

access

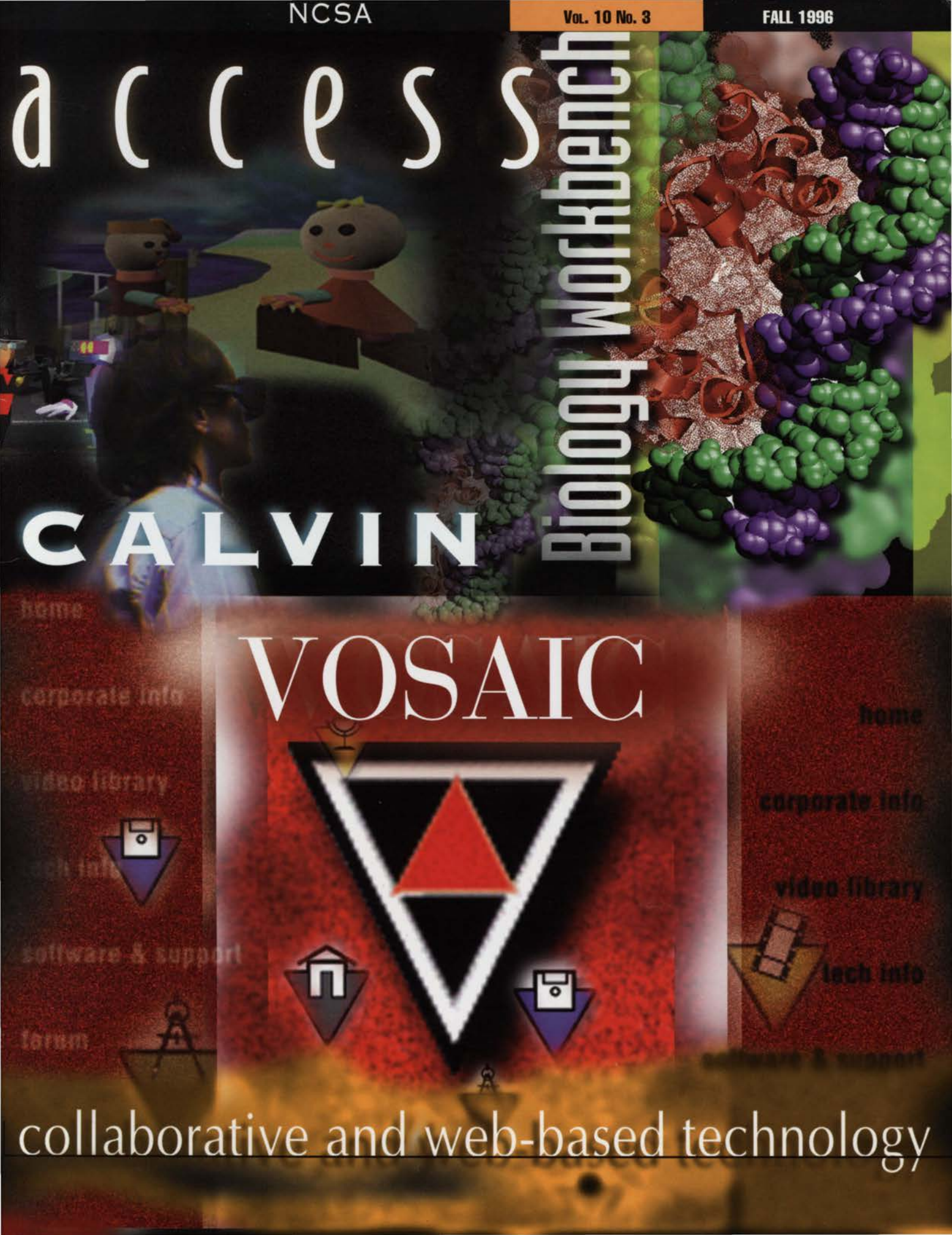
Biology Workbench

CALVIN

VOSAIC



collaborative and web-based technology





Benjamin Franklin, in a 1787 letter, wrote “. . . but in this world nothing can be said to be certain, except death and taxes.” To this list I would add change. We expect change. We even try to prepare for and anticipate its occurrence. Often we initiate it. Such is the case with *access* magazine.

Over the past 10 years we’ve watched *access* grow from a modest newsletter to an impressive magazine. Whatever its shape or size, its content has always reflected the center’s purpose, achievements, and dreams.

Our goals are shaped by many influences. In recent years, the Internet and the World Wide Web have precipitated change and growth in the way we communicate and collaborate like few other innovations in recent history. We are no longer in the Information Age but in the Age of Digital Communication.

access in its current print form, ends; *access* in its next iteration will be striving to break ground in the way we share information on the Web. This new online interpretation will serve up experiments and experiences as we formulate and evolve this new paradigm.

In order to provide you with the information you need and expect to receive from NCSA, your feedback on our progress in this new venture will be most beneficial. We look forward to your comments as we shape the next *access*.

Melissa Johnson
Managing Editor

access

NCSA's high-performance computing magazine

Fall 1996

Managing EditorMelissa LaBorg Johnson
melissaj@ncsa.uiuc.edu**Research Editor**

Paulette Sancken

New Technologies Editor

Ginny Hudak-David

Outreach Editor

Fran Bond

Copy Editor

Stephanie Drake

Designer

Carlton Bruett

Printer

Original Smith Printing



access (ISSN 1064-9409) is published by the National Center for Supercomputing Applications at the University of Illinois at Urbana-Champaign (UIUC) with support from the National Science Foundation, the Defense Advanced Research Projects Agency, other federal agencies, corporate partners, the University of Illinois, and the State of Illinois. Permission to reprint any item in access is freely given, provided that the author and access are acknowledged. Copyright © 1996 Board of Trustees of the University of Illinois. All brand and product names are trademarks or registered trademarks of their respective holders.



This publication is printed on Northwest Gloss Text and Northwest Gloss Cover.

RESEARCH

<i>Biology Workbench</i>	2
<i>Biology Workbench Unravels the Human Genome</i>	5
<i>Enhancing Structural Biology Research through MDScope</i>	6
<i>New Features Enhance Alpha Shapes Software</i>	8

NEW TECHNOLOGY

<i>CALVIN: A Collaborative Environment for Design in Virtual Reality</i>	10
<i>@ATS: User Support with an Interactive Web-Based System</i>	12
<i>SGI CRAY Origin2000 Installed</i>	13
<i>netWorkPlace: Enlarging the Scope of Your Next Work Place</i>	14
<i>Adding Video to the Net: Video + Mosaic = Vosaic</i>	16
<i>NCSA Web Update</i>	18
<i>NCSA Multicast</i>	19

OUTREACH

<i>Partnership Illinois</i>	20
<i>CyberEducation Takes to the Road</i>	21
<i>Illinois's First Community Networks Conference</i>	22
<i>Shell Oil Joins NCSA's Industrial Program</i>	22
<i>Interactive Lesson</i>	23

<i>NCSA Contacts Directory</i>	24
--------------------------------	----

cover images

CALVIN, courtesy Jason Leigh, EVL/UIUC; Biology Workbench, courtesy Shankar Subramaniam, NCSA; Vosaic, courtesy Roy Campbell, UIUC

access retrospective, inside cover

Designed by Meadow Sabelko, NCSA

Fran Bond, editor of access from 1989-1996, retired this past summer.

Biology Workbench

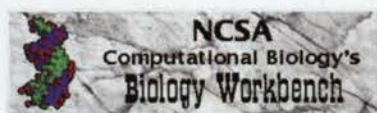
Point-and-Click Technology That Frees Biologists to Be Biologists



Interview with Shankar Subramaniam

It has everything a molecular or structural biologist wants: databases, analysis tools, and the computational power of a supercomputer. To use it, researchers only need access to the Internet.

by Holly Korab



Listening to an exasperated Curt Jamison describe the four to eight hours he used to spend juggling DNA data between three different software packages on three different computers, it is easy to understand the love-hate relationship many biologists have with the computing hardware/software upon which their research is increasingly dependent. Yes, it is opening new realms of biology, but only when biologists aren't battling the software. Reminiscent of John Merrick's impassioned plea in *The Elephant Man*, they declare, "I am not a computer scientist; I am a biologist."

Call it the dilemma of plenty. Since the advent of analysis tools like x-ray crystallography, nuclear magnetic resonance, and automated DNA sequencing, the amount of sequence and structure data has exploded. The number of gene sequences biologists have cataloged has leapt from about a dozen to between 50,000 and 60,000. The number of unique protein structures they've unraveled has climbed to between 500 and 600.

This should be good news. Research on everything from the common cold to cancer is heavily dependent on sequence-structure-function studies. *Sequence* refers to the string of DNA that specifies the order of amino acids defining a protein. *Structure* is the complex 3D shape that this linear string folds into in response to interactions along the string of amino acids. This structure is what ultimately defines the protein's *function* in the human body. For instance, enzymes bind with a particular substrate to catalyze metabolic reactions because the shape of a critical "active site" on its surface complements that of the substrate—like a hand and glove. The same holds true for antibodies, which latch only onto specific antigens. By comparing a map of one protein with sequences of proteins whose structure and function are known, scientists can begin to gauge functional relationship and hence approach the problem of solving molecular diseases.



The complaint biologists sometimes have with this wealth of knowledge is that the databases—and the software running them—conform to no common standards. Biology is a scientific cottage industry with data being generated in thousands of independent labs around the world, each applying its own format and syntax. There are now hundreds of biological databases talking in different tongues. Not quite a Tower of Babel, but close.

A new model

Until recently, two common ways for scientists to get around the incompatibilities among databases were to learn every software program associated with the databases they wanted to use or to wait days for results to return from an outside lab.

In June researchers at NCSA offered another choice with the release of Biology Workbench™. Researchers now have a platform-independent interface to more than 100 public domain databases and software for sequencing DNA and identifying protein structures.

As easily as they surf the Web, biologists can use Biology Workbench to search major molecular and structural biology databases such as GenBank, the repository of genetic information maintained by the National Center for Biotechnology Information. Or they can execute such software tools as BLAST for homology searches. Best of all, because it is located on NCSA's SGI POWER CHALLENGEarray, Biology Workbench turns every desktop computer into a supercomputer. "We're giving the biology community access to our supercomputer for speeding up database software," says Jim Fenton, a research programmer at NCSA who helped build the prototype. The workbench concept originated with Shankar Subramaniam, NCSA computational biologist and the project's leader. Helping him implement it were Fenton; NCSA biophysicist Eric Jakobsson; research programmers Mark Stupar and Roger Unwin; and Curt Jamison, a former postdoctoral student in NCSA's Community Systems Group now with the University of Maryland Department of Plant Biology.

Using existing software as building blocks, the researchers assembled a generic structure in which tools, databases, servers, and compute engines based on different formats interoperate. The Web-based interface to these components works with any forms-capable, standard HTML Web browser. As a result, all a

user needs to run Biology Workbench is a Web browser and Internet access.

Biology Workbench is clearly more than another Web tool. NCSA Director Larry Smarr says it represents an entirely new way of thinking about software architecture. It's a model for Web-based computing.

"It is a radical departure from the old view of one piece of software, one machine," says Smarr. "If you think of the Web as an extension of your hard drive, then the Biology Workbench is the framework that ties together and leverages the software that's already out there. You let the data sit on the Web machine where it makes the most sense, you let the software sit out on the Web machine that makes the most sense, then you grab it all in your Web browser. It is a twenty-first century approach to global knowledge and global integration of data and software."

