MISSISSIPPI
EPSCoR

P.O. Box 6343
Miss State, MS 39762

# EPSCoR HIGHLIGHT

Blount attends EPSCoR State meeting

Dr. Henry Blount (left), head of the EPSCoR office at the National Science Foundation, discusses student research posters with MSU researcher, Dr. Keith Walters of the Computational BioSimulation and Modeling research group. Blount's presentation, *"the devil is in the details,"* was given during the State meeting luncheon held at MSU on April 16, 2009. Blount closed his presentation with a quote from J. DeSimone on how to employ diversity effectively — "Diversity is not the objective. It is a means to facilitate our achieving the *critical* objective: innovation."
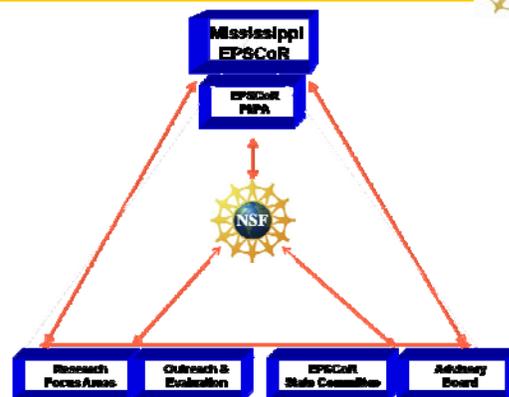
Contact Us:
Project Director:
Dr. Sandra Harpole
sharpole@research.msstate.edu

Project Administrator:
Dr. Teresa Gammill
tgammill@research.msstate.edu

Research Focus Area Leaders:

Computational Biology
   Dr. Susan Bridges, MSU
   sbridges@cse.msstate.edu

   Dr. Shane Burgess, MSU
   burgess@cvm.msstate.edu

Computational Chemistry
Dr. Jerzy Leszczynski, JSU
jerzy@ccmsi.us

Computational BioSimulation
Dr. Keith Walters, MSU
walters@me.msstate.edu

Education and Outreach
Dr. Giselle Thibaudeau-Munn, MSU
giselle@emcenter.msstate.edu

MISSISSIPPI EPSCoR

NEWSLETTER

MSU host MCBIOS conference

Mississippi's four research universities (Jackson State University (JSU), Mississippi State University (MSU), University of Mississippi (UM), University of Southern Mississippi (USM)) hosted the sixth annual conference of the MidSouth Computational Biology and Bioinformatics Society at the Hunter Henry Center on the MSU campus, February 20 – 21, 2009. The theme for this year's conference was "Transformational Bioinformatics: Delivering Value from Genomes."

Dr. Dawn Wilkins of the UM and Dr. Susan Bridges of MSU served as co-program chairs. Over 140 faculty and students from 10 states in the Mid-South ranging from Colorado to Alabama attended the conference. Drs. Bindu Nanduri and Andy Perkins of MSU were poster co-chairs for MCBIOS and coordinated the set up and judging of 80 posters (a conference record).

Keynote speakers included Dr. Howard Cash, president and CEO, Gene Codes Corporation, the company responsible for DNA forensics analysis after 9-11; Dr. Laura Elnitski, Head of the Genomic Functional Analysis Section at the National Human Genome Research Institute, and Dr. Cathy Wu, Director of the Protein Information Resource and professor in the Departments of Oncology and

## Molecular modeling and DNA hairpins structures

Dr. Randy Wadkins at the University of Mississippi and Dr. Xu Zhang at the Washington University School of Medicine in St. Louis, recently captured the cover picture on the March, 2009 edition of the Biophysical Journal. Their accompanying article *DNA Hairpins Containing the Cytidine Analog Pyrrolo-dC: Structural, Thermodynamic, and Spectroscopic Studies* can be found on pages 1884—1891. Structures formed by single-strand DNA have become increasingly interesting because of their roles in a number of biological processes, particularly transcription and its regulation. Of particular importance is the fact that antitumor drugs such as Actinomycin D can selectively bind DNA hairpins over fully paired, double-strand DNA. A new fluorescent base analog, pyrrolo-deoxycytidine (PdC), can now be routinely incorporated into single-strand DNA. The fluorescence of PdC is particularly useful for studying the formation of single-strand DNA in regions of double-strand DNA. The fluorescence is quenched when PdC is paired with a complementary guanine residue, and thus is greatly enhanced upon formation of single-strand DNA. Hence, any process that results in melting or opening of DNA strands produces an increase in the fluorescence intensity of this base analog.

