Three Trailblazing Faculty Named Among Top Scholars

The Department of Computer Science and Engineering is starting 2013 with three faculty members earning one of the nation’s most prestigious scientific awards for young professors—the Faculty Early Career Development (CAREER) award. Given each year to the nation’s top scholars, the CAREER award supports junior faculty who exemplify the role of teacher-scholars. Among the criteria used for the National Science Foundation award: outstanding research, excellent education, and the integration of education and research within the context of the mission of each organization. In conjunction with the award, these assistant professors will receive at least $400,000 to support their research—an investment that according to the NSF will help these young scholars build a foundation for “a lifetime of leadership in integrating education and research.” Below are their stories.

Mike Bond joined Ohio State in 2011 with the goal of making modern computer systems reliable and efficient. Achieving this goal presents serious challenges as chip manufacturers make processors faster by adding more and more cores; this trend makes it notoriously difficult for programmers to develop and debug software that is both accurate and fast. As part of his current project, “Practical Language and System Support for Reliable Concurrent Software,” Professor Bond will work closely with graduate and undergraduate students in Programming Languages and Software Systems (PLaSS), his research group, to design and implement the first practical approaches for guaranteeing reliable parallel execution without sacrificing performance. These innovations will ultimately help parallel software systems overcome existing challenges and address society’s growing computing needs.

Kannan Srinivasan studies and develops wireless network and communication systems with the aim of improving performance, reliability, and security. He joined the university in 2011 and during that time has investigated everything from networking protocols to measurements to wireless nodes. His current project "Together We Rise: A Unified MIMO-Pull Duplex Network Architecture," aims to find a solution for one of the field’s most pressing problems: the need for higher capacity wireless networks. In the past, wireless networks have relied on a system that uses either all of its antennas for transmission or for reception; or, uses half of them for transmission and the other half for reception. Working closely with students and researchers, Professor Srinivasan will develop more flexible radios that can dynamically choose the number of antennas to transmit and receive, greatly increasing their capacity. Such a flexible radio can be used for optimizing reliability, security, or capacity. After development, he plans to work closely with Ohio State’s Technology Commercialization Office to patent and market the fully redesigned system.

Radu Teodorescu leads Ohio State’s Architecture Research Lab, a group focused on computer architecture, power management, and the impact of technology scaling on microprocessor design. Since joining the faculty in 2008, Professor Teodorescu’s research has centered on improving the energy efficiency of computing devices. His current project "An Integrated Treatment of Voltage Noise and Process Variability in Many-core and GPU Systems with Microarchitectural Solutions," aims to develop a new class of microprocessors that dynamically adapt to their environment and the applications they run, reducing energy usage. These systems are essential for big data centers, as well as personal gadgets such as mobile phones and portable devices, both of which are experiencing an increased demand for faster, more energy efficient computing. Teodorescu will partner closely with the Metro Early College High School, recruiting minority and female students as part of the project.
Message from the Department Chair

Dear CSE Alumni, Parents, Friends, and Colleagues,

Things are going well as we finish up the first academic year on semesters. This newsletter presents several important recognitions to CSE faculty and alums. On the junior faculty side, CSE assistant professors Michael Bond, Kannan Srinivasan, and Radu Teodorescu received NSF Career Awards. CSE alum Sriram Chellappan (PhD’07, Assistant Professor of Computer Science at Missouri University of Science and Technology) was also on the NSF CAREER awardee list this year. On the senior faculty side, two CSE family members became ACM Fellows in the end of last year: Ahmed Elmagarmid (PhD’85, Executive Director of Qatar Computing Research Institute, and Professor of Computer Science at Purdue University) and myself.

In addition, CSE Professor Bruce Weide received the Joel and Ruth Spira Excellence in Teaching Award. The award’s namesake, Joel Spira founded Lutron Electronics in 1961. He and his wife Ruth believe in recognizing the importance of American engineering education and its crucial role in the nation and world’s economic growth and health. They founded this teaching award more than 20 years ago to recognize outstanding engineering processors annually from a small selected group of universities including Cornell, Georgia Tech, Lehigh, MIT, Michigan, Notre Dame, Ohio State, Penn State and Purdue. Bruce has served in the department for 35 years, starting here upon completion of his PhD from CMU. He definitely deserves this prestigious award before his retirement in June.

I am glad to tell you that Neelam Soundarajan has agreed to take the associate chair position after Bruce retires. The CSE faculty has a strong consensus that Neelam is the best candidate for this important position.

Currently, we are busy recruiting five new faculty members in open ranks, which will significantly grow the department in different key areas including multidisciplinary research. In the most recent US News & Reports Ranking publication, our computer engineering graduate program is ranked #19. We will continue to make the best efforts to improve our education and research programs.

I look forward to providing more updates about the CSE family in the next issue of the Buckeye Blog.

Xiaodong Zhang
Chair and Robert M. Critchfield Professor
Computer Science and Engineering

2013 Graduate Poster Exhibit

First place winner, Joe Barker.

Second place winner, Onur Kucuktunc.

Third place winner, Preethi Jyothi.