How it works

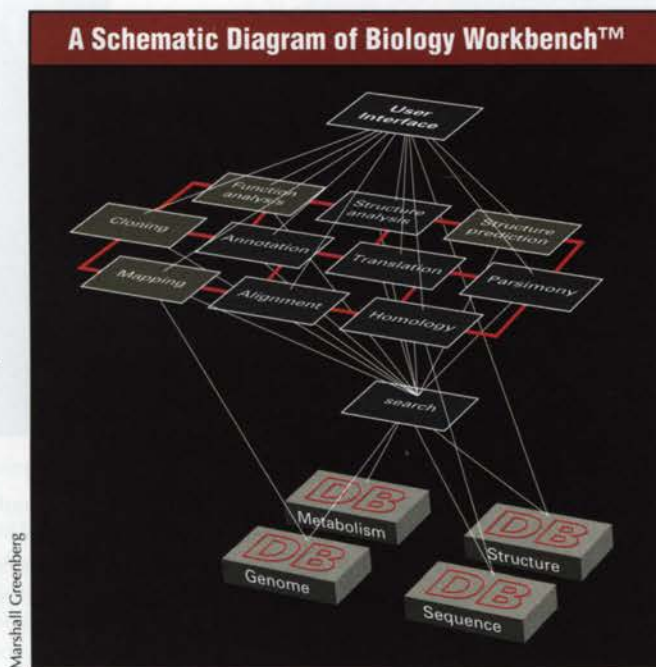
The philosophy behind Biology Workbench is illusion. The Web interface lets databases and tools interoperate and appear to be located on your machine. In reality, however, each component remains at its remote location.

To demonstrate the power of Biology Workbench's distributed structure, Subramaniam searches across a federation of databases for the protein pancreatic secretory trypsin inhibitor. This protein naturally inhibits the enzyme trypsin, which is involved in digestion. He selects several databases (PIR, GenBank, and PDB) and enters the name of the protein in the query box. Within seconds, sets of sequences appear on his computer screen. Subramaniam imports the sequences from the remote databases to the Workbench by clicking the *Import* button. With another click—this time on the *Multiple Sequence Alignment* button—the sequences instantly align. Still another click (on *MSAShade Tool*) highlights the matches and mismatches in yellow and green. Because Subramaniam is interested in seeing the protein's 3D structure, he then asks the workbench to predict the secondary structure of one of the trypsin inhibitor proteins.

The entire process takes less than three minutes.

"A process like this would have taken a molecular biologist months or weeks. Now it takes hours or minutes," says Subramaniam. "We can think seriously now in terms of analyzing protein sequences and rationally understanding function mechanism and therefore targeting drug design."

A Schematic Diagram of Biology Workbench™





Operating behind the scenes in the workbench is a dynamic database manager that integrates the databases and eliminates duplicate entries. To overcome semantic barriers, the workbench's translation libraries convert a generic query language into the query language unique to each database. Scripts residing in the background seamlessly convert databases and tools from one format to another. To keep the databases downloaded at NCSA current, the Workbench sends out an intelligent agent each night to prowl mirror sites on the Internet for updated versions of databases. (All the analysis tools sit on the NCSA server, but the only databases downloaded are those that are slow to access, such as those located overseas.)

To protect the thousands of other files at NCSA, the workbench is hosted on a dedicated server that has been *wrapped*, a common security practice that electronically cordons off a portion of the computer as a safeguard against hacker attacks. "Someone using Biology Workbench shouldn't get access to anything else on NCSA's computing system," says Ken Rowe, NCSA's security coordinator.

Averaging 325 visitors a day

Server overload is one of the issues Subramaniam will soon be addressing. The eight gigabytes of disk space reserved on the POWER CHALLENGEarray for the databases and tools is already restricting the addition of any new databases. Immediately after the debut of Biology Workbench at the meeting for Intelligent Systems in Molecular Biology, held June 12 in St. Louis, MO, schedules for purging temporary files had to be revamped to prevent filling all the available disk space. The workbench software has been licensed by the University of Illinois to AM Technologies for commercial distribution. The software is freely available to academic and governmental institutions.

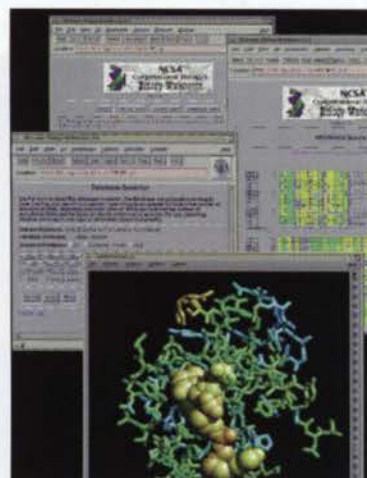
Eli Lilly and Co.—an NCSA industrial partner—was so taken with the menu-driven tool that it immediately incorporated it into its computing system. By mid-June scientists in Lilly research laboratories were using the workbench. "Already we can see the benefits from better access to DNA analysis tools," says Paul Rosteck, group leader for DNA Technology Research. Anticipating many upgrades, the Lilly team wrote the communications gateway in Perl5, a modular, object-oriented programming language that is easy to update.

In September collaborators from Rice University, the University of Wisconsin, and the USDA began working with Subramaniam's team at NCSA to adapt the workbench for network-based computing. Using software developed at the University of Wisconsin, they began prototyping a system for tapping networks of idle workstations. This kind of distributed computing is a more efficient use of computing resources and is expected to speed computations for tools like the workbench, which will have more computing resources to draw upon.

Future versions of Biology Workbench will include more databases and analytic tools—such as for x-ray crystallography and electrostatic and dynamics calculations. Other likely additions are the 24 databases from the National Agriculture Library and several tools and databases specifically geared toward aiding the Human Genome Project (see facing page).

An important source of ideas for further modifications will be workbench users themselves. "This is a tool for biologists designed by biologists, so we will be paying attention to feedback," says Subramaniam. "We want to help them spend less time on computing and more time on biology. After all, there is a biological universe of myriad complexity still to be discovered." ●

Holly Korab is a science writer in the NCSA Publications Group.



Images: Shankar Subramaniam, NCSA

Biology Workbench interfaces with more than 100 public domain databases and software.

Biology Workbench Unravels the Human Genome

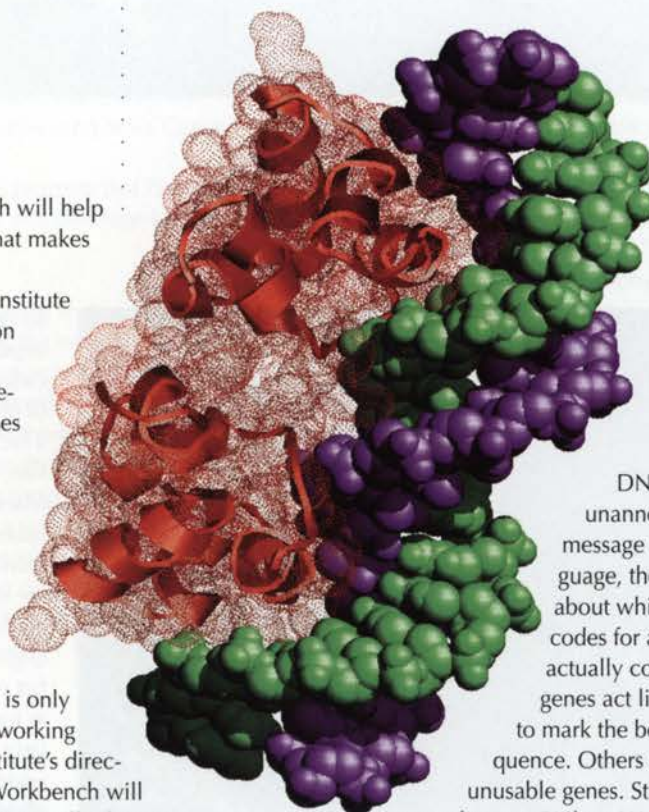
by Holly Korab

One complexity that Biology Workbench will help scientists decipher is the genetic code that makes humans human.

This summer researchers from the Institute for Biomedical Computing at Washington University in St. Louis selected Biology Workbench to integrate the dozens of genome-related tools and massive databases emanating from the Human Genome Project. The institute, which is developing tools that automatically annotate the genome sequence and test its accuracy, is teamed with Shankar Subramaniam's Computational Biology Group at NCSA to expand and customize the workbench's capabilities for genome research. Although the institute is only one of the 12 U.S. research institutions working on the Human Genome Project, the institute's director, David States, believes the Biology Workbench will prove so useful that all the other institutions will adopt it.

"Biology Workbench gives us a way to access these tools and data in a uniform environment and to disseminate them to others," says States, who is also associate professor of Biomedical Computing at Washington University in St. Louis. "It provides the biology community with an essential tool for beginning to look at the genome data and for understanding it."

The Human Genome Project is a massive multiagency undertaking begun in 1987 by the Department of Energy and the National Institutes of Health (NIH) to map the 50,000 to 100,000 genes that constitute the human genome. The genome is the complete set of instructions for making and maintaining an organism. In humans, this master blueprint is organized into 24 chromosomes located in the nucleus of each of the body's trillions of cells. The initial goal of the Human Genome Project was to map the location of genes along these chromosomes. Now scientists are beginning to sequence all 3 billion or so base pairs of nucleotides that constitute human genes.



Knowing this sequence is expected to make it easier for scientists to understand genetic causes of diseases and to develop treatments. But first scientists need to decode the sequence. The information spilling out of

DNA sequencers amounts to an unannotated stream of data. Like a message written in an unknown language, the sequence offers few clues about which proteins a particular gene codes for and whether or not a gene actually codes for a protein. Some genes act like punctuation in a sentence to mark the beginning and end of a sequence. Others are duplicates or broken and unusable genes. Still others have functions that are unknown. Biology Workbench will help tease out the 10 percent of genes used by a cell to build proteins; then it will help scientists predict protein shapes and functions.

Scientists also need an easy means of accessing these data, something that Biology Workbench's uniform computing environment can provide. Some experts predict that by the project's end in 2002 there will be enough data to fill 200 volumes, each the size of the Manhattan phone book.

A less direct benefit from the workbench's inclusion in the Human Genome Project is its potential to expose more scientists to this kind of Web-based technology. "If we can make a dent in this enormous amount of data, we can show the technology's value to every science," says Subramaniam. "It can be a paradigm for many disciplines." ●

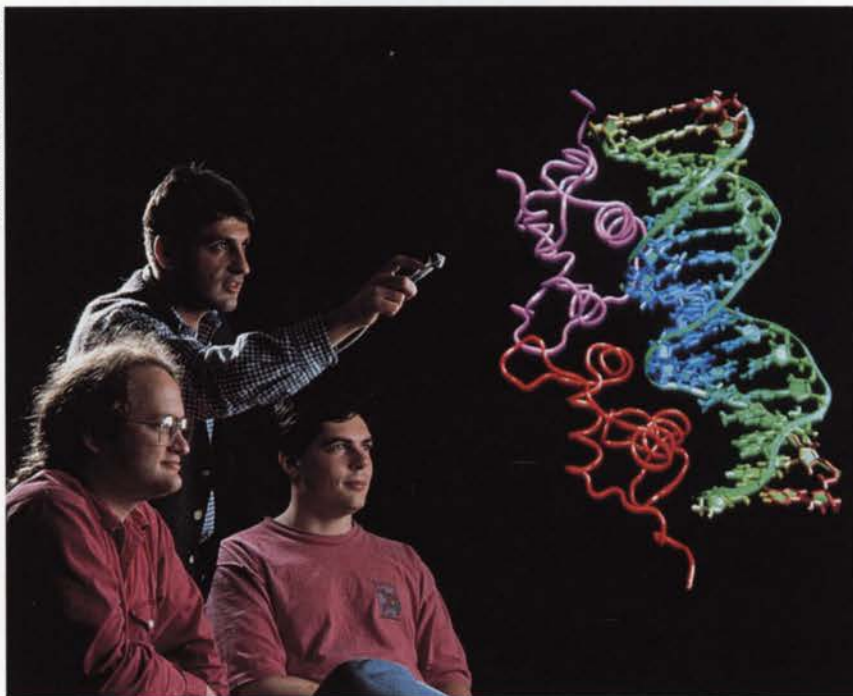
The Human Genome Project is sequencing all 3 billion base pairs of nucleotides that constitute the genes in the human DNA. Above, a section of a double strand of DNA is depicted in green and purple, with a regulatory protein bound to one of its base pairs.

