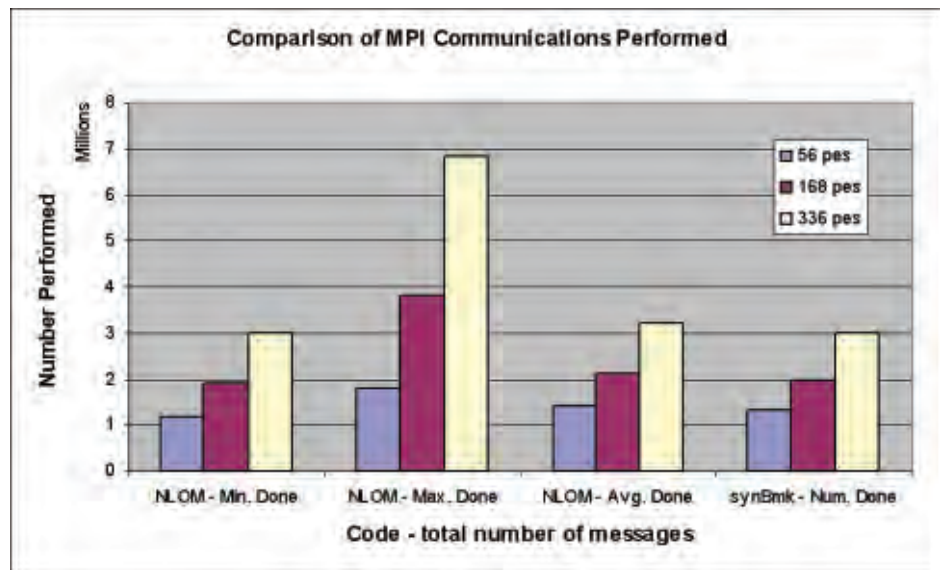

Figure 4. Performance comparison of NLOM with synBmk on 56, 168, and 336 pes

Scientific Visualization Center Technology Update

By Paul Adams

As computational simulation becomes commonplace for the scientists across the DoD, advanced visualization techniques become an even more essential data interpretation tool. With the recent upgrades to the ERDC MSRC Scientific Visualization Center (SVC), the users have a 50-fold increase in data analysis capabilities.

A new SGI Onyx 340 (Prism), a state-of-the-art graphics and file server, was recently installed in the SVC. Prism contains 32 processors, 32 Gbytes of memory, the latest graphics, and approximately 1.7 Tbytes of disk space. New hardware has also been introduced in new workstations that permit interactive volume rendering of very large data sets on the desktop. Two IBM 22-inch, 9-megapixel flat-panel monitors allow users to visualize their large scientific data sets with higher fidelity than previously possible. Additional computational capability comes with a render farm that consists of 25 racks, each containing dual 1.8-GHz Intel Xeon processors, 1 GB of memory, and 40 GB of disk space.

Prism allows the SVC to reduce the time to discovery. The capability that Prism adds to the SVC allows a researcher to view, for example, over 8 years of daily data of Arctic Sea Ice thickness. The interactive capability to view over 3,000 data sets gives scientists unprecedented opportunity to explore and discover phenomena within their data. The previous capability only allowed about 52 data sets to be loaded, or one data set per week of a year.

SGI Onyx 340 (Prism)

In addition, Prism allows the SVC to reduce the time to delivery . Combined with the capability of the render farm, this allows researchers to view their data within some contextual situation. A recent example had 600 data sets, each representing a different time-step, processed in parallel on Prism in a day. The following day they were then ray traced in parallel on the render farm with context added into the scene. The finished movie was delivered to the researcher within days, whereas previously the process would have taken several weeks.

With these advancements and expanded multimedia authoring capabilities, the SVC continues to be a leader in delivering to users the capability to display their conceptual and scientific data in any forum.

Army Science Conference – "Transformational Science & Technology for the Army…a race for speed and precision"

By Paul Adams

The ERDC MSRC Scientific Visualization Center (SVC) displayed and demonstrated its products at the 23rd annual Army Science Conference, sponsored by the Assistant Secretary of the Army for Acquisition, Logistics and Technology, in Orlando, Florida, December 2-5, 2002. The theme for the conference was "Transformational Science & Technology for the Army…a race for speed and precision."

