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Femtoseconds and nanoManipulators
Computer Science Forges New Research Frontiers

UNC-CH's Department of Computer Science joins forces with many academic disciplines as it develops innovative applications in medicine, business and education. In its 35 years, the department's focus on research and "peaks of excellence" have earned it national accolades and attracted a distinguished faculty and research staff.

by Sarah Madry

"Of course, we can't get around the speed of light," said Dr. Kevin Jeffay, leaning back in his chair one recent fall afternoon. "And we're still limited by the fact that the clock on the wall reads differently, one time zone to another."

He seems slightly irritated by this bedevilment.

Jeffay specializes in real-time systems, multimedia networking and computer-supported cooperative work at the Department of Computer Science at the University of North Carolina at Chapel Hill. That is, he's in the business of creating ways for people to work with each other from diverse points on the planet. Someone in New York, for example, might have to be in his office at midnight, to accommodate a co-worker in Nairobi, who works best just after breakfast.

Since its institution in 1964, the department has been joining faculty of genius, the nation's best graduate students, along with a network of collaborators from the College of Arts and Sciences, the School of Public Health and the School of Medicine to create tools for doctors, business people, scientists and administrators.

"We are toolsmiths," says department founder Dr. Fred Brooks (see separate article this issue). "The only way to tell whether the tools you're creating are successful is to have collaborators who use your tools to tell you whether you're on the right track."

At the heart of Sitterson Hall are computer laboratories where myriad research projects are visible on banks of computer screens as twisting, colorful images and gray columns of figures. And in the offices and hallways, graduate students and professors are reasoning together, taking notes, listening to each other, interrupting and correcting- trying to fit another piece of the puzzle together.

The work is complicated and requires theoretical thinking. The department brochure tells interested student applicants to have knowledge of "data structures and abstract data types, linear algebra or matrix theory, differential and integral calculus, design and analysis of algorithms, formal languages and automata theory and software engineering," among other subjects. Some recent Ph.D. dissertation titles are "Image Geometry Through Multiscale Statistics," "Efficient Object Sharing in Shared-Memory Multiprocessors," and "Continuous Mixture Modeling Via Goodness-of-fit Cores." Not for those of us who may have trouble balancing our checkbooks, the hallways of Sitterson.

Dr. Stephen Weiss, department chair, notes that he and his scientists are not just out to teach students how to use computers. The department's goal is to make useful tools.

The HiBall--Not To Drink But To Wear

To see and experience the real world and a computer-generated environment as one and to connect the two to work seamlessly together-this might be one aim of the computer graphics scientists at UNC-CH.

The Department of Computer Science, whose computer graphics curriculum is ranked second nationally, has designed an instrument which may lead the way to make virtual living an everyday experience. The HiBall is a lightweight headgear system with six small cameras, which communicate with thousands of tiny light emitting diodes in the ceiling of an 18' X 36' room in Sitterson Hall. With headsets displaying visuals to its wearer, the system transports him to a virtual environment. The emitters and cameras track the person's movements and orientation, and computers constantly adjust the images to match the wearer's motions causing the environment to seem real.

The Office of the Future

You may not need to see inside a submarine motor or study the vagaries of a molecule. Your everyday world is your office or home. Though The Office of the Future may sound like a Disney World ride, UNC-CH scientists are showing that the future office may be an environment where computers that control projectors create a mirage of pictures, data and sound directly on the walls, desks, and floor.

Lead research scientist Dr. Henry Fuchs uses the words "telecollaboration" and "teleimmersion" to describe his work. If you connect the idea of immersion, where the walls of the room are converted into a huge projection screen showing convincing, life-sized pictures and data, with the idea of a telecommunications network, which connects the local computer to other systems worldwide, you get the idea of teleimmersion.

Your office, through computers, video displays and other devices, will be merged with that of your colleagues. Video pictures of co-workers will be projected into the spaces around you as you collaborate on projects, creating a strong feeling that your partners are in the room with you-even if you live in one state and work in another.

Your e-ticket to this experience will be the pieces of equipment and computers harbored in your walls and your desk, which will transport you to your shared projects at any moment.

Collaboration in Virtual Worlds

Two familiar tools which already help people work together from distant places are the Internet and e-mail. Jeffay's research supports interactive multimedia applications on the Internet. He and his students are designing ways for computer networks to support communication.

Also, they want people to be able to use microscopes and other instruments which are miles away. Telephony, videoconferencing, and immersive virtual environments allow distant humans, machines and instruments to work together at the same time and even see the same space.