Enhancing Structural Biology Research through MDScope



Interview with Klaus Schulten

Rhonda Anderson Photography



Through MDScope, 3D images of molecules share the space of researchers Attila Gursoy (standing), Andrew Dalke (left), and William Humphrey. Images can be explored with automatic speech and gesture recognition as well as with keyboard or mouse commands.

To describe the value of being able to explore a molecule with MDScope applications, Klaus Schulten, UIUC professor of physics, chemistry, and biophysics and a faculty member of the Beckman Institute, uses the analogy of an alien from Mars encountering an automobile. To understand what this object is and how it works, the Martian might first play with the easily accessed windows and doors, gradually work his way around to the engine, and eventually discover that it is hot when it runs, needs gas from the tank to fuel the combustion, and so on. Similarly, a structural biologist who tries to understand a particular structure would probe the various aspects of the system under study. Aided by a structural biology computational environment, *MDScope*, an investigator would share the same physical space with the model as well as view and manipulate 3D images of molecules in real time.

The UIUC Beckman Institute's Theoretical Biophysics Group (TB), a Resource for Concurrent Biological Computing supported by the National Institutes of Health, is led by Schulten. The group studies the structure and function of biopolymers and biopolymer aggregates by theoretical and computational means. Coprincipal investigators are Laximikant Kalé, UIUC professor of computer science and electrical and computer engineering, and Robert Skeel, UIUC professor of computer science. A key goal

of the TB Group is to develop high-end graphics tools that interface with a molecular dynamics simulation code for use on high-performance parallel computers for structural biology research.

Since July 1995, the group has been distributing its interactive molecular dynamics modeling program, MDSCOPE, for large-scale and longtime simulations on serial and parallel computers. At the core of MDSCOPE are three major software components:

- VMD—a visualization program for the interactive display and animation of molecules, designed and developed by William Humphrey, research assistant, and Andrew Dalke, research programmer

- NAMD—a parallel, distributed-memory, molecular dynamics program that is scalable, modular, and portable, designed and developed by Mark Nelson, Humphrey, and Robert Brunner, research assistants; Dalke; and Attila Gursoy, postdoctoral research associate

- MDCOMM—a communications program that links VMD and NAMD over a network, designed and developed by Rick Kufrin, NCSA research programmer

MDSCOPE creates a visual computing environment for molecular dynamics and modeling. In this environment biomolecules can be viewed and the structures of naturally existing molecules can be predicted based on empirical data. Researchers can modify and refine the model to reduce discrepancies between observed data and the properties of the computational model. For example, changes to a structure—such as moving a water molecule or a sidechain—are currently made with either the keyboard or a mouse. The resulting changes in interatomic forces are then calculated and the final configuration is displayed. For a small molecule of 500 to 1,000 atoms, calculations take less than a second. For a very large



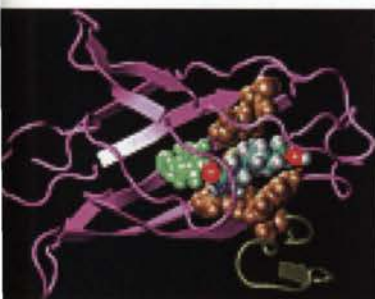
molecule, calculations may take from 10 to 30 seconds. More complex changes may require up to a minute to calculate.

The TB Group is well on its way to demonstrating the benefits of powerful and novel computational technologies, such as MDSCOPE, for structural biology.

Their discovery of a new protein structure that collects light in purple bacteria was published this spring[†]. The protein structure, Light-Harvesting Complex II (in photo above), collects light and transfers it to reaction centers within the photosynthesis system. Schulten and his team are extremely excited about their discovery. "It's beautiful, really beautiful," Schulten says of the wreath-like ring of polypeptides, chlorophylls, and lycopenes. ●

† Jürgen Köpke, Xiche Hu, Cornelia Münke, Klaus Schulten, and Hartmut Michel. 1996. The crystal structure of the light-harvesting Complex II (B800-850) from *Rhodospirillum rubrum*. *Structures*, 4:581–597.

The original version of this article, written by Sarana Schell, graduate student in the UIUC Department of Journalism, appeared in the Fall/Winter 1995–96 issue (Vol. 6/No. 1) of Beckman Institute News. Jennifer Allerson, an intern in the NCSA Public Information Office and a senior in the UIUC Department of Industrial Distribution Management, also contributed to this article.



MDSCOPE simulation of protein ligand adhesion to avidin-biotin complex.

MDSCOPE in Action

by Jennifer Allerson

While the development of MDSCOPE—the integrated set of computational tools (VMD, NAMD, and MDCOMM) that functions as an interactive visual computing environment for the simulation

and study of biopolymers—is still underway, its applications are already used by the Theoretical Biophysics Group at UIUC. Graduate students in physics Sergei Izrailev and Manuel Balsera and postdoctoral research associate Sergey Stepaniants, with Beckman Institute faculty Yoshitsugu Oono and Klaus Schulten, are using MDSCOPE to study one of the strongest interactions known in biology—the binding of the protein avidin with its ligand biotin.

Determining the actual mode of this binding requires highly sensitive experimental studies. The molecular dynamics simulations generated by MDSCOPE are helping the researchers understand the mechanism that accounts for both the binding and dissociation of the avidin-biotin complex. This system consists of the biotin molecule—a B-complex vitamin—that preferentially binds to the avidin protein. The group is trying to find out which aspects of binding are the most important and when they come into play.

MDSCOPE is used to view the system and to determine the optimal direction of the force pulling biotin from the binding pocket in the avidin structure. To modify the conformation of one avidin loop, another force was sent from VMD via MDCOMM to NAMD, where the new loop conformation was then computed.

The research group's findings may have numerous applications in diagnostics, targeted drug delivery, and biosensors as well as in other aspects of biotechnology. ●

New Features Enhance Alpha Shapes Software

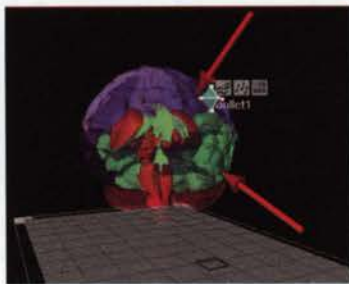
Interview with Ping Fu



by Holly Korab



The reconstructed surface of a motor's water cooling kernel. The 50,000 surface points were measured manually from photographic records on a photogrammetric analytical stereoplotter.



A brain constructed by Alpha Shapes from MRI data.

Fans of Virtual Alpha Shapes Visualizer, or VALvis, the virtual reality version of NCSA's popular Alpha Shapes 3D modeling program, can now alter the world as well as model it. This past summer, NCSA Research Program Manager Ping Fu—together with Jiang Qian, NCSA, and Herbert Edelsbrunner and Nataraj Akkiraju, UIUC—added two new functionalities to VALvis so that researchers can *deform* objects and generate smoother appearing images. Both capabilities are fast, accurate, and produce visually striking images.

Deforming

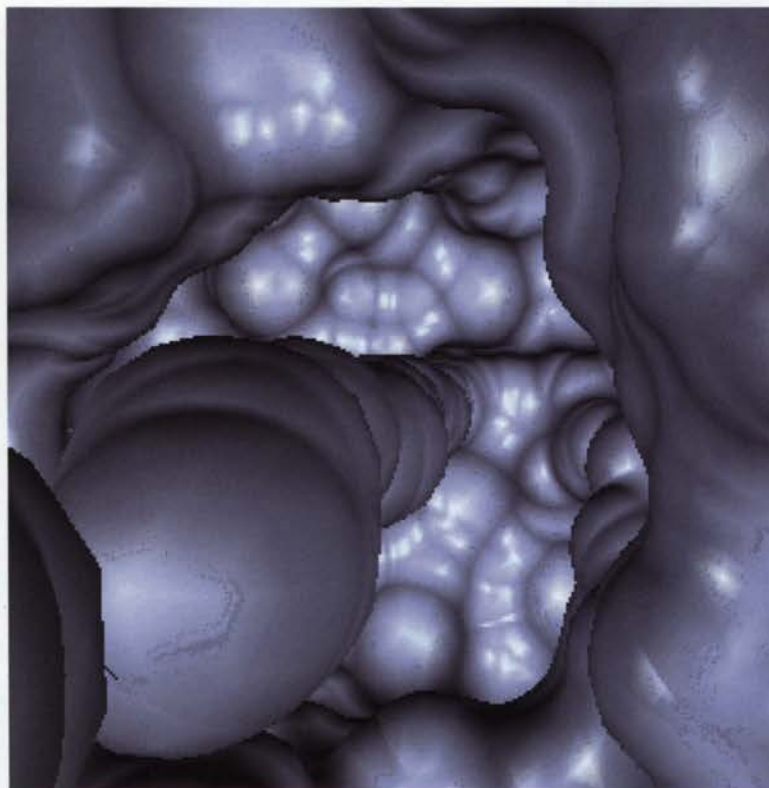
The first of these new features—*deformation*—is a way of clarifying relationships between objects by altering their form. Similar to morphing, it gradually changes objects from one form or state into another, such as from an apple into a snail or a fist into an open hand. In the music video for Michael Jackson's song *Black and White*, deformation/morphing technology made people's faces seem to melt into each other's.

Fu prefers the term deformation to distinguish VALvis's highly accurate, geometrically-based images from the cartoonish images popularly associated with morphing. Since VALvis's images comply with the laws of physics and are scientifically sound, they are attracting the interest of scientists from academia and industry. For example, medical researchers are using VALvis to deform a damaged brain into a healthy one in order to identify the location and causes of a brain injury. A scientist at the

University of British Columbia wants to predict the life span of tooth implants by using VALvis to model the deformation of jaws as people age. Industry is interested in applications that take into account the elastic nature of objects, such as a piston sliding along a cylinder in response to changes in pressure.

Fu attributes VALvis's accuracy and flexibility, as well as its speed, to its unique approach to modeling. Whereas other programs model only the object, VALvis models the object as well as its complement space. Without knowledge of the space around it, an object that deforms typically collides with itself and breaks apart at the joints when bent. This tendency of objects to violate most basic laws of physics when deformed is symptomatic of software that has good local control but no global control. "This is one of the most difficult problems in 3D modeling because to have global control the program must understand the empty space around the shape," says Fu.

VALvis and the Alpha Shapes program on which VALvis is based [see *access*, Summer 1994, page 11, and Fall 1995, page 8] compute shapes and complement space using geometric and topological formulations that mimic the properties of a system. More than simply rendering 3D image snapshots of objects, these programs reconstruct the object and its place in space. To do this, Alpha Shapes and VALvis define an object's basic geometry by generating a complex of basic elements called *simplices* from datapoints and their corresponding weights.



Both of these images are of the same interior channel in gramicidin A, an antibiotic. The image above is a molecular surface with visually striking smoothness and complete surface triangulation underneath, a new capability in VALvis. The image at right is a corresponding solvent accessible surface.

Copies of VALvis and Alvis are available via anonymous ftp at <ftp.ncsa.uiuc.edu/Visualization/Alpha-shape>. VALvis also requires the CAVE library.

There is another view or interpretation of this complex. Much like the particle model of light—which appears entirely different and may be even contradictory to the wave model—this view looks nothing like the alpha complex. Or so it seems at first. Think of each datapoint as the center of a round sphere; the spheres are allowed to overlap and interfere with each other. The alternative, or dual view, is the surface defined by these spheres. It consists of patches that meet along circles where they form valleys, and valleys flow together meeting at corner points. The object then may be further refined through surface triangulation so that a researcher can calculate an object's properties, such as its electrostatic potential and other force fields. Fu exploits surface triangulation for animating continuous deformations.