At the 7th Annual CSE Graduate Student Poster Exhibition the following students were best poster award winners: first place went to Joe Barker’s poster “Temporally-Dependent Dirichlet Process Mixtures for Video Segmentation,” with adviser Jim Davis; in second place was Onur Kucuktunc’s poster, “The Advisor: A Web Service for Academic Recommendation,” with advisor Umit Catalyurek; and in third place was Preethi Jyothi’s poster, “Discriminatively Trained Pronunciation Models for Conversational Speech Recognition,” with advisor Eric Fosler-Lussier.
The Department: By the Numbers

Faculty
34 Regular Faculty
2 Clinical / Research Faculty
7 Research Scientists
1 Adjunct Faculty

Undergraduate Enrollment
480 Computer Science and Engineering Majors
398 Computer Science and Engineering Pre-Majors
173 Computer and Information Science Majors
222 Computer and Information Science Pre-Majors

Graduate Enrollment
117 MS Students
188 PhD Students

Research Expenditures
2012 $8.3 million
2011 $7.3 million
2010 $6.2 million
2009 $5.6 million

Alumni
5,828 BS Alumni
314 BA Alumni
2,183 MS Alumni
494 PhD Alumni
“We won, we won,” said my younger son. He had been watching a basketball game on TV while I was working on my laptop. The Ohio State men’s basketball team had just beaten the Michigan State team, and my son was happy about it. Although my son has never been to Ohio State, he identifies with it because I obtained my PhD in Computer and Information Science from OSU. Identity and loyalty apparently run in families and get passed from one generation to another.

I confess that I am quite fond of The Ohio State University. I completed my PhD there in 1989 under the guidance of Professor B. Chandrasekaran. My PhD dissertation investigated knowledge-based design. My dissertation committee included Professors Terry Patten and Jordan Pollack. I also worked with Dr. John Josephson and Dr. Sattiraju Prabhakar, as well as Professors Tom Bylander, P. Sadyappan and Neelam Soundaranjan. My colleagues in the Laboratory for Artificial Intelligence Research at the time included Dean Allemand, Olivier Fisher, Anne Keuneke, Kathy Johnson, Todd Johnson, Hari Narayanan, William Punch, Michael Tanner and Jon Sticklen.

I joined the computer science faculty at Georgia Institute of Technology immediately after my graduation from Ohio State, and have been at Georgia Tech since then. Although I have not changed jobs since 1989 (for Georgia Tech too is a fine university!), I have spent professional leave at Rutgers University and NEC Research Institute. At least two of my long-time faculty colleagues at Georgia Tech, Karsten Schwan and Jun Xu, also have strong connections with OSU.

Over the years since 1989 my research program has evolved. Initially upon joining the Georgia Tech faculty, I continued to develop AI theories and techniques for knowledge-based design, focusing on the themes of analogical thinking, systems thinking, and meta-thinking. After receiving promotion and tenure in the mid 1990s, I set up the Design & Intelligence Laboratory, and started exploring new topics. In particular, the goals of my research expanded from computational design to computational creativity, including, for example, scientific modeling. My research methodology expanded from knowledge-based AI to include Cognitive Science and my research foci expanded to include visual reasoning. By the late 1990s, I came to view analogical thinking, systems thinking, visual thinking and meta-thinking as fundamental processes of computational creativity.

Let me share one result of this line of research. We have developed a computational model of cognition in autism, based on the hypothesis that people with autism have a disposition to think in pictures. Although this hypothesis has been known in research on autism for quite a while, it has received surprisingly little scientific attention. We have tested our computational model on the Raven’s Progressive Matrices Test of intelligence that consists of visual analogy problems on which people with autism are known to perform as well as neurotypical people.

Our computational model correctly solves 50 out of the 60 problems on the standard test, a performance comparable to that of a typical 17-year old American and at least as good as any other model of the test. Imagine: a computer program that thinks only in pictures, takes intelligence tests and does as well as many humans.

Around 2005, my research program evolved again. In particular, the goal and methodology of my research evolved from AI and Cognitive Science into Human-Centered Computing. Thus, instead of building cognitive models or autonomous systems, I started building interactive tools for helping people with their tasks. Much of this work focuses on biologically inspired design: biologically inspired design is an old design paradigm that over the last generation has blossomed into a design movement, pulled in part by the need for environmentally sustainable development, and pushed partly by the desire for creative designs. The topic of biologically inspired design allows me to integrate and build on my long-standing research themes of analogical thinking, systems thinking, visual thinking, and meta-thinking.

Fortunately, our work on biologically inspired design has received some success. I recently gave a TEDx talk on biologically inspired design. I now serve on the Board of Biomimicry 3.8 Institute and the BioInspired! digital magazine. Our theories have helped transform the teaching and learning in Georgia Tech. For example, ME/ISyE/MSE/PTFe/BIOL 4740 is an interdisciplinary, senior-level, project-based course on biologically inspired design. Springer is about to publish a volume on computational methods and tools for biologically inspired design that I co-edited. We are now trying to spawn a start-up company for commercializing our interactive tools for biologically inspired design. Thus, I expect the next few years to be quite exciting.

I also have many personal memories of time at Ohio State. It is there that I fell in love for the first time (and did so more than once!). I am now blessed with two sons. My older son, Gautam, is a sophomore at Georgia Tech with a double major in applied mathematics and computer science. I think he too wants to become a professor at a research university and devote his life to science and education. My younger son, Kunal, who likes to watch Ohio State games on TV, is a junior in high school. He says he wants to study journalism at Ohio State though I don’t know whether he actually will join Ohio State next year. I do know that wherever I go, I will take fond memories of Ohio State and act as an ambassador for the great university.

The following link will direct you to my webpage: <http://home.cc.gatech.edu/dil/3>.
In looking for a graduate program in computer science in the spring of 1969, I was attracted to Ohio State primarily because of the energy and the diversity of interests in its faculty. I arrived in Columbus in the fall of 1969. Professor B. Chandrasekaran arrived early in 1970 and I would eventually become his second computer science PhD graduate. I had some interesting experiences at OSU; in 1971, at the tender age of 23, I found myself teaching a junior-senior level course in “business data processing” to mostly accounting majors because I had spent four undergraduate summers with IBM in New York, which made me one of the few people in the department with business computing experience.

