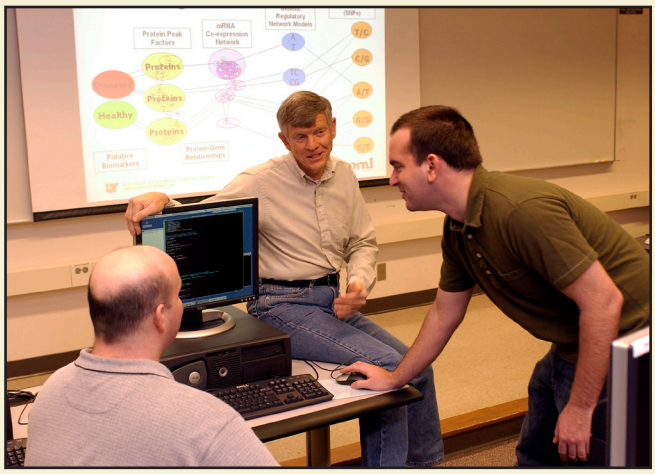
Faculty Focus — Dr. Michael Langston

Dr. Michael A. Langston, professor in the Department of Electrical Engineering and Computer Science, has always checked the box next to mathematics when given a career choice.

"I tell my students, 'If you concentrate on learning math and learning it well, it will open doors to many other fields,'" said Langston, whose love for math has opened many doors for him over the last four decades. Mathematics has most recently helped him build collaborations with molecular biologists in using a number of powerful algorithmic tools to solve cutting-edge problems in genetics and genomics.



Mike Langston (center) discusses computational and statistical issues for biological data integration with two of his PhD students, Jeremy Jay (right) and Charles Phillips (left).

Computation has forever changed scientists' ability to analyze and understand genes and proteins that control a myriad of cell functions at the heart of biological systems. Nevertheless, basic questions such as "What are the driving biological networks," "How do we find them" and "How do we alter them in order to improve human health" have long seemed out of reach. Limited biological information and a paucity of analytical tools have made it difficult even to make educated guesses. But that bleak landscape is rapidly changing. By coupling new sources of high-throughput biological data with novel combinatorial algorithms and high performance computer architectures, teams of scientists such as those working with Langston can now solve problems that were until only recently considered unassailable.

"Advances in our ability to generate, interpret and decompose biological data have dramatically improved our ability to understand highly complex biological systems," said Langston. "With a single experiment, we can now produce a snapshot of how every gene in an organism responds to stimulus. Combine that snapshot with our algorithms and access to supercomputing platforms, such those furnished to my team by the Department of Energy at Oak Ridge National Laboratory, and we can routinely solve in real time problems that were previously considered hopelessly intractable. This can help biologists who formerly devoted much of their careers to working on one or a few genes now to decipher immense numbers of gene and protein interactions at the network level."

Langston views his role as a computational scientist as something of a middleman in the tool chain. Biological scientists produce data in huge supply and Langston's team employs abstraction via graph and statistical theoretical tools to eliminate noise and irrelevant data, thereby focusing on key network interactions and reducing the problem to its compute core. Langston's team solves this core with their most efficient methods implemented on the fastest computational resources and are thus able to deliver relatively small and highly distilled solutions, such as sets of genes and proteins, back to the biological scientist, who is then able to complete the study and verify novel results with more traditional "wet lab" techniques.

"Such verification remains expensive and time consuming," said Langston. "By its nature it is highly infeasible without the computational component we provide, because otherwise there are overwhelmingly too many candidate solutions to consider."

Langston has devised novel tools to solve applied graph theoretical problems for over 25 years, and it is not surprising that he is one of the most visible people leading efforts to integrate new discrete mathematical techniques with high performance computational approaches to solve complex biological problems. Because Langston's work is in much demand around the globe, he has research contracts in several countries and travels as much as 200,000 miles each year to work with other scientists in order to delve deeper into human and other genomes.

"Student recruiting is also a major goal of my travels," said Langston, who considers himself an international ambassador for the university.

A typical example of his collaborative efforts is centered in Göteborg, Sweden, where Langston works as co-principal investigator on one of two contracts from the European Union.

"Scandinavia has a rich history of producing excellent twin data, specifically on monozygotic or so-called 'identical' twins," said Langston. "The question we want to answer is why is it that two individuals, born with the same DNA and raised in the same environment, are

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Faculty Updates

Dr. Way Kuo

Dr. Way Kuo, dean of engineering and a University Distinguished Professor, was elected as a Foreign Member of the Chinese Academy of Engineering (CAE) on a new members list that was announced December 29, 2007. A membership in the CAE is the highest academic title in engineering science and technology in China. Established in 1994, the Chinese Academy is the most prestigious and authoritative advisory institution in the nation's engineering and science field.

Dr. Kevin Tomsovic

Dr. Kevin Tomsovic has been named head of the University of Tennessee's Department of Electrical Engineering and Computer Science (EECS).

Tomsovic, who earned both his M.S. and Ph.D. in electrical engineering from the University of Washington, recently replaced interim head Dr. Luther Wilhelm.

Prior to coming to UT, where he will also serve as the CTI Chair in the EECS department, Tomsovic was a professor at Washington State University. From 2004-2006, he served as the program director for the Division of Electrical and Communication Systems for the National Science Foundation.

Dr. Mingjun Zhang

Dr. Mingjun Zhang has recently joined the University of Tennessee's Department of Mechanical, Aerospace, and Biomedical Engineering. Prior to coming to UT, Dr. Zhang worked in the Life Sciences and Chemical Analysis Division at Agilent Technologies in California.

