Collaboration Key to Research Project

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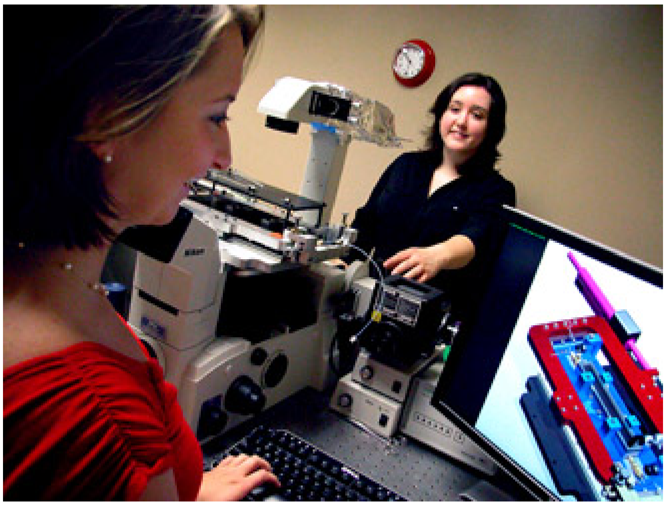
The aphorism that multiple heads are better than one in solving a problem delineates the idea behind a $9 million grant from the National Science Foundation's Experimental Program to Stimulate Competitive Research. The funding continues a multi-institutional research project involving nine Louisiana institutions including Tulane University.



Tulane University graduate students Kate Hamlington, left, and Jerina Pillert experiment with the computational model of a micro-fluidic chamber that they've designed. Their research is funded by the National Science Foundation's EPSCoR program. (Photo by Alicia Duplessis)

Now entering the second year of the three-year EPSCoR project, a team of Tulane faculty and student researchers is working with the other institutions to create a biosensor that will be used to test fluids for pollutants. As the universities conduct this research, they are also testing a larger scaled computational project that aims to keep Louisiana researchers connected through a string of “super computers.”

Researchers are using the technology of the Louisiana Optical Network Initiative, a fiber optic network that links research universities through the real-time transmission of information.

Ricardo Cortez, director of the Tulane Center for Computational Science (CCS) and one of two principal investigators for the project at Tulane, said that the work to develop a blueprint for the final product is distributed among multiple institutions. At Tulane, the departments of biomedical engineering, chemical and biomolecular engineering, mathematics and biochemistry are involved along with the CCS.

“Some people are doing lab experiments with the antibodies used in the biosensor and some are doing computer simulations that show how these antibodies interact with the pollutants we want to detect,” said Cortez. “All the while, our colleagues at Louisiana Tech are working to actually manufacture this device. It's a tremendous group effort by researchers across the state and it's neat how everyone interacts as they work.

“We perform infrastructure research so that all the universities in Louisiana can take advantage of the state-of-the-art computational infrastructure available," said Cortez of the part of the project that his department is involved in. "We are going to develop software that makes it easier for researchers to use the supercomputers."

Two Tulane biomedical engineering PhD students — Jerina Pillert of Coral Springs, Fla., and Kate Hamlington of Bethel Springs, Tenn. — are working in collaboration with Donald Gaver, professor and chair of biomedical engineering, in the CCS and in the biomedical engineering biofluid mechanics laboratory on the uptown campus to develop a computer model of the "micro-fluidic mixing chamber" that would be used in the biosensor.

They are working closely with Diane Blake's lab in the Department of Biochemistry on the downtown campus. Blake, professor of biochemistry, is developing new ways to generate an electrochemical signal for the antibody-based biosensor. Blake's lab also works closely with Henry Ashbaugh, assistant professor of chemical and biomolecular engineering, and Thomas Bishop, research associate professor of mathematics, who investigates molecular structures using computer simulations.

Micro-fluidic devices are tiny fluid-flow systems with channels less than a millimeter wide. The miniscule size of the sensor requires that the process to detect harmful biological or chemical agents takes place on a sub-millimeter scale. This makes the necessary mixing and reactions of the agent and antibodies very difficult before delivery to the electrochemical sensing device.

"It's very expensive to manufacture different designs of these mixing channels, so we're developing it through computational models of the micro-channel and we're looking at different geometric designs to optimize the device," said Hamlington.