In 1972 I was one of the first students to join Professor Charles Csuri’s Computer Graphics Research Group, which was then housed in a nondescript, multi-purpose research building somewhere on the other side of the Olentangy River. I know the building was multi-purpose because one day I had to dodge some white mice in the hallway that apparently escaped from another lab in the building. My dissertation was the invention of the world’s first computerized facial compositor. I was one of four co-developers, and the first application user, of Tom DeFanti’s Graphics Symbiosis System, an early graphics language written in DEC PDP 11/45 assembler language, that was eventually used to produce a couple of the special effects in the first Star Wars movie. (I wrote the code that apparently was used to make an image of the Death Star rotate on a rear projection screen in the movie, as the good guys were planning their attack.)

When I graduated in early 1974, I was determined to go into industry and, not surprisingly, I joined IBM full-time. I quickly discovered that at that time in industry, there was very little going on in artificial intelligence or computer graphics, except in pure research, which I did not want. I was given an opportunity to start working in database management and I took it (I later knew Ed found that I derived the most satisfaction from the seven years that I spent as the youngest faculty member in what was then IBM’s most advanced, internal teaching facility, the IBM Systems Research Institute (SRI) in New York. While at SRI, I wrote two books on databases and conducted the first, large-scale survey on the subject of data administration in 1981.

In the late 1980s, I made the leap to academia. I decided to go the management information systems route partly because of the type of experience I had gained in IBM and partly because of the eye-opening view of MIS departments that I had acquired as one of the judges in a competitive program that IBM ran in 1984 to encourage the growth of MIS programs. Eventually, I was offered the MIS department chairman position at the University of Memphis. Today, as an MIS professor at Memphis, I continue to write database books (my third book is in its second edition), and to conduct research in data administration, as well as in other interests including software testing and electronic commerce. In 2007, I conducted a survey on data administration using some of the same questions from 1981, providing a unique quarter-century view of the evolution of that discipline.

I’ve never grown tired of the computing field and have embraced the excitement of the constant innovation and change. And, being in the business this many years provides some interesting perspectives. For example, the very same algorithms that we studied and used in visual pattern recognition in the early 1970s are now applied to marketing and financial data and they call it “business intelligence.”

Alumni: We Want to Hear From You
Win a Pair of OSU Football Tickets

Do you have an update to include in the next alumni newsletter? Do you have any suggestions for topics you would like to see covered? Do you have any photos from your college days or today that we can include? We want to hear from you! Email us your updates, photographs or suggestions to Carrie Stein at alumni@cse.ohio-state.edu or mail them in the attached envelope to be entered to win a pair of OSU football tickets.
Alumni Notes

ACM Awards Honor of Fellow to Ahmed Elmagarmid

Ahmed Elmagarmid, PhD ’85, was named an Association of Computing Machinery (ACM) Fellow for his contributions to database management systems. ACM, the largest scientific and educational computing society, awards this distinction to outstanding members who have made exceptional contributions to information technology, and whose work has generated advances in computer science and information systems.

Elmagarmid currently serves as the inaugural executive director of Qatar Computing Research Institute, part of the Qatar Foundation, and has served professor of computer science at Purdue University. Elmagarmid’s interests have focused on the application of database technology and cyber infrastructure to a variety of societal problems. The areas of his research include digital government, health care and telemedicine, and life science applications. Elmagarmid has worked in video databases, data quality and confidentiality, data integration, web service, bioinformatics and multidatabase systems. Preceding his position at Qatar Institute, he was director of both the Indiana Center for Database Systems and the Cyber Center at Purdue University's Discovery Park.

Elmagarmid’s awards and distinctions include the National Science Foundation’s Presidential Young Investigator award and distinguished alumni awards from both The Ohio State University and the University of Dayton. He is a fellow of the IEEE and has published six books and over 150 papers.

Mathew Boston, BS ’08, is the client principal at Neo Innovation Inc.

Stephen Edwards, PhD ’95, is an associate professor of computer science at Virginia Tech and received the 2013 Virginia Outstanding Faculty Award recognizing his excellence in teaching, research, knowledge integration, and public service. He also received the W.S. “Pete” White Chair for Innovation in Engineering Education by the Virginia Tech Board of Visitors in 2012.

Christopher Fahey, BS ’11, is a software engineer at Cardinal Solutions.

James Fowler, BS ’90, PhD ’96, is professor and graduate program director at Mississippi State University.

Steve Harman, BS ’04, is currently the developer and developerer for Highgrove/Big Nerd Ranch. As developerer-and no, that’s not a typo, he helps software developers advance their fundamental software design skills.

Jason Hurley, BS ’03, is a reporting services and information strategist for TenEleven group in Clarence Center, New York.

Mohammad Karim, BS ’04, is an automation engineer/architect for Morningstar Inc. in Chicago, Illinois.

Edward Kowalski, BS ’90, retired from Alcatel Lucent as a member of their technical staff.

Thomas Loffing, BS ’08, MS ’10, is a software engineer at IBM in Dublin, Ohio.

Cindy Mills, BS ’78, is director in advance procurement at Alcatel-Lucent in Galena, Ohio.

Sagy Mintz, BS ’84, MS ’88, is a distinguished software engineer, and innovation leader at Allscripts Healthcare Solutions in Lincolnshire, Illinois.

Mark Poulson, BS ’84, is a software engineer at the Boeing Company in Kent, Washington.

Neal Schneider, BS ’07, is a manager for Crowe Horwath LLP.

Simone Perry, BS ’12, is an application analyst for Big Lots Stores, Inc. in Columbus, Ohio.
Patrick Shuff, BS '10, joined Facebook’s site reliability team in Menlo Park, California. His job is to ensure the availability of the entire infrastructure and work with new product tiers to ensure they are taking advantage of the high availability services.

Donald Stuber, MS ’76, works as a senior software developer for Post-N-Track, Inc. in Connecticut. Also as time permits, he often teaches an evening computer science course at Naugatuck Valley Community College.