Zhang was the first recipient of the Early Career Award (Government/Industry) by the IEEE Robotics and Automation Society in 2003 and is currently the associate editor for the IEEE Transactions on Automation Science and Engineering.

UT Associate Vice President for the University of Tennessee Space Institute **Dr. Don Daniel** will retire in May of 2008.

Dr. Don Daniel

Before joining UTSI, Daniel served as a research engineer with Boeing and worked for 30 years with the Department of the Air Force. He has also served as chairman of NATO's research and technology board.

Daniel joined UTSI in 2006 after being selected in a national search to lead the organization.

Faculty Focus *(continued from page 3)*

"The question we want to answer is why is it that two individuals, born with the same DNA and raised in the same environment, are concordant in their response to pollen and other allergens until they are a few years old and then, in many cases, they become discordant, with one but not the other developing a severe allergic response? That this happens at all may seem surprising to the layperson, but there are useful randomizations built into our immune systems that help to explain this behavior. With the high quality data we are receiving from Sweden, we are beginning to unravel the breakdown in gene network feedback mechanisms that appear to be root causes for allergen sensitivity and that will eventually, we hope, lead to better treatments."

Langston received his Ph.D. in computer science from Texas A&M University in 1981. Before coming to UT, he worked at Washington State University, the University of Illinois and the European division of the University of Maryland. He has authored over 200 refereed journal articles, conference papers, book chapters and other reports and served on a variety of editorial boards, including the Association for Computing Machinery's flagship publication, *Communications of the ACM*. Throughout his career, Dr. Langston has received honors for duty, teaching, research and service. Most notable among these are the Commendation Medal from the U.S. Army in 1979; the Distinguished Teaching Award from Texas A&M University in 1981; the Chancellor's Award for Research and Creative Achievement from UT in 1994; and the Distinguished Service Prize from ACM Special Interest Group on Algorithms and Computation Theory in 2001. The Department of Defense, Department of Energy, the National Science Foundation, the Australian Research Council, the European Union and a variety of other funding agencies have supported Langston's work.

Langston's three children, Glen, Katie and Keith, said when growing up that they had watched how hard dad worked and never wanted to emulate his example. Nevertheless, all three graduated from UT and wound up with scientific careers (biomechanical engineering, chemistry and computer science, respectively).

"I guess it must be in the genes somewhere," said Langston with a wink as he proudly shared his children's achievements. Ina, his wife of over 32 years, is also a UT graduate and works as an assistant principal at a local elementary school.

"We have great students here at UT," said Dr. Langston, who loves working with students at the university level. "Working alongside them helps keep you young...and relevant!"

Having the freedom to work on his own research agenda appeals to him, as does the flexibility to travel and collaborate with others as needed. "I like calling my own shots," said Langston.

"This is a wonderful time to be a scientist. We are confronted with an exciting confluence of emerging technologies that give us new problems and, hopefully, new solutions every day," said Langston.

Story by Amanda Womac

Chancellor's Message *(continued from page 2)*

to find the best dean possible for the engineering college, and we will continue in this search until we have found a candidate that meets that criterion.

The interim dean, Dr. Wayne Davis, who has served the college for over 30 years, and the COE administrators, faculty and staff remain committed to continuing the college's advancement.

We will continue to keep you informed about the progress of both the chancellor and dean's searches, and we value your input and comments. Please direct any correspondence to coe@utk.edu.

Jan F. Simek
Interim Chancellor
The University of Tennessee, Knoxville

Zachariah Named UT Vice President of Science and Technology

Dr. Thomas Zacharia, the UT-Battelle distinguished professor in the Department of Electrical Engineering and Computer Science (EECS), was recently appointed as the University of Tennessee's new vice president for science and technology. In addition to this new role, Zacharia will continue to act as the associate laboratory director for computing and computational sciences at Oak Ridge National Laboratory (ORNL).

Dr. Thomas Zacharia

"This new appointment helps to advance joint research activities," said Zacharia. "While there are now a number of joint UT/ORNL faculty positions, I would like to see the number of these positions increase, fostering more cooperation and collaboration."

"While the College of Engineering has strong departments and a great faculty, there is the potential to make it even stronger, primarily through more interaction between students and faculty via mentoring and programs such as internships at both the UT and ORNL campuses," Zacharia said.

Zacharia also points to the University of Tennessee Space Institute (UTSI) as another great collaborating opportunity that could further strengthen the college.

"Dr. Zacharia's appointment as UT vice president for science and technology also provides a unique opportunity for maximizing the extraordinary assets generated through this partnership," said UT System President John Petersen.

Building bridges between UT and ORNL is a role familiar to Zacharia. In 2007 he led the effort to bring one of the world's most powerful supercomputers to the Joint Institute for Computational Sciences, a collaboration between UT and ORNL, resulting in a $65 million award from the National Science Foundation.

"Researchers need increasingly powerful computing resources if they are to deliver the breakthroughs that society demands in climate science, energy research, and other fields," Zacharia said. "This award will guarantee that we are able to deliver those resources."

The award is the largest research grant ever received by the University of Tennessee. The new partnership, to be led by UT, is called the National Institute for Computational Sciences (NICS), and will facilitate the use of the new supercomputer, to be housed at Oak Ridge National Laboratory.

Zacharia received his B.S. in mechanical engineering from India's Karnataka Regional Engineering College, his master's degree in material science from the University of Mississippi, and his Ph.D. in engineering science from Clarkson University in 1987.

In the next edition of

TENNESSEE engineer

Information about Homecoming 2008
Save the date!
Saturday, November 8, 2008