The nanoManipulator

If the nanoManipulator were described as "an intuitive interface to scanning probe microscopes" as the department's brochure describes it, you might not know what it is. But this exciting creation allows gene therapists, chemists and physicists to both see and touch miniscule objects and study how these tiny objects move, collide and interact.

Dr. Russell Taylor presents himself quietly, but his microscope project has caused a lot of noise in the world of materials science. The tip of the nanoManipulator, when dragged across the surface containing molecules, can detect surface changes and measure friction. Using the nanoManipulator, chemists and physicists can see, touch, push and squish particles as if they were blown up 100,000 times. Taylor and his students are fine-tuning the experiment to more closely correlate to the actual environment of a virus in a cell.

Surgeons Peer Into Patients…With Computers

This year, the UNC-CH Medical Image Display and Analysis Group celebrates 25 years of multidisciplinary research into improving the quality of diagnosis and treatment doctors can provide for their patients via computers and medical images. MIDAG is led by Dr. Stephen M. Pizer, and includes more than 90 faculty, staff, and graduate students in 12 departments at UNC-CH, as well as colleagues at Duke University.

MIDAG's clinical work includes, among others, applications in neurosurgery, radiation oncology, breast biopsy, and abdominal laparoscopy. Radiologists at UNC Hospitals use the computer images to diagnose diseases, especially those of the breast. Dr. Guido Gerig is forming a new team to use the computer to characterize and measure the shape and structure of the brain and use those measurements to examine the diseases of the brain.

"When you are doing neurosurgery and want to block a vessel, you don't want to get the wrong one," said Dr. Liz Bullitt of the Department of Surgery at the UNC-CH Medical School, one of MIDAG's team members. She's trying to find ways to let surgeons invade their patients more safely.

Bullitt wants a 3-D view of the vessel or the artery and, just as important, a picture of what the connections are. You need to know, she says, what other arteries supply the same area. And she praises the coordinated work between the Department of Computer Science and other departments and specialists on campus. "It takes time to build bridges, to learn each other's vocabulary," she states. But once that's done, "we can go so much farther in a collaborative effort than we can as individual researchers."

Augmented Reality Augurs Well for Medicine

Dr. Henry Fuchs strides the halls of Sitterson often pursued by graduate students and staff who need just a few moments of his day.

Fuchs and his collaborators have designed a head-mounted camera unit for surgeons. With the unit, the surgeon has full awareness of his surroundings plus a 3-D image of the human body's interior. "Augmented reality enables the physician to look inside a patient," says Fuchs. An ultrasound probe is used to scan and view the patient's interior anatomy. With the help of computer-driven headgear, the surgeon can view into the body, and that view can guide the surgeon in performing surgery with minimal incisions to the patient. Pizer says UNC-CH is in the vanguard of augmented reality for surgeons.

From Seconds to Atoseconds
The parallel computing group led by Jan Prins and Siddhartha Chatterjee uses many computers simultaneously to perform faster and more accurate scientific simulations. These simulations reflect events that occur so fast; they use what's called a femtosecond timescale (there are quintilian femtoseconds in one second). One use is to study the behavior of proteins and drug molecules. Among other users: biochemists at the School of Medicine who want to improve their ability to make disease-curing drugs.
The concept of parallel computing also lies at the heart of the world's fastest 3-D graphics computers, some of which were developed at UNC-CH by Professors Fuchs, John Poulton, and their colleagues.

Tools to Train, Treat, Explain and Entertain
The department's faculty and researchers use scientific skills to make practical tools to help us work, study, see a physician, ride in a car or even play games. They work towards being able to pose the real and the unreal together at once, to connect the human and the mechanical in a way that the two work seamlessly together.
At Carolina, if the Department of Computer Science can't move the moon and the sun, they'll fit you with mechanical headgear-and walk you into the virtual sunset.

Carolina's Department of Computer Science has forged a web of collaboration and research through which have emerged successes and breakthroughs in the areas of medicine, public health, teaching and communication. The department needs support for computers, facilities, technical assistants and laboratories. If you are interested in supporting the work of the department, please contact Dennis Cross, Executive Director, Arts and Sciences Foundation, (919) 962-6183.

To the Computer Science webpage

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Knowing is not enough; We must Apply. Willing is not enough; We must Do.…
--Goethe

Computers in the future may weigh no more than 1.5 tons.
--Popular Mechanics, forecasting the relentless march of science, 1949

I think there is a world market for maybe five computers.
--Thomas Watson, Chairman of IBM, 1943

The Department of Computer Science
At a Glance

Chair Dr. Stephen Weiss
Founded 1964
Number of tenure-track and research faculty 32
Graduate Students* 141
Number of computers in Sitterson 500
Department "homes" West House, 1964-1987
New West Hall, 1969-1987
Sitterson Hall, 1987- Present
Where alumni are today..... Worldwide in research, business, medicine, television, forensics, higher education.
Department Web page address..... www.cs.unc.edu Check out the site for: faculty honors, alumni information (many have their own homepages); events and lectures, and department research.