Stephen Sullivan, BS ’86, is co-founder and management partner of Convergent Law Group.

Brian Thomsen, BS ’05, is a computer research scientist at GE Healthcare in Milwaukee, Wisconsin.

John Tolbert, BS ’83, has worked as a government contractor performing software development, systems engineering, biometrics, records management, and organizational change for the DoD and Intelligence Community for 29 years. Tolbert started First In Solutions, Inc. in November 2006. Although it is still in the start-up phase, the company is poised to grow in the coming years.

William Triest III, BS ’07, works for The Ohio State University as a senior systems manager-DMS.

Richard Sharp, PhD ’06, is the lead software developer at the Natural Capital Project, a non-profit partnership between Stanford University, the Nature Conservancy and the World Wildlife Fund. Rich leads a software team that developed a land use planning software used by governments around the world to make optimal land use decisions by modeling and optimizing a range of services that nature provides including avoidance of catastrophic floods, water pollution and severe soil erosion. After earning his PhD in computer science from Ohio State with his adviser Raghu Machiraju, Rich joined the faculty at St. Lawrence University and moved to California in 2010 to follow his wife, Mariana Sharp PhD ’07, when she accepted a job at Google. Rich’s research interests include developing software for natural science applications, high performance computing applications and scientific visualization.

John Woodruff, PhD ’12, is an algorithm developer for Audience, Inc. in San Jose, California.

Nathan Hessler, BS ’07, is a software engineer for Customlink in Arlington, Virginia.

CSE alumnus, Sriram Chellappan, PhD ’07, has received a CAREER award from the National Science Foundation in 2013. The award focused on Chellappan’s research “Human Behavior Assessment from Internet Usage: Foundations, Applications and Algorithms,” that improves upon current self-reporting studies in cyber-psychology that are limited in reliability. The goal of the research is to establish private, passive and unobtrusive internet applications to monitor mental health care, improve online socializing, enhance cyber security and detect cyber bullying. The data collected from these applications, in tandem with behavioral psychology will be analyzed by classification algorithms; the research will ultimately demonstrate the application’s potential to achieve significant insights and conclusions in assessing human behavior through internet usage data. The research is currently tested with college-aged students but Chellappan will also collaborate with K-12 schools to further enhance project outreach.

Chellappan received his PhD in computer science and engineering from The Ohio State University under the direction of CSE Professor Dong Xuan. He is currently an assistant professor in the Department of Computer Science at the Missouri University of Science and Technology.

Monitoring Mental Health with Passive Internet Applications

SEND US YOUR UPDATES AT
www.cse.ohio-state.edu/cgi-bin/alumni/alumni.cgi
Radu Teodorescu

Designing Low-Power Microprocessors in the Era of Unpredictable Transistors

For many decades we have taken for granted the fact that computer performance has been doubling every one or two years. This extraordinary growth created an industry that has impacted almost every aspect of our lives—from the way we work to the way we play, and how we communicate or provide healthcare. This revolution was enabled in no small part by one of the computer’s core technologies: the microprocessor. Over the last fifty years, microprocessors have benefited tremendously from technology innovations that have delivered more and faster transistors with every new generation. Unfortunately, that technology has reached an impasse in recent years, as transistors have approached low-nanometer dimensions. Transistors are so small in the latest technology that about 6 million of them would fit in the period at the end of this sentence. These transistors are less predictable, less reliable and their energy efficiency is increasing very slowly. Building chips with these minute transistors is likely the most significant manufacturing challenge humans have ever undertaken.

These technological challenges are happening at a time when the need for energy efficient computing is greater than ever. The recent explosive growth of ultra-portable computing devices like smartphones and tablets is reshaping the consumer computing landscape. Expectations of battery life for these devices are now measured in days rather than hours. At the same time, these ultra-portable devices are rapidly becoming gaming consoles and productivity platforms with high performance demands. Meeting these performance requirements, while keeping power consumption under control, requires dramatic improvements in the energy efficiency of computation. Power consumption is now the main roadblock facing one of our fastest-growing industries.

The work conducted at Ohio State in the Computer Architecture Research Lab, led by Assistant Professor Radu Teodorescu is taking on the challenge of designing faster and more energy efficient microprocessors under the most adverse technological challenges our industry has ever faced. Overcoming these challenges will enable a new class of energy-conscious microprocessors that deliver the performance of supercomputers in mobile form factors, and enable environmentally-responsible growth in computing.

The principal approach used in this undertaking is a new computing paradigm generally referred to as “Near-Threshold Computing” (NTC). This technique relies on lowering the supply voltage (Vdd) of a chip to a level only slightly higher than the threshold voltage (Vth)–the level at which transistors begin conducting current. Vdd is the most powerful lever for improving energy efficiency because it impacts both dynamic and static power super-linearly. Even though NTC significantly reduces chip speed, it allows for many more computation units (cores) to be powered on simultaneously for the same power cost. Multi-threaded workloads that can take advantage of the increased parallelism can run much more efficiently at NTC. Experimental data shows these applications can attain 8x to 10x higher energy efficiency at NTC compared to conventional super-threshold computing (STC). A recent prototype of a low-voltage chip from Intel Corp. is showing very promising results.

Unfortunately, Near-Threshold Computing faces multiple challenges before it can become a mainstream technology. This is because NTC is less reliable than conventional technology, requiring additional protection against failures. NTC also amplifies the effects of process (post-manufacturing) and runtime variability.