The Army sponsored an HPC room at the conference to showcase the contribution of HPC to the Army mission. Scientists and principal investigators using the resources at the ERDC MSRC presented formal demonstrations of the projects Fuel Injectors for Gas Turbine Engines, Blast Protection in Urban Terrain, and Predictions of Glass Particle Velocities. These projects each highlight the way in which HPC and the ERDC MSRC are helping to transform the way in which the DoD gets its work done.

John E. West briefed conference attendees on the capabilities of the ERDC MSRC. He also discussed these capabilities in a looping movie on the plasma screen at the conference. ERDC SVC personnel Paul Adams, Tom Biddlecome, and Dr. Michael Stephens presented immersive demonstrations during the informal sessions at the conference. One of the informal presentations of the Blast Protection in Urban Terrain project was for Dr. Walter F. "Rick" Morrison, ERDC Deputy Director, and Major General Tilley, who was at Khobar Towers in Saudi Arabia. An informal presentation of the SHAMRC: Environmental and Vehicle Loading project was made to the Honorable Claude M. Bolton, Jr., the Assistant Secretary of the Army for Acquisition, Logistics and Technology, and General Paul J. Kern, the Commanding General, U.S. Army Materiel Command. Scientific movies of the Fuel Injectors for Gas Turbine Engines, SHAMRC: Environmental and Vehicle Loading, and Divine Kingfisher 31-B projects were shown on the touch screen. Copies of the Fall 2002 edition of *The Resource* were available. It featured graphics from the SHAMRC: Environmental and Vehicle Loading project on its cover and included a feature article by Joe Crepeau of Applied Research Associates, who provided the computational data sets for this project that were generated on the ERDC SGI Origin 3800.

Tommy Bevins, ERDC Geotechnical and Structures Laboratory (GSL), gave the formal presentation of the Blast Protection in Urban Terrain project.

Chris Stone, Georgia Institute of Technology, presented an immersive demonstration of the Fuel Injectors for Gas Turbine Engines project.

Photos courtesy of ARL.

John E. West, ERDC MSRC Director, briefed conference attendees on the capabilities of his Center.

Donald Nelson, ERDC GSL, gave the formal presentation of the Predictions of Glass Particle Velocities project with an immersive application with Dr. Mike Stephens.

Paul Adams (far left) and Tom Biddlecome (far right), both of the ERDC MSRC, presented the SHAMRC: Environmental and Vehicle Loading immersive application to Army members.
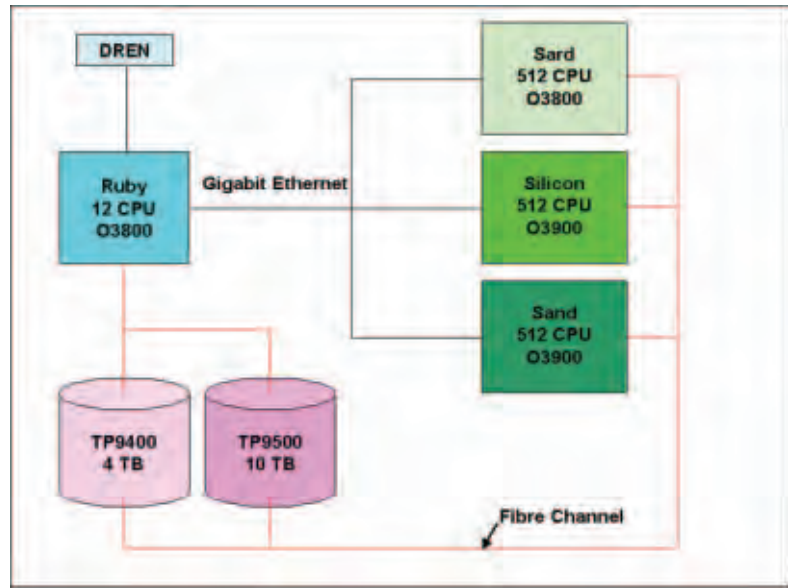

Paul Adams (far right) talked with (left to right) the Honorable Claude M. Bolton, Jr., the Assistant Secretary of the Army for Acquisition, Logistics and Technology, and General Paul J. Kern, the Commanding General, U.S. Army Materiel Command, before presenting the SHAMRC: Environmental and Vehicle Loading project on the ImmersaDesk.