Smoothing

To make the triangulated surfaces appear more realistic, Fu has incorporated another new capability into VALvis. The new *smooth surface feature* makes images appear as if a ball has been rolled along their surfaces, slightly filling in and rounding off the valleys and corners that formed when the initial surface was created. Usually this is a time-consuming process, but Fu has been able to streamline it in VALvis by combining computational steps. VALvis implicitly knows the locations of all valleys and corners; therefore, the software computes the smooth surface as it computes the shape.

Fu cautions that these computations, though fast, are expensive. Each primary datapoint generates hundreds more points to construct a smooth surface. Rendering an object much larger than a half million points, for example, may exceed even a supercomputer's computational limits. "One has to weigh the benefits of prettier imaging versus more memory," says Fu. "In some applications, smooth surfaces are unnecessary. That's why we left it as a command line option."

Both the deformation and smoothness features are available at present only in VALvis. However, Fu plans to eventually incorporate them into Alvis, the desktop version of Alpha Shapes, so that these capabilities will scale from the desktop to virtual reality. ●

Holly Korab is a science writer in the NCSA Publications Group.

CALVIN: A Collaborative Environment for Design in Virtual Reality

by Jason Leigh and Andrew E. Johnson

RESEARCHERS AT EVL UNDERSTAND THE IMPORTANCE OF COLLABORATION AND ARE WORKING WITH NCSA SCIENTISTS TO DEVELOP COLLABORATIVE TOOLS FOR VIRTUAL REALITY. AS NETWORK SPEED AND BANDWIDTH INCREASE, OPPORTUNITIES IMPROVE FOR INTERACTIVE INTERDISCIPLINARY COLLABORATION— OPPORTUNITIES THAT CAN INVOLVE SCIENTISTS, ENGINEERS, DESIGNERS, STUDENTS, AND MANAGERS FROM LOCATIONS AROUND THE GLOBE.



Virtual environments may provide the common ground that allows disparate groups to work together successfully, giving the collaborators an experience beyond that of simply meeting face-to-face. Instead of trying to reproduce the reality of everyone working together in the same physical room, virtual environments have the potential to offer the participants abilities not available to people in the real world. Consider, for example, the opportunity for a designer and an engineer to poke their heads into a running jet engine simulation to offer their expert opinions on what they see. Such a scenario could not take place in the real world.

Collaborative virtual environments create technological and social challenges and opportunities over conventional workstation-based computer-supported cooperative work. Understanding how interdisciplinary collaboration can be facilitated in virtual reality (VR) to create a user-centered integration of collaborative VR resources is part of the mission of the UIC's Electronic Visualization Laboratory (EVL). Collaboration with NCSA provides EVL's innovative researchers with users whose applications requirements help drive technology development. For example,

computational scientists and engineers are very interested in remote VR collaboration for rapid prototyping, distance learning, and data analysis and comprehension. EVL and NCSA's history as collaborators includes joint projects on scientific visualizations, virtual reality environments, and the I-WAY.

CALVIN (Collaborative Architectural Layout Via Immersive Navigation) is a testbed developed by EVL to investigate technological and social challenges by implementing a shared virtual-design environment. Users in a CALVIN space can walk around the virtual space and manipulate objects (e.g., by moving, rotating, scaling) within it. A database contains the current state of all objects in the scene and maintains consistency between various users. A simple revision system lets users see past designs as well as the current design.

Mortals, deities, and avatars

The main collaborative work paradigm emphasized by CALVIN is the support of multiple, heterogeneous perspectives. These perspectives may consist of the different positions used to look at a scene, the different mental models designers and engineers have of the same scene, or the per-

spectives that result from viewing an evolving design. For multiperspective collaborations, CALVIN uses a metaphor called mortals and deities. Some participants in the scene are *mortals*, who view the architectural space as though they are standing life-size inside it. Others are *deities*, who view the space from above as though it were a dollhouse.

Mortals and deities are represented in the virtual environment space by *avatars*—computer-generated personas depicted as head, body, and hand (see above far right). CALVIN generates an avatar for each participant, who wears magnetic trackers on his head and hand. The trackers let the avatar mimic gestures such as pointing, waving, and nodding. EVL is currently investigating how realistic avatars need to be to sufficiently transmit social cues between participants in a collaborative environment.

Mortals and deities share the same space but see it from different perspectives—which give different abilities. Generally, a deity is better at gross manipulation and seeing the overall view, while a mortal is better at fine manipulation and seeing how well the design works from a human perspective.



Scenes from the island where GULLIVR stories are created.

How CALVIN works

Written in C++ with OpenInventor as the underlying graphics library, CALVIN can be used to explore the large collection of VRML (Virtual Reality Modeling Language) objects and worlds available on the World Wide Web. CALVIN designs spaces that can be saved and easily converted to VRML [see access, Summer 1996, pages 20–22] for distribution over the Web.

CALVIN runs in the CAVE™, on the ImmersaDesk™, and on the Infinity Wall™ [see access, Summer 1996, page 16]. Because each platform offers the user a different virtual experience, the choice of VR platform affects a person's interaction with the virtual environment and leverages the innate advantages of each platform.

CALVIN's user interface takes wand-directed input using the CAVE's wand, gaze-directed input using a computer-generated heads-up display, and speech recognition using a speaker-independent voice recognition system. Comparing these various input modalities allows developers to see which are most appropriate in a collaborative design environment.

Users communicate using both audio and video streamed over a high-speed Asyn-

chronous Transfer Mode connection. Audio is used to coordinate design tasks, while video is used in situations where participants may wish to negotiate face-to-face. EVL is testing various types of microphones and low-light cameras to determine effective and unobtrusive ways to integrate videoconferencing into virtual environments. CALVIN's many components interact and interrelate to create a virtual space that not only supports onsite collaborative work, but also actively encourages both formal and informal remote collaboration.

CALVIN in action

A major impetus in the creation of CALVIN—and CALVIN's first real test—was to experiment with design ideas for integrating a 12- x 9-foot, four-screen Infinity Wall into NCSA's Numerical Lab before the current Infinity Wall was built. Designers used CALVIN to check things, such as unobstructed views and space for floor traffic, that would otherwise have required moving actual equipment into an actual room. It also allowed people at EVL in Chicago to give feedback on a room at UIUC two hours away by car and several months away from construction.

CALVIN was next used to help design the layout for the Gil Testbed rooms at Supercomputing '95 [see access, Fall 1995, pages 14–17]. During that conference CALVIN was demonstrated in a collaborative design session between the San Diego Convention Center and the Integration Testbed Prototype room at DARPA headquarters in Arlington, VA.

Both the technology developed for CALVIN and the designs created in CALVIN are currently being used to build a collaborative education environment called GULLIVR (see image left). GULLIVR is part of the NICE (Narrative Immersive Constructionist/Collaborative Environments) Project, a joint research project of EVL and UIC's Interactive Computing Environments lab for exploring the use of collaborative VR in education.

Many educators believe that constructionism and narrative are essential components of the learning process. *Constructionism*, as an educational concept, is similar to apprenticeship in that students construct their own knowledge by gathering cues from their environments. *Narrative* and storytelling can significantly stimulate students' imaginations while learning. The NICE project is actively developing virtual environments that combine the two approaches of constructionism and narrative in order to engage students in an educational process through story building.

CALVIN's future

Concurrent with the NICE project, EVL is collaborating with industry to apply techniques developed from CALVIN to the areas of collaborative scientific visualization, manufacturing design, rapid prototyping, and education. EVL is designing new VR server technology that will provide unprecedented opportunities for collaborative work integrating visualization, networking, supercomputing, and massive database resource technologies within the next generation of VR applications. ●

A Ph.D. candidate at UIC, Jason Leigh is preparing a dissertation on developing techniques for enhancing collaborative work in VR.

Andrew E. Johnson is a postdoctoral researcher at EVL researching collaborative virtual environments and using VR as a high-level interface to large scientific databases.

@ATS: User Support with an Interactive Web-Based System

by Will Ridenour

@ATS™ (ASSISTED TECHNICAL SUPPORT)

WAS SUPPOSED TO SOLVE ONLY ONE SMALL, THOUGH CERTAINLY COMPELLING, PROBLEM—HELPING NCSA MOSAIC SOFTWARE SUPPORT CONSULTANTS OFFER QUICKER AND BETTER ANSWERS TO THE LARGE NUMBER OF EMAIL QUERIES THAT COME TO THEM EVERY DAY. BUT, AS JOHN TOWNS SAYS, “IT GREW TO BE MUCH MORE THAN INTENDED.”



Ben Johnson

Towns is Technical Program Manager for Consulting Services at NCSA. When Mosaic consultants were moved from the Software Development Division to Consulting Services in early 1995, the problem of how to handle all the Mosaic email fell to his group.

Tools and methods that worked for a reasonable flow of questions weren't working anymore. The consultants had been reading the mail with Elm, a respected mail reader that was just not designed for multiple users. Assigning and routing mail, keeping documentation updated and organized, and training and supervising new consultants all took time away from answering email. And the delay between the questions and their answers was too long and growing longer.

Graduate student and consultant Ben Johnson volunteered to tackle the problem. A 1994 St. Olaf College graduate, Johnson had worked at NCSA since August 1994 while studying for a masters in computer science at UIUC. With lots of input, comments, and discussion with Towns and the consulting group, Johnson wrote all of the code for @ATS. Version 1.0, written in Perl with some C, was finished in August 1995.

A Web-based system

The result was an interactive Web-based system with three basic components: a document management system to organize and maintain lists of frequently asked questions (FAQs) and other documents; a search engine, called AskMe, for searching that information; and the Electronic Hotline, which uses the other two subsystems to automatically propose answers to incoming mail.

It works like this. Information is entered into the system in small, discrete portions of HTML-coded text, like one paragraph of a document or one question and its answer from a FAQ. The author then

assigns a few keywords to each entry. The Document Structuring System (DSS) then formats the text into a standard structure and generates a table of contents for all the entries in a document. AskMe, the search engine, uses a thesaurus of keywords and synonyms to find possible answers to questions posed in natural language, such as “How do I configure Mosaic to use different image viewers than the default?”

The end result is that when a consultant sits down to answer a question, @ATS automatically presents a choice of possible answers. The consultant can select those answers that work by clicking on associated check boxes, use AskMe to look for other possibilities, and edit the results into a finished reply.

@ATS is a success at solving the problem it was designed for. Consultants for the X Window System, Macintosh, and MS Windows versions of Mosaic are now answering as many as 300 email queries a day, at least twice what they could handle before @ATS.

“It has also turned out to be a great learning tool,” says Towns. He explains that



@ATS
Top



Generate
HTML



Configure



Thesaurus



Bug
Report

when new consultants come into the group, they may not know all the answers, but they do have the background to recognize the right answers when they see them. With experience, consultants have more answers and more information resources at hand for the answers they don't have. Many of the Mosaic consultants are students, working just a few hours a week, often for only a semester or two. The experience they gather has to be gathered quickly. @ATS makes it possible for new consultants to start out a mouse click or two away from all of the experience and expertise that went into the documents in the first place.

The sum of its parts

If that were the end of the story, @ATS would still be a useful and elegant solution to a problem that is not unique to Mosaic consultants. Although it was not designed to be a full help-desk package—it has no problem-tracking functions, for example—@ATS could be useful in all kinds of support operations, perhaps as a front-end to such a package.

But as consultants began to use the system, more and more possible uses became apparent. @ATS has several features that make it ideal as a general technical document management system. In adding

new information to the DSS, authors can concentrate on content and leave all of the structural issues to @ATS. Because new questions and answers can be added almost as easily as they can be retrieved, FAQs very nearly assemble themselves. The automatic handling of standard features also makes the system useful for generating and organizing presentation slides.

Several NCSA groups (for example, Technology Management and HDF support) are now using @ATS to manage their Web pages. @ATS automates structure and style elements and provides other useful features such as built-in navigation buttons and context-sensitive help.