Process variability is caused by the relative imprecision in the manufacturing process of chips with very large numbers of minute transistors. This imprecision makes transistor dimensions and properties somewhat uncertain and with a high degree of variability—not unlike cells in the human body. This variability affects crucial transistor parameters such as threshold voltage and leads to heterogeneity in transistor speed and power consumption. A microprocessor, which is generally homogeneous by design, will instead behave more like a heterogeneous system with cores that have different speeds and power consumption profiles. This heterogeneity is very large at NTC, with design-identical cores having 2-3x variation in top speed (Figure 1). This very large and unpredictable heterogeneity can be very detrimental to the performance

![Intel NTC chip. (source: Intel Corp.)](image)

![Figure 1: Variation in core frequency in a simulated 64-core NTC chip.](image)
and energy efficiency of synchronized parallel applications such as those used in scientific computing.

Professor Teodorescu's group at OSU has developed mechanisms for addressing variation-induced heterogeneity in near-threshold chips. One such solution relies on a microprocessor design that provides two power supply lines to each core set at two very low but different voltages. Each core in the CMP can be dynamically assigned to either of the two power rails using a gating circuit. This allows each core to periodically switch between two different maximum frequencies, on a predetermined schedule. The schedule is different for each core and is chosen so that core frequencies average to the same value over a finite interval. This means that cores that are inherently slow are scheduled to spend more time on the high voltage rail while those that are fast will spend more time on the low voltage rail. The result is a CMP that achieves performance homogeneity from an underlying heterogeneous fabric.

Low-voltage operation slows down transistors and makes them more likely to behave unpredictably which can lead to computation or memory retention errors. Large memory blocks such as those used in large on-chip caches are especially vulnerable. They are optimized for density and therefore built using the smallest transistors, which are the most sensitive to low-voltage operation.

Professor Teodorescu's group has developed a new error correction technique designed for near-threshold caches. The basic idea is to apply a simple error correction code repeatedly, in multiple permutations, to a data block to achieve an exponential increase in error correction capability. The proposed solution trades off correction strength for decoding time. While this iterative decoding process takes longer than traditional schemes, it is a pay-as-you-go approach (depending on the severity of the errors and the correctness requirements). This means applying more decoding iterations to lines that suffer larger numbers of errors and fewer decoding iterations to the others, while keeping the storage overhead low. This technique allows near-threshold chips to operate reliably in the presence of high error rates.

Another significant challenge of NTV operation is the increased sensitivity to voltage fluctuations. These fluctuations are caused by abrupt changes in power demand triggered by processor activity variation with workload. If the voltage deviates too much from its nominal value, it can lead to so-called "voltage emergencies," which can cause timing and memory retention errors. Figure 2 illustrates voltage variability across a 4-core chip at some time instance T. The heat map represents percentage drop in supply voltage relative to nominal values. Voltage variability correlates with chip activity. Sections of the chip that are inactive show no voltage drop (purple areas on the map), while areas of intense activity exhibit significant voltage drops (red and yellow areas).

Figure 2: Voltage variability in a 4-core chip multiprocessor.

Professor Teodorescu's group is developing hardware/software co-design solutions that enlist software support to address these hardware vulnerabilities. For example, by redesigning synchronization libraries to include knowledge about voltage variability effects, the synchronization primitives can smooth-out power spikes and eliminate voltage emergencies.

Near-Threshold Computing has the potential to sustain the performance and energy efficiency growth of computing systems for another decade or more. Overcoming its significant challenges however requires a new level of innovation that spans multiple layers of the computing stack including circuits, microarchitecture, runtime systems and software. Professor Teodorescu's team brings together experts in each of these areas to work on making NTC a reality. The applied nature of this research benefits tremendously from close collaboration with industry partners interested in NTC such as Intel and Mentor Graphics. As part of a GOALI (Grant Opportunities for Academic Liaison with Industry) project funded by the National Science Foundation Professor Teodorescu's team is working with Mentor Graphics researchers to design and enhance the capabilities of modeling and CAD tools to accurately support NTC development.

Professor Teodorescu's research is contributing to and is supported in part by the Defense Advanced Research Projects Agency (DARPA) through the Power Efficiency Revolution for Embedded Computing Technologies (PERFECT) program, an ambitious five and a half year project that seeks to build an embedded computing system for military and other applications with a computation efficiency of 75 gigaflops/watt. By comparison, a typical system today achieves a computation efficiency of about 1 gigaflop/watt, almost two orders of magnitude lower. The driving technology behind this embedded system is Near-Threshold Computing. Professor Teodorescu's team together with teams from University of Illinois and University of Wisconsin are responsible for designing circuits, architecture and runtime components that mitigate and tolerate parameter variations at Near Threshold.

"Near-Threshold Computing has the potential to sustain the performance and energy efficiency growth of computing systems for another decade or more."

-Radu Teodorescu
Faculty Updates

Team Researches Ways to Build Speech Recognition Systems for New Languages Under Severe Data and Time Constraints

CSE Associate Professor Eric Fosler-Lussier is participating in a multi-institution IARPA Babel Program focused on building speech recognition solutions. Using only a fraction of the training data usually required, the team aims to build speech recognition systems for several languages. The work aims to better understand fundamental challenges and to discover new methods for the development of speech models for emerging languages.

“The goal of the Babel program is to rapidly develop agile and robust speech recognition technology to support effective key word search for new languages using limited amounts of transcribed speech recorded in real-world conditions,” Mary Harper, the IARPA Program Manager of the Babel program said.

The effort of Fosler-Lussier’s lab will focus on developing techniques for rapidly building acoustic representations of new languages based on the linguistic patterns found in other languages, while also investigating novel methods for combining information from disparate sources to improve the search process of finding keywords in audio streams.

“The real challenge that all teams in this program face is making our machine learning algorithms robust, flexible, and precise: we need to leverage many sources of information and learn what information is crucial for different languages,” Fosler-Lussier said.