*The Computer Science Department offers master's and doctoral degree programs. Undergraduates interested in a computer science degree may enroll in the Mathematical Sciences Computer Science Option.

Department founder Fred Brooks
Set the Standard

When Dr. Frederick Brooks was an internationally acclaimed computer architect at IBM in 1963, he was asked to start Carolina's Ph.D.- granting computer science department, the second in the nation.
After nearly 35 years, Brooks' stamp on the culture of the department is permanent. Today, he is the department's only remaining original faculty member, having served as a guiding force since the department offered its first course in 1964.
Brooks, a specialist in interactive computer graphics, computer architecture and software engineering, led the IBM team that introduced the groundbreaking System/360. The system allowed a family of computers to run on the same programs, a new concept in computing's early days. Brooks also had a major role in developing a system that would recognize lower-case letters-making widespread business use possible.
In a 1996 interview with the University Gazette, Brooks said the career change from business to academics required soul-searching, and "the move to UNC-CH was against the advice of most of my friends. It also involved a considerable salary cut. And I've never regretted it."
Brooks told the Gazette that in organizing the department, "we knew we would always have a small to middle-size department, rather than a massive department, so we wanted to concentrate on building peaks of excellence in

a small number of areas rather than covering the waterfront."
Among those peaks of excellence: computer graphics, medical imaging, virtual reality that will improve the quality of life.
Brooks, a Durham native who grew up in Greenville, N.C., graduated summa cum laude from Duke University with a bachelor's degree in physics, and from Harvard University with a master's and Ph.D. in applied mathematics. His numerous honors include National Medal of Technology, 1985, awarded by President Ronald Reagan; Thomas Jefferson Award, UNC-CH, 1986; and Allen Newell Award, Association for Computing Machinery, 1994.

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Study Abroad: Passport to the Future For Carolina Students

"Socrates was asked where he was from. He replied not "Athens," but "The World." He… embraced the universe as his city, and distributed his knowledge,
his company, and his affections to all mankind, unlike us who look only at what is underfoot."

Michel de Montaigne…From his essay,
"On the Education of Children"

The distance from the bench under the Davie Poplar to the vast, open space of Tiananmen Square in Beijing or the sunny streets near the Campo Santa Maria Formosa in Venice shrinks every time a Carolina student walks through the doors of the Study Abroad Office in Caldwell Hall. Eight hundred Carolina students received credits earned overseas this past year and the number grows by about 20% each year. Of these 800, about 700 are in the College of Arts and Sciences.

The close of the century has brought with it an international marketplace and an era of relative peace. The black limousines that once carried stern-faced dignitaries to meetings on the threat of nuclear war have been passed on the road by rental cars driven by international business people talking into cellular phones. They are opening new markets or expanding their businesses in ways and regions unimaginable a generation ago.

Senior Associate Dean of the College of Arts and Sciences Richard Soloway says that Carolina is well aware of the dividends study abroad can bring to students. "A study abroad experience gives a student a broader view of the world at large and of his or her own native land. Personal growth, maturation, confidence and experience are gained from entering and successfully maneuvering in a foreign environment. But our students must

also be aware of the economic realities of the present day. If we're serious about preparing young people to serve effectively today's increasingly international economic and cultural environment, we must diligently strive to make international study abroad a possibility for every Carolina student."

First Stop-The Study Abroad Office

The Study Abroad Office is the first place most students go to explore study abroad opportunities. It keeps a large library of brochures and information on programs offered by Carolina, and by other universities around the country and around the world. It handles enrollment for the programs and counsel students on what academic credits they may receive for courses. It also directs students to financial aid to fund these journeys. The Study Abroad office was created in 1985. In 1986, 30 students used their services, 66 students in 1988. Last year hundreds of students made their way overseas with counsel from the Study Abroad Office. Students pursuing majors in almost every undergraduate department on campus are found on study-abroad rosters.