With the addition of code to provide ASCII, LaTeX, and PostScript output from the HTML source—now in its early stages of development—@ATS looks promising as a solution to the problems of maintaining technical documentation in both printed and online forms. Because the procedures for producing printed documents have the weight of history behind them, online documentation often begins in a format ready for the printed page. With @ATS, technical documentation can be written and edited using the familiar tools and advantages of the World Wide Web. When the document is complete, it is available immediately for

searching, online browsing, and, when the output code is finished, for sending to the typesetter. NCSA is currently exploring the use of @ATS for its first user guide produced online.

Future plans

Ben Johnson finished his masters in May 1996 and, after giving a poster presentation on @ATS at the Fifth International World Wide Web Conference in Paris this spring, went to work for incNet in Eden Prairie, MN, as an Internet applications developer. The system was at version 1.2.3 when Johnson reluctantly stopped working on it. "There are several more things I would have liked to do," he said.

"@ATS has been very useful," says Towns. "We definitely plan to continue working on it."

According to Towns, @ATS will be available without charge for use by government and academic institutions and by commercial organizations for internal use. (Redistribution will not be allowed without a royalty agreement.) Final distribution arrangements are expected later this fall. ●

Will Ridenour is a freelance writer with a special interest in emerging technologies.

SGI CRAY Origin2000 Installed

On October 7 NCSA received a top-of-the-line 128-processor Silicon Graphics CRAY Origin2000 high-performance server for its computational science and engineering users. The supercomputer is the first 128-processor system to be delivered by SGI. The 128 processors initially will be configured as four 32-processor systems. With mid-year availability of the Meta Router—an extended capability of the new CrayLink interconnect technology—the four systems will be integrated into a single system. NCSA is committed to doubling its Origin2000 system to 256 processors within 12 months.

"The Origin system's scalable shared-memory architecture combines the ease of programming found on shared-memory multiprocessors (SMP) with the scalability found on massively parallel processors," said Larry Smarr.

NCSA has provided access to high-performance computers from Cray Research and Silicon Graphics for more than 10 years. The CRAY Origin2000 system represents the first joint product from Silicon Graphics and Cray Research following the merger of the two companies. Its installation opens a new chapter in that relationship as NCSA begins its final assault on the teraflop goal with scalable shared-memory architectures.



NCSA Director Larry Smarr poses in front of the new hardware.

"Origin is a major step forward in the integration of hardware and software technologies for large-scale computing systems from Cray Research with the microprocessor SMP technology from Silicon Graphics in an exciting new scalable architecture," said Forest Baskett, SGI chief technology officer. "We are looking to NCSA's national leading-edge facility to provide critical early-performance data on a broad range of applications optimized for this new architecture."

The CRAY Origin2000 system is a shared-memory system based on SGI's new S2MP architecture and is configured with 32 gigabytes of memory. Whether they program with a message-passing paradigm or with a shared-memory programming model, users will be able to easily move to the CRAY Origin2000 system from a wide range of other machines. The system uses the same MIPS R10000 processor, shared-memory programming model, and operating system that are currently used in the POWER CHALLENGE platforms. As a result, third-party application software packages currently running on CHALLENGE servers become available immediately. The architecture is compatible with today's SGI workstations. Users can develop and debug codes on their desktops and then execute large simulation production runs on NCSA's leading-edge machines. Codes do not have to be rewritten or recompiled. As the number of processors increase, researchers can focus on adding complexity, not starting over. ●

netWorkPlace: Enlarging the Scope of Your Next Work Place

by Allison Miller

YOU CAN RELAX. NCSA'S INFORMATION TECHNOLOGY GROUP (ITG) HAS NOT REPLACED WORKERS AND THEIR WORKPLACE. THEY'VE CREATED A COLLABORATIVE OFFICE ENVIRONMENT ON THE WORLD WIDE WEB FOR GEOGRAPHICALLY SEPARATED TEAMS TO WORK TOGETHER ON COMMON PROBLEMS.



The netWorkPlace team clockwise from upper left: Jennie File, Duane Moore, Colleen Bushell, and Alan Craig.

ITG has succeeded in taking its first step in changing the World Wide Web paradigm from an "online brochure stand" to a place where work is done collaboratively with members of an online work team, regardless of geographic location, time frame, and computer platform of individual team members. This prototypical environment, called netWorkPlace™, offers a viable way of *telecommuting*, or working remotely from one's physical office.

By attempting to harness the fluidity of the Web, netWorkPlace has laid the framework for a new suite of tools that facilitate collaborative working and learning. The lessons learned from this prototype environment and other projects such as NCSA Habanero will be applied to create the next generation of NCSA collaborative software.

Office supplies

netWorkPlace can be thought of as a combination of different pieces of technology all brought together in one location and viewed with Web browser software. The office environment provides a framework integrating many preexisting collaborative tools currently available on the Web with newly created tools—such as a collaborative calendar—in a coherent fashion. Within the environment, team members have

access to a document library, shared calendars, discussion and chat spaces, and a variety of other tools that aid in group collaboration.

netWorkPlace's interface employs an office metaphor, combining familiar terminology with a clearly defined structure. The office building Web page (see page 15) is structured with a public first floor where anyone browsing the Web can view items such as documents in the News Room. A receptionist for the entire building answers specific questions, and public information space provides general information. The next floor—the mezzanine—is shared by all the teams in the building and includes conference rooms and casual discussion areas, such as a café. Each team has its own floor, and members can restrict access for the entire floor or for just certain sections.

Alan Craig, ITG manager; Jennie File, multimedia developer; Colleen Bushell, lead architect and designer; and a team of UIUC undergraduates including Duane Moore combined their efforts to enhance this interface with scripts. These scripts aid in integrating tools and, combined with a navigation scheme that is coherent and easy to use, transform the concept of telecommuting into a true, interactive office environment.

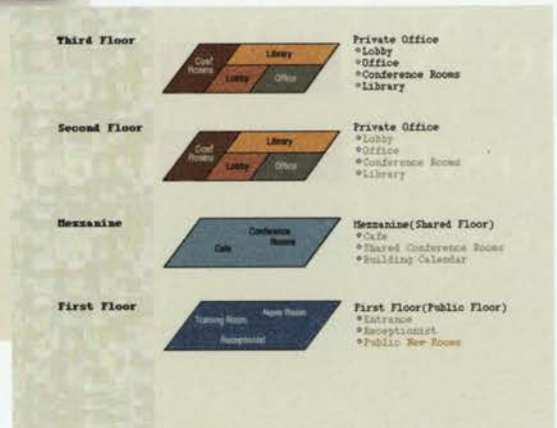
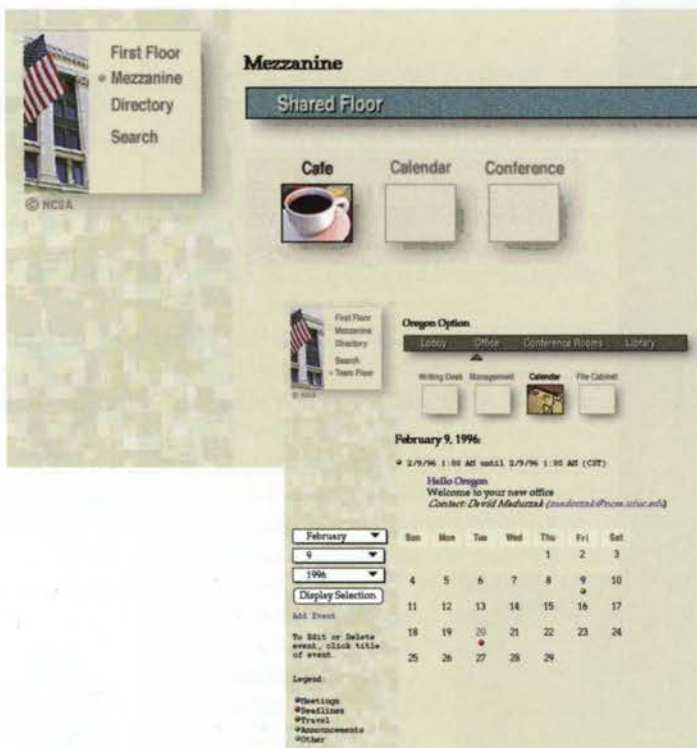
Chatter, banter, and discussion

One aspect of telecommuting that has been criticized is the absence of the type of casual contact and conversation that occurs while waiting for the elevator. Realizing the value of such discussion to the collaborative process, ITC incorporated opportunities for more casual interaction in netWorkPlace. For example, at the watercooler users who choose to write down their thoughts can instantly communicate with the whole group at once and have a record of the conversations in one spot. All users have access to the watercooler and are able to read the messages at a personally convenient time.

Collaborating on collaborative environments

netWorkPlace began developing when ITG, a part of NCSA's Education and Outreach Division, was approached by the National Performance Review (NPR) team from U.S. Vice President Gore's office. NPR's request for assistance in updating their Web site fostered the creation of the prototypical environment to be used by the state of Oregon.

"At Oregon we are using netWorkPlace as a tool to support weekly conference calls between federal agencies and their partners at the state and local level, for preparing and tuning the agenda beforehand, and for



Floor components for the Oregon Option are shown on this image map: the mezzanine level (top left); the floor plans for each level in the office (right); the shared calendar (bottom middle). Each navigation panel is color keyed.

following up on assignments and responsibilities afterwards," says Christopher Berendes, NPR's coordinator of the Oregon Option Communications and Information Technology team.

The response of the Oregon group to their netWorkPlace has been positive. Group members are excited about the collection of integrated tools.

"We are also excited about the ability to involve people all over the country, as long as they have standard Web browsers and an Internet connection," continues Berendes. "That saves us the trouble of having to configure custom client software for our growing user population."

Working offices

Another implementation of the netWorkPlace environment is the NSF/NCSA World Wide Web Federal Consortium [see access Fall 1995, pages 28-30]. SDD staff has taken pieces of the netWorkPlace prototype and customized it for the consortium's particular needs. Another project includes an office space designed for Illinois Governor Jim Edgar prompted by a February 1996 visit to NCSA (see photo right).

Perhaps the most complex project to date is the one administered for NCSA's industrial partners. After a netWorkPlace

demonstration during the annual Industrial Partner meeting in May 1996, partners were given access to a partner workplace. Specific partners and NCSA staff have access to this 24-hour-a-day meeting with resources such as contact information, links to partner home pages, and conference rooms using Hypernews for discussion groups on NCSA-related topics. Because NCSA's partners are not in competitive fields, they are encouraged to share information to facilitate the expansion of their collaborations with NCSA.

Building a better office

Despite the presence of finished "offices" for groups such as Governor Edgar's staff, general access to the current offices is restricted. Although the offices are closed to the public, the outcome of the prototypes is not. With the construction of each office ITG members glean additional knowledge about the development of collaborative environments. The philosophy of netWorkPlace and the knowledge gained from each prototype are the cornerstones of future collaborative development on the Web. The lessons learned will be incorporated not only into future offices, but into future NCSA software products. ●

Allison Miller, a recent UIUC graduate, works at Shandwick USA in Minneapolis, MN.



In a Beckman Institute meeting room, Colleen Bushell (seated at computer) demonstrates netWorkPlace to (seated left to right) UI President James Stukel, Illinois Governor Jim Edgar, UIUC Vice-Chancellor for Research Richard Alkire, UIUC Chancellor Michael Aiken, UI Trustee Thomas Lamont, and NCSA Director Larry Smarr.

netLearningPlace™

Transforming distance learning into a Web-based environment, netLearningPlace is a framework for virtual-classroom education and just-in-time workforce training. This new technology is, like its predecessor netWorkPlace, radically changing its environment—the traditional classroom model used in education and training—by using asynchronous and synchronous communication to reach people worldwide.