The speech recognition systems are used to index recorded audio to make it easier to find “key words” in recordings. “Imagine trying to find YouTube videos that mention Chihuahuas, or finding the portion of a recorded computer science lecture that talks about Dijkstra’s algorithm,” Fosler-Lussier said. “That’s time consuming for humans, but possible. Now imagine trying to find the same place in a French video if you don’t speak French. That’s roughly what our systems are trying to do, given the equivalent of a few lessons in the language.”

Due to the challenges of the Babel Program, the team will research basic principles of speech technology rather than incremental improvements to existing technology. In addition, this research will be useful in enabling keyword-search systems for those languages that do not have large amounts of transcribed audio.

The project is led by Professor Nelson Morgan of The International Computer Science Institute (ICSI) at Berkeley University, in collaboration with Fosler-Lussier, Steven Wegmann of ICSI, Professor Mari Ostendorf of the University of Washington, Professor Janet Pierrehumbert of Northwestern University, and Professor Dan Ellis of Columbia University.

The project is funded by the Intelligence Advanced Research Projects Activity (IARPA), a research arm of the Office of the Director of National Intelligence, which invests in high-risk/high-payoff research programs.

Gagan Agrawal, with RNET Technologies, received a DOE SBIR Phase I award entitled “Simplified Access to Massive Climate Modeling Data Sets for End Users.” In addition, Agrawal gave an invited presentation titled “Graph Mining Using the Ex-MATE System,” as part of a workshop on Parallel Algorithms and Software for Analysis of Massive Graphs.

Tamal Dey published a book titled Delaunay Mesh Generation with Siu-Wing Cheng from HKUST and Jonathan Shewchuk from UC Berkeley. The book describes state-of-the-art algorithms with justifications for generating Delaunay meshes. The constructed meshes are used in applications such as finite element methods, interpolation, rendering, terrain databases, and geographic information systems. The book is intended to benefit researchers, graduate students, and engineers who work with meshes.

Rajiv Ramnath and Eric Fosler-Lussier were awarded a grant from the Institute of Education Sciences entitled “Reducing special education/reading risk through an oral reading fluency intervention for urban learners,” led by Gwen Cartledge, OSU College of Education.

Dhabaleswar K. (DK) Panda, is participating in the university-wide NSF award entitled “C-NIE Integration: Innovations to Transition a Campus Core Cyberinfrastructure to Serve Diverse and Emerging Researcher Needs.” In addition, he received a gift from Intel in support of Enhanced MVAPICH2 Design for Stampede with Intel MIC. Professor Panda also delivered keynote talks at IEEE Cluster ‘12 conference in Beijing, HPC Advisory Council Conference in Spain, HP-CAST’ 19 in Salt Lake City and HPC Advisory Council Conference in China.
Bruce Weide to Retire After 35 Years

After 35 years of inspiring and advising both undergraduate and graduate students, Professor Bruce Weide has announced that he will be retiring in June from his position as professor. Since his career started at OSU in 1978, Weide has advised or co-advised 28 PhD graduates and has encouraged countless undergraduates. His excellent work with students was recognized by the IEEE Computer Society through their Computer Science and Engineering Undergraduate Teaching Award, which he received in 2000 along with his recently retired friend and colleague Tim Long. In addition, Weide has recently been awarded the Joel and Ruth Spira Excellence in Teaching Award and the CSE Departmental Teaching award.

Further evidence of his dedication to teaching is his foundations-focused course curriculum. Weide has been engaged in a long-term effort to integrate component-based software engineering principles developed through research activities of the Resolve/Reusable Software Research Group (RSRG) into the undergraduate computer science curriculum. The ultimate goal of these activities has been to create the core of an instructional system capable of producing software professionals with greater awareness and understanding of the foundational issues to be faced by tomorrow’s software industry, and with demonstrably better software design and development skills than they would have from a traditional curriculum.

In an effort to reach this goal, Weide worked with a number of students and colleagues in the design and implementation of new software components and tools. Longtime friend of Weide and Professor Emeritus Stuart Zweben recalls the skills that have helped Weide become a successful professor and researcher.

“Bruce has been a strong advocate and practitioner of transparency in administration. Also, he has a gift of being able to explain concepts clearly in both oral and written form. This has made him successful in both teaching and research. He is quick to give credit to others and is not one to toot his own horn. This made him a very easy person with whom to collaborate, and is why he is liked by so many students and faculty,” Stuart Zweben said.

Accompanying his work in the classroom, Weide works as a director of the Resolve/Reusable Software Research Group RSRG, a distributed research group with members across the country. The research focuses on component-based software engineering and is currently tackling Tony Hoare’s Grand Challenge of a “verifying compiler.” This work is grounded in formal specification of functionality and performance, modular verification of correctness and efficiency of implementations, and design of programming languages and systems, while keeping one eye on adaptation of the Resolve research technology to practice.

Weide graduated in 1978 from Carnegie Mellon University with a PhD in Computer Science and in 1974 with a BSEE from the University of Toledo.

Feng Qin received a NSF three-year award for collaborative research on the topic of automated model synthesis of library and system functions for program-environment co-analysis.

Prasun Sinha received a one-year National Science Foundation grant entitled “WideSpot: Enabling Predictable Wide-Area Coverage over Scattered Hotspots.”

Nasko Rountev received a Google Research Award for his work “LeakDroid: Exposing and Debugging Leaks in Android Applications.”

Xiaodong Zhang and Cathy Xia received an award from IBM Shared University Research Award to support their research on “Big Data, Analytics, and Cloud Project.” In addition, he received an IBM Faculty Research Award.

P. (Saday) Sadayppan received a two-year Phase 2 AFOSR STTR grant with RNET Technologies on the topic of scalable multi-tiered CFD and CSD codes for kestrel.

