JUNIOR FACULTY ENGAGED IN SIGNIFICANT RESEARCH

By Mary Reed

Junior Russ College faculty members are taking everyday situations—from Wikipedia searches to traffic safety—and making them more accurate and safe for the public. One way to measure the importance of this research is the $2.3 million in grants these projects received in just the past fiscal year.

BREAST CANCER RESEARCH

Monica Burdick, assistant professor of chemical and biomolecular engineering, recently won a $500,000 award from the National Science Foundation to study breast cancer stem cells (the basic cancer cells from which other specialized cells are generated). “We’re trying to figure out how a breast cancer stem cell marker set may be related to the mechanical properties of a cell—how soft or how solid a cell is—and whether or not those mechanical properties may be another type of marker that we could use to study or otherwise identify these cancer stem cells,” she says.

Burdick is also a principal investigator on a three-year, $442,000 National Institutes of Health/National Cancer Institute grant to analyze the biochemistry of cancerous tissues. “In the simplest sense, we are trying to bring in an engineering analysis to standard pathology assays, which are the things that doctors use to figure out if you have cancer or other diseases,” she explains.

ONLINE ANSWERS

Razvan Bunescu, assistant professor of computer science, has won a $224,000 National Science Foundation grant to create computer programs that analyze the Wikipedia text and allow computers to then process the information. “Suppose you learn about a subject at school, then you get a question on the exam. The path that you use to get to the answer is based not only on knowledge in the textbook. You also use knowledge you have about the world—common sense knowledge,” Bunescu says. “The computers, they process only what is given to them.”

His program will create graphs, which include nodes—basic information pieces, such as the city of Athens or the state of Ohio—and arcs, which connect these nodes to their categories, in this case city, county, and state.

Along with his colleagues at the University of North Texas, Bunescu wants “to build a computer program that identifies the true categories—ones that indicate a true subsumption relationship,” he says. The resulting graph of world knowledge might then be used in a wide array of natural language processing applications, such as in helping Web users connect with answers to questions they post in natural language on sites such as Yahoo! Answers.
Deborah McAvoy, assistant professor of civil engineering, received a $244,817 U.S. Department of Justice grant to evaluate the effectiveness of lighting, paint, and reflective material schemes on first responder vehicles. “There are no federal guidelines as to what emergency vehicles should look like—no regulations,” she says. The average crash rate for all vehicles is 1.27 per million vehicles miles traveled. For ambulance drivers, the rate jumps to 7.7. “Drivers have a lot of distractions,” McAvoy allows. She hopes to determine what works to “get them back into the zone”—and save lives.

McAvoy also received nearly $23,000 in Federal Highway Administration funds from the University of Akron to evaluate so-called dynamic speed signs, which look like regular speed limit signs, but use LED lights to allow for a change in the speed limit. For instance, when road construction reduces two lanes to one, changing the speed limit from 65 to 45 can reduce crashes and traffic backups. “We know they work in theory—it’s just that when people see those signs, will they obey them?” McAvoy asks. She performs some tests in the field and some in the driving simulation lab on campus, a facility that opened in 2010 with funding from the National Science Foundation.

Assistant Professor of Computer Science, Avinash Kodi and Associate Professor of Electrical Engineering Wojciech Jadwisienczak have each won a National Science Foundation Faculty Early Career Development (CAREER) grant. Kodi received a five-year, $407,000 grant to improve the way computer cores—they execute the instructions from any computer application—communicate with one another. As computing demands increase, the number of cores in a computer also increases. “These computing cores are going to talk to each other, and inter-core communication is actually a bottleneck. That’s where a lot of power is being consumed,” Kodi says. His research uses optics (in the form of photons) rather than metal (electrons) to communicate, and does so while reducing power consumption by a significant factor. Silicon photonics technology, while considered the future of computing, is also expensive. Kodi is working on maximizing the utilization of available photonics via novel reconfiguration techniques.

Jadwisienczak received a five-year, $444,000 award to continue his research in optoelectronics, specifically solid state lighting devices, such as LEDs and laser diodes. “The principle is to capitalize on efficient energy conversion which is happening in semiconductors,” he says. Currently, much of the energy in solid state lighting devices is wasted as heat. Along with colleagues and graduate students, Jadwisienczak is working to make this energy conversion even more efficient than today’s compact fluorescent lights.

“We’re trying to engineer new materials capable of doing that. Engineering materials means we need to better understand the semiconductors we work with—their physical, chemical, and structural properties when adopting them for specific optoelectronic applications.”