Louisiana EPSCoR

EXPERIMENTAL PROGRAM TO STIMULATE COMPETITIVE RESEARCH VOL.6 NO.10 OCTOBER 2009

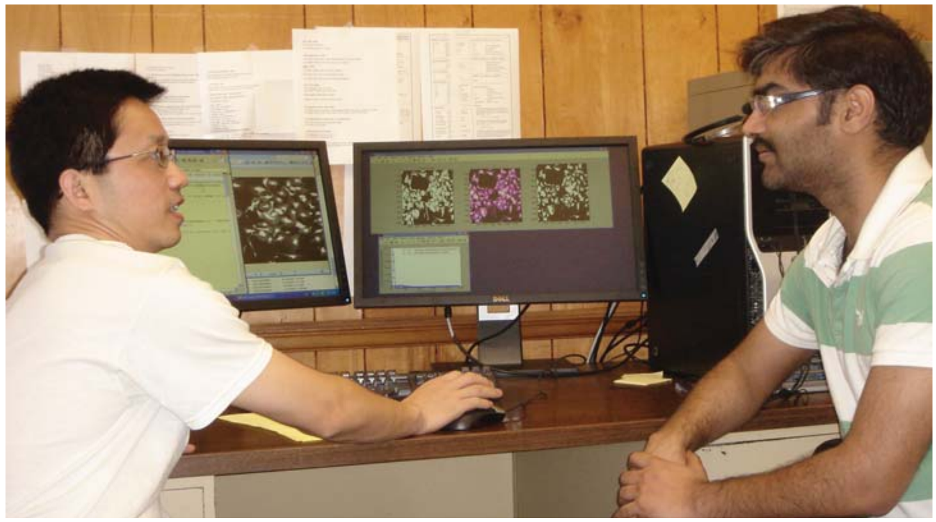
Detecting with CyberTools

The accompanying article includes highlights of three of the National Science Foundation's three year, $9 million grant awarded to LA EPSCoR in 2007 for a team of researchers from nine Louisiana universities to develop a multi-functional cyberinfrastructure (CyberTools).

The objective: to broadly enable significant advances in modern science and engineering. The goals of the project, which received matching funds of $3 million from the Board of Regents Support Fund and $3.2 million from the participating institutions, are to: (1) enhance the scientific capabilities of researchers by linking experimental and computational investigations; (2) enable scientific investigation through the use of advanced computational CyberTools; and (3) drive CyberTools development by directly linking to prototype scientific projects.

A critically important feature is the recognition that CyberTools cannot be built in isolation from the scientific projects. They are instead developed in-tandem with close-knit teams investigating the project's Science Drive foci: (1) the simulation, design and manufacturing of miniaturized biosensors that, for example, detect chemical elements associated with a variety of chemical and biochemical targets, and (2) bio- and environmental transport processes.

The participating institutions are: Louisiana State University – Baton Rouge, LSU Health Sciences Center – New Orleans, Louisiana Tech University, Southern University – Baton Rouge, Tulane University; Tulane University Health Sciences Center, University of New Orleans, and Xavier University of Louisiana.



Dr. Xian Du, left, Louisiana Tech University Post Doctoral Research Associate with the CyberTools Informational Services and Portals Team, is explaining cell image segmentation algorithm--the sequence of logical instructions--to LA Tech PhD student, Sheetal Saini.

Detecting Cancerous Brain Cell Changes

The accurate measurement of brain tumor growth is critical for the detection of cancerous changes in brain cells. Research has shown that geometric features, such as shape and area, indicate cell morphological—size, shape and structure—changes during apoptosis, a process of programmed cell death that describes how cells undergo an ordered sequence of events leading to their death.

To establish guidelines for brain cell classification using geometric features, tools are needed to detect and describe cell shape and cell growth in images.

A framework of geometric descriptions of brain tumor growth has been developed by a team of CyberTools researchers from the Louisiana Tech University's Computer Science Program and its Institute for Micromanufacturing, and the Louisiana State University Health Sciences Center's New Orleans School of Medicine.

They have developed an image segmentation tool to capture the region of interest in cell images and created a shape-learning model that shows such important tumor features as shape, circularity, roughness, compactness, and tumor area.