Largest Group from OSU Attends the Grace Hopper Conference in Boston

Twelve CSE/CIS female undergraduate students traveled to Baltimore, Maryland this October to attend the 12th Annual Grace Hopper Celebration of Women in Computing (GHC). The annual conference, presented by the Anita Borg Institute for Women and Technology, is the world’s largest gathering of women in computing. This year’s theme, “Are We There Yet?” focuses on achieving concrete goals in the continuously evolving culture of technology. The conference is composed of several sessions led by well-known keynote speakers and invited technical speakers, as well as, panels, workshops, new investigator technical papers, PhD forums, technical posters, birds of a feather sessions and the ACM Student Research Competition followed by an awards celebration. Leading researchers present their current work, while specific sessions focus on the role of women in today’s technology fields, including computer science, information technology, research and engineering.

Bettina Bair, a senior lecturer for CSE, participated in a special session about starting and maintaining student or professional organizations for women in the IT industry. This session received strong attendance from students at the conference.

The students attendance was made possible by former Association of Computing Machinery Committee on Women President Rosi Wyan with help from Bair and Associate Professor Paul Sivilotti. The group was able to receive funding from the National Center for Women and Information Technology (NCWIT) as well as funding from local companies, including Chase, CoverMyMeds, Harris, Epic, etc. In addition, they were sponsored by the Computer Science and Engineering and Department and the OSU College of Engineering.

NOWLAB Research Group Attends Supercomputing 2012

NOWLAB, a CSE research group directed by Professor Dhabaleswar K. (DK) Panda, was invited by Mellanox Technologies to participate in their booth at Supercomputing 2012 in Salt Lake City. NOWLAB focuses on experimental computer science research; the development of better middleware, API, and programming environments; performance of integrated research; and new designs for high performance network-based computing systems. Specifically, NOWLAB develops and maintains MVAPICH2/MVAPICH2-X software that delivers the best performance for scalability and fault tolerance for high-end computing systems and servers using InfiniBand, 10GigE/iWARP and RoCE networking technologies. This open-source software is used by more than 2,015 organizations world-wide; including some of the highest ranked supercomputers like Stampede at Texas Advanced Computer Center, ranked 7th; Pleiades at NASA, ranked 14th; and Tsubame 2.0 at Tokyo Institute of Technology, ranked 17th. The software helps users to extract the potential of emerging networking technologies for modern systems. Over 158,000 downloads of the software have occurred as of March 2013.

Members of the NOWLAB team participated in multiple activities at the conference; including Krishna Kandalla who presented at the Doctoral Showcase program and Professor Panda presented a keynote talk at the HP-CAST event and an invited talk at the HPC-China workshop. Team members had tutorials, presentations and demos on performance and scalability tuning for the MVAPICH2/MVAPICH2-X software, fault-tolerance and resiliency support, and support for GPGPUs, Intel MIC and Hybrid MPI+PGAS. They also demonstrated research results related to the new Hadoop-RDMA project. Two papers were presented at the main conference under the Technical Papers program: RDMA-level designs for Hadoop (HDFS) by Nusrat Islam and Topology-aware Placement of Processes by Hari Subramoni. “Design of a Scalable InfiniBand Topology Service to Enable Network-Topology-Aware Placement of Processes,” by Hari Subramoni, Sreeram Potluri, Krishna Kandalla, B. Barth, J. Vienne, J. Keasler, K. Tomko, K. Schulz, A. Moody and D. K. Panda, was a best paper and best student paper finalist.
Preethi Jyothi, CSE PhD candidate, was awarded one of three ISCA Best Student Paper awards at Interspeech 2012 for her paper “Discriminatively Learning Factorized Finite State Pronunciation Models from Dynamic Bayesian Networks” with Eric Fosler-Lussier, CSE, and Karen Livescu, Toyota Technological Institute at Chicago. Recognizing conversational speech is particularly challenging for automatic speech recognition systems because of a large amount of pronunciation variability. The paper presents a general approach to exploring a model that better explains pronunciation variations, using a machine learning framework called dynamic Bayesian networks (DBNs), to relate the movements of a speaker’s articulators (e.g., lips, tongue) to sounds produced in the form of loosely coupled streams.

Bin Ren, CSE PhD candidate, was awarded a Best Paper Award at CGO 2013 for his paper “SIMD Parallelization of Applications that Traverse Irregular Data Structures,” with authors Gagan Agrawal, James R. Larus, Todd Mytkowicz, Tomi Poutanen, and Wolfram Schulte. SIMD parallelism is becoming more commonplace, but so far has only been used for regular applications. This paper describes methods that allow irregular, pointer-traversal based applications to be parallelized on SIMD hardware.

Arnab Nandi won the Vision Track Best Paper Award at the 2013 Conference on Innovative Data Systems Research in Asilomar, California. His paper “Querying Without Keypads,” outlines a vision for database system architectures in the age of keyboardless computing devices such as tablets, smartphones, and Kinects.

Jing Li, CSE PhD candidate, received a best paper award for “Achievable Throughput in Duty-Cycled Wireless Networks,” authored by Li, Wenjie Zeng and Anish Arora, at IEEE MASS 2012 in Las Vegas, Nevada. The paper presents throughput capacity bounds in wireless networks whose radios must alternately wakeup and sleep to conserve energy. The paper examines canonical classes of existing duty in terms of the capacity they achieve, and shows that the class of “receiver-centric, synchronous” MACs achieve capacity that is closest to a certain theoretically optimal (but not easily implemented) duty-cycled MAC scheduler.

Louis-Noel Pouchet (former post-doctoral researcher in CSE), with co-authors Peng Zhang and Jason Cong, UCLA, and P. Sadayappan, CSE, received the best paper award at the 21st ACM/SIGDA International Symposium on Field-Programmable Gate Arrays (FPGA 2013). The paper describes a new tool called PolyOpt/HLS that can automatically and simultaneously perform loop transformations on-chip memory buffering, off-chip data access re-ordering, and design-space exploration that frequently outperforms hand-coded Register Transfer Logic design. Pouchet is now a visiting research professor at UCLA.

