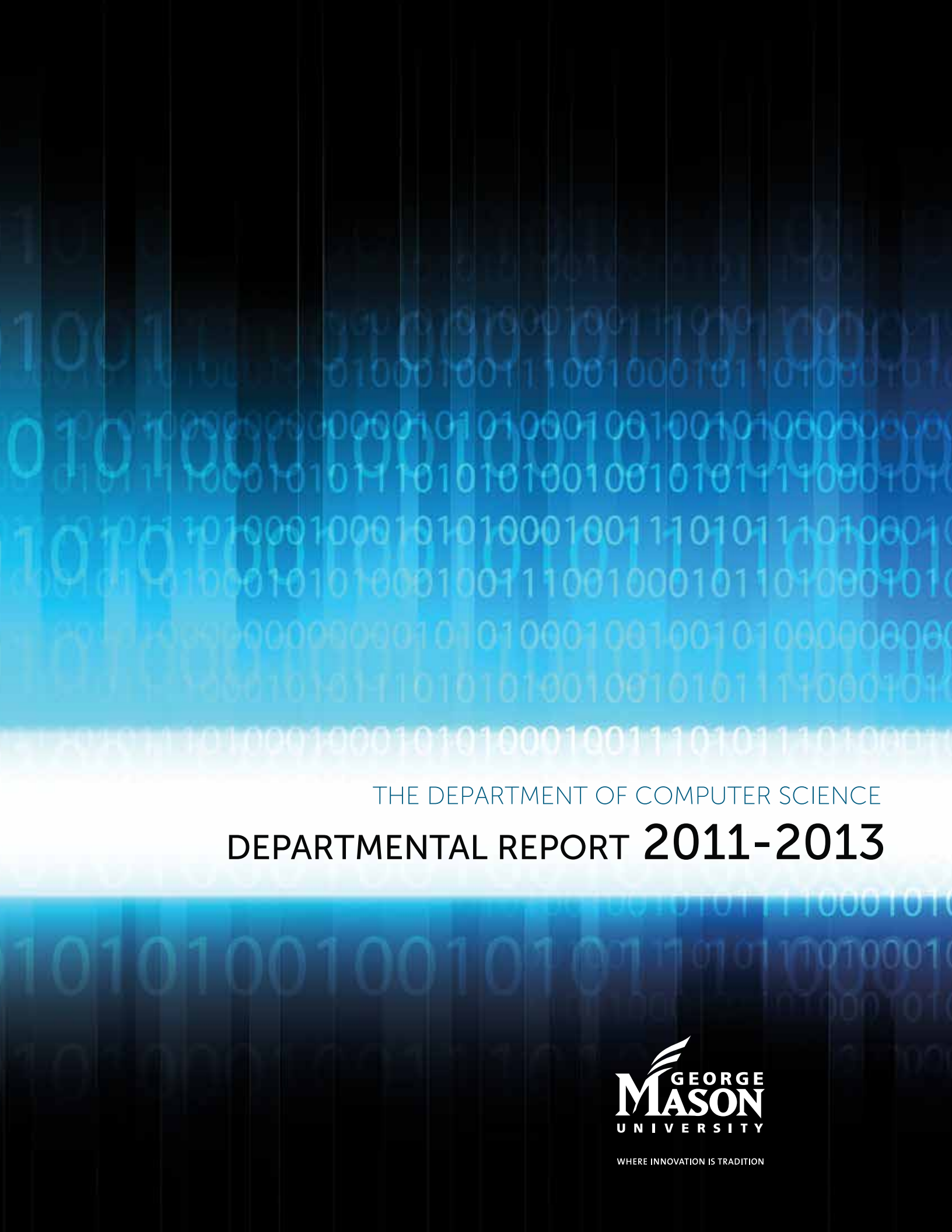

THE DEPARTMENT OF COMPUTER SCIENCE

DEPARTMENTAL REPORT 2011-2013

GEORGE MASON UNIVERSITY

WHERE INNOVATION IS TRADITION

DEPARTMENT OF COMPUTER SCIENCE

Volgenau School of Engineering
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MESSAGE FROM THE **CHAIR**

SANJEEV SETIA

With more than forty faculty members and over a thousand students, the Computer Science Department at George Mason University is one of the largest computer science departments in the Washington, DC metropolitan area and in Virginia. This report highlights some of the accomplishments of the faculty and students of the department over the last two years.

These have been banner years for the department with several faculty receiving national awards for their excellence in research. Three of our faculty – **Amarda Shehu, Sam Malek** and **Huzefa Rangwala** – received NSF Career awards, bringing to eleven the number of Career and Young Investigator awards received by our faculty. **Damon McCoy** is part of a multi-university team that received a prestigious and highly competitive $10M, five-year NSF Frontier award for research in cybersecurity. **Angelos Stavrou** received the 2012 IEEE Reliability Society Engineer of the Year award. **Sameh Saleh**, a 2012 CS graduate, was a finalist for the Computing Research Association's (CRA) Outstanding Undergraduate Researcher award.

The Department's research expenditures continue to grow reaching $6.4M in the latest fiscal year, which corresponds to a 50% increase during the last two years. Our student enrollments are also growing at a healthy clip, especially at the undergraduate level. This is part of a positive nationwide trend showing an increase in interest in computing among undergraduates. On the personnel front, I am delighted to welcome five new faculty members – **Yotam Gingold, Chris Kauffman, Damon McCoy, Mark Snyder** and **Avinash Srinivasan.**

Finally, I am excited to report that the CS Department is participating in a new inter-disciplinary program focused on big data and data mining. The **MS in Data Analytics Engineering** is a program offered in collaboration with other departments in the Volgenau School of Engineering. With several faculty working in machine learning and data analytics, the department is well poised to contribute to both research and educational initiatives in this emerging field of computing. I anticipate that in the coming years, we will continue to build on our strengths in areas such as data mining and cybersecurity to launch new initiatives that enable us to better serve our industry partners as well as government agencies in the DC metropolitan region.

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FAST FACTS ABOUT **CS@GMU**

FACULTY

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Research EXPENDITURES

$6M fiscal year 2012

$6.4M fiscal year 2013

Faculty **AWARDS**

10 NSF Career Awards
1 AFOSR Young Investigator Award
2 ACM Fellows
3 IEEE Fellows
1 IAPR fellow

PROGRAMS

BS in Computer Science, BS in Applied Computer Science with concentrations in Bioinformatics, Computer Game Design, Geography, & Software Engineering

MS in Computer Science, MS in Information Systems, MS in Information Security, MS in Software Engineering

PhD in Computer Science

Students

Undergraduates **677** Masters **391** PhD **123**

DEGREES Conferred

2011-12: BS: 80, MS: 185: PhD: 15
2012-13: BS: 86 MS: 183 PhD: 16

REACHING **YOUNG RESEARCHERS**

Universities are institutions of research with the goals of advancing society, inspiring leaders, and encouraging the exploration of new ideas. But for most students, the opportunity to engage in meaningful research is reserved for their graduate student peers. As a university, Mason is encouraging its schools to engage in more undergraduate research. The CS department serves as a model of how effective and beneficial undergraduate research programs are to the entire CS community.

Associate Chair, **Pearl Wang** oversees the department's undergraduate program. She says, "Our faculty strongly supports research. Research activities help prepare students for graduate studies, internships opportunities, and jobs". And while job placement and success are key metrics to a successful degree, research opportunities are important because they level the playing field for many students and open doors for others.

Wang has taught hundreds of students over the years and worked with faculty involved with undergraduate research. "When students work with faculty members and are given space to solve their own problems, they have a better appreciation for what they are learning. Research also promotes creativity, something not always seen as important in CS but a truly essential skill for success." The department has seen a surge in undergraduate enrollment from ninety students last year to a 150 this year. Wang says that popular culture is driving interest back into CS studies. A CS degree still requires fundamental coding skills, but now students are working with computer graphics, robotics, bioinformatics, big data, and cyber security. CS is now part of the cross-disciplinary trend to solve problems from all areas of science. Researchers no longer work in discipline silos, they have expansive skills and interest.

In an effort to encourage this growth in the field, the CS Department offers undergrads a variety of research outlets. In addition to joining faculty projects, there is the Louis Stokes Virginia/ North Carolina Alliance for Minority Participation (LSAMP) program, funded by the National Science Foundation (NSF), to increase the quality and quantity of minority students in STEM professions. The Summer Research Experience for Undergraduates (REU) program allows students to extend their learning beyond the school year and work directly on a project with a faculty mentor.

STUDENTS AS SCHOLARS
»oscar.gmu.edu«

The George Mason University Office of Student Scholarship, Creative Activities, and Research (OSCAR) supports a variety of undergraduate research projects. Recently, OSCAR has funded the CS department to create two new CS classes: CS 390, Research and Project Design Principles, and CS 490 Design Exhibition. Wang is excited by these two courses explaining that CS390 teaches students how to conduct actual CS research. Students learn about design principles, review methods, evidence gathering, and documenting project outcomes. The follow-on CS 490, challenges students to work on a semester-long research project with a faculty mentor.

Amarda Shehu and Bethany Usher, Director, Students as Scholars

THE VALUE OF MENTORS

Amarda Shehu, a CS assistant professor and a recent OSCAR Mentoring Excellence Award recipient began mentoring undergraduate students while still a graduate student at Rice University. She admits that she at first felt the added responsibility was a bother that would take away from her research time. But at the end she says, "I absolutely loved taking something complex that was the result of decades of research and scholarship and explaining it intuitively to undergraduates with little technical background. I felt responsible when they did not find something as exciting as I did, which often motivated me to find new ways to make material tangible and motivating."

In the five years she has been teaching in the CS Department, Shehu has brought in more than ten undergraduates who have significant research accomplishments such as posters, software tools, and journal and conference papers. She explains that the most successful student researchers are not always the most outgoing or outspoken. She makes a special effort to reach out to female undergraduates, as she understands how difficult it can be for a woman working in such a male-dominated field.

STUDENT VOICES

Jennifer Van approached Amarda Shehu about undergraduate research opportunities even before starting at Mason. She was interested in how structure determines and encodes biological function in protein molecules. She joined Shehu's lab during summer 2012, working in collaboration with a CRA-W DREU student from Williams College. She was part of a team that worked on a hypothesis that it is the structural pieces and their combination in protein structures that encode biological function. Shehu says, "They spent the summer analyzing known protein structures and building a library of these small structural pieces known as supersecondary structure motifs (SSmotifs). The team was able to show that most protein structures, including novel protein folds, had frequently occurring SSmotifs." They presented their research findings in the form of a poster at the Grace Hopper Celebration of Women in Science and Technology.

Van says, "Research has been the most important part of my undergraduate career." She was awarded an OSCAR fellowship to conduct research in Shehu's lab during spring 2013. She looks at the opportunity as an adventure where you "get to answer questions that nobody has answered. You get to think freely, apply all of the skills and knowledge learned from classes, and ultimately innovate." In addition to the academic foundation, Van says she has "expanded her network of powerful, intelligent women " and has confidence to stay focused in this male-dominated field. Her future plans include enrolling in a PhD program in computational biology.

Sameh Saleh, a CS Department graduate and first-year medical student at the University of Virginia, graduated last May with a degree in Applied Computer Science in Biology. Saleh was seeking a research opportunity "that had an intersection between biology and computer science or engineering." He contacted Amarda Shehu who spent considerable time with him explaining her research and opportunities in her lab.

Saleh was accepted to the Undergraduate Student Research Program. He spent four semesters and a summer developing an algorithm to predict the final structure of a protein based on just the amino acids that make it up using elements from evolutionary algorithms and robot kinematics. He says, "There's nothing better than learning by doing and applying and seeing the fruits of your work. In terms of medical school, this research was one of the forefront aspects of my application and Dr. Shehu's support, mentorship, and recommendation letters really spurred me on to medical school."

Sameh received the OSCAR Outstanding Undergraduate Scholar award and was a finalist at the Computer Research Association (CRA) Outstanding Undergraduate Research Award in 2013.

The research opportunity was essential to his success as he says, "It strengthened my application to medical school. The fact that I could talk about it comfortably backed up the achievements that I was able to accomplish."

John Mooney, the 2013 Volgenau School of Engineering Outstanding Undergraduate Student of the Year recipient, credits his undergraduate research as the reason he is now working on his PhD at Mason. Mooney began working with Jan Allbeck who is the faculty advisor for the BS ACS concentration on Computer Game Design and teaches courses in visual computing and game design. He says, "Research gives your coursework context." He explains that when you take a senior-level class you are at the end of your studies and you don't have time to apply all that you are learning. Research projects give you those "ah-ha" moments and a new understanding of how concepts apply to real applications. He says research also helps transition students into internships and jobs because you learn how to actually work through tasks.

Mooney is currently working on non playable character (NPC) behavior in games and will continue to work with Allbeck and other students. ■

PhD RECIPIENTS 2011-2013

2011-2012

Mohammad A. Abu-Mater
Dissertation Title:
Variability Modeling and Meta-Modeling for Model Driven Service Oriented Architectures
Director: Hassan Gomaa

Dalal Al-Arayed
Dissertation Title:
Trust Management in Smart Spaces
Director: João Pedro Sousa

Ahmed Al-Faresi
Dissertation Title:
Risk-Based Models for Managing Data Privacy in Health Care
Director: Duminda Wijesekera,

Serene Al-Momen
Dissertation Title:
A Self-Managed Healthcare Emergency Department System
Director: Daniel A. Menascé

Ahmed K. Alazzawe
Dissertation Title:
Sharing Intelligently Derived Location Context While Preserving Privacy
Director: Duminda Wijesekera

Khalid I. Alodhaibi
Dissertation Title:
Decision-Guided Recommenders with Composite Alternatives
Director: Alexander Brodsky

Vinay Devadas
Dissertation Title:
System-Level Energy Management for Real-Time Systems
Director: Hakan Aydin

Ahmed M. Elkhodary
Dissertation Title:
A Learning-Based Approach for Engineering Feature Oriented Self-Adaptive Software Systems
Director: Sam Malek

Julie Street Fant
Dissertation Title:
An Approach to Building Domain Specific Software Architectures Using Software Architectural Design Patterns
Director: Hassan Gomaa

Anyi Liu
Dissertation Title:
Development of a Source Mobile GPS Tracking and Management System
Director: Jim X. Chen

Juan Luo
Dissertation Title:
Machine Learning in Decision Guidance Systems: Models, Languages and Algorithms
Director: Alexander Brodsky

Thomas H. Rozenbroek
Dissertation Title:
External Labeling as a Framework for Managing Objects
Director: Edgar H. Sibley

Faisal M. Sibai
Dissertation Title:
Defeating Insider Attacks via Autonomic Self-Protective Networks
Director: Daniel A. Menascé

Jiang Wang
Dissertation Title:
Hardware-Assisted Protection and Isolation
Director: Angelos Stavrou

Bo Zhang
Dissertation Title:
Performance Management for Energy Harvesting Wireless Sensor Networks
Director: Robert P. Simon

2012-2013

Firas B. Alomari
Dissertation Title:
An Autonomic Framework for Integrating Security and Quality of Service Support in Databases
Director: Daniel Menascé

Nada A. Basit
Dissertation Title:
Computational Mutagenesis Using Transduction, Active Learning, and Association Rule Mining
Director: Harry Wechsler

Jeffery K. Bassett
Dissertation Title:
Methods for Improving the Design and Performance of Evolutionary Algorithms
Director: Kenneth A. De Jong

Reza Gharavi
Dissertation Title:
Detecting Polymorphic and Mutated Malicious Access in Online Ad Serving Systems
Director: Edgar H. Sibley

Khondkar Islam
Dissertation Title:
Design and Development of a Distributed Architecture with Integrated Peer-to–Peer Multicasting System (DAIPPMS)
Director: J. Mark Pullen

Yao Liu
Dissertation Title:
Towards Power-Efficient Internet Streaming to Mobile Devices
Director: Songqing Chen

Paul Ngo
Dissertation Title:
Emergency Communications via Handheld Devices
Director: Duminda Wijesekera

Brian Olson
Dissertation Title:
Evolving Local Minima in the Protein Energy Surface
Director: Amarda Shehu

Remo P. Perini
Dissertation Title:
A Method for Using Cognitive Psychophysiological Event Related Potentials (ERPs) as a Biometric Modality to Confirm the Identity of a Person or Information System User
Director: Edgar H. Sibley

Venkatesh Ramanathan
Dissertation Title:
Adversarial Face Recognition and Phishing Detection Using Multi-Layer Data Fusion
Director: Harry Wechsler

Zeehasham Rasheed
Dissertation Title:
Data Mining Framework for Metagenome Analysis
Director: Huzefa Rangwala

Gordon Shao
Dissertation Title:
Decision Guidance for Sustainable Manufacturing
Directors: Alexander Brodsky and Paul Ammann

Zhaohui Wang
Dissertation Title:
Secure Smart Mobile Devices: A Data-Centric Approach
Director: Angelos Stavrou

Xiaohui Yang
Dissertation Title:
Facilitating Secure Peer-to-Peer Telecommunication in a Small World Network
Director: Duminda Wijesekera

Inja Youn
Dissertation Title:
Delay-Based Methods for Robust Geolocation of Internet Hosts
Director: Dana Richards

Baoxian Zhao
Dissertation Title:
Joint Reliability and Energy Management for Real-Time Embedded Systems
Director: Hakan Aydin

FACULTY **AWARDS & RECONGITION**

Over the past two years, computer science faculty members have been recognized on both a university-wide and national level for their excellence in teaching and research, including:

ACADEMIC ADVISING EXCELLENCE

Paul Ammann, associate professor, is recognized as one of ten outstanding academic advisors selected from candidates across the university by the Academic Advising and Transfer Center.

