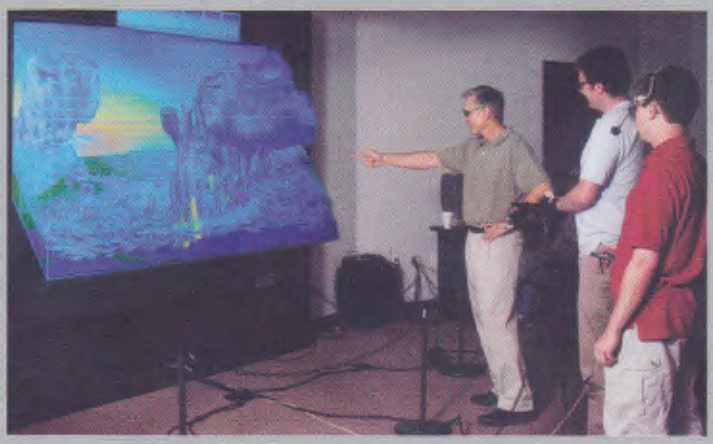
Industrial Mathematics Institute Provides Research Opportunities for Undergraduate Students

Having the opportunity to conduct research as an undergraduate is a fundamental aspect of the academic careers of many COSM students. Luckily, there are many opportunities for undergraduates to participate in research activities here at the University of South Carolina. Three undergraduates who have been rewarded with the chance to conduct research at USC are Todd Adams, Matthew Hielsberg, and Jeb Winders. These students work within the Industrial Mathematics Institute (IMI) under the guidance of mathematics department faculty members such as Dr. Bob Sharpley and Dr. Ron DeVore. "If you put forth the effort to talk to your professors, going the extra mile, you will be rewarded with the benefit of working with great people like Dr. Sharpley," says Jeb Winders.

Each of these three students is extremely familiar with "going the extra mile." Todd Adams, a graduate of Ben Lippen High School, is a senior mathematics and computer science double major. Todd sees mathematics as "a great foundation that can be applied to many other disciplines." Originally from San Diego, Calif., Matthew Hielsberg, also a senior, graduated from high school in Charleston and is studying computer science with a minor in mathematics. Both Todd and Matthew have worked in the IMI laboratory for about one year. Of the three undergraduate researchers, Jeb Winders has been with the IMI the longest. Winders, from Clover, S.C., is a South Carolina Honors College student majoring in mathematics with a cognate in economics. As academic scholarship recipients and diligent students, Todd, Matt, and Jeb have excellent futures and careers ahead of them. Helping them to achieve their goals and to gain valuable career experience are the researchers of the IMI.

Under the direction of Dr. Daniel Dix, Matthew Hielsberg studies molecular dynamics and modeling of molecules. Matthew has been working to use graph theory and trees developed by Dr. Dix in order to apply these mathematical equations to programming that will allow researchers to visualize molecules on the PowerWall visualization system. The PowerWall is an advanced simulation system that uses a powerful SGI Onyx 2, a graphics supercomputer, with two Barco projectors in order to display three-dimensional images. Using special input devices, the images on the projector screen can be manipulated. With Dr. Dix, Matthew hopes to be able to load onto the PowerWall display the molecular structures that he has been working on in order to manipulate these structures. The researchers will be able to edit the molecules and adjust certain properties in order to test conjectures without the expense that comes from such manipulation within the chemistry or biology laboratory. The applications for such research, says Matthew, are numerous, including drug manufacturing as well as general medical applications.

Todd Adams is conducting research similar to that of Hielsberg. Adams is also developing programs that will be used on the PowerWall. Under the guidance of Dr. Sharpley, Adams is working to develop a program that will model atmospheric data in the three spatial dimensions and in the time dimension, plus the addition of different variables such as air pressure, wind speed, and geophysical elements. The original program, Vis 5D, was developed solely for atmospheric data. Adams hopes to adapt this by adding additional



Dr. Bob Sharpley and undergraduate students Jeb Winders (center) and Todd Adams (right) demonstrate the PowerWall 3-D visualization system. While Sharpley and the two students are controlling the movement on the screen, the audience members are still able to "participate" in the simulation by wearing special 3-D glasses.

displays such as soil layers and dense rock formations to study the effects of these conditions on atmospheric pressure.

As an IMI system administrator, Jeb Winders often finds himself involved in many different projects with many different areas of interest. One of his main areas of interest is parallel programming, one of Dr. Sharpley's interests as well. The goal of parallel programming is to bring separate, high-speed computers together so that in collaboration they can solve problems at a faster, more efficient pace. Parallel programming can be applied to many different projects within the IMI, including the PowerWall visualization system. One specific project that Winders has worked on is the terrain approximation project for the U.S. Navy. Here, researchers hope to compress complex data, encoding it for transmission to weapons systems and therefore making it less susceptible to intelligence leaks. For example, says Winders, enemy forces in the case of an unexploded "dud" could easily intercept the complex data that is carried in a Tomahawk missile, directing the missile to the target. Winders and other researchers hope to prevent intelligence breeches by streaming data to the missiles so that they keep their data secure and so that their mission may be dynamically redirected.