Adding Video to the Net: Video + Mosaic = Vosaic™

by Sara Latta

WORLD WIDE WEB BROWSERS HAVE BEEN ENORMOUSLY SUCCESSFUL IN DELIVERING TEXT, IMAGES, AND—WITH SUFFICIENT TIME AND DISK SPACE—PRERECORDED AUDIO CLIPS AND VIDEO SEQUENCES. THE COMING TREND IS STREAMING VIDEO AND AUDIO—REAL-TIME DELIVERY OF VIDEOS THAT MAY BE LARGER THAN THE CLIENT'S DISK STORAGE.



Roy Campbell



Streaming video and audio development could drastically change the way the Web is used for education, research, entertainment, and business. But efforts to use browsers to deliver real-time audiovisual materials have, until recently, been hampered by the Internet's variable low bandwidth capacity. The standard TCP (Transmission Control Protocol) deals with this problem by resending packets of information that get lost—a great solution for static data or images, but disastrous for real-time videos.

Roy Campbell, UIUC professor of computer science and senior research scientist at NCSA, along with UIUC graduate students Zhigang Chen and See-Mong Tan, David Raila, UIUC programmer in computer sciences, and Dong Zie, a student at the University of Norway, have solved the problem with Vosaic (short for Video Mosaic), which easily delivers audiovisual materials even at peak Internet traffic times. Campbell and his colleagues created Vosaic, starting with video embedded in Mosaic, using NCSA's Mosaic and HTTPd (HTML server) source codes. The video server cooperates with the HTTPd server to provide a user-friendly HTML interface for

video. The team has since developed plug-ins that work with other browsers from Netscape and Spyglass; the Vosaic video server is available for the Windows 95 and NT platforms, the Macintosh Power PC platform, and for various flavors of UNIX.

A new protocol

TCP copes with variable low bandwidth capacity by retransmitting dropped packets, a strategy which, when applied to continuous streams of video and audio, results in congestion on the Web. Moreover, TCP transmission often destroys the temporal relations between video frames and audio packets.

Vosaic transmits video and audio over the Internet using a new network-friendly protocol called VDP (Video Datagram Protocol), which transmits 40 times faster than TCP or IP (Internet Protocol). VDP evaluates both the bandwidth and the latency between the server and the client. "If the server is sending video packets," explains Campbell, "and it doesn't believe it can send a packet in time to be received and displayed in sequence by the client, it won't do it; it just skips and goes on to the next packet."



HOME



CORPORATE
INFO



VIDEO
LIBRARY



TECH INFO



SOFTWARE
& SUPPORT



FORUM

Vosaic software Home Page Images

Because dropped audio packets are a lot more noticeable than dropped video frames, VDP assigns audio streams a higher priority. "If a video picture jerks a bit, you don't notice it, but if the audio jerks, you can't understand it," he adds. The minimum bandwidth needed to transmit Vosaic over a telephone line, Campbell says, is about 28.8 K bits-per-second.

Using VDP, Vosaic does away with time-consuming downloading: the viewer can watch a movie *as it's transmitted*. Because the video isn't downloaded, it doesn't take up disk space.

In addition to viewing video as it comes across the Internet, the user can pause, fast-forward, rewind, or even click on HTML links embedded within the video to view related text or another movie. The video may even be detached from the browser window and scaled up to fill the entire monitor. It's been possible to do this with downloaded videos for years, but Vosaic lets users stream video directly, so they can see the first frames as soon as they click.

Applications in education, research, and entertainment

There are a host of potential applications, of course. A professor teaching a course on atmospheric science, for example, might use Vosaic to put a tornado activity lecture online. Students could watch the hour-long lecture straight through, pause while they clicked on embedded links, search for related homework problems, or rewind the video to review a concept in the lecture. "This would be a tremendous way of creating video materials for a virtual university," says Campbell.

A Grand Challenge researcher might use Vosaic to deliver a simulation to a collaborator in another state. NCSA software developers are investigating the possibility of embedding Vosaic into collaborative software such as Habanero, making it possible to conduct Web-based videoconferences.

NCSA has begun using Vosaic to communicate with the public. "You'll be able to read an article in our online version of *access*," says John Melchi, formerly NCSA's public information officer, "and then hyperlink to a related video. By incorporating Vosaic into our communications program, we'll be in a good position to push the technology even further."

Academic and educational applications notwithstanding, Vosaic may make its biggest splash in the world of advertising, entertainment, and business. One of Vosaic's test videos last spring, for example, was a trailer for the Warner Brothers movie *Twister*. Alternatively, clients may pay a fee to watch a horse race. Businesses might use Vosaic to distribute audio and video materials within the organization.

Although Vosaic's optimum transmission rate over telephone lines is only about 12 frames-per-second (standard video uses 30 frames-per-second) using a 28.8 modem, it is adequate for advertising or educational purposes, according to Campbell. As networks improve, so will transmission rates. "We're making some enhancements on the protocol side," said Campbell, "and different coding schemes for audio," both of which should improve the quality of the movies.

Last June, the University of Illinois signed a licensing agreement with Digital Video Communications, based in Chicago and Los Angeles, to market and sell Vosaic; the university will own one-third of the new company and receive a share of the royalties.

The public can download a free 60-day evaluation copy of Vosaic (see URL below right). The Vosaic plug-ins (for browsers that support them) are free to the academic community, and the server software is discounted for universities, says Campbell. Nonacademic users can purchase Vosaic by accessing the Web site.

Vosaic—on the move

Vosaic servers worldwide include a number in Taiwan, Norway, and Great Britain. The UIUC Vosaic server is an NCSA HP200 workstation. Vosaic servers must handle unusually large loads: the server software must manage large video and audio files; support fast-forward, pause, and rewinding capabilities; and handle Vosaic's adaptive network protocols. Jeff Terstriep, technical program manager of NCSA's Distributed Information Systems Group, believes Vosaic could be a valuable multimedia asset management tool. "If you look at the way the Web works right now," he says, "you essentially deliver files out of your file system. There's very little you can do as far as managing and searching. We want to be able to use a database that will provide a little more sophisticated front-end to this system so that you can do queries against the database to find the videos you might be interested in."

"With Vosaic, we're creating a participatory video experience," says Campbell, "where viewers can be involved in a variety of different ways: just choosing what videos to play through hotlinks or even creating their own videos. It's a dynamic, active environment." ●

Sara Latta is a freelance science writer.

NCSA Web Update



The goals of FIRST are to foster cooperation among information technology constituents in the effective prevention of, detection of, and recovery from computer security incidents; to provide a means to communicate alert and advisory information on potential threats and emerging incidents; to facilitate the actions and activities of the FIRST members, including research and operational activities; and to facilitate the sharing of security-related information, tools, and techniques.

As a FIRST member, NCSA will provide other members with expertise on security issues relating to supercomputing technologies and Web-based technology products (e.g., NCSA Mosaic and NCSA Habanero).

In return, NCSA will have access to encrypted mailing lists that provide FIRST members with exclusive technology and security updates; voting rights at FIRST general meetings; and, in light of the sensitive nature of NCSA-industrial partner relationships, a means to share security concerns with a trusted set of security experts. ●

NCSA HTML Beginner's Guide Noted Nationally

Dave Farrell, author of the nationally syndicated newspaper column *Roadside Attractions Along the Information Highway*, recently referenced the *NCSA Beginner's Guide to HTML* as "...one of the best primers I've found for beginning HTMLers." Farrell goes on to say that he highly recommends NCSA's guide for newbies who want to learn how to build Web pages but don't know where to start.

The guide (also referred to as the NCSA Primer) was originally written by Marc Andreessen, developer of NCSA Mosaic and cofounder of Netscape Communications Corporation. The NCSA Publications Group assumed responsibility for the guide several years ago. Ginny Hudak-David recently completed a major revision to the guide (version 2.0 released in April 1996). Tom Magliery of SDD provided technical comments and suggestions.

The Beginner's Guide, which is the second most frequently requested file on NCSA's Web server, may be purchased using the *NCSA Technical Resources Catalog* (TRC). For the online version of the guide and the TRC, see the URLs left. ●

Highlighting Advances

Perhaps you check the NCSA Home Page (see URL left) on a regular basis. Perhaps not. Beginning in June 1996, NCSA has offered a good reason to check its home page at least every two weeks.

The home page sidebar changes bi-weekly with a focus on new projects, software, or information. The sidebars link to additional information on the topic.

Part of the new home page designed this spring by Carlton Bruett of NCSA, the sidebars are created by Tyler Munson of the webmaster team. Webmaster Cordelia Baron Geiken oversees the selection of the sidebar images and information and ensures that information is rotated regularly. ●

NCSA Joins FIRST

NCSA was formally accepted as a member of the Forum of Incident Response and Security Teams (FIRST) in July 1996. FIRST is an international consortium of computer incident response and security teams that handles computer security incidents and promotes preventive activities. Currently, FIRST has approximately 50 members from government, law enforcement, academia, and the private sector.

Video Press Release Available on Web

NCSA's first video press release (see URL right) was made available on the Web in June. Created to experiment with new Vosaic technology (see page 16), the video discusses the development of NCSA's Biology Workbench—a new paradigm in computing (see page 2). Other video press releases, dubbed SpinTV™, are anticipated in late 1996.

According to John Melchi, formerly of the Public Information Office, NCSA plans to emphasize ubiquitous video-streaming technology in the second half of 1996. "One way to do that," he noted "is to use the Web to distribute audio and video information about NCSA to its public. We want to have a library of video information ready for the public when the technology matures."

Melchi and Jay Rosenstein, NCSA video producer, directed the pilot project. Other collaborators from the Media Technology Resources Group include Tony Baylis, Jeff Carpenter, Doug Fein, Steve Kleinvehn, Juhan Sonin, and Rob Stein. ●

NCSA Multicast

NCSA's repository of links to Web
resources for high-performance
computing users

Alliance and User Group Meetings Held

John Towns, NCSA Alliance Programs Coordinator, issued calls for participation in two meetings held this fall: the Second SGI POWER CHALLENGEarray User's Group Meeting held in September at NCSA and the HP-Convex Exemplar Alliance Fall '96 Meeting held in early October in San Diego, CA.

The POWER CHALLENGEarray User's Group meeting, hosted by NCSA, was a chance for representatives from sites running POWER CHALLENGEarray systems to meet and discuss their successes and challenges. Towns noted that sessions on the work and experiences of array users were the key to the successful meeting. SGI staff gave presentations and collected feedback from the users who represented sites across the U.S.

The Exemplar Alliance meeting was jointly hosted by The Scripps Research Institute and the NRC Command and Control High Performance Computing Research Facility. Representatives from sites running HP-Convex Exemplar systems discussed their efforts and heard presentations by and offered feedback to HP-Convex staff. Birds-of-a-feather meetings gave attendees a

chance to exchange information and tips informally.

The Exemplar and Power Grid Alliance programs, coordinated by NCSA, represent an international coalition of corporate, government, and academic sites running SGI or HP-Convex systems. Meetings provide open forums for discussion of the issues related to support and use of these systems. Institutional membership information is available on the Alliance Web site (see URL right). ●

NCSA Upgrades POWER CHALLENGEarray

To expand the resources available to our user community, NCSA upgraded the SGI POWER CHALLENGEarray in late summer. The original configuration consisted of a 12-processor R4400 (150 MHz) Challenge machine, and six 16-processor R8000 (90 MHz) POWER CHALLENGE machines. This upgrade included installation of the Irix 6.2 operating system on all SGI systems, conversion of two 8-processor R8000 systems to R10000 systems, and the addition of two R10000 systems. A new suite of compilers—MIPSpro 7.0—is available under IRIX 6.2 on the R4400, R8000, and R10000 processors. Current status of the upgrade is available from the URL at right. ●

Silicon Graphics—Chicago

SGI Systems Applications Engineer Kumaran Kalyanasundaram, who is based in Chicago, manages a Silicon Graphics-Urbana page that offers important Web resources to SGI users both at NCSA and at other sites running SGI HPCC systems.