Technology Enhancements in the ERDC MSRC Computational Environment

By Jay Cliburn

The fiscal year 2003 hardware installations are well under way at the ERDC MSRC. In February 2003 the Center took delivery of and installed two new 512-processor SGI Origin 3900 systems, boosting the computational power of the Origin by 1,434 peak giga-FLOPS from 410 to 1,844 gigaFLOPS. The systems, named silicon and sand, are each configured with 700 MHz MIPS R16000 processors and 512 gigabytes of total random access memory (RAM). They are integrated into the MSRC similar to the current Origin 3800 (sard) and are accessible by the batch queuing system (LSF) through the front-end host, ruby, which incidentally has been expanded from eight to twelve central

Functional layout of the O3K

processing units (CPUs). In addition to the added processing power, all Origin 3000 (O3K) systems are now connected to a new 20-terabyte (TB) storage area network (SAN) that was delivered with the new systems; the existing 4-TB disk subsystem has been integrated into the new SAN as well. The ajacent diagram illustrates the functional layout of the O3K.

The ERDC MSRC is very excited to take delivery of a liquid cooled 64-CPU Cray X1 in late June 2003. This system will provide 816 gigaFLOPS (peak) of computational power to ERDC users through the employment of 64,800 MHz CPUs, each containing four multistreaming processors and four gigabytes of RAM, for a total of 256 gigabytes of memory. The system will be configured with 8 TB of Fibre Channel disk storage for home directories and user workspace.

The addition of these new systems will boost the ERDC MSRC's aggregate peak computational rating to 6.4 tera-FLOPS, continuing ERDC's commitment to world-class capabilities to support the DoD.

Cray X1

Origin 3900

ERDC MSRC Prepares to Assist Users When Cray X1 Arrives

By Robert Alter, Dr. Paul Bennett, Dr. Ruth Cheng, Robert Hunter, Carrie Mahood, Dr. Thomas Oppe, and Dr. Fred Tracy

In the summer of 2003, the ERDC MSRC will install a Cray X1 supercomputer as part of the Technology Insertion 2003 (TI-03) procurement process. In preparation for its deployment, the Computational Science and Engineering (CS&E) group from the ERDC MSRC attended a 3-day class giving an overview of the Cray X1 architecture and programming tools. The class was offered April 8-10 at Jackson State University and was taught by Dr. Richard Walsh of the Army High Performance Computing Research Center (AHPCRC). AHPCRC has installed two early production air-cooled versions of the Cray X1, while the ERDC MSRC expects to install a liquid-cooled 64-processor version in June. The CS&E team learned that the Cray X1, a multistreaming vector-computing supercomputer, would create a distinctly new parallel programming environment for ERDC MSRC users.

The basic user-addressable Cray X1 processor, called an MSP (for multistreaming processor), will not be comparable with processors on the Cray T3E, SGI Origin 3000 (O3K), or HP SC40/45 platforms at the ERDC MSRC. The 64 MSP processors are grouped into 16 nodes, with each node containing four MSPs that share memory in an SMP (symmetric multiprocessor) manner. Each MSP consists of four SSPs (single-streaming processors). Each SSP has a dual-pipe vector unit, a scalar unit, and 32, 64-element vector registers. The dual-pipe vector units can theoretically produce four 64-bit results per clock cycle running at 800 MHz, thus achieving a peak speed of 3.2 gigaFLOPS per SSP and 12.8 gigaFLOPS per MSP. The Cray X1 can also operate in 32-bit mode at twice the speed of 64-bit computations, thus achieving a peak speed of 25.6 gigaFLOPS per MSP for 32-bit calculations. The clock speed of the SSP scalar unit is 400 MHz, half that of the vector unit. In addition to the four MSP processors, each node board also has two I/O chips, 16 memory-management chips, and up to 16 gigabytes of memory. Each MSP has direct access to the memory on its node and will be able to access the memory on other nodes with a latency penalty. Thus, the Cray X1, like the O3K, exhibits a nonuniform memory access (NUMA) architecture.