Award recipients are proven to have demonstrated a caring and helpful attitude toward students; give accurate information regarding university academic requirements; have knowledge of university regulations, policies, and procedures; and support student development through advising.

OUTSTANDING TEACHER AWARD

Huzefa Rangwala, assistant professor, has been selected for the Volgenau School of Engineering's Outstanding Teacher Award.

He has also been nominated for the statewide Rising Star award recognizing faculty with between two to six complete years of fulltime faculty experience and who are in at least their third year as a faculty member in Virginia.

OSCAR MENTOR EXCELLENCE AWARD

Amarda Shehu, assistant professor, has received the 2013 OSCAR Mentor Excellence Award. The award, given annually by the Student as Scholars QEP Leadership Council, recognizes and rewards outstanding Mason community members who mentor undergraduate students on their research and who foster a culture of student scholarship in support of Mason's Students as Scholars initiative.

STATE COUNCIL FOR HIGHER EDUCATION FOR VIRGINIA (SCHEV), OUTSTANDING FACULTY AWARD

Danny Menascé, professor, has been selected to represent Mason as a nominee for the statewide Outstanding Faculty Award. Nominees must have a demonstrated record of superior accomplishments in teaching, research, knowledge integration, and public service.

The Outstanding Faculty Awards are the Commonwealth's highest honor for faculty at Virginia's public and private colleges and universities. Since the first awards in 1987, just over 300 Virginia faculty members have received this high honor.

MASON TEACHING EXCELLENCE AWARD

Tamara Maddox, associate professor, received Mason's 2012 Teaching Excellence Award. Maddox teaches CS 105 Computer Ethics and Society and CS 306 Synthesis of Ethics and Law for the Computing Professional.

Jeff Offutt, professor, received Mason's 2013 Teaching Excellence Award. Offutt leads the MS in software engineering program, teaches MS and PhD courses in software engineering, and has developed new courses in a variety of software engineering subjects, including web engineering, software testing, construction, design, usability, experimentation, and analysis.

The award is Mason's highest recognition for faculty members who demonstrate exceptional skill in and commitment to their teaching and learning practices.

MASON EMERGING RESEARCHER, SCHOLAR, CREATOR AWARD

Angelos Stavrou, associate professor, and associate director of the Center for Secure Information Systems has received the 2012 Mason Emerging Researcher, Scholar, Creator Award. Each year, Mason recognizes the best of its younger scholars and selects three faculty members who show exceptional promise in their disciplines to receive the award.

To qualify for this award and its $3,000 stipend, the faculty member must be within 10 years of receiving his or her terminal degree and have growing national and international recognition for his or her work.

NSF CAREER AWARD

The NSF CAREER Award is a prestigious five-year award in support of junior faculty who exemplify the role of teacher-scholar through outstanding research, excellent education, and the integration of education and research. Three CS faculty members received CAREER awards in the last two years:

Sam Malek, "A Mining-Based Approach for Consistent and Timely Adaptation of Component-Based Software."

Huzefa Rangwala, "Annotating the Microbiome using Machine Learning Methods."

Amarda Shehu, "Probabilistic Methods for Addressing Complexity and Constraints in Protein Systems."

To date, ten faculty members from the Department of Computer Science have received an NSF CAREER award.

NSF FRONTIER AWARD

Frontier Awards are given to large, multi-institution projects that address and heighten the visibility of grand challenge research areas in science and engineering with broad economic and scientific impact.

Damon McCoy, assistant professor, and his team members from UC-San Diego and ICSI at UC Berkeley received an NSF Frontier Award. The team will receive a $10 million, five-year grant for their project titled, "Beyond Technical Security: Developing an Empirical Basis for Socio-Economic Perspectives." ■

DISTINGUISHED **LECTURE SERIES**

Each year the Department of Computer Science hosts its Distinguished Lecture Series to feature notable and engaging computer scientists from a variety of research areas to share their research with the Mason community. Five guest speakers will be presenting to the community during the 2013-2014 academic year.

2012-2013

KEITH ROSS
Leonard J. Shustek Professor of Computer Science and Department Head
Department of Computer Science and Engineering, Polytechnic Institute of NYU
"Invasion of Privacy: How Bad Will It Get?"

ALEXEI EFROS
Finmeccanica Associate Professor
School of Computer Science, Carnegie Mellon University
"Mining Big Visual Data"

DON TOWSLEY
Distinguished University Professor
Department of Computer Science, University of Massachusetts Amherst
"A Walk in the Dark: Random Walks and Network Discovery"

LYDIA KAVRAKI
Noah Harding Professor
Department of Computer Science, Rice University
"Automatic Annotation of Protein Function"

ERIC XING
Associate Professor
School of Computer Science, Carnegie Mellon University
"Machine Learning Approaches to Network and Social Media"

2013-2014

VIPIN KUMAR
William Norris Professor and Head of the Computer Science and Engineering Department
University of Minnesota
"Understanding Global Climate Change-a Data Driven Approach"

ANNIE I. ANTÓN
Chair and Professor, School of Interactive Computing
Georgia Institute of Technology
"Regulatory Compliance Software Engineering"

RICARDO BIANCHINI
Professor, Department of Computer Science
Rutgers University
"Greening Datacenters: Past, Present and Future"

VIJAY KUMAR
Professor, School of Engineering and Applied Sciences
University of Pennsylvania
"Beyond UAVs: Flying Robot Swarms"

ROGER DINGLEDINE
Project Leader, Director, Researcher
Tor Project
"Tor and Censorship: Lessons Learned"

FACULTY

JANET M. ALBECK
Assistant Professor
PhD Computer and Information Science, University of Pennsylvania, 2009

Jan Allbeck is the faculty advisor for the BS ACS concentration in Computer Game Design and is affiliated with the laboratory for Games and Intelligent Animation. She has taught at George Mason University since 2009. She has explored many aspects of computer graphics, but is most drawn to research at the crossroads of animation, artificial intelligence, and psychology in the simulation of virtual humans.

Selected Publications

1. Li, W., and J. M. Allbeck. "The Virtual Apprentice." In proceedings of the 12th International Conference Intelligent Virtual Agents, 15–27. Springer, 2012.
2. Durupinar, F., N. Pelechano, J. Allbeck, U. Gudukbay, and N. Badler. "The Impact of the OCEAN Personality Model on the Perception of Crowds." *IEEE Computer Graphics and Applications* 31, no. 3 (2011): 22–31.
3. Li, W., and J. M. Allbeck. "Populations with Purpose." In proceedings of Motion in Games, 133–144. Springer, 2011.
4. Allbeck, J. M., and H. Kress-Gazit. "Constraints-Based Complex Behavior in Rich Environments." In proceedings of the 10th International Conference on Intelligent Virtual Agents, 1–14. Springer, 2010.

PAUL AMMANN
Associate Professor
PhD Computer Science, University of Virginia, 1988

Paul Ammann has taught at George Mason University since 1989. His areas of interest and expertise are software testing and secure information systems. He received the Volgenau School Outstanding Teaching Award in 2007.

Selected Publications

1. Kaminski, Garrett, Paul Ammann, and Jeff Offutt. "Improving Logic-Based Testing." *The Journal of Systems and Software* 86, no. 8 (2013): 2002–2012.
2. Kaminski, Garrett, and Paul Ammann. "Reducing Logic Test Set Size While Preserving Fault Detection." *Software Testing, Verification, and Reliability* 21, no. 3 (2011): 155–193.
3. Fraser, Gordon, Paul Ammann, and Franz Wotawa. "Testing with Model Checkers: A Survey." *Software Testing, Verification, and Reliability* 19, no. 3 (2009): 215–261.
4. Ammann, Paul, and Jeff Offutt. *Introduction to Software Testing*. Cambridge, U.K.: Cambridge University Press, 2008.

HAKAN AYDIN
Associate Professor
PhD Computer Science, University of Pittsburgh, 2001

Hakan Aydin has taught at George Mason University since 2001. His research interests include real-time embedded systems, low-power computing, and fault tolerance. He was a recipient of the NSF CAREER award in 2006. He served as the technical program committee chair of the IEEE RTAS 2011, and as the general chair of the IEEE RTAS 2012 conferences.

Selected Publications

1. Zhao, B., H. Aydin, and D. Zhu. "Shared Recovery for Energy Efficiency and Reliability Enhancements in Real-Time Applications with Precedence Constraints." *ACM Transactions on Design Automation of Electronic Systems* 18, no. 2 (2013).
2. Zhao, B., H. Aydin, and D. Zhu. "Energy Management under General Task-Level Reliability Constraints." In proceedings of the 18th IEEE Real-Time and Embedded Technology and Applications Symposium, Beijing, China, April 2012.
3. Devadas, V., and H. Aydin. "On the Interplay of Voltage/Frequency Scaling and Device Power Management for Frame-Based Real-Time Embedded Applications." *IEEE Transactions on Computers* 61, no. 1 (2012): 31–44.
4. Zhang, B., R. Simon, and H. Aydin. "Maximal Utility Rate Allocation for Energy Harvesting Wireless Sensor Networks." In proceedings of the 14th ACM International Conference on Modeling, Analysis, and Simulation of Wireless and Mobile Systems, Miami Beach, Florida, October 2011. (Best Paper Award)

DANIEL BARBARÁ
Professor
PhD Computer Science, Princeton University, 1985

Daniel Barbará has taught at George Mason University since 1997. His areas of expertise are data mining and machine learning. He served as the program chair of the SIAM International Conference on Data Mining in 2003, and he has received numerous grants from the National Science Foundation, the Army, and other federal and state institutions.

Selected Publications

1. AlSumait, Loulwah, Daniel Barbará, James Gentle, and Carlotta Domeniconi. "Topic Significance Ranking of LDA Generative Models." In proceedings of the European Conference on Machine Learning and Principles and Practice of Knowledge Discovery in Databases, 2010.
2. AlSumait, Loulwah, Daniel Barbará, and Carlotta Domeniconi. "The Role of Semantic History on Online Generative Topic Modeling." In proceedings of the Workshop on Text Mining, SIAM International Conference on Data Mining, SIAM, 2009.
3. Barbará, Daniel, Carlotta Domeniconi, Zoran Duric, Maurizio Filippone, Richard Mansfield, and Wallace Lawson. "Detecting Suspicious Behavior in Surveillance Images." In proceedings of the 1st International Workshop on Video Mining, IEEE International Conference on Data Mining, 2008.
4. AlSumait, Loulwah, Daniel Barbará, and Carlotta Domeniconi. "On-line LDA: Adaptive Topic Models for Mining Text Streams with Applications to Topic Detection and Tracking." In proceedings of the IEEE International Conference on Data Mining, 2008.

FACULTY

ALEXANDER BRODSKY
Associate Professor
PhD Computer Science, Hebrew University of Jerusalem, Israel, 1991

Alex Brodsky joined George Mason University in 1993. His research interests include Decision Support, Guidance and Optimization systems and applications, for which he has received an NSF CAREER Award, NSF Research Initiation Award, and awards from ONR, NASA, NIST, and Dominion Virginia Power. He has published over 90 scholarly refereed journal and conference papers and co-edited a LNCS volume on Constraint Databases and Applications. He serves as program chair of the 2012 IEEE International Conference on Tools with Artificial Intelligence, and served as program co-chair of the 2012 and 2013 IEEE ICDE workshops on Data-Driven Decision Guidance and Support Systems.

Selected Publications

1. Brodsky, A., N. E. Egge, and X. S. Wang. "Supporting Agile Organizations with a Decision Guidance Query Language." *Journal of Management Information Systems* 28, no. 4 (2012): 39–68.
2. Brodsky, A., and H. Nash. "CoJava: Optimization Modeling by Nondeterministic Simulation." In proceedings of the 12th International Conference on Principles and Practice of Constraint Programming, 2006.
3. Brodsky, A., C. Farkas, and S. Jajodia. "Secure Databases: Constraints, Inference Channels, and Monitoring Disclosures." *IEEE Transactions on Knowledge and Data Engineering* 12, no. 6 (2000): 900–919.
4. Brodsky, A., V. Segal, J. Chen, and P. Exarkhopoulo. "The CCUBE Constraint Object-Oriented Database System." Constraints 2, no. 3 (1997): 245–277.

RICHARD CARVER
Associate Professor
PhD Computer Engineering, North Carolina State University, 1989

Richard Carver has taught at George Mason University since 1990. His areas of interest and expertise are in the specification, testing, and verification of concurrent programs. He won the Volgenau School Outstanding Teacher Award in March 2007.

Selected Publications

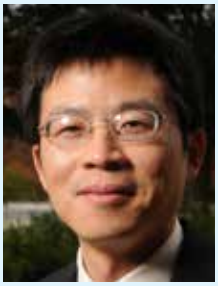
1. Xu, Jing, Richard H. Carver, Yu Lei, and David Kung. "A Dynamic Approach to Isolating Faulty Patterns in Concurrent Program Executions." In proceedings of the International Conference on Multicore Software Engineering, Performance, and Tools, 2013.
2. Carver, Richard H., and Yu Lei. "A Class Library for Implementing, Testing, and Debugging Concurrent Programs." *International Journal on Software Tools for Technology Transfer* 12, no. 1 (2010): 69–88.
3. Carver, Richard H., and Yu Lei. "A Stateful Approach to Testing Monitors in Multithreaded Programs." In proceedings of the 12th IEEE International Symposium on High-Assurance Systems Engineering, 54–63. 2010.
4. Carver, Richard H., and Yu Lei. "Distributed Reachability Testing of Concurrent Programs." *Concurrency and Computation: Practice and Experience* 22, no. 18 (2010): 2381–2513.

JIM X. CHEN
Professor
PhD Computer Science, University of Central Florida, 1995

Jim Chen is the director of the Visual Computing and Graphics Lab. He has taught at George Mason University since 1995. He is associate editor-in-chief of *Computing in Science & Engineering*, a senior member of the Institute of Electrical and Electronics Engineers, and an associate member of the Association for Computing Machinery. He has authored four books, edited two conference proceedings, published over 100 research papers, and acquired three patents. His research interests include computer graphics, virtual reality, visualization, networking, and simulation.