Mehtem Kurt and Professor Gagan Agrawal received a best paper award from HiPC 2012, for their paper “A Fault-Tolerant Environment for Large-Scale Query Processing.” This paper focuses on making a large data store fault-tolerant, by strategically replicating data. The foundation of the paper is storage and query processing in a cluster environment where data from scientific experiments are stored. The goal is to provide not only high fault-tolerance, but also load balancing both in absence and presence of failures.

The GRAVITY research group received a best poster award and an honorable mention for best paper award at the IEEE Scientific Visualization conference (SciVis) and the Symposium for Large-Scale Data Analysis and Visualization (LDAV), respectively. While both works focus on large-scale flow visualization, they address two different challenges. The poster entitled “Exploring Flow Fields Using Fractal Analysis of Field Lines,” authored by Abon Chaudhuri, Teng-Yok Lee, Han-Wei Shen, Marc Khoury and Raphael Wenger, presented a fractal theory based method of visually exploring large data without becoming tedious and ineffective to the user. The paper “Flow-guided File Layout for Out-of-core Pathline Computation,” authored by Chun-Ming Chen, Boonthanome Nouanensengy, Teng-Yok Lee and Han-Wei Shen, provided a novel algorithm which allows efficient computation of pathlines from large-scale time-varying flow fields.
Awards and Honors

Wang Receives $1.8M NIH Award to Improve Speech Intelligibility for Hearing Impaired Listeners

Department of Computer Science and Engineering Professor DeLiang (Leon) Wang will lead a five-year $1.8 million research grant from the National Institute on Deafness and Other Communication Disorders to develop an algorithm to improve speech reception in noise by hearing-impaired listeners.

“My lab has developed a completely new approach to speech segregation that treats segregation as a classification problem, which has the potential to overcome the longstanding challenge of improving speech understanding in noisy background for millions of listeners with hearing loss. This NIH grant will enable us to further develop this approach and systematically test on hearing impaired subjects,” says Wang.

Wang, in collaboration with co-investigator Eric Healy, associate professor, Department of Speech and Hearing Science, together with graduate students Sarah Yoho and Yuxuan Wang, has recently provided the first demonstration of speech intelligibility improvements by hearing-impaired listeners. All listeners in their study demonstrated improvements in sentence recognition following algorithm processing. These improvements were often quite substantial, as many listeners who were unable to understand any speech showed near-perfect recognition after processing. This NIH project has the potential to revolutionize our treatment of hearing loss.

Wang received his BS and MS degrees from Peking University in Beijing. He then went on to receive a PhD in computer science from the University of Southern California. His research interests include machine perception and neurodynamics. In 2008, he won the Helmholtz Award from the International Neural Network Society. He is an IEEE Fellow, and currently serves as the co-editor-in-chief of Neural Networks, a premier journal in the field.

Wang Receives $1.8M NIH Award to Improve Speech Intelligibility for Hearing Impaired Listeners

Zhang Named ACM Fellow

Xiaodong Zhang, the Robert M. Critchfield professor in engineering, and CSE chair, was named Fellow by the Association of Computing Machinery (ACM). This prestigious honor is given to the foremost computer scientists worldwide for their outstanding undertakings in computing and information technology. Zhang’s recognition is attributed to his contributions to the field of data and memory management in distributed systems. Through Zhang’s leadership, his research group produced innovations that are commonly used in commercial processors, major operating systems, databases and distributed systems. Zhang and other 2012 Fellows will be formally recognized at the June ACM Annual Awards banquet in California.

Zhang Named ACM Fellow

Narayanan Awarded an SBC Fellowship

Arun Narayanan, a 5th year CSE PhD candidate in Artificial Intelligence with concentration in computational audition and machine learning, recently received an SBC Presidential Fellowship. The Presidential Fellowship is the most prestigious award given by The Ohio State University Graduate School to recognize the outstanding scholarly accomplishments and potential of graduate students. Arun joins 16 others in winning the autumn 2012 competition, and this is the first time a CSE graduate student has received this honor in several years.

The goal of Arun’s research is to improve the performance of automatic speech recognition systems in the presence of background noise by utilizing both the low-level acoustic properties of speech and the learned top-down models of phonetic units and time-frequency masks. The fellowship will fund 12 months of his study towards the completion of a doctoral dissertation.

“Arun is one of the very top students I have come to be associated with. His doctoral research has the potential to elevate the performance of robust automatic speech recognition to a new level,” Arun’s advisor DeLiang Wang said.

Prior to joining Ohio State, Arun earned an undergraduate degree in Computer Science and Engineering from the University of Kerala, India. Afterwards, Arun worked at IBM India for three years until beginning his graduate studies in 2008.

Zweben Awarded Grinter Service Award

Stuart Zweben, professor emeritus and former CSE chair, was awarded the 2012 Linton E. Grinter Distinguished Service Award from ABET, Inc., the organization that accredits programs in computing, engineering, technology and applied science. During his 27 years of service to the ABET and the Computer Sciences Accreditation Board (CSAB), Zweben was a catalyst behind the growth of computing accreditation in the United States. Zweben also facilitated the successful integration of computing accreditation from CSAB into ABET, and is currently a member of ABET’s global council. He joined CSE in 1974 and retired from his position as the College of Engineering’s Associate Dean for Academic Affairs and Administration after six years in 2011.
Many Thanks to Our Alumni and Friends!

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Rosi Wyan, BS ’12, with OSU President Gordon Gee.  
Graduate students present their work at the 2013 Poster Session.
Congratulations to CSE Autumn Semester Graduates!
The Department wishes you the best of luck in your future endeavors.

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