Vector processing on the Cray X1 is done by the SSP vector units. Each SSP has 32 vector registers, each containing 64, 8-byte words (or 128, 4-byte words). The Cray compiler can vectorize many loops for the user, and the user can also help the compiler by inserting compiler directives before problematic loops. Generally, vectorization works best for long loops that are computationally intensive. In such cases, the compiler will attempt to multistream the vector calculations across the four SSPs in an MSP. A loop can be vectorized if each iteration of the loop represents independent work that could be done in any order. Coding constructs within a loop that can inhibit vectorization include subroutine or function calls, unstructured branches, GOTO statements, and data dependencies. Vectorized code can easily run 10 to 20 times faster than scalar code. In addition, because an MSP is the smallest user-addressable processor, code that runs in scalar mode will run on only a single SSP scalar unit, thus wasting the eight vector pipes on an MSP. Thus, it is incumbent on the user to vectorize as much of the code as possible.

Multistreaming is done at the loop level, where loop iterations are divided between the SSPs of a single MSP. The compiler will attempt to multistream long or compute-intensive vector operations, and the user can guide the compiler with multistreaming compiler directives that look very similar to OpenMP directives. Iterations of a multistreamed loop can be divided into cyclic or block chunks. The full potential of the Cray X1 can be utilized when a large amount of the work can be divided between the four SSPs of an MSP and the vector processing is done by each SSP.

The Cray X1 will support the C, C++, and Fortran95 languages. The default data types are 32-bit (IEEE format), unlike the default 64-bit of the Cray T3E. The parallel models that are available now are MPI, Pthreads, SHMEM, UPC (Unified Parallel C), and CAF (Co-array Fortran), with OpenMP becoming available in the third quarter. UPC and CAF use the same concept of adding an extra dimension to distributed arrays that index over the process IDs.

The CS&E team recently completed a week of valuable hands-on experience with this new architecture. The speedups and performance increases seen for some test codes that could be vectorized and multistreamed were quite impressive. The Cray X1 supercomputer at the ERDC MSRC should provide some new challenges to ERDC MSRC users, but it should also provide new opportunities for greater performance in high-performance computing.

Job Shadowing in Computer-Related Fields

By Rose J. Dykes

Because the ERDC MSRC wants to help prevent a human resource shortage in the future science and engineering workforce, it is always eager to participate in programs to increase student interest in science, math, and technology careers. It shares the same concerns as that of the Army, which in the fall of 2000 started eCYBERMISSION, a unique science, math, and technology competition via the Internet.

On February 27, 11 students from Vicksburg High School, Vicksburg, Mississippi, who are interested in computer-related careers, spent the day in the ERDC ITL. They shadowed ITL team members in the fields of computer science, computer engineering, computer analysis, etc., as well as toured the facilities. Anyone who visits ITL seems to be most interested in seeing and hearing about the high-performance supercomputers.

Visitors are also intrigued while observing the capabilities of the SVC, and these students were no different.

MSRC team member Jerry Morris has served as a mentor for the job shadowing program for the 2 years that he has been part of the MSRC. Lance Henry had chosen the computer engineer field to shadow and was teamed up with Morris. Morris shared his experiences with him and discussed the prospects of the field.

Bob Athow, also of the MSRC, spent time with all of the job shadowers as he took them through the high-performance computer center and SVC. Athow mentioned later that comments from the students indicated their amazement with the powerful computers and also the great opportunities that existed in their hometown in the computer-related fields.

Bob Athow (far right) discusses mass storage in the HPC center with ITL mentors Patti Duett and John Marshall (far left) and the job shadowing students.