Selected Publications

1. Wei, Q., J. X. Chen, and N. Yu, "Robust Object Tracking using Enhanced Random Ferns." *Visual Computer* (2013).
2. Yang, L., T. Zhang, J. X. Chen, and P. Dai. "Motion Simulation of Inner Hair Cell Stereocilia." *Computing in Science and Engineering* 15, no. 2 (2013): 27–33.
3. Wan, X., S. Liu, J. X. Chen, and X. Jin. "Geodesic Distance-Based Realistic Facial Animation Using RBF Interpolation." *Computing in Science and Engineering* 14, no. 5 (2012): 49–55.
4. Qiu, H., L. Chen, J. X. Chen, and Y. Liu. "Dynamic Simulation of Grass Field Swaying in Wind." *Journal of Software* 7, no. 2 (2012): 74–79.



SONGQING CHEN
Associate Professor
PhD Computer Science, College of William and Mary, 2004

Songqing Chen has taught at George Mason University since 2004. His areas of interest and expertise are Internet content delivery systems, Internet measurements and modeling, system security, distributed systems, and high-performance computing. In addition to the NSF CAREER and AFOSR Young Investigator Awards, he has also received the George Mason University Emerging Researcher, Scholar, and Creator Award; the Volgenau Rising Star Faculty Award; and the Department of Computer Science Outstanding Research Award.

Selected Publications

1. Tan, Enhua, Lei Guo, Songqing Chen, Xiaodong Zhang, and Eric Zhao. "UNIK: Unsupervised Social Network Spam Detection." In proceedings of the ACM Conference on Information and Knowledge Management, San Francisco, California, October 27–November 1, 2013.
2. Liu, Yao, Fei Li, Lei Guo, Bo Shen, and Songqing Chen. "A Server's Perspective of Internet Streaming Delivery to Mobile Devices." In proceedings of the IEEE INFOCOM, Orlando, Florida, March 25–30, 2012.
3. Liu, Lei, Xinwen Zhang, Guanhua Yan, and Songqing Chen. "Chrome Extensions: Threat Analysis and Countermeasures." In proceedings of the 19th Annual Network and Distributed System Security Symposium, San Diego, California, February 5–8, 2012.
4. Liu, Yao, Fei Li, Lei Guo, Yang Guo, and Songqing Chen. "BlueStreaming: Towards Power-Efficient Internet P2P Streaming to Mobile Devices." In proceedings of the ACM Multimedia Conference, Scottsdale, Arizona, November 28–December 1, 2011.

FACULTY

KENNETH DE JONG
University Professor
PhD Computer Science, University of Michigan, 1975

Kenneth De Jong is the associate director of the Krasnow Institute at George Mason University. He has taught at Mason since 1984. His research interests include evolutionary computation, complex adaptive systems, and machine learning. He is the founding editor-in-chief of the MIT Press journal *Evolutionary Computation*, a board member of the Association for Computing Machinery Special Interest Group on Genetic and Evolutional Computation, and the recipient of the Institute of Electrical and Electronics Engineers Pioneer award in evolutionary computation.

Selected Publications

1. Kamath, U., J. Compton, R. Islamaj Dogan, K. De Jong, and A. Shehu. "An Evolutionary Algorithm Approach for Feature Generation from Sequence Data and its Application to DNA Splice-Site Prediction." *Transactions on Computational Biology and Bioinformatics* 9, no. 5 (2012): 1387–1398.
2. Cioffi, C., K. De Jong, and J. Bassett. "Evolutionary Computation and Agent-Based Modeling: Biologically-Inspired Approaches for Understanding Complex Social Systems." *Computational & Mathematical Organization Theory* 18, no. 3 (2012): 356–373.
3. Bassett, J., and K. De Jong. "Using Multivariate Quantitative Genetics Theory to Assist EA Customization." In proceedings of the Foundations of Genetic Algorithms, Schwarzenberg, Austria, January 2011.
4. De Jong, K. A. *Evolutionary Computation: A Unified Approach*. Cambridge, Massachusetts: MIT Press, 2006.

KINGA DOBOLYI
Term Assistant Professor
PhD Computer Science, University of Virginia, 2010

Kinga Dobolyi has taught at George Mason University since 2010. Her research focuses on software engineering, testing, and web applications.

Selected Publications

1. Dobolyi, Kinga, Elizabeth Soechting, and Westley Weimer. "Automating Regression Testing Using Web-Based Application Similarities." *International Journal on Software Tools for Technology Transfer* 13, no. 2 (2011): 111–129.
2. Dobolyi, Kinga, and Westley Weimer. "Modeling Consumer-Perceived Web Application Fault Severities for Testing." In proceedings of the International Symposium on Software Testing and Analysis, July 2010.
3. Dobolyi, Kinga, and Westley Weimer. "Harnessing Web-Based Application Similarities to Aid in Regression Testing." In proceedings of the 20th IEEE International Symposium on Software Reliability Engineering, November 2009.
4. Dobolyi, Kinga, and Westley Weimer. "Changing Java's Semantics for Handling Null Pointer Exceptions." In proceedings of the 19th IEEE International Symposium on Software Reliability Engineering, November 2008.

CARLOTTA DOMENICONI
Associate Professor
PhD Computer Science, University of California, Riverside, 2002

Carlotta Domeniconi has taught at George Mason University since 2002. Her areas of interest and expertise are machine learning, data mining, pattern recognition, feature relevance estimation, and ensemble methods, with applications in text mining and bioinformatics. She received an ORAU Ralph E. Powe Junior Faculty Enhancement Award and the 2008 George Mason University Emerging Researcher, Scholar, and Creator Award. She has worked as PI or co-PI on projects supported by the US Army, Air Force, and DoD. Her research has been in part supported by an NSF CAREER Award.

Selected Publications

1. Gullo, F., C. Domeniconi, and A. Tagarelli. "Projective Clustering Ensembles." *Data Mining and Knowledge Discovery* 26, no. 3 (2013): 452–511.
2. Yu, G., C. Domeniconi, H. Rangwala, and G. Zhang. "Protein Function Prediction using Dependence Maximization." In proceedings of the European Conference on Machine Learning and Principles and Practice of Knowledge Discovery in Databases, Prague, Czech Republic, September 23–27, 2013.
3. Wang, P., K. B. Laskey, C. Domeniconi, and M. I. Jordan. "Nonparametric Bayesian Co-clustering Ensembles." In proceedings of the SIAM International Conference on Data Mining, Mesa, Arizona, April 28–30, 2011.
4. Domeniconi, C., and M. Al-Razgan. "Weighted Cluster Ensembles: Methods and Analysis." *ACM Transactions on Knowledge Discovery from Data* 2, no. 4 (2009).

ZORAN DURIĆ
Associate Professor
PhD Computer Science, University of Maryland, College Park, 1995

Zoran Durić has taught at George Mason University since 1996. His areas of interest and expertise are computer vision, haptics, and motion-capture technologies, with applications to analysis and synthesis of human movement for rehabilitation, video analysis, and information hiding. He is an area editor for the *Pattern Recognition* journal.

Selected Publications

1. Vishnoi, N., Z. Durić, and N. L. Gerber. "Markerless Identification of Key Events in Gait Cycle Using Image Flow." In proceedings of the IEEE Engineering in Medicine and Biology Society, San Diego, California, August 28–September 1, 2012.
2. Narber, C., Z. Durić, and N. L. Gerber. "Haptic Devices as Objective Measures for Motor Skill." In proceedings of the IEEE Conference on Human System Interactions, Perth, Australia, June 6–8, 2012.
3. Vishnoi, N., C. Narber, Z. Durić, and N. L. Gerber. "Methodology for Translating Upper Extremity Motion to Haptic Interfaces." In proceedings of the IEEE Conference on Human System Interactions, Perth, Australia, June 6–8, 2012.
4. Fleck, D., and Z. Durić. "Predicting Image Matching Using Affine Distortion Models." In proceedings of the IEEE Conference on Computer Vision and Pattern Recognition, 105–112. ACM, 2011.

FACULTY

YOTAM GINGOLD
Assistant Professor
PhD Computer Science, New York University, 2009

Yotam Gingold has taught at George Mason University since 2012. His research interests include interactive geometric modeling, creativity support, topology for computation, crowdsourcing, and game design.

Selected Publications

1. Shtof, Alex, Alexander Agathos, Yotam Gingold, Ariel Shamir, and Daniel Cohen-Or. "Geosemantic Snapping for Sketch-Based Modeling." *Computer Graphics Forum* 32, no. 2 (2013): 245–253. Also in proceedings of Eurographics, Girona, Spain, 2013.
2. Gingold, Yotam, Ariel Shamir, and Daniel Cohen-Or. "Micro Perceptual Human Computation for Visual Tasks." *ACM Transactions on Graphics (TOG)* 31, no. 5 (2012).
3. Weinkauf, Tino, Yotam Gingold, and Olga Sorkine. "Topology-Based Smoothing of 2D Scalar Fields with C1-Continuity." *Computer Graphics Forum* 29, no. 3 (2010): 1221–1230. Also in proceedings of EuroVis, Bordeaux, France, 2010.
4. Gingold, Yotam, Denis Zorin, and Takeo Igarashi. "Structured Annotations for 2D-to-3D Modeling." *ACM Transactions on Graphics (TOG)* 28, no. 5 (2009): 148:1–148:9. Also in proceedings of SIGGRAPH, Asia, 2009.

HASSAN GOMAA
Professor
PhD Computer Science, Imperial College, London, 1976

Hassan Gomaa served as chair of the Department of Computer Science from January 2008 to August 2011, and previously as chair of the Department of Information and Software Engineering from June 2002 to December 2007. He has taught at George Mason University since 1987. He has over 30 years of experience in software engineering, both in industry and academia, and has published over 200 technical papers and four textbooks. His current research interests include software architectures and patterns, dynamic software adaptation, and software modeling and design for concurrent, real-time, and distributed systems and product lines.

Selected Publications

1. Abu-Matar, M., and H. Gomaa, "Feature-Based Variability Meta-Modeling for Service-Oriented Product Lines." In proceedings of Models in Software Engineering—Workshops, and Symposia at MODELS 2011, LNCS 7167, edited by Jörg Kienzle, 68–82. Springer, 2012.
2. Gomaa, H., and K. Hashimoto. "Dynamic Self-Adaptation for Distributed Service-Oriented Transactions." In proceedings of the ACM/IEEE 7th International Symposium on Software Engineering for Adaptive and Self-Managing Systems, Zurich, Switzerland, June 2012.
3. Gomaa, H. *Software Modeling and Design: UML, Use Cases, Patterns, and Software Architectures*. Cambridge, U.K.: Cambridge University Press, 2011.
4. Menasce, D., H. Gomaa, S. Malek, and J. Sousa. "SASSY: A Framework for Self-Architecting Service-Oriented Systems." *IEEE Software* 28, no. 6 (2011): 78–85.

CHRISTOPHER KAUFFMAN

Term Assistant Professor

PhD Computer Science, University of Minnesota, 2013

Christopher Kauffman has taught at George Mason University since 2012. His research interests center on machine learning and optimization applied to structural biology problems such as protein folding.

Selected Publications

1. Kauffman, Chris, and George Karypis. "Coarse- and Fine-Grained Models for Proteins: Evaluation by Decoy Discrimination." *Proteins: Structure, Function, and Bioinformatics* 81, no. 5 (2013): 754–773.
2. Kauffman, Chris, and George Karypis. "Ligand Binding Residue Prediction." *Introduction to Protein Structure Prediction: Methods and Algorithms*. Hoboken: Wiley, 2010.
3. Kauffman, Chris, and George Karypis. "LIBRUS: Combined Machine Learning and Homology Information for Sequence-Based Ligand-Binding Residue Prediction." *Bioinformatics* 25, no. 23 (2009): 3099–3107.
4. Kauffman, Chris, Huzefa Rangwala, and George Karypis. "Improving Homology Models for Protein-Ligand Binding Sites." In proceedings of the LSS Computational Systems Bioinformatics Conference, Stanford, California, 2008.

LARRY KERSCHBERG

Professor

PhD in Systems Engineering, Case Western Reserve University, Cleveland, 1969

Larry Kerschberg has taught at George Mason University since 1986 and served as chair of the Department of Information and Software Engineering from 1989 to 1997. His current research interests include social networks, social semantic search, agent-based systems, semantic web, knowledge management, and intelligent information integration. He has over 40 years of experience in both industry and academia, and is the principal inventor on two patents related to intelligent semantic search. He is a founding editor-in-chief of Springer's *Journal of Intelligent Information Systems*, which has been in continuous publication since 1992.

Selected Publications

1. McDowall, John, and Larry Kerschberg. "A Multi-Agent Approach for Generating Ontologies and Composing Services into Executable Workflows." In proceedings of the International Conference on Extending Database Technology / International Conference on Database Theory Workshops, 2010.
2. Muthaiyah, Saravanan, Marcel Barbulescu, and Larry Kerschberg. "An Improved Matching Algorithm for Developing a Consistent Knowledge Model across Enterprises Using SRS and SWRL." In proceedings of the Hawaii International Conference on System Sciences, 2009.
3. Muthaiyah, Saravanan, and Larry Kerschberg. "A Hybrid Ontology Mediation Approach for the Semantic Web." IJEBR 4, no. 4 (2008): 79–91.
4. Muthaiyah, Saravanan, and Larry Kerschberg. "Achieving Interoperability in E-Government Services with Two Modes of Semantic Bridging." *The Journal of Theoretical and Applied Electronic Commerce Research* 3, no. 3 (2008): 52–63.

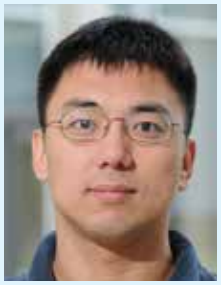
FACULTY

JANA KOŠECKÁ
Associate Professor
PhD Computer Science, University of Pennsylvania, Philadelphia, 1996

Jana Košecká has taught at George Mason University since 1999. Her research interests are the acquisition of static, dynamic, and semantic models of environments by means of visual sensing, object recognition, scene parsing, and human-robot interaction. She has over 90 selected publications in refereed journals and conferences and is a coauthor of a monograph titled, *Invitation to 3D vision: From Images to Geometric Models.*

Selected Publications

1. Micusik, B., and J. Košecká. "Multi-View Superpixel Stereo in Urban Environments." *International Journal of Computer Vision* 89, no. 1 (2010): 106–119.
2. Micusik, B., and J. Košecká. "Piecewise Planar City Modeling from Street View Panoramic Sequences." In proceedings of the IEEE Conference on Computer Vision and Pattern Recognition, 2009.
3. Murillo, Ana C., J. Košecká, J. J. Guerrero, and C. Sagues. "Visual Door Detection Integrating Appearance and Shape Cues." *Robotics and Autonomous Systems*, 2008.
4. Micusik, B., H. Wildenauer, and J. Košecká. "Detection and Matching of Rectangular Structures." In proceedings of the IEEE Conference on Computer Vision and Pattern Recognition, 2008.



FEI LI
Associate Professor
PhD Computer Science, Columbia University, 2008

Fei Li has taught at George Mason University since 2007. His areas of interest and expertise include online, approximation, and randomized algorithm design and analysis, and energy-aware scheduling algorithms. He has won IBM's First Patent Application Invention Achievement Award and has been on the editorial board of the *International Journal of Operations Research and Information Systems* since 2008.

Selected Publications

1. Li, Fei. "Scheduling Packets with Values and Deadlines in Size-Bounded Buffers." *Journal of Combinatorial Optimization* 25, no. 2 (2013): 165–175.
2. Jez, Lukasz, Fei Li, Jay Sethuraman, and Clifford Stein. "Online Scheduling of Packets with Agreeable Deadlines." *ACM Transactions on Algorithms* 9, no. 1 (2012).
3. Zhang, Zhi, and Fei Li. "Scheduling Weighted Packets with Deadlines over a Fading Channel." *Algorithmic Operations Research* 6, no. 2 (2011): 68–78.
4. Devadas, Vinay, Fei Li, and Hakan Aydin. "Competitive Analysis of Online Real-Time Scheduling Algorithms under Hard Energy Constraint." *Real-Time Systems* 46, no. 1 (2010): 88–120.