Through the Study Abroad office there are 127 different programs in 53 countries from which students can choose. These encompass exchange or non-exchange programs and internships lasting a semester, a year or a summer. Programs are available in France, Spain, The U.K., Italy, Belgium, The Netherlands, Denmark, Switzerland, Portugal, Ireland, Sweden, Austria, Germany, Greece, Hungary, Poland, The Czech Republic, Russia, Israel, Australia, New Zealand, Bali, Japan, China, India, Indonesia, The Republic of Korea, Nepal, Thailand, Vietnam, Indonesia, Western Samoa, Mali, Morocco, Ghana, Cameroon, Kenya, Tanzania, Uganda, Madagascar, Zimbabwe, Botswana, South Africa, Canada, Jamaica, Mexico, Nicaragua, Venezuela, Ecuador, Brazil, Bolivia, Chile and Argentina.

Exchange students attend a foreign university and an equal number of foreign students from that school come to Carolina. In exchange programs, a Carolina student pays the UNC tuition he or she would pay as a campus resident. The student pays boarding fees either at Carolina or at the university abroad, depending on the exchange agreement. Exchange students have recently studied at many universities including the University of Melbourne in Australia; the University of Edinburgh in Scotland; and Keio University in Tokyo, Japan.

Non-exchange study options are available throughout the world. London is desirable, as is Paris. But Florence, Italy draws a greater number of Carolina students than any other place. Last year, 155 students studied for a semester at The Instituto Lorenzo de Medici. The semester costs $3,250 for tuition plus $400 for excursions. Housing and meals are not included. The tuition charge for the summer program is $1,150. Among the classes offered this fall are: "Italian Cities-History of Urban Design"; " Italian and European Theater: From Early Renaissance to Commedia dell'Arte"; "Comparative European Politics"; and "The Italian Grand Tour: Italy Through the Eyes of Famous Travelers." The students take field trips to cities such as Rome, Venice, Pompeii, Naples, Capri, Ravenna, San Marino, Urbino, Siena, San Gimignano, and Assisi.

If a student wishes to work overseas in his or her area of study, the Study Abroad Office also has information on internships, several of which carry academic credit. The foreign program has to meet certain requirements, and the student must write a research paper on his/her internship.

Honors Programs Located Abroad

Thirty-three students spent last spring in the Honors Semester in London program, one of Carolina's most successful initiatives planned and administered in Chapel Hill. This fall, twenty-six students are participating. The program costs $7000 which includes tuition, fees, and room but doesn't include food, travel and extras. The curriculum is organized around specially arranged seminars grounded in the experience of living and learning in London. Specially selected London-based faculty, drawn from English universities, teach the seminars. There are nine or ten seminars offered each semester, reflecting a range of disciplines across the arts and sciences. The students choose four of these. One seminar is taught by the program's UNC resident director in his/her area of expertise. Carolina History Professor Sylvia Hoffert is the on-site professor this fall. Especially interesting to art history enthusiasts will be a class on the British Museum taught this fall by the museum's staff and organized around some of its most important artifacts. Each course uses London as a part of the classroom, taking full advantage of museums, galleries, archives, architectural sites, and other resources. The students share apartments in downtown London.

The Honors Program also offers semesters in Australia at Murdoch University and at the University of Melbourne. A new program has started this fall at the Jerome College in Prague, The Czech Republic. Students will go on excursions within the country and to Poland as part of their study experience.

Montpellier and Seville…Veteran Cities to Carolina Visitors

Many alumni will remember that the Romance Language Department's Year in Montpellier is one of the most popular programs at UNC. The program was started by Professor Fred Vogler in 1964, first in Lyon, and then moved to Montpellier in 1974. The Year in Montpellier costs $7,500 per year for living and academic expenses. It is estimated that the student needs another $4,800 for food, travel to and from Europe as well as within, textbooks and personal expenses. It is currently under the direction of Professor Catherine Maley.

When the students arrive in France, they do sightseeing in the Loire Valley and then undergo intensive linguistic and cultural training designed to prepare them to attend regular classes at Montpellier when it opens in early October. The students choose three to four courses from among a large list including "Eighteenth Century French Literature," "American Myth in the Two Wars," "Pre-Roman and Roman History," "La Littérature et les Idées," "The Baroque and Classical Novel," "Introduction to Ecology," "Social History of Contemporary France," "Twentieth Century French History," "Regional History," and "The History of the Industrial Revolution."

Also administered by the Department of Romance Languages is The Year at Seville, which began in 1972 and is under the direction of Professor Larry King. To attend The Year at Seville, a NC resident pays $9,025, which doesn't include travel, personal expenses or textbooks. Students live in homes of local residents. They receive 12 to 15 credit hours per semester. Various program tracks can be followed by the students. All include language studies. Students visit important cities in Spain including Madrid, Toledo, Granada and Córdoba. There is support staff from UNC to help the students in a variety of ways.

But Is Study Abroad Affordable?