Guidance from COSM faculty and from faculty across the University is a vital part of the research that these students conduct. "As far as the math department," says Todd Adams, "I am very pleased with the faculty and instructors. We have a lot of very knowledgeable professors." Adams, Hielsberg, and Winders have each benefited from the support of such mathematics faculty as Dr. Colin Bennett, Dr. David Sumner, Dr. Daniel Dix, Dr. George McNulty, Dr. Bob Sharpley, and Dr. Ognian Trifonov. Winders says, "I am pleased with the professors in other departments as well, especially in the Honors College. I feel that the Honors College has provided me with a very well-rounded education." Two particular professors who have inspired Winders are Associate Provost and Dean of Undergraduate Affairs Dr. Don Greiner of the English department and Dr. Robert Carlsson of

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IRIX Pharmaceuticals Presents Gift to COSM

IRIX Pharmaceuticals, Inc., a Florence, S.C., based pharmaceuticals company engaged in the generation of process technology for new and existing drugs, has donated a 400 MHz Nuclear Magnetic Resonance (NMR) unit to the USC spectroscopy laboratory. Worth nearly $200,000, this gift will benefit many COSM faculty members and students in their research. For more information about this gift, contact Dr. Dan Reger or Dr. Bruce Dunlap.

Corporations Donate Seismic Software Programs to COSM

Two Houston, Texas,-based companies, Paradyme Geophysical and Landmark Graphics Corporation, have donated their seismic software programs to the Department of Geology. The gift from Paradyme Geophysical is worth $713,900, while the Landmark Graphics gift is worth $609,500. Both companies are involved in the oil industry, and their software will be used by USC Department of Geology faculty members, including Dr. James Kellogg and Dr. Christopher Kendall, to study petroleum deposits and seismic activity.

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the economics department. Winders said, "Dr. Greiner taught me, a science student, to enjoy English."

For these three undergraduate students, working in the Industrial Mathematics Institute provides the opportunity to gain job experience and prepare them for the future. The IMI "is a real working environment," says Todd Adams. "I feel that working here is preparing me for the real world and for my graduate work in mathematics." For Matthew Hielsberg, the IMI has provided an opportunity to further develop his programming skills. Hielsberg hopes to pursue a career in animation or video game development, an area of high demand, promising a lucrative career. Jeb Winders is also pleased with the experiences he has gained working with the IMI faculty. "I enjoy what I do, and I know that working here is preparing me for whatever career path I decide to follow," says Winders.

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have developed higher dimensional multiresolution-based data compression and processing libraries to enable efficient and effective assessment of interactive simulations on massively parallel platforms.

Currently, DeVore and Sharpley are collaborating with faculty from the University of Wisconsin's School of Medicine and its Computer Science Department on a project that applies the PowerWall technology to electron microscopy and cellular research. The goal of this research is the creation of mutually accessible cellular graphics, or virtual molecular displays, that can be manipulated using the PowerWall visualization system. In this collaboration, DeVore and Sharpley act as consultants in compression of data using wavelets so that the data can travel via the Internet and then researchers in Wisconsin and in South Carolina, or anywhere in the world, can see and manipulate the same image of the same cell, tumor, or tissue formation.

Another application of the PowerWall technology and wavelet analysis is in geophysical studies. Using actual and approximated data, Dr. Sharpley, Dr. Hong Wang, and undergraduate student Todd Adams have been able to simulate petroleum reservoirs, seismic events, groundwater models, and atmospheric activity. The applications of such simulations are numerous, including advances in enhanced oil production; innovations in detecting, preventing, and controlling groundwater contaminants; and global climate studies. One very interesting simulation that demonstrates the PowerWall's potential is that of the *Perfect Storm*. This demo involves real and simulated data from the deadly storm that struck New England in October 1991. Represented in a novel by Sebastian Junger and in a film by Wolfgang Petersen, the *Perfect Storm* was a storm stronger than any in recorded history, as it was created from the combined force of three separate storms. The PowerWall simulation provides an amazing view of the events that transpired in late October of 1991. Similar to 3D satellite weather images, the simulation shows the movement of precipitation, the wind speed and direction, sensor surfaces, as well as the monstrous cloud formations. Using the PowerWall input devices, the person controlling the simulation can move through, around, above, or under the storm as if they were flying. The audience is able to see the immensity of this and other weather events without having to put on their raincoats.

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with H-shaped canyons, with 'hot' and 'warm' sides," said Gray. "The explosion took out 100 meters of the hot canyon wall." "Fortunately," said Gray, "there were no injuries, as the accident took place at lunchtime when no people were there." Gray was invited (by the Department of Energy) to join the team because of work he had done regarding a similar explosion at the Savannah River Site in South Carolina in 1975.

The 26th annual Actinide Separations Conference was doubly exciting for Gray, as it was from the podium, immediately after accepting the Seaborg Actinide Separations Award that he proposed to his high-school sweetheart, Sandra Purdom Byrd. With over 100 friends and colleagues in the audience, some from as far away as Australia, England, and France, Dr. Gray got on bended knee to ask Sandy to marry him.

Leonard and Sandy met in the sixth grade at Wacona Grammar School just north of Waycross, Ga. The couple dated in high school and they shared the lead roles in their junior class play, a love story in which they played an engaged couple. Following graduation, Sandy traveled to Atlanta to begin training as a nurse, while Leonard went off to college in New Mexico. The two parted ways and lost touch: "We met our first spouses, married, and raised our families," says Gray. Unfortunately, both Leonard and Sandy found themselves widowed at early ages. Early this year, Gray was shocked to hear from Sandy after nearly 42 years of not seeing one another. "Sandy found my name on the Internet and e-mailed me. I later went to visit her in Perry, Fla.," says Gray. Their love was renewed from there. Gray, a widower of Jeanette Joyce, and Byrd, a widow of Jack Byrd, were married on Aug. 10 of this year in Perry, Fla. Leonard and Sandy currently reside in Livermore, Calif.