JYH-MING LIEN

Associate Professor

PhD Computer Science, Texas A&M University, 2006

Jyh-Ming Lien is an affiliate of the Motion and Shape Computing group and the Autonomous Robotics Laboratory at George Mason University. He has taught at Mason since 2007. His research goal is to develop efficient, robust, and practical algorithms for representing, manipulating, and analyzing massive geometric data of shape and motion. His research finds applications in the areas of computational geometry, computer graphics, GIS, visualization, and robotics.

Selected Publications

1. Behar, Evan, and Jyh-Ming Lien. "Dynamic Minkowski Sums Under Scaling." In proceedings of the ACM/SIAM Symposium on Solid and Physical Modeling, Dijon, France, October 2012.
2. Lu, Yanyan, Evan Behar, Stephen Donnelly, Jyh-Ming Lien, Fernando Camelli, and David Wong. "Fast and Robust Generation of City-Scale Seamless 3D Urban Models." In proceedings of the SIAM Conference on Geometric and Physical Modeling, October 2011.
3. Lien, Jyh-Ming, and Yanyan Lu. "Planning Motion in Similar Environments." In proceedings of the Robotics: Science and Systems Conference, June 2009.
4. Lien, Jyh-Ming, and Nancy Amato. "Approximate Convex Decomposition of Polyhedra and Its Applications." *Computer Aided Geometric Design* 25, no. 7 (2008): 503–522.

JESSICA LIN

Associate Professor

PhD Computer Science, University of California, Riverside, 2005

Jessica Lin joined George Mason University in 2005. Her areas of interest and expertise are temporal, spatiotemporal, multimedia, and stream data mining. Her work particularly focuses on the development of efficient algorithms to visualize and discover non-trivial patterns (e.g. anomalies, motifs, contrasting patterns, and latent structure) in massive time series data. Her work has been applied in domains as diverse as medicine, geoinformatics, earth sciences, astronomy, manufacturing, and national security.

Selected Publications

1. Oates, Tim, Arnold Boedihardjo, Jessica Lin, Crystal Chen, Susan Frankenstein, and Sunil Gandhi. "Motif Discovery in Spatial Trajectories Using Grammar Inference." In proceedings of the 2013 ACM International Conference on Information and Knowledge Management (CIKM), San Francisco, California, October 27–November 1, 2013.
2. Li, Yuan, Jessica Lin, and Tim Oates. "Visualizing Variable-Length Time Series Motifs." In proceedings of the SIAM International Conference on Data Mining, Anaheim, California, April 26–28, 2012.
3. Lin, Jessica, Rohan Khade, and Yuan Li. "Rotation-Invariant Similarity in Time Series Using Bag-of-Patterns Representation." *Journal of Intelligent Information Systems* 39, no. 2 (2012): 287–315.
4. Lin, Jessica, Eamonn Keogh, Li Wei, and Stefano Lonardi. "Experiencing SAX: A Novel Symbolic Representation of Time Series." *Data Mining and Knowledge Discovery* 15, no. 2 (2007): 107–144.

FACULTY

SEAN LUKE
Associate Professor
PhD Computer Science, University of Maryland, College Park, 2000

Sean Luke is the associate director of the George Mason University Center for Social Complexity. He has taught at Mason since 2000. His areas of interest and expertise include stochastic optimization and metaheuristics, evolutionary computation, multi-agent systems and multi-agent learning, autonomous robotics and robot swarms, and simulation development. He is the author of several widely used open-source software packages, including the MASON multi-agent simulator and the ECJ evolutionary computation toolkit—the most widely used such tool in the world.

Selected Publications

1. Balan, Gabriel, Dana Richards, and Sean Luke. "Long-Term Fairness with Bounded Worst-Case Losses." *Autonomous Agents and Multiagent Systems* 22, no. 1 (2011): 43–63.
2. Hrolenok, Brian, Sean Luke, Keith Sullivan, and Christopher Vo. "Collaborative Foraging Using Beacons." van der Hoek et al, eds. In proceedings of the 9th International Conference on Autonomous Agents and Multiagent Systems, 2011.
3. Luke, Sean. "Essentials of Metaheuristics." 2009. http://cs.gmu.edu/~sean/book/metaheuristics/.
4. Panait, Liviu, Karl Tuyls, and Sean Luke. "Theoretical Advantages of Lenient Learners: An Evolutionary Game Theoretic Perspective." *Journal of Machine Learning Research* 9 (2008): 423–457.

TAMARA A. MADDOX
Term Associate Professor
JD Doctor of Jurisprudence, Marshall-Wythe School of Law, College of William and Mary, 1991

Tamara Maddox has been teaching in the Department of Computer Science at George Mason University since 1999. She is the coordinator of the department's Computer Law and Ethics program and Undergraduate Teaching Assistant program. She teaches courses in computer law and ethics and core technical courses in the curriculum, including C, C++, and Java. She was previously the department's assistant chair from 2003 to 2006 and was responsible for many administrative duties, including scheduling all the department's faculty classes, coordinating undergraduate advising, and hiring adjunct faculty members.

SAM MALEK
Associate Professor
PhD Computer Science, University of Southern California, 2007

Sam Malek is the director of the Software Design and Analysis Laboratory and a faculty member of the Center of Excellence in Command, Control, Communications, Computing, and Intelligence Center. He has taught at George Mason University since 2007. His general research interests are in the field of software engineering with a focus on software architecture, autonomic computing, and software dependability. Malek received the NSF CAREER award in 2013 and Mason's Computer Science Department Outstanding Young Faculty Research award in 2011. The results of his research have been published in over 70 refereed manuscripts.

Selected Publications

1. Esfahani, Naeem, Sam Malek, and Kaveh Razavi. "GuideArch: Guiding the Exploration of Architectural Solution Space Under Uncertainty." In proceedings of the 35th International Conference on Software Engineering, San Francisco, California, May 2013.
2. Canavera, Kyle R., Naeem Esfahani, and Sam Malek. "Mining the Execution History of a Software System to Infer the Best Time for its Adaptation." In proceedings of the 20th ACM SIGSOFT International Symposium on the Foundations of Software Engineering, Cary, North Carolina, November 2012.
3. Malek, Sam, Nenad Medvidovic, and Marija Mikic-Rakic. "An Extensible Framework for Improving a Distributed Software System's Deployment Architecture." *IEEE Transactions on Software Engineering* 38, no. 1 (2012): 73–100.
4. Esfahani, Naeem, Ehsan Kouroshfar, and Sam Malek. "Taming Uncertainty in Self-Adaptive Software." In proceedings of the 8th Joint Meeting of the European Software Engineering Conference and ACM SIGSOFT Symposium on the Foundations of Software Engineering, Szeged, Hungary, September 2011.

DAMON MCCOY
Assistant Professor
PhD Computer Science, University of Colorado, Boulder, 2009

Damon McCoy is an assistant professor in the Department of Computer Science at George Mason University. Previously, he was a Computer Innovation Fellow at the University of California, San Diego. His research includes work on wireless privacy, anonymous communication systems, cyber-physical security, and economics of e-crime. His general interests are in exploring and improving the security and privacy of large-scale systems.

Selected Publications

1. Meiklejohn, Sarah, Marjori Pomarole, Grant Jordan, Kirill Levchenko, Damon McCoy, Geoffrey M. Voelker, and Stefan Savage. "A Fistful of Bitcoins: Characterizing Payments Among Men with No Names." In proceedings of the ACM Internet Measurement Conference, Barcelona, Spain, October 2013.
2. Thomas, Kurt, Damon McCoy, Chris Grier, Alek Kolcz, and Vern Paxson. "Trafficking Fraudulent Accounts: The Role of the Underground Market in Twitter Spam and Abuse." In proceedings of the USENIX Security Symposium, Washington D.C., August 2013.
3. McCoy, Damon, Hitesh Dharmdasani, Christian Kreibich, Geoffrey M. Voelker, and Stefan Savage. "Priceless: The Role of Payments in Abuse-advertised Goods." In proceedings of the ACM Conference on Computer and Communications Security, Raleigh, North Carolina, October 2012.
4. Grier, Chris, Kurt Thomas, Lucas Ballard, Juan Caballero, Neha Chachra, Christian J. Dietrich, Kirill Levchenko, Panayiotis Mavrommatis, Damon McCoy, Antonio Nappa, Andreas Pitsillidis, Niels Provos, Zubair Rafique, Moheeb Abu Rajab, Christian Rossow, Vern Paxson, Stefan Savage, and Geoffrey M. Voelker. "Manufacturing Compromise: The Emergence of Exploit-as-a-Service." In proceedings of the ACM Conference on Computer and Communications Security, Raleigh, North Carolina, October 2012.

FACULTY

DANIEL MENASCÉ
University Professor
PhD Computer Science, University of California, Los Angeles, 1978

Daniel Menascé has taught at George Mason University since 1992. He is a Fellow of the ACM and of the IEEE and he received the A.A. Michelson Award from the Computer Measurement Group in 2001. His areas of interest and expertise include autonomic computing, software performance engineering, service-oriented computing, and the modeling and analysis of computer systems, web, and e-commerce systems.

Selected Publications

1. Abdullah, I. S., and D. A. Menascé. "The Meta-Protocol Framework." *The Journal of Systems and Software* (2013).
2. Alomari, F., and D. A. Menascé. "Efficient Response Time Approximations for Multiclass Fork and Join Queues in Open and Closed Queuing Networks." *IEEE Transactions on Parallel and Distributed Systems* (2013).
3. Sibai, F., and D. A. Menascé. "Countering Network-Centric Insider Threats through Self-Protective Autonomic Rule Generation." In proceedings of the IEEE 6th International Conference on Software Security and Reliability, Washington, D.C., June 20–22, 2012.
4. Menascé, D. A., E. Casalicchio, and V. Dubey. "On Optimal Service Selection in Service-Oriented Architectures." *Performance Evaluation Journal* 67, no. 8 (2010): 659–675.

AMIHAI MOTRO
Professor
PhD Computer and Information Science, University of Pennsylvania, 1981

Amihai Motro is the director of the Department of Computer Science's PhD program. He has taught at George Mason University since 1990. His research interests are in database management, information systems (with a focus on information integration), information retrieval, cooperative user interfaces, virtual enterprises, and service-oriented architectures.

Selected Publications

1. Acar, A. C., and A. Motro. "Segmenting and Labeling Query Sequences in a Multidatabase Environment." In proceedings of the 19th International Conference on Cooperative Information Systems, October 2011. Lecture notes in *Computer Science* 7044: 367–384.
2. Church, J., and A. Motro. "Learning Service Behavior with Progressive Testing." In proceedings of the IEEE International Conference on Service-Oriented Computing and Applications, 1–8. 2011. (Best Paper Award)
3. Motro, A., and Y. Guo. "The SOAVE Platform: A Service Oriented Architecture for Virtual Enterprises." In proceedings of the 13th IFIP Working Conference on Virtual Enterprises, October 2012. Also in *IFIP Advances in Information and Communication Technology* 380: 216–224.
4. Berlin, J., and A. Motro. "Database Schema Matching Using Machine Learning with Feature Selection." *Seminal Contributions to Information Systems Engineering: 25 Years of CAiSE*, 315–330. Springer, 2013.

DAVID NORDSTROM
Term Associate Professor
PhD Mathematics, University of California, Berkeley, 1976

David Nordstrom has taught at George Mason University since 1993. He has over 30 years of teaching experience, including 13 years at Mason, with courses ranging from low-level programming to operating systems, computer systems architecture, algorithms, and compilers. He was the first faculty member to teach several new undergraduate courses, developing the course material and assignments. He has taught a greater variety of undergraduate courses than any other faculty member in the department.

JEFF OFFUTT
Professor
PhD Computer Science, Georgia Institute of Technology, 1988

Jeff Offutt is the director of the software engineering MS program. He has published over 150 refereed research papers with an H-index of 51, is the coauthor of *Introduction to Software Testing*, and is editor-in-chief of Wiley's journal of *Software Testing, Verification and Reliability*. He was the IEEE International Conference on Software Testing, Verification, and Validation founding steering committee chair. He received the university's Teaching Excellence Award, Teaching with Technology, in 2013, and was named an Outstanding Faculty member in 2008 and 2009. His research interests include secure software engineering, software evolution, and software testing and analysis of web applications and web services.

Selected Publications

1. Offutt, Jeff, and Chandra Alluri. "An Industrial Study of Applying Input Space Partitioning to Test Financial Calculation Engines." *Empirical Software Engineering* (2012).
2. Offutt, Jeff, Vasileios Papadimitriou, and Upsorn Praphamontripong. "A Case Study on Bypass Testing of Web Applications." *Empirical Software Engineering* (2012).
3. Reales Mateo, Pedro, Macario Polo Usaola, and Jeff Offutt. "Mutation at the Multi-Class and System Levels." *Science of Computer Programming* (2012).
4. Ammann, Paul, and Jeff Offutt. *Introduction to Software Testing*. Cambridge, U.K.: Cambridge University Press, 2008.

FACULTY

J. MARK PULLEN
Professor
DSc, The George Washington University, 1981

Mark Pullen is the director of the Center of Excellence in Command, Control, Communications, Computing, and Intelligence. He has taught at George Mason University since 1992. His research interests include networked multimedia applications (with an emphasis on command and control), networked education and training, distributed virtual simulation, and interoperation of command and control with simulations. He is a fellow of the Institute of Electrical and Electronics Engineers (IEEE), fellow of the Association for Computing Machinery, and recipient of the IEEE Harry Diamond Award.

Selected Publications

1. Pullen, J., D. Corner, R. Wittman, A. Brook, P. Gustavsson, U. Schade, and T. Remmersmann, "Multi-Schema and Multi-Server Advances for C2-Simulation Interoperation in MSG-085." In proceedings of the NATO Modeling and Simulation Symposium, 2013.
2. Pullen, J., D. Corner, P. Gustavsson, and M. Grönkvist. "Incorporating C2-Simulation Interoperability Services into an Operational C2 System." In proceedings of the International Command and Control Research and Technology Symposium, Alexandria, Virginia, 2013.
3. Pullen, J. M., D. Corner, S. Singapogu, and P. McAndrews. "Interpreted Web Services as a Tool for Development of Command and Control Interoperability with Simulations." In proceedings of the IEEE Distributed Simulation and Real Time Applications Symposium, Singapore, October 2009.
4. Pullen, J. M., and J. Chen. "Distributed Application Launching for High Quality Graphics in Synchronous Distance Education." *ACM Special Interest Group on Computer Science Education Bulletin* 40, no. 3 (2008): 204–208.

HUZEFA RANGWALA
Assistant Professor
PhD Computer Science, University of Minnesota, Minneapolis, 2008

Huzefa Rangwala holds an affiliate appointment in the Department of Bioengineering. He has taught at George Mason University since 2008. His areas of interest and expertise are data mining, bioinformatics, and high-performance computing, with an emphasis on the development of computational methods for proteins structure and function prediction, metagenomic analysis, and drug design. He is the recipient of the 2013 NSF CAREER award, the 2012 Departmental Outstanding Teaching Award, the 2013 School of Engineering Teaching Award, and the 2011 Departmental Junior Faculty Research Award.

Selected Publications

1. Rasheed, Zeehasham, and Huzefa Rangwala. "Mc-MinH: Metagenome Clustering Using Minwise Based Hashing." In proceedings of the SIAM International Conference in Data Mining, 677–685, Austin, Texas, 2013.
2. Samuel, Blasiak, Rangwala Huzefa, and Kathryn Laskey. "A Family of Feed-Forward Models for Protein Sequence Classification." In proceedings of the European Conference in Machine Learning, 419–434, Bristol, United Kingdom, 2012.
3. Charuvaka, Anveshi, and Rangwala Huzefa. "Multi-Task Learning for Classifying Proteins using Dual Hierarchies." In proceedings of the IEEE International Conference in Data Mining, 834–839, Brussels, Belgium, 2012.
4. Rangwala, Huzefa, and Salman Jamali. "Defining a Coparticipation Network Using Comments on Digg." *IEEE Intelligent Systems* 25, no. 4 (2010): 36–45.