Wadkins and Zhang measured the structural effects of incorporating PdC into DNA hairpins, and the effect of this incorporation on the binding of the hairpins by a fluorescent analog of the drug Actinomycin D. Two hairpin DNAs were used: one with PdC in the stem (basepaired) and one with PdC in the loop (unpaired). The thermal stability, 7-aminoactinomycin D binding, and three-dimensional structures of PdC incorporated into these DNA hairpins were all quite similar as compared to the hairpins containing an unmodified dC residue. Fluorescence lifetime measurements indicate that two lifetimes are present in PdC, and that the increase in fluorescence of the unpaired PdC residue compared to the basepaired PdC is due to an increase in the contribution of the longer lifetime to the average fluorescence lifetime. Data indicated that PdC can be used effectively to differentiate paired and unpaired bases in DNA hairpin secondary structures, and should be similarly applicable for related structures such as cruciforms and quadruplexes. Further, the data indicated that PdC can act as a fluorescence resonance energy transfer donor for the fluorescent drug 7-aminoactinomycin D.
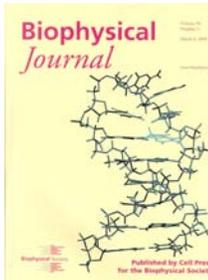
JSU's CBCB host Bioinformatics Awareness Month

The Center for Bioinformatics & Computational Biology (CBCB), College of Science and the Engineering & Technology (CSET) at Jackson State University (JSU) hosted an inaugural Bioinformatics Awareness Month from March 30—April 30, 2009. Under the direction of Dr. Raphael Isokpehi, director of the CBCB and assistant professor in the Department of Biology at JSU, the goal of the bioinformatics awareness month was to promote institutional capacity in bioinformatics and computational biology by infusing bioinformatics topics into courses; present students with graduate school opportunities; enhance collaborative bioinformatics research; and promote economic development in Mississippi through bioinformatics.

Collaborators from Pittsburgh Supercomputing Center at Carnegie Mellon University, Mississippi Computational Biology Consortium, University of Arkansas-Little Rock, Rutgers University, and National Center for Integrative Biomedical Informatics at University of Michigan visited JSU during this time. The key activities of the month included lectures and computer laboratory sessions on Bioinformatics topics, guest lectures on Bioforensics, grid computing, and cancer proteomics, training workshop on tools for adaptive searching of PubMed Literature database for graduate and postdoctoral students, and the speed networking for small business and higher education luncheon. The keynote speaker for the Technology and Informatics Luncheon and Speed Networking for Small Business and Higher Education was Dr. Wil Minter, director of Asset Management and Small Business Programs Division of the Oak Ridge National Laboratory. This event provided a unique opportunity for participants to quickly meet potential collaborators and business partners.

Calculating Health: DigitalHuman simulator prepares for blastoff

-Jack Mazurak

With a few keystrokes in DigitalHuman, a computer program developed at the University of Mississippi Medical Center, researchers can create an overweight and diabetic virtual patient, run him up a flight of stairs, give him a heart attack, then analyze thousands of moment-by-moment metrics to better understand the human body.

Scientists at NASA, using a version of the program, are predicting health problems astronauts could encounter three years into a mission to Mars.

Dr. Tom Coleman, professor emeritus of physiology and biophysics, estimates between 50-100 medical schools around the world use DigitalHuman for training.

Training is one thing, but Coleman and two colleagues, Dr. Robert Hester (left) and Dr. Richard Summers, are throwing open the doors even wider. They plan to release DigitalHuman in open-source code next month.

Coleman, also senior biomedical systems analyst in the Department of Emergency Medicine, began building digital models of the human circulatory system in the late 1960s with the late Dr. Arthur Guyton. They used off-hours computing power rented on room-sized monstrosities belonging to a hospital billing department and an area bank.

"Think about when I first started. The digital computer was just being invented," Coleman said. "The integrative model, now called DigitalHuman, was started in 1985. Before that, Dr. Guyton, myself and others were building smaller models – since the available technology at that time couldn't solve big models."

The 1985 model offered about 150 variable traits, including respiration rate and arterial pressure. That's now expanded to more than 5,000 variables, including liver-glucose uptake rates and hypothalamus function.

Hester, professor of physiology and biophysics, helped guide DigitalHuman and secured research funding that's come from agencies including NASA, the National Institutes of Health and the National Science Foundation EPSCoR.

"Over the years, Tom's done an amazing job developing it and Richard on testing it. We realize we'll never be done adding to it, but we're ready to put out an open-source version," Hester said.

The new version will let other scientists build on the program, adding their own specialties with more variables. It all but guarantees DigitalHuman will expand as quickly as scientific knowledge itself.

"It'll still be a UMMC product, but we want to open it up to the scientific community," said Summers, professor of emergency medicine.

To handle submissions from other scientists, they plan to use a system akin to Wikipedia's.

"As the scientific community becomes more involved, scientists could put forward modeled relationships and submit them to a library as potential add-ons to the larger program," Summers said. "We would, of course, verify the work before adding it. But you'd have groups of scientists submitting smaller models specific to their specialties."