The four main categories—who we are, cool stuff, help, and enter the vault—are updated regularly by webmaster Robert Stein, a UIUC senior in computer engineering. Of particular interest to NCSA users are the Web files devoted to supercomputing and parallel computing. Kalyanasundaram and Stein define this section as offering a "list of resources intended as a data repository for applications developers and users." It includes links to training materials, sites running SGI POWER CHALLENGE systems, general resources, and other institutions. Check here for up-to-date information about SGI's new R10000 architecture (including a Web-based training module on performance tuning by SGI's Jeff Fier), Mon-goose compilers, and the R8000 systems.

While most documents are in HTML format, some are provided as SGI Showcase slides and some are in PostScript. ●

NCSA HDF on the Web

If you use NCSA Hierarchical Data Format (HDF)—a platform-independent data format for storing and exchanging scientific data—for your high-performance computing, check out the HDF Group's Web site. More to the point, if you *don't* use HDF, perhaps now is the time to learn more about it.

You'll find links to general information on HDF and its uses, the names of some projects currently using HDF (for example, the U.S. Global Change Research Program), links to NCSA's FTP server with the source code for the HDF library, and a partial list of HDF tools.

HDF documentation is available in a variety of formats (PostScript, MIF, PDF). The *HDF Reference Manual* is available online in HTML. Other manuals, such as *The HDF User's Guide*, can be downloaded via FTP. The HDF Group doesn't stop there. Their newsletter—with fixes, patches, and bug reports—is online too. Hard copy of the user's guide can be ordered through the *NCSA Technical Resources Catalog* (see URL page 18).

For a summary of the HDF project, see *access*, Spring 1996, pages 14–16. ●

Partnership Illinois



by Amy Whitaker

Educators from six states—representing grade levels from elementary school to community college—spent two weeks in July with NCSA staff and scientists learning how virtual reality (VR) can be used in education. “It is the first time virtual reality technology training has been directed toward education,” said Umesh Thakkar, E&O program coordinator.

The summer session began a yearlong effort to make NCSA’s virtual environment resources available to educators at all grade levels. Groups from NCSA and UIUC will provide consulting and technological support to the teachers as they create VR projects specific to their classroom needs.

The Virtual Reality and Education Program for Educators is only one example of how NCSA brings technology into the classroom. Other NCSA E&O programs—many in collaboration with other UIUC units—help to bring leading-edge technology into communities across Illinois. Like hundreds of UIUC



Don Hamerman, courtesy UIUC

Through its E&O Division, NCSA works with many schools statewide to enhance educational opportunities at all levels.

“Partnership Illinois is a way of creating dialog across the state to help us rethink and reconfigure our programs to meet specific needs,” says Carol Menaker.

outreach programs, NCSA projects are touching the lives of Illinois residents.

Partnership Illinois, a UIUC initiative, seeks to make sure that Illinois citizens are aware of the outreach offered by numerous university departments. By communicating about its partnerships with the state, UIUC hopes to create new relationships between the university and Illinois citizens and to strengthen existing programs.

“Part of Partnership Illinois is to inform ourselves about what we are doing [in order] to avoid overlap and duplication,” says Carol Menaker, director of communications, UIUC Office of Public Affairs. “It is also a way of creating dialog across the state to help us rethink and reconfigure our programs to meet specific needs.”

UIUC launched Partnership Illinois beginning with a preview exhibit tent at the Illinois State Fair on August 9. Early this September, the university celebrated its outreach programs by inviting faculty, advocates, and recipients to recognize those partnerships and to establish UIUC as a central figure in the state’s economic development. Governor Jim Edgar proclaimed September 9 Partnership Illinois Day.

Partnership Illinois consists of programs in thirteen areas: food and fiber production; manufacturing and service industries; business management and economic development; social welfare; health and wellness, aging, and disabilities; environment; culture and arts; lifelong learning; local and state government; sports and athletics; K–12 education; technology transfer; and information technology. NCSA’s outreach efforts fall into the last three categories.

Several activities coordinated by NCSA’s E&O Division are part of Partnership Illinois. Those activities include helping establish Champaign County Network (CCNet) and the Champaign County Web site [see access, Spring 1996, page 13], conducting research on the impact of community networking, and presenting educational and business conferences and workshops (see pages 21 and 22 for a few examples).

NCSA also works with school districts and colleges in Illinois, including those in Bloomington, Champaign, Charleston, Chicago, Danville, Decatur, Edwardsville, Elgin, Fisher, Springfield, Rantoul, Teutopolis, and Urbana. ●

Amy Whitaker, a senior in journalism at UIUC, is a student intern in the NCSA Public Information Office, Marketing Communications Division.

CyberEducation Takes to the Road

by Holly Korab



© Chun Y Lai Photography

CyberEd's roving ambassador, "Ed," brought state-of-the-art technology training to the neediest schools in the U.S. On its sides was the slogan "CyberEd—Driving the Vision of 21st Century Education."

The 18-wheeler that pulled into towns around the country this past summer was not hauling freight. It was carrying a vision of education for the twenty-first century.

The bright yellow CyberEd truck, called the "Bookmobile for the Digital Age" by U.S. Vice President Al Gore, was bringing the latest information technology to the nation's inner-city classrooms and rural communities. For five months, this electronic classroom on wheels traveled thousands of miles, reaching 400 schools in 15 federally designated empowerment zones to train teachers and community leaders in the latest information technology. Though privately funded, it was founded to support a White House initiative to make all children technologically literate by the start of the twenty-first century. Through educating the educators, the program hoped to assure that all students partake in the benefits of information technology.

"Administrators know their schools need to use Internet technology, but they just aren't sure how to use it—CyberEd was there to help show them how," says Lisa Bievenue, NCSA specialist in education, E&O. Bievenue, along with Stan Silverman from the New York Institute of Technology, coordinated the content for the training sessions and led nearly a quarter of them.

The CyberEd truck was outfitted with six personal computers on a local area network with ISDN Internet connectivity and CD-ROMs. Another room was equipped for video playback and videoconferencing. The state-of-the-art classroom was donated by MCI Communications Corporation, which also initiated the project. Hardware,

connectivity, training, and Internet access were donated by the Milken Family Foundation, William G. McGowan Charitable Fund Inc., Corning Inc., DSC Communications Corp., and Microsoft Corp. The project was organized by TECH CORPS™, which recruits volunteers from corporations and universities to help integrate technology into the classroom. The Illinois program is coordinated by NCSA [see access, Fall 1995, page 21].

After its April 1996 kick-off at the White House, the CyberEd truck traveled to the federal empowerment zones shown below. Schools within the zones were selected, based on need and commitment, by the National Education Foundation, Washington, DC.

The truck parked in each empowerment zone for two to five days. Each day was packed with three training sessions. During these whirlwind sessions, as many as 12 people at a time were introduced to technological tools and curriculum ideas. Morning and afternoons sessions were usually reserved for teachers and administrators selected by the local school districts. This group was given a thick stack of resources, such as where to apply for grants and how to obtain professional development. Evenings and Saturdays were open to parents, families, and others.

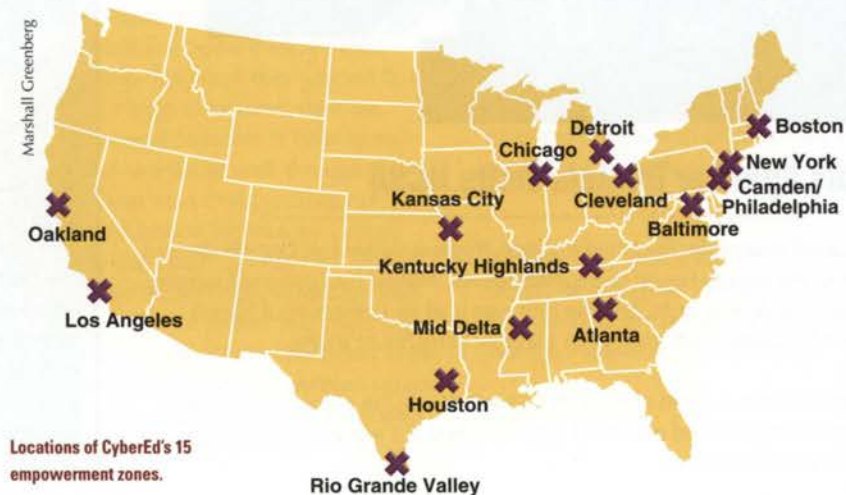
During Bievenue's two-and-a-half-month stint on the truck, she got a firsthand look at how teachers were incorporating Web technology into their curricula. At most schools

teachers were still using the Internet in spurts for isolated projects rather than integrating it into the total learning experience. An exception was Du Sable High School in Chicago where the teachers had integrated the Internet into almost every class and curriculum. They had embraced the technology as a means to multiply their resources and customize teaching for students with different learning styles. "I learned from their example that it takes proactive teachers with a vision for the Internet in order for it to become a useful tool in the classroom," says Bievenue.

To encourage more teachers, administrators, and parents to craft visions for the Internet, the CyberEd project will be followed up with a national drive to link schools with local chapters of TECH CORPS. In preparation for that drive, each stop on the CyberEd tour included a roundtable discussion with local leaders on how they would like to interact with the corps.

As Bievenue says, the goal of CyberEd was not to try to teach schools everything they needed to know about technology but to motivate them to learn more. "The biggest technology issue in all schools is staff development," says Bievenue. "They can get grants for computers, software, and even connectivity, but teacher education gets left out. We are trying to change that." ●

Holly Korab is a science writer in the NCSA Publications Group.



Illinois's First Community Networks Conference

by Jennifer Allerson

Illinois's first conference on community networks, "Moving Your Community Online," came to the UIUC Levis Faculty Center on June 26. This one-day conference, organized by E&O's Alaina Kanfer, provided a forum for civic, educational, and state leaders in Illinois to learn and exchange information about community networks as communities around the nation increasingly become electronically connected to the rest of the world via the Internet.

An overflow audience of more than 225 attendees heard several speakers address a variety of issues. Speakers included Larry Smarr, NCSA director; Frank Odasz, founder and director of Big Sky Telegraph community network, Western Montana College of the University of Montana, and senior advisor on community networks for the Morino Institute; and Larry Amiot, Argonne National Laboratory.

Smarr emphasized the benefits of community networks and the current status of evolving technology. In his keynote address, Odasz presented community



Courtesy Frank Odasz

"Computers are teaching us to use our imaginations in ways we have never seen before," says Frank Odasz.

A majority of conference attendees requested a follow-up conference, a Web site of the conference, a listserv, and a printed newsletter to continue conversations.

Sponsors of the conference included Illinois Lt. Governor Bob Kustra, NCSA, UIUC, Champaign County Network (CCNet), Prairienet, UIUC Cooperative Extension Service, Lincoln Trail Libraries System, Illinois State Board of Education, and the Office of the Secretary of State/Illinois State Library. ●

Jennifer Allerson is an NCSA intern in the NCSA Marketing Communications Division and a senior in the UIUC Department of Industrial Distribution Management.

networking models for bringing people together, highlighting their potential for enhancing communication and problem solving within and between communities ranging from global to local. Following the keynote address, Amiot discussed various alternative means of connecting a community to the Internet and providing information services. Other program sessions focused on effective technology, building community support, public institutions and FreeNets, private service providers, and state agencies' resources.

Illinois Community Networks <http://www.conted.ceps.uiuc.edu/ILnetwork>



Illinois Speaker Daniels visits NCSA

During a fall tour of the Beckman Institute, Representative Lee Daniels (center), speaker of the Illinois House of Representatives, offered his continued support to research underway at NCSA. The tour was lead by University of Illinois President Jim Stukel (left) and NCSA Director Larry Smarr (right).

The tour included a demo of the CAVE (inset). Inside the virtual environment, Speaker Daniels, decked out in 3D glasses, asked if it would be possible to fill the place with Democrats.