DANA RICHARDS
Associate Professor
PhD Computer Science, University of Illinois, 1984

Dana Richards has taught at George Mason University since 1994. His research focus is in algorithms. He previously worked at the National Science Foundation and at the University of Virginia.

Selected Publications

1. Gabriel Catalin Balan, Dana Richards, Sean Luke, "Long-term fairness with bounded worst-case losses," Autonomous Agents and Multi-Agent Systems 22(1): 43-63 (2011)
2. Arthur L. Liestman, Dana S. Richards, Ladislav Stacho, "Broadcasting from multiple originators," Discrete Applied Mathematics 157(13): 2886-2891 (2009)
3. Dana Richards, Zhenlei Jia, "The Structure of PEC Networks," Internet Mathematics 6(1): 3-17 (2009)
4. Inja Youn, Brian L. Mark, Dana Richards, "Statistical Geolocation of Internet Hosts," ICCCN 2009: 1-6

SANJEEV SETIA
Professor & Chair
PhD Computer Science, University of Maryland, College Park, 1993

Sanjeev Setia's research interests are in ad hoc and sensor networks, network security, and performance evaluation of computer systems. In recent years, he has worked extensively on security mechanisms and protocols for ad hoc and wireless sensor networks. He has served as chair of the CS department since September 2011.

Selected Publications

1. Sankardas Roy, Mauro Conti, Sanjeev Setia, Sushil Jajodia. "Secure Data Aggregation in Wireless Sensor Networks." *IEEE Transactions on Information Forensics and Security* 7, no. 3 (2012): 1040-1052.
2. Gabrieli, Andrea, Luigi Mancini, Sanjeev Setia, and Sushil Jajodia. "Securing Topology Maintenance Protocols for Sensor Networks." *IEEE Transactions on Dependable and Secure Computing* 8, no. 3 (2011): 450–465.
3. Zhu, Bo, Sanjeev Setia, Sushil Jajodia, Sankardas Roy, and Lingyu Wang. "Localized Multicast: Efficient Distributed Detection of Node Replication Attacks in Sensor Networks." *IEEE Transactions on Mobile Computing* 9, no. 7 (2010): 213–926.
4. Huang, Leijun, and Sanjeev Setia. "CORD: Energy-Efficient Reliable Bulk Data Dissemination in Sensor Networks." In proceedings of the 27th IEEE International Conference on Computer Communications (INFOCOM), March 2008.

FACULTY

AMARDA SHEHU
Assistant Professor
PhD Computer Science, Rice University, 2008

Amarda Shehu holds affiliate appointments in the Department of Bioengineering and in the School of Systems Biology. She has taught at George Mason University since 2008. Her research focuses on modeling complex biological systems in the presence of constraints through novel algorithmic frameworks that unravel the role of molecular sequence, structure, assembly, and dynamics in biological processes in healthy and diseased cells. She has been recognized with a 2012 NSF CAREER award, a 2013 Jeffress Memorial Trust Award in Interdisciplinary Science, the 2012 Department of Computer Science Young Faculty Research Award, and the 2013 OSCAR Undergraduate Mentor Excellence Award.

Selected Publications

1. Ashoor, Abrar, Jacob C. Nordman, Daniel Veltri, Keun-Hang Susan Yang, Lina Al Kury, Yaroslav Shuba, Mohamed Mahgoub, Frank C. Howarth, Bassem Sadek, Amarda Shehu, Nadine Kabbani, and Murat Oz. "Menthol Binding and Inhibition of Alpha7-nicotinic Acetylcholine Receptors." *PLOS One* 8, no. 7 (2013): e67674.
2. Molloy, Kevin, Sameh Saleh, and Amarda Shehu. "Probabilistic Search and Energy Guidance for Biased Decoy Sampling in Ab-initio Protein Structure Prediction." *IEEE/ACM Transactions on Computational Biology and Bioinformatics* 10, no. 2 (2013): 1234-1247.
3. Olson, Brian, and Amarda Shehu. "Evolutionary-Inspired Probabilistic Search for Enhancing Sampling of Local Minima in the Protein Energy Surface." *Proteome Science* 10, no. 1 (2012): S5.
4. Molloy, Kevin, and Amarda Shehu. "A Robotics-Inspired Method to Sample Conformational Paths Connecting Known Functionally-Relevant Structures in Protein Systems." In proceedings of the IEEE International Conference on Bioinformatics and Biomedicine-Computational Structural Biology Workshop, 56–63, Philadelphia, Pennsylvania, October 4–7, 2012.

ROBERT SIMON
Associate Professor
PhD Computer Science, University of Pittsburgh, 1996

Robert Simon serves on the editorial boards of four computer science journals, and has participated in numerous program committees in various capacities. His research interests include embedded systems, wireless and mobile computing, ad hoc networking, performance modeling and analysis, and distributed computing. He is the co-inventor for two patents, has three best paper awards, and has graduated six PhD students.

Selected Publications

1. J. Pope and R. Simon, "CREST: An Epoch-Oriented Routing Control Plane for Low-Power and Lossy Networks." *IEEE SENSEAPP* 2013, Sydney, Australia, July 2013.
2. B. Zhang, R. Simon, and H. Aydin. "Harvesting Aware Energy Management for Time Critical Wireless Sensor Networks with Joint Voltage and Modulation Scaling." *IEEE Transactions on Industrial Informatics*, vol. 9, no. 1, pp. 514 - 526, February 2013.
3. B. Zhang, R. Simon, and H. Aydin. "Maximal Utility Rate Allocation for Energy Harvesting Wireless Sensor Networks." *Proceedings of the 14th ACM International Conference on Modeling, Analysis and Simulation of Wireless and Mobile Systems (MSWIM'11)*, Miami Beach, FL, October 2011. Best Paper Award
4. G. Alnifie and R. Simon. "MULEPRO: a multi-channel response to jamming attacks in wireless sensor networks," *Wireless Communications and Mobile Computing*, Vol. 10, No. 5, pp. 704-721, April 2010

MARK SNYDER
Term Assistant Professor
PhD Computer Science, University of Kansas, 2011

Mark Snyder has taught at George Mason University since 2011. His research interests are in languages and type theory, domain specific languages, and the application of functional languages.

Selected Publications

1. Frisby, N., M. Peck, M. Snyder, and P. Alexander. "Model Composition in Rosetta." In proceedings of the Engineering of Computer-Based Systems, Las Vegas, Nevada, 2011.
2. Snyder, M., and P. Alexander. "Monad Factory: Type-Indexed Monads." In proceedings of the 11th International Symposium on Trends in Functional Programming, 106–120, Norman, Oklahoma, 2010.
3. Snyder, M., N. Frisby, G. Kimmell, and P. Alexander. "Writing Composable Software with InterpreterLib." In proceedings of the 10th International Conference on Software Composition, ETH, Zurich, Switzerland, 2009.

ARUN SOOD
Professor
PhD Electrical Engineering, Carnegie Mellon University, 1971

Arun Sood is the director of the International Cyber Center. He has taught at George Mason University since 1987. His areas of interest are security architectures, intrusion tolerance, image analysis and computer vision, optimization, parallel and distributed processing, performance modeling, and simulation and modeling. His research team developed "Self-Cleansing Intrusion Tolerance Technology," which was the winner of the Global Security Challenge sponsored by the Security Technology of Tomorrow Challenge.

Selected Publications

1. Nguyen, Quyen, and Arun Sood. "Comparative Analysis of Intrusion-Tolerant System Architectures." IEEE Security and Privacy, 9 (4), July 2011.
2. Nguyen, Quyen L., and Arun Sood. "Multiclass S-Reliability for Services in SOA." In proceedings of the 5th International Conference on Software Engineering Advances, Nice, France, 2010.
3. Nagarajan, Ajay, and Arun Sood. "SCIT and IDS Architectures for Reduced Data Ex-Filtration." In proceedings of the 4th Workshop on Recent Advances in Intrusion-Tolerant Systems, Chicago, Illinois, 2010.
4. Bangalore, Anantha K., and Arun K. Sood. "Securing Web Servers Using Self Cleansing Intrusion Tolerance (SCIT)." In proceedings of the 2nd International Conference on Dependability, Athens/Vouliagmeni, Greece, 2009.

FACULTY

AVINASH SRINIVASAN
Term Assistant Professor
PhD Computer Science, Florida Atlantic University, 2008

Avinash Srinivasan is the Program Manager for the Education Partnership Agreement between George Mason University and Department of Defense Cyber Crime Centre (DC3). He has taught at George Mason University since spring 2012, predominantly for the MS ISA program with occasional graduate level courses for the MS CS and MS INFS program. His current research interests include information and network security, malware characterization, mobile and network forensics, and security and forensics challenges in cloud computing.

Selected Publications

1. A. Srinivasan, S. Kolli, and J. Wu. "Steganographic Information Hiding that Exploits a Novel File System Vulnerability." I*nternational Journal of Security and Networks (IJSN),* vol. 8, no. 2, 2013.
2. H. Kalva, A. Parikh and A. Srinivasan. "Accelerating Video Carving from Unallocated Space." In *The Proceedings of SPIE 8665 - Media Watermarking, Security, and Forensics*, 2013, 86650H, 3-7 Feb. 2013, Burlingame, CA, USA.
3. A. Srinivasan, S. Thirthahalli, and A. Stavarou. "HIDEINSIDE - A Novel Randomized & Encrypted Antiforensic Information Hiding." In *International Conference on Computing, Networking and Communications (ICNC)*, 28-31 Jan. 2013, San Diego, CA, USA.
4. J. Spaulding, A. Krauss and A. Srinivasan. Exploring an Open WiFi Detection Vulnerability as a Malware Attack Vector on iOS Devices." In *7th IEEE International Conference on Malicious and Unwanted Software (IEEE MALWARE)*, pages 87-93, 16-18 Oct. 2012, Fajardo, PR.

ANGELOS STAVROU
Associate Professor
PhD Computer Science, Columbia University, 2007

Angelos Stavrou is an associate professor at George Mason University and the associate director at the Center for Secure Information Systems. He is an active member of NIST's Mobile Security team, is a member of the ACM, IEEE, and USENIX, and has written over 40 peer-reviewed conference and journal articles. His research interests include security and reliability for distributed systems, security principles for virtualization, and anonymity, with a focus on building and deploying large-scale systems. Stavrou was awarded the 2012 George Mason Emerging Researcher, Scholar, Creator Award, the 2013 IEEE Reliability Society Engineer of the Year award, and he is the recipient of an NSF Trustworthy Computing grant.

Selected Publications

1. Boggs, Nathaniel, Sharath Hiremagalore, Angelos Stavrou, and Salvatore J. Stolfo. "Cross-Domain Collaborative Anomaly Detection: So Far yet So Close." In proceedings of the 14th International Symposium on Recent Advances in Intrusion Detection, Menlo Park, California, September 2011.
2. Le, Meixing, Angelos Stavrou, and Brent ByungHoon Kang. "DoubleGuard: Detecting Intrusions in Multi-Tier Web Applications." *IEEE Journal on Transactions on Dependable and Secure Computing* (2011).
3. Wang, Jiang, Angelos Stavrou, and Anup K. Ghosh. "HyperCheck: A Hardware-Assisted Integrity Monitor." In proceedings of the 13th International Symposium on Recent Advances in Intrusion Detection, Ottawa, Canada, September 15–17, 2010.
4. Song, Yingbo, Michael E. Locasto, Angelos Stavrou, Angelos D. Keromytis, and Salvatore J. Stolfo. "On the Infeasibility of Modeling Polymorphic Shellcode: Re-thinking the Role of Learning in Intrusion Detection Systems." Machine Learning. Pavel Laskov and Richard Lippmann, eds. (2009).

GHEORGHE TECUCI

Professor

PhD Computer Science, University of Paris-South, 1988

PhD Computer Science, Polytechnic Institute of Bucharest, 1988

Gheorghe Tecuci is the director of the Learning Agents Center and a member of the Romanian Academy. He has followed a career-long interest in the development of a computational theory and technology that allows non-computer scientists to develop cognitive agents that incorporate their expertise to act as problem-solving and decision-making assistants to experts, as consultants to non-experts, or as intelligent tutors to students. He has published over 185 papers with contributions to artificial intelligence, instructable agents, multistrategy learning, knowledge engineering, and computational evidence-based reasoning.

Selected Publications

1. Boicu, M., G. Tecuci, and D. Marcu. "Rapid Argumentation Capture from Analysis Reports: The Case Study of Aum Shinrikyo." In proceedings of the 7th International Conference on Semantic Technologies for Intelligence, Defense, and Security, Fairfax, Virginia, October 23 –26, 2012.
2. Tecuci, G., D. Marcu, M. Boicu, D. A. Schum, and K. Russell. "Computational Theory and Cognitive Assistant for Intelligence Analysis." In proceedings of the 6th International Conference on Semantic Technologies for Intelligence, Defense, and Security, Fairfax, Virginia, November 16–18, 2011.
3. Boicu, M., D. Marcu, G. Tecuci, and D. Schum. "Cognitive Assistants for Evidence-Based Reasoning Tasks." In proceedings of the AAAI Fall Symposium on Advances in Cognitive Systems, Arlington, Virginia, November 4–6, 2011.
4. Tecuci, G., D. Schum, M. Boicu, D. Marcu, and B. Hamilton. "Intelligence Analysis as Agent-Assisted Discovery of Evidence, Hypotheses and Arguments." *Advances in Intelligent Decision Technologies*. G. Phillips-Wren, L. C. Jain, K. Nakamatsu, and R. J. Howlett, eds. (2010).

PEARL Y. WANG

Associate Professor

Associate Chair

Director of Undergraduate Programs

PhD Mathematics, University of Wisconsin, Milwaukee, 1983

Pearl Wang joined George Mason University in 1983 as a founding member of the Department of Computer Science. She currently serves as the department associate chair. She is an ABET volunteer and serves on the ABET CAC Commission and the CSAB Board. Her research interests include interconnection networks for massively parallel systems, and the development of sequential and parallel algorithms for combinatorial optimization problems. She has served on the editorial boards of professional journals, including the *IEEE Transactions on Parallel and Distributed Systems*, the *Journal of Parallel and Distributed Computing*, and the *European Journal of Operational Research*.

Selected Publications

1. John E. Dorband, Christine L. Mumford, Pearl Y. Wang, "Developing an aCe Solution for Two-Dimensional Strip Packing," IPDPS 2004
2. Christine L. Valenzuela, Pearl Y. Wang, "VLSI placement and area optimization using a genetic algorithm to breed normalized postfix expressions," IEEE Trans. Evolutionary Computation 6(4): 390-401 (2002)
3. Pearl Y. Wang, Christine L. Valenzuela, "Data set generation for rectangular placement problems," European Journal of Operational Research 134(2): 378-391 (2001)
4. Christine L. Valenzuela, Pearl Y. Wang, "A Genetic Algorithm for VLSI Floorplanning," PPSN 2000: 671-680

FACULTY

XINYUAN (FRANK) WANG
Associate Professor
PhD Computer Science, North Carolina State University, 2004

Frank Wang's main research interests are computer network and system security, including malware analysis and defense, attack attribution, privacy and anonymity, VoIP security, steganography, and digital forensics. His work includes the demonstration of tracking encrypted, anonymous peer-to-peer VoIP calls on the Internet, and the fundamental limitations of existing low-latency anonymous communication systems in the presence of timing attacks.

Selected Publications

1. Wang, Xinyuan, and Douglas S. Reeves. "Robust Correlation of Encrypted Attack Traffic through Stepping Stones by Watermarking the Interpacket Timing." *IEEE Transactions on Dependable and Secure Computing* 8, no. 3 (2011): 434–449.
2. Wang, Xinyuan, and Xuxian Jiang. "Artificial Malware Immunization based on Dynamically Assigned Sense of Self." In proceedings of the 13th Information Security Conference, October 2010.
3. Jiang, Xuxian, Xinyuan Wang, and Donyan Xu. "Stealthy Malware Detection and Monitoring through VMM-Based 'Out of the Box' Semantic View Reconstruction." *ACM Transactions on Information and System Security* 13, no. 2 (2010).
4. Jin, Jing, and Xinyuan Wang. "On the Effectiveness of Low Latency Anonymous Network in the Presence of Timing Attack." In proceedings of the 39th Annual IEEE/IFIP International Conference on Dependable Systems and Networks, July 2009.