At the same time, Coleman will keep adding more depth and specificity. Users recently asked for a female model so they could figure in different hormones, menstrual cycles and other variables. Coleman has completed simulation of the menstrual cycle and plans other additions.

"But just going from male to female gave us the notion of traits: age, gender, adiposity, muscularity and so on. This is getting pretty close to predicting individual-specific outcomes," he said.

DigitalHuman

With more depth, researchers globally will get more use from the program. At NASA's Glenn Research Center in Cleveland, Ohio, scientists are expanding a version called DigitalAstronaut. Why? Because nobody's got much data about what happens to humans biologically during long space flights. Or when we live on Mars, which has three-eighths gravity. Since it's a bit clunky to send a research facility into space, running DigitalAstronaut simulations in Ohio makes more sense.

"We're adding depth in areas where more detailed simulations are needed to reflect the possible outcomes of prolonged space flight," said Dr. DeVon Griffin, DigitalAstronaut project manager.

At the moment, he's working on detailed modules for cardio, bone turnover and renal-stone formation.

"If you go to Mars, you're going to spend six months in flight, a year-and-a-half on the ground and six months back. We have zero data on what happens in three-eighths G, but this program could simulate it," said Dr. Jerry Myers, technical lead on DigitalAstronaut at Glenn.

One way the different gravity would affect humans is cell absorption rate of water, Coleman said. "And you'd need to know how much water to send on a mission."

Summers, who coordinates with NASA, said DigitalAstronaut solved some problems that confounded the agency for 20 years. Though other scientists have developed computer-simulation programs, Griffin said none are as integrated and comprehensive. "The Mississippi Code is the most advanced, the most cutting-edge," he said.

The U.S. Environmental Protection Agency is using DigitalHuman to model chemical exposures, including carbon monoxide. Previously, the EPA tracked a virtual inhalation of toluene, an industrial chemical and solvent believed to affect the nervous system. Scientists at Stanford University programmed DigitalHuman's respiratory component into a device that could predict optimal settings for a ventilator

2008 MCBIOS Conference

Biochemistry and Molecular Biology at Georgetown University Medical Center.

Awards were given for the best student presentations and posters. Award winners were:

<u>Presentation Award Winners:</u>
First place: Enis Afgan of the University of Alabama Birmingham; second place: Lipi R. Acharya, University of New Orleans; third place: Anastasia Chueva, Mississippi Valley State University.

<u>Poster Award Winners:</u>
First place: Eric Morales, University of New Orleans; second place: Teresia Buza, MSU; third place: Prashanti Manda, MSU.

<u>Honorable Mention:</u>
Amanda Alba, University of New Orleans; Surya Saha, MSU; Sudhir Chowbina, Indiana University School of Informatics.

Dr. Raphael Isokpehi of JSU, chair of student activities, arranged a panel discussion and a networking event for student participants. The panel session for students was entitled Careers in Computational Biology and Bioinformatics: Perspective from Employers and Students. Employers from DOE, the FAA, DOD, provided student attendees with the qualifications they look for in new employees and answered student questions. A former JSU student, Cynthia

Jeffries, who now works for DOE described her experiences on entering the bioinformatics workforce. After the conference dinner, JSU faculty and students hosted "Bioinformatics Speed

Networking." Faculty, senior researchers, and students participated in a series of 3-minute sessions in which they introduced their research to another participant. The networking session lasted for over 2 hours and all participants were both excited and exhausted when it was over. The Office of Research at JSU provided prizes for participants that were awarded through drawings throughout the event.

The proceedings of this MCBIOS conference will be published as a supplement to the highly ranked journal *BMC Bioinformatics.* Dr. Jonathan Wren of the University of Oklahoma is editor of the supplement and co-editors include Isokpehi, Wilkins, and Bridges.

Bioinformatics Awareness Month

The objectives of the Bioinformatics Open House Symposium were to introduce the discipline of Bioinformatics; present efforts in the State of Mississippi to develop Bioinformatics capabilities, and showcase the Bioinformatics research and education at JSU. Invited speakers included Dr. Steven Jennings , executive director of the MidSouth Bioinformatics Center, University of Arkansas—Little Rock; Dr.

Susan Bridges, professor in the Department of Computer Science and Engineering at Mississippi State University, and Dr. Mohamed Elasri, associate professor in the Department of Biological Sciences at the University of Southern Mississippi. The symposium was followed by the ribbon cutting of the research laboratory, poster presentations, and software demonstrations.

at a patient's bedside. Researchers at the University of Scranton have used it to model high-altitude exercise and found its outcomes very close to human results, Hester said.

The opportunities for future uses for DigitalHuman will expand with tech-

nology and scientific knowledge.

"A hospital in Washington, D.C., wants to use it to train clinicians on treating burn victims," Hester said.

"We've been contacted by a lot of companies about looking into it."