Louisiana EPSCoR
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Masters of Their Universe

Being a research graduate student isn't what it used to be.

Graduate students used to work on various sub-components of a large research project supervised and held together by the faculty advisor.

"But this is different, more like a teamwork endeavor, where they are masters of their particular part of the project. For it to work, you need very smart, strongly motivated students who get along with each other," says Dr. Donald Gaver, the Alden J. 'Doc' Laborde Professor and Chair, Tulane University Department of Biomedical Engineering.

Tulane University graduate students Jerina Pillert, left, and Katharine Hamlington with Dr. Donald Gaver examine microfluidic experiments involving micro particle image velocimetry, an optical technique for measuring fluid velocity.

Waiting for the teasing punch line —"Too bad we don't have any."— are Katharine "Kate" Hamlington and Jerina Pillert, two Tulane biomedical engineering graduate students who are doing "over the top research" in a large scale multidisciplinary project funded by the National Science Foundation EPSCoR program that involves researchers from nine Louisiana universities.

The two graduate students are responsible for the development of computational models that simulate processes critical to the development of biosensors and microfluidic chips on which biological and/or chemical agents are detected in real-time, commonly referred to as lab-on-a-chip.

One focus of the Research Infrastructure Improvement (RII) grant is the development of multi-function cyberinfrastructure tools (CyberTools) to enhance the ability of the State's university researchers

Masters Continued on page 2

NSF Recruits LA EPSCoR Scientist

Astrophysicist Edward Seidel, one of the lead scientists of the statewide Louisiana Research Infrastructure Improvement (RII) project funded by the National Science Foundation EPSCoR program in October 2007, has been appointed director of the NSF Office of Cyberinfrastructure, effective September 1, 2008.

The NSF Office coordinates and supports the acquisition, development and provision of state-of-the-art cyberinfrastructure resources, tools and services essential to the conduct of 21st-century science and engineering research and education.

"The selection of Dr. Seidel is a reflection of his multi-faceted accomplishments, particularly his scientific and cyberinfrastructure expertise," says Dr. Michael

Khonsari, Project Director of Louisiana EPSCoR and RII.

"It also speaks volumes for Louisiana; for LSU, which had the vision to recruit him to leverage its investment in the Governor's Information Technology Initiative that led to the creation of the Center for Computation and Technology (CCT); and for our EPSCoR program, which has taken a leading role in developing of a statewide cyberinfrastructure that is among the nation's best.

"Louisiana EPSCoR remains firmly committed to continue working with CCT to further the very important objectives of the CyberTools project.

Dr. Seidel, who heads the CCT, is also the Floating Point Systems Professor in LSU's departments of Physics & Astronomy and Computer Science. Prior to joining LSU in 2003, he was a professor at the Max-Planck Institution for Gravitational Physics (Albert-Einstein Institute) in Potsdam, Germany. While there, he led the EU Astrophysics Network of 10 institutes across Europe and participated in the EU GridLab project.

The recipient of numerous national and international awards, he also served as Chief Scientist of the Louisiana Optical Network Initiative, founded the $15 million LONI Institute involving Louisiana's six research universities, and helped lead a $2.2 million NSF award enabling LONI to join the TeraGrid in January 2008.

Masters Continued from page 1

to formulate and test scientific hypotheses by improving methods to manage data, foster development of complex simulations, improve visualization, and mine data.

The CyberTools are being developed in tandem with Science Drivers, the scientific projects that concomitantly utilize the CyberTools. Members of these research teams are investigating topics that include bio-transport phenomena, and the simulation, design and manufacturing of biosensing devices.

Hamlington and Pillert are members of the Immuno Sensors Science Driver team headed by Drs. Gaver and Ricardo Cortez, Associate Director and Director, respectively, of Tulane's Center for Computational Science. The team connects faculty members and students from Tulane, Louisiana Tech University and the University of New Orleans.

"Microfluidic chips sense the presence of an agent as a very small amount of fluid flows through the device. The success of the sensors is directly related to whether or not you can induce mixing and transport, a process that is hindered at these very small scales," explains Dr. Gaver.

"If, for example, you put milk in your coffee, it mixes in no time; if, however, you put it in the microfluidic chip device, the fluids may flow through the system without mixing at all."

Noting that building a computational model is a very complicated procedure requiring multiple steps, Dr. Cortez says that rather than manufacturing a large variety of physical chips, Hamlington and Pillert are computationally developing models to identify the design criteria that will optimize the mixing process suitable for a particular use(s) and this is where CyberTools come in.

Hamlington, who received her undergraduate degree in biomedical engineering from Tulane, focuses on building internal geometries (or obstacles) and simulating fluid flow in the microchannels. Pillert, who earned her degree in physics and computer engineering from the Rose-Hulman Institute of Technology, has been developing the transport portion and documenting the code for general use.

Pointing out how the computational models can be used for different applications, Dr. Gaver explains that different regimes or physical conditions exist for which the same equation can be used. The model must then be tailored for each of the existing regimes.

"For example, while there aren't a lot of hurricanes in your body, it depends on your assumptions as to whether a model would work for both body and hurricane transports."

In addition to simulating the fluid flow and transport for a specific problem, Hamlington and Pillert conduct investigations to determine the possibilities of employing the code for general purpose use. The Louisiana Optical Network Initiative (LONI) enables them to write code that takes advantage of multiple uses beyond their own particular objective. Ideally, the computational models will be used to predict the appropriate design of the biosensors. This is being accomplished in partnership with Louisiana Tech's Institute for Micromanufacturing.

"This process requires careful experimentation using prototype models, and a very strong link between experimentation, theoretical development, and computational simulation. Therefore, the project's success greatly depends upon the collaboration and motivation of graduate students, faculty and researchers in multiple disciplines and institutions across Louisiana.

"It's great to have graduate students who are both colleagues in our research and masters of their particular part of the project," concludes Dr. Gaver.

Participating institutions in the Research Infrastructure Improvement project are Louisiana State University, Louisiana State University Health Sciences Center-New Orleans, Louisiana Tech University, Southern University-Baton Rouge, Tulane University, Tulane University Health Sciences Center, University of Louisiana-Lafayette, University of New Orleans, and Xavier University.

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