The costs of these programs can be steep. Even a short three and a half week program such as the UNC Summer Study Program in Greece, run by Professor Jim McCoy of the History and Classics Departments, costs $2,495, not including transatlantic transportation, books, most food and personal expenses. In addition, because state funding does not fully cover the operating costs of the Study Abroad Office, most students who study abroad must currently pay a non-refundable $500 fee to them to cover office overhead and personnel expenses. If a student is on student aid and wishes to study abroad, the experience can appear beyond possibility, even though some financial aid is often available. Increased private funds to allow Carolina students to travel and study abroad are a high priority of the College of Arts and Sciences. In the College, out of 358 funds administered by the Arts and Sciences Foundation, only 11 are designed specifically to help students with study abroad.

One of these funds is quite new, instituted just last year by the Class of 1998. Class President Franklin Golden said the idea for the "Class of 1998 Fund for Research Abroad" came about after he had a conversation with Professor Jim Leloudis of UNC's History Department. They discussed what sort of gift would meet a pressing need for the university. The study abroad fund was the product of Golden's research. The fund is used to help students pursue research abroad in the junior or senior years or during the summer after the sophomore or junior year. Students design an independent study project under the guidance of faculty members. Travel abroad must be arranged with the purpose of furthering the study project.

Arts and Sciences Foundation funds supporting student study abroad would include: The Nicholas A. Cassas Fund in Greek Studies, The James R. Copland, Jr. Scholarship Study Abroad Award, The Suzanne Hynes Memorial Travel Award, The Art Department Student Travel Award, The John D. Eyre Geography Travel Fund, The Joseph C. Sloane Travel Fund, The Samuel T. Emory Travel Fund, The J.P. Harland Endowment Fund in Classical Archaeology, The Michael L. and Matthew L. Boyatt Award Fund and the Lucius E. Burch III Fellows Program Fund.

> "For this reason, mixing with men is wonderfully useful, and visiting foreign countries, not merely to bring back, in the manner of our French noblemen, knowledge of the measurements of the Santa Rotonda…or…how much longer or wider Nero's face is in some old

ruin there than on some similar medallion; but to bring back knowledge of the characters and ways of those nations, and to rub and polish our brains by contact with those of others."

Michel de Montaigne…from his "Essay on the Education of Children"

New Perspectives, New Knowledge, Long Memories

"Carolina students benefit greatly from studying overseas," says Dennis Cross, Executive Director of the Arts and Sciences Foundation and Associate Dean in the College of Arts and Sciences. "Donors who support study abroad are doing a great service to the students and to the ability of the University to graduate independent, well- rounded, enlightened people with enlarged horizons and informed perspectives. Young people often come home from a study abroad experience with a clearer view of the world and the place of themselves and their country in it."

When one talks to students who have traded a carrel in Davis Library for one in the Bodelian at Oxford or for a chance to hear the thoughts of professors in the far and near east, one always hears that this changed world view has been one of the greatest dividends they received from study abroad. Michael Farmer, a '95 graduate in English and now an English graduate student, went to Dar Es-Salaam, Tanzania during his junior year. While attending the University of Dar Es Salaam, he took African Literature, History and Swahili courses. He also found time to travel to Israel, Egypt, South Africa and Namibia. He says his experience made him see the world differently. He is also a more independent person. Maria Muscarella, a former student who benefited from the Lucius E. Burch III Fellows Program Fund, says her experience was wonderful. "It taught me you could do what you wanted to do if you put your mind to it. I spent nine weeks in Ireland studying midwifery at the Rotunda Maternity Hospital in Dublin. I had the best time of my life."

Dean Soloway sums up the university's position on encouraging study abroad by saying, "Students need to understand that their futures are intimately connected with peoples, cultures, businesses and politics from all over the world. Every corner on earth is their neighborhood. They must be prepared, when they leave the confines of the rock walls that circle our campus, to interact ably with foreign cultures, working partners, institutions and conventions in a way that benefits their careers and their personal lives. When they cross borders to study, they learn to stretch their minds, to re-think cultural stereotypes, to become aware of how others see us, and to temper judgment with experience. Giving every student have the opportunity to study abroad is one of our goals for the twenty-first century."

More about the programs mentioned in this article can be found on-line at:
http://www.unc.edu/depts/sevi
http://www.unc.edu/depts/mont/

http://www.unc.edu/depts/abroad/
http://www.unc.edu/depts/honors/

If you are interested in finding out more about ways to support study abroad for Carolina's students, please contact Raymond Farrow at the Arts and Sciences Foundation, 134 East Franklin Street, CB #6115, Chapel Hill, NC 27599-6115 or call 919-962-0108.