ERDC MSRC Staffers Share Career Knowledge with Students

By Ginny Miller

ERDC MSRC personnel have gone back to the classroom to share career knowledge with students at three local high schools. Employees spoke to students at Vicksburg High School (VHS) and Warren Central High School (WCHS) in October 2002 and St. Aloysius High School in February 2003.

"The goal was to expose students in grades 9-12 to career opportunities in engineering and science and to encourage them to seek higher education degrees," said Jeanie McDonald, who organized the ERDC MSRC's participation in the events and distributed copies of *The Resource* at each of the schools.

"Speakers from the MSRC talked about how they came to work here, the goals and rewards of their jobs, and why their job is important," McDonald said. "Some speakers also addressed what is expected of an employee, from being on time for work to dressing professionally, and almost everyone noted that decisions students make today could affect their employment opportunities in the future."

After speaking to students during "Business in the Classroom" activities at VHS on October 7, Bobby Hunter of the Computational Science and Engineering (CS&E) group said he would be glad to participate again.

Paul Adams, Director of the ERDC MSRC Scientific Visualization Center, shows some of the center's work to students at local career day activities.

> **"Capturing young minds for science and engineering is key to our country's continued technological leadership, and is key to developing a sustainable workforce in HPC."**
>
> *John West*
> *ERDC MSRC Director*

"There was a lot of motivation there," Hunter said. "The students seemed really excited about their future. They may not always know exactly what they want to do leaving high school, so I talked about more of what they need to focus on to get ready. I told them they need to study as much as they can about the type of work they want to do so they are prepared for it."

Dr. Fred Tracy, also from CS&E, said a mentoring relationship with high school students is very important to their future. "We need to go in and show them a vision of what they can do, because right after high school they're going to have to make a very critical decision," he said.

Tracy also told students there was more to a career than just working. "There's more than doing it, there's wanting to do it," he said. "One of the things they've got to have is hope."

Beverly Boyd, a 17-year-old VHS senior, said many of her classmates "are still in the process of deciding what it is that they want to spend the rest of their life doing. This program gives us a head start on the road to discovering it."

At WCHS, where career activities were held over a 2-day period from October 23-24, speakers included Jerry Morris and Rikk Anderson, a former intern now working at the ERDC MSRC.

"The key to success is taking the initiative, not just following the program," Anderson told students.

Morris also gave students a "reality check," supplying information about entry-level wages and living expenses.

"How much money do you need to live in the real world? That's an important question," he said. "You're right at the brink of moving out of school into the

community outreach ....

workforce, so you have to be ready. You're going to have to go to college or technical school. You're going to have to mainstream yourself. You have to prepare yourself, and you have to make yourself marketable."

WCHS junior Joel Langford, 16, said the career program was very effective. "The speakers told us to study hard and stay in school, which I already knew," he said, adding that participants from the ERDC MSRC, where he would like to work one day, reinforced his goal of becoming a computer scientist.

In addition to providing speakers for school career activities, the ERDC MSRC participates in a number of education initiatives, including Job Shadowing programs, tours, and internships. "I enthusiastically support these events," MSRC Director John West said. "Capturing young minds for science and engineering is key to our country's continued technological leadership, and is key to developing a sustainable workforce in HPC."

Dr. Fred Tracy (left) and Bobby Hunter speak to students during local career day activities.

CS&E Director Dr. Bill Ward speaks to students during local career day activities.

(Left to right)
John E. West, ERDC MSRC Director,
Dr. Walter F. (Rick) Morrison, Jr.,
ERDC Deputy Director,
and Dr. Deborah Dent,
ERDC ITL Deputy Director,
April 3, 2003

(Left to right)
John E. West, Dr. Richard Cave and
Jim Platt, British Embassy Washington,
and Dr. Walter F. (Rick) Morrison,
April 1, 2003

(Left to right)
John E. West, Denise Martin, ERDC ITL,
Dr. Buddy Clairain,
ERDC Environmental Laboratory,
and William Hinsley, PBS&J Consultants,
U.S. Army Engineer District, New Orleans,
March 18, 2003

David Stinson (second from right),
ERDC MSRC, with students from
the University of Louisiana at Monroe,
March 12, 2003