HARRY WECHSLER
Professor
PhD Computer and Information Science, University of California, Irvine, 1975

Harry Wechsler has taught at George Mason University since 1988. His expertise includes image analysis and computer vision; data mining, machine learning, pattern recognition, contents based image retrieval (CBIR), cyber security, biometrics, and identity management. His research focuses on robust authentication for uncontrolled settings characterized by incomplete information and uncertainty. He is a Fellow of the Institute of Electrical and Electronics Engineers, and a Fellow of the International Association of Pattern Recognition.

Selected Publications

1. Wechsler, H. "Biometrics, Forensics, Security, and Privacy Using Smart Identity Management and Interoperability: Validation and Vulnerabilities of Various Techniques." *Review of Policy Research* 29, no. 1 (2012): 63–89.
2. Ho, S. S., and H. Wechsler. "A Martingale Framework for Detecting Changes in the Data Generating Model in Data Streams." *IEEE Transactions on Pattern Analysis and Machine Intelligence* 32, no. 12 (2010): 2113–2127.
3. Li, F., and H. Wechsler. "Face Authentication Using Recognition-by-Parts, Boosting and Transduction." *International Journal of Artificial Intelligence and Pattern Recognition* 23, no. 3 (2009): 545–573.
4. Ho, S. S., and H. Wechsler. "Query by Transduction." *IEEE Transactions on Pattern Analysis and Machine Intelligence* 30, no. 9 (2008): 1557–1571.

ELIZABETH WHITE
Associate Professor
PhD Computer Science, University of Maryland, College Park, 1995

Elizabeth White has taught at George Mason University since 1994. Her areas of interest and expertise include compilers, software architecture, distributed computing, and dynamic reconfiguration. She is an NSF CAREER Award recipient.

Selected Publications

1. Gerald S. Doyle, Elizabeth L. White, "Comparative Architecture Performance Analysis At Design Time," Int. CMG Conference 2007: 231-242
2. Elizabeth L. White, Ranjan Sen, Nina Stewart, "Hide and show: using real compiler code for teaching," SIGCSE 2005: 12-16
3. Elizabeth L. White, "General strategies for dynamic reconfiguration," ACM SIGSOFT Software Engineering Notes 25(1): 93 (2000)
4. Elizabeth L. White, Jeffrey Ruby, Laura Denise Deddens, "Software Visualization of LR Parsing and Synthesized Attribute Evaluation," Software: Practice & Experience. 29(1): 1-16 (1999)

DUMINDA WIJESEKERA
Professor
PhD Mathematical Logic, Cornell University, 1990

PhD Computer Science, University of Minnesota, 1998

Duminda Wijesekera is the acting director of energy initiatives at the Critical Infrastructure and Homeland Security Institute at George Mason University. He has taught at Mason since 1999. His research interests are information security and applying logical methods to computing. He is a fellow of the Potomac Institute of Policy Studies, a visiting scientist at the National Institute of Standards and Technology, and a visiting professor at the Naval Postgraduate School.

Selected Publications

1. Mehmet, Murad, and Duminda Wijesekera. "Money Laundering Transaction Risk Scoring." In proceedings of the 13th Annual IEEE Conference on Technologies for Homeland Security, November 12–14, 2013.
2. Abadie, Andre, and Duminda Wijesekera. "An Approach for Risk Assessment and Mitigation in Cognitive Radio Technologies." *International Journal of Information Privacy, Security and Integrity* 2, no. 3 (2013): 111–120.
3. Yu, Bo, and Duminda Wijesekera. "Building a Dialysis Workflow into an EMR, International Conference on Health and Social Care Information Systems and Technologies." Paper presented in Lisbon, Portugal, October 23–25, 2013.
4. Hartong, Mark, Goel Rajni, and Wijesekera Duminda. "Secure Interchange Routing." *Journal of Transportation Technologies* 1, no. 2 (2011): 21–29.

Ronald Ritchey, PhD

Peng Ning, PhD

ALUMNI PROFILE

Computer Science Department graduates have distinguished themselves in academic, government, and business careers in the metro Washington, DC community and across the globe. Our featured alumni have maintained their research interests while applying their academic foundations to reach the top of their professional careers.

RONALD RITCHEY, PHD

PhD, 2007

The classrooms, colleagues, and lessons acquired over two decades of study at George Mason University are never far from the thoughts of Dr. Ron Ritchey. As the Chief Scientist of Internet Security and a senior vice-president in the Global Information Security division for Bank of America, Ritchey draws upon an array of academic and professional experiences for his work at the bank.

Ritchey, who earned his BS and MS degrees in computer science and PhD in Information Technology from the Volgenau School of Engineering, heads up a team who works to keep the bank secure.

A computer aficionado since his teens, Ritchey spent his childhood bouncing from state to state as the son of an Air Force officer. His family landed in Springfield, Virginia and he finished high school there and began his CS studies at George Mason University.

In the mid-1990s, Booz Allen Hamilton's cyber-security team hired Ritchey. He spent 13 years there and by the time he left in 2011, he oversaw 150 security professionals.

"The amount of expansion on that team while I was there was amazing," he recalls.

While at Booz Allen, Ritchey was a full-time student. He hadn't intended to pursue a doctorate but he stumbled upon a research area that fascinated him. He developed a technique to automate the creation of network attack graphs, which show how adversaries can work their way through a computer network. He and his colleagues and faculty advisors expanded the idea to scale to a real world network. After Ritchey graduated in 2007, Mason received grants to further develop the technology, patenting it and selling it to companies along the way.

> Ritchey was the 2013 Volgenau School Alumni of the Year and Serves as Chair of the Computer Science Industrial Advisory Board.

While working on his PhD, Ritchey also was asked to design a software security course and joined the school as an adjunct faculty member.

"Teaching is something I truly enjoy," says Ritchey. "I feel my ability to bring real world scenarios to the classroom keeps the content fresh and relevant to students and better prepares them for what they are going to find when they go to work."

In addition to teaching at Mason, Ritchey has also taught courses at the SANS Institute and the Institute for Applied Network Security, training organizations for information security professionals. While his workload at Bank of America has limited his teaching at Mason, Ritchey stays involved with the university. In May 2013, he was honored as the Volgenau School Alumni of Year for his contributions. He also serves as Chair of the Computer Science Industrial Advisory Board, a group of industry

professionals tasked with helping the department develop curriculum, seeking ways for companies to work with the department and students, and promoting the school to the larger academic and professional world.

Ritchey enjoys staying connected to former professors and new trends in Internet security research. "A lot of work we do today involves testing and research," says Ritchey. "I still enjoy getting down to the code-writing level of projects, though I don't have the time for as much of that anymore. It's valuable for me to be able to reach out to my professors and just stay connected to their current research."

Yet the rising tide of criminality on the web means that academic theory has to translate into actual tools and strategies. Ritchey relishes the opportunity and challenge: "There are other organizations I could work for that are smaller, but at the bank I'm able to use my expertise to protect employees, customers and shareholders."

PENG NING, PHD

PhD, 2001

The era of the "BYOD" or "bring your own device" workplace has arrived as more people consider using a single phone or tablet to manage both their professional and personal lives a necessary convenience. Businesses like BYOD because it saves their IT departments money and empowers an increasingly mobile workforce to be productive anywhere, anytime.

A vice-president at Samsung Telecommunications America, Dr. Peng Ning is one of the players developing the technology that allows us to toggle easily between work and play. His mandate is to ramp up the platform security features of Samsung phones so they pass muster with enterprises with enormous security needs — like multi-national corporations or the federal government. Samsung already enjoys popularity in the consumer electronics market.

On leave from North Carolina State University where he is a professor of computer science, Ning leads a group of engineers at a Samsung research facility in Santa Clara, California, focused on system security on Samsung devices running Android.

"This is a great opportunity to have a real world impact," he says. "Now, I understand what the industry needs, to bring something from research to a product. Samsung is a good place to do such things since they're willing to take risks to make their products the best in the world."

Ning's team works on a platform security application for business and government clients called Knox, named after Fort Knox, a U.S. Army base in Kentucky whose origins date back to the Civil War. Samsung Knox phones won't be on sale in the U.S. until the last quarter of 2013. The Knox unit is led by Senior Vice President Dr. Injong Rhee, based at Samsung's Suwon, South Korea headquarters.

Knox uses several sophisticated technologies to pursue the seemingly contradictory aims of BYOD – create a super-secure environment for company data while assuring employees that their personal info won't be monitored. Certain smartphones use a technology called "secure boot," a front-line defense against attacks right when a device is turned on. Knox gives government and business clients the ability to customize this process to meet their own higher security standards. Knox also runs on a constellation of safeguards – called TrustZone Integrity-Based Measurement Architecture, or TIMA – developed by Ning's group. Measuring the "cryptographic hash value," TIMA can tell if an employee has installed a non-Samsung operating system on her phone. If this happens, the employee will no longer be able to access company data.

Third-party applications employees download to their phones, which appear to be "appealing and exciting" or mimick well-known apps but have malicious logic, are the biggest threat to an enterprise's data, Ning says. Through its Security Enhancements for Android, Knox isolates apps into multiple "domains" so that if one domain is compromised, the others aren't, containing the threat to the data.

> Ning leads a group of engineers at a Samsung research facility in Santa Clara, California.

From Ning's perspective, BYOD is a chance for Samsung to shine and break into the lucrative enterprise market. The company's Galaxy S4 phone with Knox recently won a coveted spot on a list of approved devices Department of Defense employees can use. "I think the BYOD trend benefits both the end users and companies," Ning says. "We're bringing a lot of technology to make BYOD a reality."

Ning has come a long way from the sub-arctic winters and monsoon summers of Hailar, his childhood city in China's Inner Mongolia province. He fell into computer science in high school and spent a fair bit of time programming in college at the University of Science and Technology in Heifei. A PhD program brought him across the world to George Mason University's Department of Computer Science, where he met Professors Sushil Jajodia and X. Sean Wang.

"I think I owe my career to my advisors," he says. "They gave me the training to do research." ■

INFORMATION SECURITY:

FROM THE CLASSROOM TO THE REAL WORLD

From our most intimate use of technology in our daily lives to issues of national transportation safety, George Mason University's Computer Science (CS) department and security research faculty are involved with today's most pressing cybersecurity challenges.

The CS department is supported by $6.4 million in grants and contracts, with $2.5 million exclusively for cybersecurity activities and research. The department has partnerships with some of the nation's leading technology companies such as Siemens, General Motors, Lockheed Martin, and Google; government agencies such as the Department of Homeland Security (DHS), Department of Transportation (DOT), and the Defense Advanced Research Projects Agency (DARPA); and academic research institutions including Carnegie Mellon's Cylab. George Mason University is also a National Security Agency (NSA) National Center of Academic Excellence.

"A great strength of the department as it directly relates to security research and instruction is our location in the Washington, DC, technology corridor and proximity to the federal government, specifically the intelligence community," says CS chair **Sanjeev Setia**. "Our ability to apply academic instruction to the latest security stories on the morning news also attracts students who are seeking the training and insight needed to succeed after they graduate."

Setia describes the value of the department's cross-industry approach to security issues that range from theoretical pursuits to researching and resolving known and potential exploits in physical devices, system software, and wireless operations, and high-level application software issues as well as the growing human factor of cyber crime, consumer fraud, and national transportation safety concerns.

The foundation for the program begins with the academics. The department offers bachelor's, master's, and doctoral programs in computer science; master's programs in software engineering, information systems, and information security and assurance; and a bachelor's program in applied computer science with various concentrations.

Because of the demand for cybersecurity professionals in the DC region, many of Mason's doctorate students are seeking specialized training. The department is working to fulfill student demand, and a new bachelor's program in cybersecurity is now awaiting final state approval. This program reflects the interest undergraduate students have shown for Mason's undergraduate security classes.

"Collaboration is also a hallmark of our program," says Setia. "We participate in a master's in management of secure information systems. This is a cross-disciplinary cybersecurity degree program with the School of Management, School of Public Policy, and the CS Department." The degree is ideal for midcareer students active in the cybersecurity field in both the private sector and government.

This summer, the National Science Foundation (NSF) awarded a two-year, $480,000 grant that will allow the school of management and the Volgenau School to work together to build a cybersecurity leadership program, "Bridging the Cybersecurity

Leadership Gap: Assessment, Competencies and Capacity Building."

A look inside the Department and its research activities provides insight into the Department's support to government agencies and private industry.

SECURITY RESEARCH

Frank Wang, an associate professor in the CS department, is one of the many CS faculty members who are bringing a human aspect to the information security field. Today, barely a week goes by without some new published threat to industry systems, government applications, and consumer devices.

Some of these threats come from people using technology to hide their online activities. An anonymizer allows Internet users to protect their identities, hide their IP addresses and locations, and communicate in censored environments. And while there are many practical and legal applications for their use, they can also be misused by the attackers. Wang's NSF-funded research in VoIP (voice over Internet protocol) tracing has demonstrated that it is possible to embed unique IDs into any given VoIP flow—flow watermarking and tracking anonymized communications over VoIP. The ID does not depend on or change the content but rather the timing of the packet. "We've proven that we can embed these IDs at the router, firewall, or hardware level," says Wang. His research has practical applications for law enforcement as they are seeking new ways to track and stop Internet crime. People using VoIP also can't hide by encrypting their transmissions. "Since the technology is based on timing, it doesn't matter if the material is encrypted," says Wang.

More recently, Wang has turned his attention to malware, specifically those employing cryptographic algorithms. "Malware has become so sophisticated that it too is encrypted by its creators." Encrypted malware is harder to track, reverse engineer, and remove. Wang has developed a CipherXRay designed on the avalanche effect that can break the cipher used in malware. "Now that we know the encryption can be broken, our challenge is to find a solution that better protects programs and system," says Wang.

With a strong industry background and experience working as a consultant with financial services firms, professor **Arun Sood** understands the economics of information security as well as the need for secure systems. Sood brings real-world security scenarios into his teaching as a way to make threats and problems relevant to students. He says that this is a common theme with his CS colleagues, many of whom, who like himself, have strong ties to industry and government needs.

Applications that advance business are often an end goal of research, but many times, the solutions are affordable only by the largest organizations or governments. "Affordability leads to its own breach of security," says Sood. Companies send their research needs overseas where coding and programming is cheaper. Unintentionally, intellectual capital is then more easily acquired by people with malicious goals. "We need to better support up-and-coming entities," says Sood. His research has led to the creation of a robust and cost-effective security solution, Self-Cleaning Intrusion Tolerance (SCIT), a patented technique that monitors servers, removes malware, and restores systems to a ready state and allows companies to run forensics. The SCIT Moving Target Defense limits the exposure systems to the Internet to short periods of time, thus making attacking difficult for intruders from exploiting systems. "Our solution is not perfect," says Sood, "but it does provide a strong building block for controlling part of the intrusion threat." The solution is ideal for companies lacking huge IT support teams as the system is self-supporting and scalable, allowing companies to build on their IT systems.

FINDING FAULTS

Our daily activities are now bound by personal technology from the music we choose to download, the coordinates we program into our GPS, and the content we share. "Computers are a form of expression," says associate professor **Angelos Stavrou**. He feels that though technology has allowed for amazing advancements in our lives, as a society we haven't fully thought out how increasing connectedness through the Internet and a growing array of smart devices can cause almost as many problems as it solves. There's a lot at stake, including our personal identities, intellectual capital, and even our personal safety. Consumers take most technology for granted and do not consider that the simple act of plugging a cable into the devices that store so much of our personal information could allow malicious applications in and compromise our personal data.

Recently, Stavrou, along with his graduate student Zhaohui Wang,

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have had some high-profile success exposing how smartphones and similar devices can be exploited through USB attacks. Working first with the Android platform, the team wrote software that changes the functionality of the USB driver. They were then able to launch an attack while the smartphone was charging or syncing data between the smartphone and a computer, all without user detection.