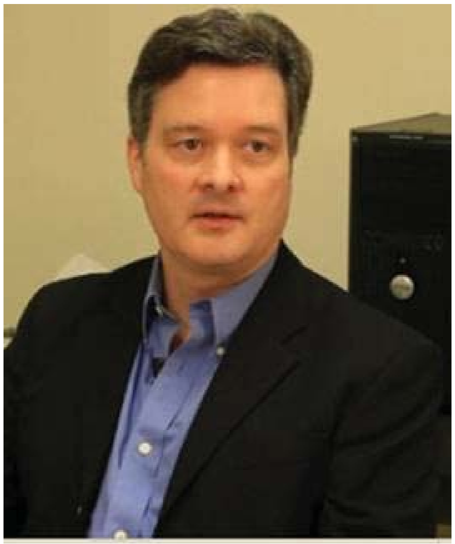
Objectives of the shape analysis are to detect similarities between tumor shapes, analyze shape variations, and establish common criteria for classification. A classification using weighted rules is employed to classify healthy and cancer brain cells.

Micro- & Nano-Scale Biosensors

The rapid increase of deadly diseases, pollutants and chemical warfare agents around the globe has resulted in increased efforts to develop biosensors, particularly to detect lower molecular weight agents, including environmental contaminants, serum constituents and chemical warfare agents.

Biosensors at the micro- and nanoscale could speed up the detection

Biosensors, Continued pg. 2



Dr. Mark DeCoster, Associate Professor of Biomedical Engineering, Louisiana Tech University Institute for Micromanufacturing, and Researcher with both the CyberTools Science Drivers' Biosensor Development and Transport Processes teams.

Biosensors Continued

and limit costs for both small and large sample sizes of some of these agents. Two components for developing novel biosensors for small volumes are: 1) to achieve effective mixing of the substances and 2) to have a rapid readout of the results.

A microsensor, a miniature electronic device used to detect changes in the environment, and a micromixer for immunosensor applications to detect the tiny changes in mass that occur in these small-volume samples have been fabricated and tested by a team of CyberTools researchers from Louisiana Tech University, Louisiana State University in Baton Rouge, Tulane University, and collaborators at Indiana University-Purdue University.

The research project also involves nanotechnology via the application of very thin films, known as nanofilms, on the microdevice surfaces as well as computational analysis to better predict mixing properties. Three generations of prototypes for the micromixer and biosensor have been fabricated, and further testing and development are currently underway.

Tiny Antibody Sensors

Advancing existing sensor technology and manufacturing miniaturized antibody-based sensors to detect a wide variety of low molecular weight components associated with environmental pollution, cancer and other disease states is the focus of a team of CyberTools researchers.

The scope of the collaboration involves engineering designs developed via new computational methods, the use of advanced molecular modeling tools to relate antibody structure and function, and the fabrication and experimental evaluation of miniaturized devices.

The team is composed of researchers from the Tulane School of Medicine's (TUSOM) biochemistry department; Tulane's School of Science and Engineering, the University of New Orleans' (UNO) chemistry department, Louisiana Tech's departments of biomedical and electrical engineering, and Xavier's College of Pharmacy.

"In addition, TUSOM researchers have hosted an 'antibody boot camp' for engineering graduate students involved in the LA EPSCoR project, and biochemistry graduate students have been cross-trained in molecular modeling labs at UNO and the Tulane Center for Computational Science.

"Such one-on-one teaching activities are instrumental in furthering student interest in competitive research, a goal of NSF and LA EPSCoR programs," notes Dr. Diane Blake, Tulane University Professor of Biochemistry and Researcher with the CyberTools Science Drivers' Biosensor Development Team.

CyberTools-assisted modeling of new lab-on-a-chip mixers for antibody-based sensors. The mixing and subsequent binding between an antibody (red) and the component measured by the sensor analyte (the sample being analyzed), in blue) are shown for 3 different mixer designs. Of the three mixers shown here, the serpentine design was predicted to generate the highest concentration of analyte-antibody complex (green) at the outlet region. Graphic courtesy of Katharine Hamlington, Tulane University Biomedical Engineering Dept.

Louisiana EPSCoR
P.O. Box 3677
Baton Rouge, LA 70821-3677
#4475