(Left to right)
U.S. Army Engineer District, Savannah,
visitors Debbie Pittman, Professional
Development Support Center, Ralph Barrett,
Chief of Engineering, Pete Oddi,
Program Manager, Military Programs,
and COL Roger A. Gerber, Commander,
shown with John E. West,
March 6, 2003

Paul Adams (far right), ERDC MSRC,
talking with officials from the Nigerian
National Inland Waterways Authority,
March 3, 2003

(Left to right)
Drs. Robert L. Hall and Albert J. Bush, ERDC Geotechnical and Structures Laboratory (GSL), with GSL Peer Review Board members Drs. Eugene Sevin, William J. Hall, and Mete A. Sozen, February 24, 2003

(Left to right)
Dr. James R. Houston, ERDC Director, with U.S. Senate staffers Gene Moran, Military Fellow, Senator Thad Cochran's office; Mitch Waldman, National Security Advisor, and Commander David Manero, outgoing Military Legislative Advisor, both of Senator Trent Lott's office; Stuart Holmes, Legislative Assistant for Defense and Veterans Affairs, Senator Cochran's office; Bo Bilbo, Field Representative, Jackson, Mississippi, office, and Major Annette Ortiz, incoming Military Legislative Advisor, both of Senator Lott's office; and Dr. Jeffery Holland, ERDC ITL Director, January 30, 2003

(Left to right)
Greg Rottman, ERDC MSRC, Milt Seekins, ERDC Congressional Affairs Staff Officer, and Mary Vincent, ERDC Executive office, December 11, 2002

acronyms ··

Below is a list of acronyms commonly used among the DoD HPC community. You will find these acronyms throughout the articles in this newsletter.

AHPCRC	Army High Performance Computing Research Center
CFD	Computational Fluid Dynamics
CHSSI	Common High Performance Computing Software Support Initiative
CPU	Central Processing Unit
CSC	Computer Sciences Corporation
CS&E	Computational Science and Engineering
CSM	Computational Structural Mechanics
CTA	Computational Technology Area
CWO	Climate/Weather/Ocean Modeling and Simulation
DoD	Department of Defense
DTRA	Defense Threat Reduction Agency
EQM	Environmental Quality Modeling and Simulation
ERDC	Engineer Research and Development Center
FCS	Future Combat System
FD	Finite Difference
GSL	Geotechnical and Structures Laboratory
HPC	High-Performance Computing
HPCMP	High Performance Computing Moderniza tion Program
ITL	Information Technology Laboratory
JSU	Jackson State University
LSF	Load Sharing Facility
MLP	Multi-Level Parallelism
MPI	MessagePassing Interface
MSP	Multistreaming Processor
MSRC	Major Shared Resource Center
NLOM	Navy Layered Ocean Model
NUMA	Nonuniform Memory Access
OKC	Online Knowledge Center
O3K	Origin 3000
PAPI	Performance Application Programming Interface
PET	Programming Environment and Training
RAM	Random Access Memory
SHAMRC	Second-Order Hydrodynamic Automatic Mesh Refinement Code
SMP	Symmetric Multiprocessor
SSP	Single Streaming Processor
SRCAP	Shared Resource Center Advisory Panel
SRTV	Soldiers Radio and Television
S&T	Science and Technology
SVC	Scientific Visualization Center
TB	Terabytes
T&E	Test and Evaluation
TI-03	Technology Insertion 2003
UAG	Users Advocacy Group
UGS	Unattended Ground Sensors
USM	University of Southern Mississippi
VHS	Vicksburg High School
VPG	Virtual Proving Ground
WCHS	Warren Central High School

training schedule ·····································

For the latest on PET training and on-line registration, please go to the Online Knowledge Center Web site:

https://okc.erdc.hpc.mil

Questions and comments may be directed to PET training at (601) 634-3131, (601) 634-4024, or *PET-Training@erdc.usace.army.mil*

Dr. Mark L. Moran
Seismic Signature Simulations for Unattended Ground Sensor Systems

Numerical simulation of ground vehicle tracking systems using seismic signatures.

100m

20m

5m

0.006 seconds