In addition to this research, Stavrou is interested in understanding cloud security and exposing security faults. He sees that the cloud offers a lot of solutions for companies and individuals, but he cautions that it is "just as important to consider the motives and capabilities of the people behind the computers managing the growing amount of data now available." Stavrou points to the CS department's work with the Department of Homeland Security (DHS) to develop and run training programs for DHS employees as a positive way to expand the conversation and find real solutions to these growing security problems.

Associate Professor **Sam Malek**, a faculty member in the software engineering group, is also taking a critical look at smartphones but from the application side. Malek says it's important to look at "how security crosses through everything in the system stack from overall system security, networking, and the application market."

One of his research projects, looking at self-securing software systems, is with Carnegie Mellon's Cylab and is funded by the Army Research Office. The Department of Defense is interested in using the Android platform for mobile tactile devices, specifically, how software can be made adaptive so that it changes its behavior to avoid an attack. Malek explains that when it comes to the Android platform, "it's easy for anyone to create an online app these days, and there is only a $25 entry fee. That means there is a lot of mad stuff out there that may be malicious and poorly tested." Malek and the Cylab team are working on a middleware framework solution called Rainbow. This two-layer software system allows the application to sit and execute on one layer and be monitored on another. This project has a three- to five-year timeline, and once it is complete, Mason will have access to it for further use and development.

CYBER CAT AND MOUSE

Real security forensics is part and parcel of **Damon McCoy's** security research goals. A recent NSF Frontier Grant winner, McCoy has been tracking cyber criminals intent on selling illegal pharmaceuticals. "Cyber crime is fueled by profits," explains McCoy.

In 2011, Damon and fourteen research colleagues from a consortium of California-based universities made news with an investigative research project that traced spam messages coming from companies selling herbal and medicinal pharmaceuticals. What began as an academic hunting mission turned into an effective tool to disrupt cyber crime. The team was able to pinpoint where the majority of online banking transactions were funneled and turned the information over to law enforcement.

The sleuthing effectively demonetizes the sellers, forcing them to find new banks to process their transactions. Damon explains that many sellers consider themselves business owners and see nothing wrong with selling gray market goods. In many cases, sellers never deliver products and just scam consumers out of their money. In some instances, products are delivered, but gray market pharmaceuticals are not regulated and can be harmful or even fatal. Damon explains they are employing stylometry—natural language processing—to trace what appears to be anonymous spam to find the spammers. Damon says it is a bit of a cat-and-mouse game as the spammers know who the team is and what they are trying to do to stop them. But with the grant, the team has the time and resources to continue the cyber chase.

SECURITY IN OUR PHYSICAL ENVIRONMENT

In the United States, trains move approximately forty-five percent of American commerce, everything from coal to corn. In 2008, the U.S. Rail and Safety Improvement Act became law. The mandate is to improve train safety by instituting positive train control (PTC), a system in which a train's movements, speed, location, rail conditions, etc., are monitored through a wireless system, wayside equipment, that constantly transmits vital data to the train, thus reducing human errors.

However, there is a trade-off. "One of the most pressing problems with trains today is security," says **Duminda Wijeskera**. "Traditionally the nation used a signaling system that relied on rail workers being able to physically see the trains and the signal beacons." Now with the implementation of PTC, in addition to the infrastructure challenges of implementing a wireless system across the nation's rail lines "is the real concern that the wireless messages broadcast openly on a single frequency band near the 220 MHz band could be intercepted." Trains carrying hazardous chemicals, for example, that also pass through urban areas could be tampered with, causing grave public danger.

Wijeskera's work is funded in part by the Department of Transportation, and he also has projects with Siemens. He and his team of graduate students have identified potential security faults and are now testing solutions with many positive outcomes. By identifying and patching the flaws, the Mason team assists the railroads as they meet the rail safety improvement requirements. ■

RoboPatriots Human Support Team. L-R Keith Sullivan, Sean Luke, Kevin Andrea, Katherine Russell

ROBOTICS: RESEARCH FOR RESULTS

Robotics research in the Computer Science (CS) Department at George Mason University consists of a number of intersecting areas of research. The hub of these activities is the Autonomous Robotics Lab (http://cs.gmu.edu/~robotics), housed on campus in the Engineering Building. While many robotics programs around the world are involved in developing new robotics hardware, Mason researchers focus more on improving robot intelligence and autonomy. Multi-agent systems are of particular interest, ranging from small teams of robots, such as the 3 vs. 3 competitions in RoboCup soccer tournaments to large numbers of simple agents (swarms) capable of performing tasks through their collective emergent behavior.

Experience tells us that hand-coding robot intelligence and autonomy is difficult enough when dealing with single robots, and orders of magnitude are more difficult for multi-agent systems. The approach taken at Mason is to use machine-learning techniques in combination with a homegrown multi-agent simulation tool called MASON (http://cs.gmu.edu/~eclab/projects/mason/) developed by Sean Luke.

Together with ongoing research in **Kenneth De Jong's** Evolutionary Computation lab, complex multi-agent system behavior can be evolved over time in simulation, visualized in MASON, and embedded in physical robots.

NAVIGATION THROUGH LANDSCAPES

The lab is also used by associate professor **Jana Košecká**, whose research on computer vision, localization, and understanding urban environments seeks to solve the problem of how to translate real-time video sensor recordings and environmental obstacles into algorithms that an agent can use to independently navigate through its surroundings. The natural environment is notoriously unpredictable and changing. Agents that can navigate through buildings or landscapes in place of humans have valuable practical applications. Košecká's research is funded in part by the National Science Foundation (NSF), Intelligence Advanced Research Projects Activity (IARPA), and the Defense Advanced Research Projects Agency (DARPA).

Where Košecká is working on visual sensors problems, associate professor **Jyh-Ming Lien** is interested in computational geometry and how to make agents move in a three-dimensional space—motion planning. When you have lots of agents moving in one set space, how do you control them? Lien is currently working on a research project with Pennsylvania State University funded by NSF on a control group of vehicles. The idea is that if a vehicle is deployed in a large crowd, the vehicle can move in particular patterns to influence the movement of the crowd.

continued on page 40 ...

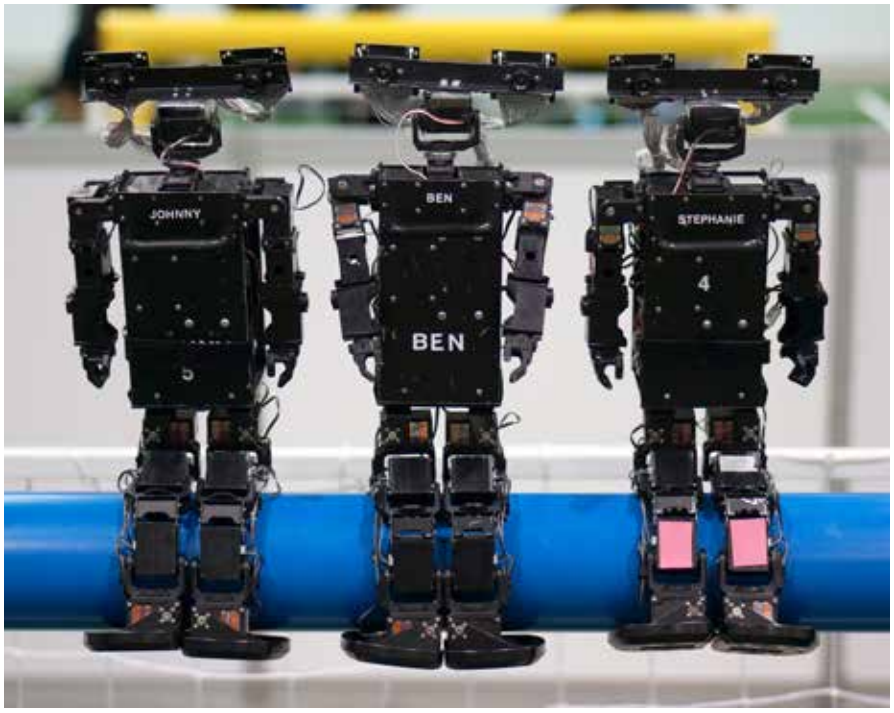
Košecká's sensor work and Lien's motion planning work complement each other, as they are two small but critical components of a larger outcome—the need for agents to sense surroundings and autonomously adapt and move through them.

Phantom Omni Haptic Device
Photo Courtesy: Geomagic, Inc.

MEDICAL DIAGNOSTICS

In addition to the Autonomous Robotics Lab, robotics research in the CS Department addresses exploration of this technology for human applications. In particular, this line of research is developing small robotic instruments for assessment and possible diagnosis of human disabilities. These disabilities include abnormalities of motion, movement planning, and cognitive function that involves problem solving and object manipulation in simulated 3D space.

This is a collaboration between CS Associate Professor **Zoran Durić** and his colleague, a rehabilitation physician, **Lynn Gerber**, working in the Laboratory for the Study and Simulation of Human Movement. Their dual goals are to build a database of functional movements performed by both normal and disabled people and then to build generative/predictive models for various functional movements. These will be used to build virtual environments in which the subject/patient can interact using a guided robotic (haptic) that simulates functional tasks. These environments can help in medical diagnostics and pinpoint hard to detect motor, cognitive, and learning difficulties.



> ...the goal is to learn how to teach and train multiple agents to work together to solve a common task.

The lab has an interdisciplinary group of researchers that includes computer scientists, engineers, students, and physicians. A portion of Durić's current work is funded by the NSF, Department of Defense (DOD), and the Henry F. Jackson Foundation. This latter funding was generated to advance diagnostic and therapeutic opportunities for people with traumatic brain injury.

SETTING REAL GOALS

The CS department participates in the international RoboCup robotics soccer competition. RoboCup promotes robotics and artificial intelligence research. And while teams across the world aim to build robots that can score the most goals, for **Sean Luke** and his team, the goal is to learn how to teach and train multiple agents to work together to solve a common task.

The current RoboPatriot team consists of three humanoid robots. In the last competition, the team stripped the robots of all their programmed movements and commands and taught them how to move and play autonomously, reacting to the field and to one another. The Mason team is working on multi-agent emergence learning issues. Each agent may only have a range of simple behaviors, but together, the group is complex. Luke would like to see if they can have a group of six to eight agents work together with some agents in the group embedded with higher level functions and able to effectively manage small tasks. Luke's research is funded in part by the NSF and the Office of Naval Research. ■

EXTERNAL **FUNDING**

The research expenditures of the Computer Science Department were $6.0 M in fiscal year 2012 and $6.4 M in fiscal year 2013. Active research grants and contracts during fiscal years 2012 and 2013 are listed below.

ALLBECK

Serious Games for Cyber-security Training
Science Applications International Corporation (SAIC)
PI: Jan Allbeck, Co-PI: Arun Sood
2012
$50,000

Exploring Game Designs, Engines, and Tools for use with the NVIG Toolset
Army Night Vision and Electronic Sensors Directorate (NVESD)
PI: Jan Allbeck, Co-PI: Michael Hieb (C4I Center)
2/1/2013-08/31/2013
$100,000

Situation Understanding Bot Through Language and Environment (SUBTLE)
Army Research Office
01/01/2010-08/31/2013
$270,000

AMMANN

Usability Analysis of Security Protocols
Dartmouth College
PI: Paul Ammann, Co-PI: Jeff Offutt
2/1/2012 - 2/28/2014
$128,993

AYDIN

CAREER: A Holistic Energy Management Framework for Real-Time Embedded Systems
National Science Foundation
06/01/2006-05/31/2011
$400,000

Generalized Reliability-Aware Power Management for Real-Time Embedded Systems
National Science Foundation
8/1/2010-7/31/2014
$268,329

BARBARA

Determination of Outstanding Scenarios for Situational Awareness
US Department of the Army
2/20/09-8/31/12
$255,000

Discovering Area Anomalies to Support Detection of Geospatial Stressing Factors
US Department of the Army
9/29/12-9/28/13
$25,000

BRODSKY

Sustainable Manufacturing
National Institute of Standards and Technology (NIST)/US Department of Commerce
PI: A. Brodsky, co-PI: D. Menasce
9/1/12-8/31/15
$298,934

Decision Guidance Approach for Power Optimization & Management
Dominion Virginia Power
PI: A. Brodsky, co-PI: D. Menasce, R. Simon
4/30/13-4/29/14
$25,000

CHEN, S

Self-detecting Stealthy Malware on Your Host
Air Force Office of Scientific Research (AFOSR) Young Investigator
02/2009-11/2011
$300,000

CAREER: Internet Resource Management to Deliver High Quality Live and On-demand Streaming for Wireless Clients.
National Science Foundation
06/2008-05/2014
$450,000

System Research to Advance Real-time Dust Storm Forecasting
National Science Foundation
PI: S. Chen, Co-PI: Chaowei Yang (Dept. of Geography and GeoInformation Sciences)
08/15/11- 07/31/14
$425,000

DEJONG

BCSP: Automated Parameter Tuning of Large-Scale Spiking Neural Networks
National Science Foundation
PI: Kenneth De Jong, Co-PI: Giorgio Ascoli (Krasnow Institute)
05/01/2013 – 04/30/2017
$474,996.15

Multidisciplinary Agent-based Modeling of a Conflict
Office of Naval Research (ONR)
PI: Claudio Cioffi (Center for Social Complexity), Co-PI: Kenneth De Jong, Sean Luke
08/01/08 – 08/31/13
$4,5235,710

DOMENICONI

Doctoral Student Forum and Student Travel at the 2010 SIAM Data Mining Conference
National Science Foundation
05/01/2010-04/30/2012
$32,240

KOSECKA

CAREER: Geometric and Appearance Based Methods for Model Acquisition
National Science Foundation
2/1/04-1/31/12
$500,000

MobiSynt: Enhancing Virtual Environments Through Motion Imagery Analysis
National Geospatial-Intelligence Agency/Office of Naval Research
PI: A. Stefanidis (Dept. of Geography and Geoinformation Science), Co-PI: Kosecka
10/22/11-10/24/12
$300,321

EXTERNAL **FUNDING**

Acquiring semantically meaningful models for robotic localization, mapping and target recognition
US Department of the Army ARO
9/13/11-9/12/14
$309,183

Geometric and Semantic Techniques for Geolocation
Object Video, Inc./ Intelligence Advanced Research Projects Activity (IARPA)
3/8/12-7/7/14
$274,404

Semantic Mapping
Google
12/20/11-12/31/14
$31,613

LI

Integrating chip reliability in designing energy-saving scheduling algorithms
National Science Foundation
09/01/2011-08/31/2013
$69,872

Algorithmic approaches to energy-efficient computing
National Science Foundation
09/01/2012-08/31/2015
$128,325

Online scheduling algorithms for networked systems and applications
National Science Foundation
08/01/2009-07/31/2014
$220,359

LIEN

DDDAMS-based Urban Surveillance and Crowd Control via UAVs and UGVs
Air Force Office of Scientific Research (AFOSR)
05/01/2012 – 04/30/2015
$171,738

VASTO - Evolutionary Agent System for Transportation Outlook
Federal Highway Administration (FHWA)
06/01/11-01/01/14
$384,666

Acquisition of a Light Detection and Ranging (LiDAR) Scanner System
National Science Foundation
PI: Jyh-Ming Lien; Co-PIs: D. Wong (Dept. of Geography and GeoInformation Sciences), J. Chen, F. Camelli (School of Physics, Astronomy, Computational Sciences), J. Kosecka
06/01/2012 – 05/31/2015
$200,775

Multi-field Responsive Origami Structures - Advancing the Emerging Frontier of Active Compliant Mechanisms
National Science Foundation
08/01/2012 – 07/31/2016
$255,000

Shape Representation of Large Geometries via Convex Approximation
National Science Foundation
09/01/2009-08/31/2013
$295,652

Development of Advanced Gridding and Visualization Tools for the USGS MODFLOW-USG Computer Program for Simulating Groundwater Flow
United States Geological Society (USGS)
6/25/2013 - 6/24/2014
$72,349