Shell Oil Joins NCSA's Industrial Program

Shell Oil Company joined NCSA's Industrial Program in October. Shell Oil Company, based in Houston, TX, is one of the largest petroleum refiners and crude oil and natural gas producers in the U.S.

"Shell Oil has been a leader in using super-computer technology to do seismic research," said Director Larry Smarr "NCSA will help them apply many of the evolving leading-edge high performance computing and information technologies to their expanding need to extract more knowledge from their huge databases in all aspects of their businesses."

Merle Bone, General Auditor and Chief Information Officer, commented "We believe NCSA's leading edge technology base and directions will aid our current growth objectives. Areas of special interest include shared memory supercomputing architectures, data visualization and analysis, and network center computing structures.

Shell Oil press release <http://www.ncsa.uiuc.edu/Indices/Spotlight/>

Interactive Lesson

by Julie Wurth

Elaine Westbrook wants to take her students wading through the waters of the Mississippi River. Michael Hinton wants his students to experience an electrically charged field, up close and personal.

Not in reality, of course. In virtual reality (VR).

The two high school teachers are taking part in a training program at NCSA, learning how to use VR in the classroom. Hinton, a physics teacher at Urbana High School, has a specific plan in mind. Other teachers came with virtually no idea at all.

"I'm here to learn from the experts," said Jane Leggett, a middle school teacher from Moline, IL. "I'm just excited to be here. This is the premier place to be for virtual reality."

What is virtual reality? A 3D, interactive, immersive computer display—with the emphasis on immersive, said senior research programmer Bill Sherman, who heads the virtual reality lab at NCSA. "It displays the world from the user's point of view," he said. "If you move, the virtual world moves with you."

To date, VR techniques have been used mostly in medicine and science, and in the design of new business products. Researchers would like to transfer its benefits to the classroom. "We're starting to get at the threshold where hardware is cheap enough," Sherman said. Once it is cheap enough, someone has to figure out how to make it useful to teachers, he said. The training program will give NCSA researchers valuable feedback, he said. "You need the technology, but you also need the people who know what they want the technology to do."

Twelve educators from six states spent two weeks in July (see page 20) learning how VR works and how to apply it to their own classroom projects. NCSA researchers will continue working with the teachers

"This is the premier place to be for virtual reality."

throughout the year, said Umesh Thakkar, E&O program coordinator at NCSA. The teachers will get together for follow-up seminars in the fall and again in the spring. They also have their own site on the World Wide Web, where they can collaborate throughout the year, Thakkar said.

One program highlight was trying out the CAVE™ (Cave Automatic Virtual Environment), the cave-like VR room at UIUC's Beckman Institute. In the dark of the CAVE, teachers donned special goggles to view virtual reality computer programs that make images come to 3D life. They saw—almost felt—animated fish swim through their legs. They peeked inside a childlike drawing of a house in "crayonland." Through satellite photos, they viewed the Earth's surface from different heights and angles, mistaking the U.S. for Australia. Some even felt their stomachs flip-flop when they jumped three stories off a huge transparent staircase.

"You could conceive of educational spaces that kids could walk through and explore," said Alan Craig, manager of NCSA's Information Technology Group. Not every classroom can have a CAVE. Thakkar said NCSA hopes to find funding for a lower-cost VR system that could travel to schools. Special glasses connected to the computer terminal create sensations similar to the CAVE's, Sherman said. In the meantime, the teachers are learning VRML, or

virtual reality modeling language—free software that allows them to use VR techniques on a desktop computer. "This is something they can do right now," said Thakkar.

Other 3D modeling software is available, but it's more expensive, said Kevin Mackie, UIUC student working with Thakkar. "You are more immersed in VRML. It's more interactive," he said. "The data surround you." VRML also is designed for the Internet, which

means the images can be sent anywhere on the World Wide Web, he said. Other 3D software is designed mostly for expensive high-end computers, so users can't easily distribute what they create.

Hinton hopes to use VR to teach his physics students about electrostatics, a difficult concept to illustrate. He envisions a walk-through visualization of an electrical field in space, showing where the field is weaker and where it is stronger.

Westbrook wants to incorporate VR into her integrated science class, which she teaches to 150 students at a magnet high school in Omaha, NE. She has in mind a river project she's been using to help students appreciate water as an important but limited resource. Westbrook would love to take her students for a swim in the nearby Mississippi River but can't.

"We could take them there virtually," she said. "I have a lot of inner-city kids. A lot of them are turned off to school. I'm hoping this is one way to get them back." ●

Reproduced by permission of The Champaign-Urbana News-Gazette. Permission does not imply endorsement by the newspaper. Julie Wurth is a News-Gazette staff writer.

NCSA Contacts Directory

<http://www.ncsa.uiuc.edu/General/NCSAContacts.html>

Allocations

<http://www.ncsa.uiuc.edu/General/Allocations/ApplyTop.html>

Radha Nandkumar

217-244-0650

allocations@ncsa.uiuc.edu

Applications Division/Faculty Program

<http://www.ncsa.uiuc.edu/Apps/AppsIntro.html>

Melanie Loots, Associate Director

217-244-2921

mloots@ncsa.uiuc.edu

Allison Clark (information)

217-244-0768

aclark@ncsa.uiuc.edu

Visitors Program

Jean Soliday

217-244-1972

jsoliday@ncsa.uiuc.edu

Computing & Communications Division

<http://www.ncsa.uiuc.edu/General/CC/CCHome.html>

Charles Catlett, Associate Director

217-333-1163

catlett@ncsa.uiuc.edu

Ken Sartain (information)

217-244-0103

sartain@ncsa.uiuc.edu

Consulting Services

<http://www.ncsa.uiuc.edu/General/Consulting/ConsultingServices.html>

217-244-1144

8:30 a.m.-5:00 p.m. Central Time

consult@ncsa.uiuc.edu

Networking

network@ncsa.uiuc.edu

Technology Management Group

Ken Sartain, acting

217-244-0103

sartain@ncsa.uiuc.edu

217-244-0710 (services/help)

help@ncsa.uiuc.edu

Education & Outreach Division

<http://www.ncsa.uiuc.edu/edu/EduHome.html>

John Ziebarth, Associate Director

217-244-1961

ziebarth@ncsa.uiuc.edu

Education

Scott Lathrop

217-244-1099

scott@ncsa.uiuc.edu

Outreach

Alaina Kanfer

217-244-0876

alaina@ncsa.uiuc.edu

Training

http://www.ncsa.uiuc.edu/General/Training/training_homepage.html

Mary Bea Walker

217-244-9883

mbwalker@ncsa.uiuc.edu

Industrial Program

<http://www.ncsa.uiuc.edu/General/IndusProg/IndProg.html>

John Stevenson, Corporate Officer

217-244-0474

johns@ncsa.uiuc.edu

Marketing Communications Division

<http://www.ncsa.uiuc.edu/General/MarComm/MarComm.html>

Maxine Brown, Associate Director

217-244-7255

maxine@ncsa.uiuc.edu

Media Technology Resources

<http://fantasia.ncsa.uiuc.edu/media/>

Tony Baylis

217-244-1996

tbaylis@ncsa.uiuc.edu

media@ncsa.uiuc.edu (services)

Orders for Publications,

NCSA Software, and Multimedia

<http://www.ncsa.uiuc.edu/Pubs/TechResCatalog/TRC.TOC.html>

Debbie Shirley

orders@ncsa.uiuc.edu

Public Information Office

<http://www.ncsa.uiuc.edu/General/PIO/NCSAInfo.html>

Tony Baylis, acting

217-244-1996

217-244-8195 fax

tbaylis@ncsa.uiuc.edu

Publications Group

<http://www.ncsa.uiuc.edu/Pubs/PubsIntro.html>

Melissa Johnson

217-244-0645

melissaj@ncsa.uiuc.edu

Software Development Division

Joseph Hardin, Associate Director

217-244-7802

hardin@ncsa.uiuc.edu

Jae Allen (information)

217-244-3364

jallen@ncsa.uiuc.edu

Staff Resource Center

<http://www.ncsa.uiuc.edu/Business/SRC/ncsasrc.html>

recruiting, staffing, employment

217-244-0634

strc@ncsa.uiuc.edu

Virtual Environments Graphics Division

<http://www.ncsa.uiuc.edu/VEG/>

Tom DeFanti, Associate Director

217-333-1527

vr@ncsa.uiuc.edu

NCSA Home Page

<http://www.ncsa.uiuc.edu/>

Mailing Address

NCSA
University of Illinois at Urbana-Champaign
605 East Springfield Avenue
Champaign IL 61820-5518

NCSA Receptionist

217-244-0072
217-244-1987 fax

For Further Information

Documentation Orders

Articles in this *access* may refer to items that are available through the *NCSA Technical Resources Catalog*. To receive a hard copy of the catalog, send your request to Orders for Publications, NCSA Software, and Multimedia [see NCSA Contacts, page 24]. To view the catalog online, access the URL: <http://www.ncsa.uiuc.edu/Pubs/TechResCatalog/TRC.TOC.html>. To obtain the catalog from anonymous ftp, see instructions below. The catalog is in the `/ncsapubs/TechResCatalog` directory.

Accessing NCSA's Servers

Many NCSA publications (e.g., user guides, *access*, technical reports) as well as software are available via the Internet on one of two NCSA servers: anonymous FTP or the World Wide Web. If you are connected to the Internet, we encourage you to take advantage of the easy-to-use servers to copy or view files.

Anonymous FTP address: `ftp.ncsa.uiuc.edu`

NCSA Web Home Page: <http://www.ncsa.uiuc.edu/>

NOTE: References in *access* to a URL refer to the server address and file location information used by Web-browser software to retrieve documents.

If you have any questions about accessing the servers, contact your local system administrator or network expert. Instructions for accessing the anonymous FTP server follow.

Downloading from Anonymous FTP Server

A number of NCSA publications are installed on the NCSA anonymous FTP server. If you are connected to the Internet, you can download NCSA publications by following the procedures below. If you have any questions regarding the connection or procedure, consult your local system administrator or network expert.

1. Log on to a host at your site that is connected to the Internet and running software supporting the `ftp` command.
2. Invoke FTP by entering the `ftp` command and the Internet address of the server:
`ftp ftp.ncsa.uiuc.edu`
3. Log on using `anonymous` for the name.
4. Enter your local login name and address (e.g., `smith@ncsa.uiuc.edu`) for the password.
5. Enter `get README.FIRST` to transfer the ASCII instruction to your local host.
6. Enter `quit` to exit FTP and return to your local host.
7. The NCSA publications are located in the `/ncsapubs` directory.

general abbreviations

CTC	Cornell Theory Center
DARPA	Defense Advanced Research Projects Agency
EVL	Electronic Visualization Laboratory
HPCC	High Performance Computing and Communications
NASA	National Aeronautics and Space Administration
NCAR	National Center for Atmospheric Research
NCSA	National Center for Supercomputing Applications
NII	National Information Infrastructure
NSF	National Science Foundation
PSC	Pittsburgh Supercomputing Center
SDSC	San Diego Supercomputer Center
SGI	Silicon Graphics Inc.
TMC	Thinking Machines Corp.
UIC	University of Illinois at Chicago
UIUC	University of Illinois at Urbana-Champaign
URL	Uniform Resource Locator
VR	Virtual Reality
Web	World Wide Web

NCSA abbreviations

Apps	Applications Division
CAVE	Cave Automatic Virtual Environment
C&C	Computing and Communications Division
E&O	Education and Outreach Division
F&A	Finance and Administration Division
IP	Industrial Program
MarComm	Marketing Communications Division
SDD	Software Development Division
VEG	Virtual Environments Graphics Division



NCSA[™]

National Center for Supercomputing Applications
University of Illinois at Urbana-Champaign
152 Computing Applications Building
605 East Springfield Avenue
Champaign, IL 61280-5518