Unstructured Grid Design for Control Volume Finite Difference Groundwater Models
United States Geological Society (USGS)
07/10/2012 – 07/9/2013
$49,993

LIN

Neurophysiological Correlates of Extremely Low Birth Weight Outcomes at 12 Months Corrected Age
INOVA
09/01/10-08/31/12
$49,770

Neuroanatomical correlates & biomarkers of Extremely Low Birth Weight Outcomes at 18 Months Corrected Age
INOVA
12/15/09-12/14/11
$10,000

Finding and Exploiting Hierarchical Structure in Time Series Using Statistical Language Processing Methods.
National Science Foundation
09/01/2012-08/31/2015
$250,000

Proactive Data Analysis and Knowledge Sharing
Semiconductor Research Corporation
07/01/2011-06/30/2014
$240,000

Discovering Latent Relationships and Ontological Structures in Massive Spatiotemporal Datasets
US Department of the Army
09/30/2012-09/29/2015
$232,484

LUKE

Cyber-Enabled Understanding of Complexity in Socio-Ecological Systems via Computational Thinking
National Science Foundation
PI: Claudio Cioffi-Revilla (Center for Social Complexity), Co-PIs: Paul Schopf (Dept. of Atmospheric, Oceanic and Earth Sciences), Sean Luke, and Dan Rogers (Smithsonian Institution)
9/1/2011 - 8/31/2015
$1,680,000

Workshop on Enhancing a Large-scale Multi-agent Simulation Tool
National Science Foundation
PI: Sean Luke, Co-PIs: Claudio Cioffi-Revilla (Center for Social Complexity), Paul Schopf (Dept. of Atmospheric, Oceanic and Earth Sciences), Kenneth De Jong, and Dan Rogers (Smithsonian Institution).
08/01/2012 - 07/31/2013
$99,537

MALEK

Architecture-Based Self-Securing Systems,
Army Research Office
10/1/2012 - 9/30/2015
$200,000

Automated Approach for Detection and Mitigation of Security Vulnerabilities in Mobile Applications
Central Intelligence Agency
7/8/2013 - 7/7/2016
$359,372

Engineering Highly Adaptive Resilient Software Systems
Defense Advanced Projects Agency
4/25/2011 - 5/31/2015
$949,065

Automated Security Testing and Analysis of Android Applications
Federal Bureau of Investigation
9/12/2012 - 9/11/2013
$90,000

CAREER: A Mining-Based Approach for Consistent and Timely Adaptation of Component-Based Software
National Science Foundation (NSF)
2/1/2013-1/31/2018
$451,481

Mining the Execution History of a Software System to Infer the Best Time for its Adaptation
National Science Foundation (NSF)
2/1/2012- 1/3/2014
$80,000

COTS Very Small Computing Platforms - Security
Science Applications International Corporation (SAIC)
1/1/2010 - 6/30/2011
$99,415

COTS Very Small Computing Platforms - Tactical
Science Applications International Corporation (SAIC)
1/1/2010 - 6/31/2011
$224,470

MCCOY

Beyond Technical Security: Developing an Empirical Basis for Socio-Economic Perspectives
National Science Foundation
10/1/12-9/30/17
$668,050, REU supplement: $10,700

Cyber-security Pen Test
General Motors
PI: D. McCoy, Co-PI: H. Homayoun (Dept. of Electrical and Computer Engg.)
5/25/13-11/24/15
$241,608

Understanding Business of Traffic Distribution System Services
Google
PI: Damon McCoy, Co-PI: Angelos Stavrou
06/2013
$75,000

MENASCÉ

SASSY: Self-Architecting Software Systems,
National Science Foundation
PI: D.A. Menascé, Co-PIs: H. Gomaa, S. Malek, and J. Sousa
06/15/2008-05/31/2012
$479,962

PULLEN

Joint Interoperability Test Center Support
Defense Information Systems Agency
01/01/09-03/09/12
$130,760.00

Battle Terrain Reasoning
Army Geospatial Center
06/14/10-06/2/12
$510,000.00

Command & Control Core Language Demonstration
US Army
10/13/10-03/01/16
$148,130.00

Joint Collaboration Command and Control Information Exchange Data Model
US Army
06/14/10-06/03/12
$66,953.00

Wide Area Focal Plane Array Camera Evaluation
US Marine Corps
11/01/11-08/30/12
$155,836.00

Integrated Standards Based Interoperability Subset
US Army
10/24/12-10/23/13
$170,695.00

Academic PlugFest Pilot
Office of the Undersecretary of Defense
06/25/13-12/31/13
$49,999.00

Advanced BML Server Prototype
Saab Corp
07/01/12-12/31/13
$100,000.00

C4I Center AFCEA Symposium
Armed Forces Communications Electronics Association
08/25/08-06/30/13
$33,850.00

C4I/Saudi C4I Academy
Kingdom of Saudi Arabia
04/15/12-12/31/12
$59,180.00

EXTERNAL **FUNDING**

RANGWALA

Systems Biology Approach to Identifying Biomarkers for Alcoholic Liver Disease
National Institutes of Health (NIH)
PI: Patrick Gillevet (Dept. of Environmental Sciences and Policy), Co-PI: Huzefa Rangwala, Robin Couch (Dept. of Chemistry and Biochemistry)
10/01/09-09/30/12
$1,974,161 ($972,966 GMU portion)

CAREER: Annotating the Microbiome Using Machine Learning Methods.
National Science Foundation
03/01/2013-02/28/2018
$550,000

Computational Methods to Advance Chemical Genetics by Bridging Chemical and Biological Spaces
National Science Foundation
09/01/2009-08/31/2013
$331,537, REU Supplement: $8000

Career Mentoring Forum and Student Travel Support for 2012 IEEE International Conference on Data Engineering
National Science Foundation
PI: Huzefa Rangwala, Co-PIs: Carlotta Domeniconi, Alex Brodsky
03/01/2012-03/01/2013
$24,000

CUDA University Research Center
nVidia
PI: Saleet Jafri (School of Systems Biology), Co-PI: Huzefa Rangwala
08/30/2011-08/30/2012.

GPU Computing for Assembly of Genomes
nVidia
02/01/2010
$3,000

USDA Bovine microRNA Transcriptome Analyses: Discovery, Tissue Specic Expression Prole and Target Gene Prediction
United States Department of Agriculture
11/01/2011-04/30/2012
$45,000

SHEHU

Probabilistic Search Algorithms: Powerful Novel Tools for Peptide Modeling
Jeffress Trust Program in Interdisciplinary Research
PI: Amarda Shehu, Co-PI: Estela Blaisten-Barojas (Computational Material Sciences Center)
09/15-2013 - 05/31/2014
$100,000

CAREER: Probabilistic Methods for Addressing Complexity and Constraints in Protein Systems
National Science Foundation
03/01/2012 -02/28/2017
$549,924, REU Supplement: $8,000

A Unified Computational Framework to Enhance the Ab-initio Sampling of Native-like Protein Conformations
National Science Foundation
09/01/2010 - 08/31/2014
$499,998

Molecular Mechanisms Underlying Menthol Cigarette Addiction
Virginia Youth Tobacco Program
PI: Nadine Kabbani (Krasnow Institute), Co-PI: Amarda Shehu
05/24/2013/05/23/2014
$27,544

SIMON

A Wireless Sensor Network Awareness System
Vectare/Department of Defense
10/1/10 – 2/18/13
$327,470

Energy Harvesting for Performance Sensitive Wireless Sensor Networks
National Science Foundation
Co-PI: Hakan Aydin
8/15/11 – 7/31/14
$430,000

Large Scale Sensing Systems
Invertix/ Department of Defense
Co-PI: Daniel Barbara
10/3/11 – 1/31/13
$40,000

Machine-to-Machine Communication
Vectare/ Department of Defense
5/11/12 – 9/30/13
$235,930

An Experimental Infrastructure for Cross-Domain Research in Wireless Computing, Cybersecurity and Data Mining
National Science Foundation
PI: R. Simon, Co-PIs: Daniel Barbara, Brian Mark (Dept. of Electrical and Computer Engineering), Angelos Stavrou
9/1/12-8/31/15
$547,307

SOOD

Kenya National Cybersecurity Master Plan
United States Trade Development Agency
2012 – 13
$59,902

CERT capacity building in Africa
National Science Foundation
2009- 2012
$140,000

Proactive Cyber Attack Deterrence: Extending Self Cleansing Intrusion Tolerance (SCIT) to Compute Rich Nodes
Office of Naval Research
1/2013-12/2015
$492,040

Series of Workshops on Cyber Security and Global Affairs
Office of Naval Research
2009 - 2012
$104,000

Virginia Global Defense Initiative — Cybersecurity Exports & Trade
Virginia Economic Development Partnership
PI: Stuart Malawer (School of Public Policy), Co-PI: Arun Sood
9/2013-12/2013
$50,000

STAVROU

DURIP: A VPN Proxy Cloud for Detecting HTTP & VoIP Malware
Army Research Office (ARO)
PI: Angelos Stavrou, co-PI: Anup Ghosh (Center for Secure Information Systems)
06/15/2011 – 06/14/2012
$205,983

Transformative Applications/ Aterrasys Securing Android Mobile Devices
Defense Advanced Research Projects Agency (DARPA)
08/24/2011 – 08/24/2012
$511,323

MEERKATS: Maintaining enterprise resiliency via kaleidoscopic adaptation & transformation of software services
Defense Advanced Research Projects Agency (DARPA)
PI: A. Stavrou, Co-PI: Fei Li
09/01/2011-09/01/2015
$800,000

CyNomix: Detecting Zero-Day Malware by Generating Behavioral Cyber Genome Sequences. DARPA-CyberGenome.
Defense Advanced Projects
PI: Angelos Stavrou, Co-PI: Huzefa Rangwala
09/01/10-08/31/14
$1,527,225

Analysis of Mobile Application Communications Using GUI & Data Instrumentation
Purdue Univ/Department of Homeland Security
8/1/13 - 7/31/14
$186,691

Scalable Malware Analysis
National Science Foundation
9/01/09 - 9/31/13
$239,884.00

Stonesoup: Securely Taking on New Executable Software of Uncertain Provenance
IARPA
PI: A. Stavrou
08/01/10 - 04/01/15
$2,174,261.00

Securing Android Smart-Phones
US Dept of Commerce / NIST
08/01/10 – 07/31/13
$315,320.00

Bridging the Cybersecurity Leadership Gap
National Science Foundation
PI: A. Stavrou, Co-PI: J.P. Auffret (School of Management)
01/08/13 – 07/31/15
$484,857

TECUCI

Intelligent Software Agent for Training Intelligence Analysts
Department of Defense
PI: G. Tecuci, Co-PIs: Mihai Boicu (Dept. of Applied Information Technology), David Schum (Dept. of Systems Engineering and Operations Research)
09/24/2009-08/31/2011
$1,040,154

TIACRITIS User Interface Improvement Roadmap: From TIACRITIS to COGENT
Intelligence Community
PI: G. Tecuci, Co-PIs: Mihai Boicu (Dept. of Applied Information Technology), Dorin Marcu (Learning Agents Center), David Schum (Dept. of Systems Engineering and Operations Research)
07/30/2012-07/29/2014
$793,254

A Computational Theory of Intelligence Analysis
National Geospatial-Intelligence Agency
PI: G. Tecuci, Co-PIs: Mihai Boicu (Dept. of Applied Information Technology), David Schum (Dept. of Systems Engineering and Operations Research)
09/24/2009-09/23/2015
$750,000

Making the Most of Big Data: Current and Future High-impact Collaborations
National Science Foundation
09/01/2013-02/28/2014
$49,994

Critical Thinking Tool Project: nSpace2 - TIACRITIS Service Integration
Oculus Info, Inc. and Department of Defense
PI: G. Tecuci, Co-PIs: Mihai Boicu (Dept. of Applied Information Technology), Dorin Marcu (Learning Agents Center)
11/01/2013-10/30/2015
$250,016

WANG, X

CAREER: Malware Immunization and Forensics Based on Another Sense of Self
National Science Foundation
3/1/2009-2/28/2014
$400,000

Potentials and Implications of Timing Based Network Covert Channel
National Science Foundation
10/1/2007-9/30/2011
$150,000

WIJESEKERA

Operation Temporal Defense
Temporal Defense Corporation
PI: Mick Kicklighter (School of Law), Co-PI: Duminda Wijeskera
9/2011-5/2012
$52,921

EXTERNAL **FUNDING**

DoD Information Assurance Scholarship Program
National Security Agency
PI: Sushil Jajodia (Center for Secure Information Systems), Co-PIs: Duminda Wijesekera, Angelos Stavrou
8/2011-12/2012
$46,175

DHS Graduate Fellowship Training for Homeland Security
Department of Homeland Security
PI: D. Wijesekera, Co-PI: Angelos Stavrou, Robert Simon, Damon McCoy, Avinash Srinivasan
1/2012-12/2017
$256,336

Axiomatizing Legal Reasoning
Syracuse Research Corporation
1/2011-12/2011
$49,512

Enforcing Kidney Dialysis Workflows in Electronic Medical Records
Cybernius Medical Ltd
10/2012-2/2013
$17,500

Evaluation of Security Mechanisms in PTC Deployment
Federal Railroad Administration/ AIRINC
5/2009-12/2011
$86,309

Logical Formulation of Agency Legal Formulations Applied to Enterprise-Level Risk Management
Syracuse Research Corporation
1/2012-9/2012
$110,000

Providing Identity and Access Management Services for Restful Web Services
Air Force Office of Scientific Research (AFOSR)
1/2012-9/2012
$21,000

Development of PTC security key distribution and deployment protocol
Federal Railroad Administration
1/2010 - 12/2012
$272,608

Building Ontologies to Model Enterprise level Security Metrics
National Institute of Standards and Technology
9/2010 - 8/2011
$45,000

Secure Compositions of Networked Systems based on User Tasks and Organizational Policy
Air Force Office of Scientific Research (AFOSR)
PI: Sushil Jajodia (Center for Secure Information Systems), Co-PIs: Duminda Wijesekera, Angelos Stavrou
7/2009 -7/2012
$650,000

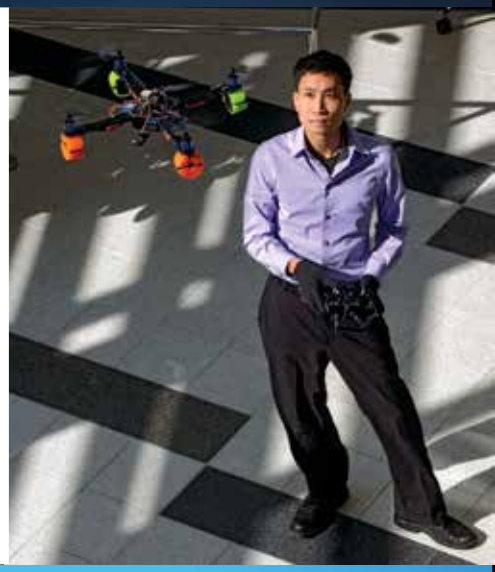
Building Policies to Control Virtual Environments using the Policy Machine
National Institute of Standards and Technology
PI: Duminda Wijesekera, Co-PI: Angelos Stavrou
07/01/2010 – 06/30/2013
$431,902

Providing Wireless bandwidth for High-Speed Rail Operations
Federal Railroad Administration
PI: Duminda Wijesekera
02/01/2012 – 01/31/2013
$330,021

VoIP Intrusion Detection
National Science Foundation PI: Sushil Jajodia (Center for Secure Information Systems), Co-PI: Duminda Wijesekera
10/01/2006 – 09/31/2009
$250,000.00

An Integrated Authorization and Intrusion Detection System for the GMPLS Control Plane
Department of Energy
PI: Duminda Wijesekera
01/01/2006- 06/31/2006
$33,000

OUR IDEAS TAKE **FLIGHT**



Christopher Vo, CS PhD student with Hexacopter Drone

Drone's Eye View of George Mason University taken with Christopher Vo's DJI F550 Hexacopter Drone
See the complete video: **http://www.youtube.com/watch?v=RwVynNwL57U**