THE DEPARTMENT OF COMPUTER SCIENCE

DEPARTMENTAL REPORT 2011-2013
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 Kaufman, Damon McCoy, Mark Snyder and Avinash Srinivasan.

Finally, I am excited to report that the CS Department is participating in a new interdisciplinary 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

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

FACULTY
38 Tenure Track
6 Instructional
1 Research
5 Postdoctoral Researchers

Research EXPENDITURES
fiscal year 2012: $6M
fiscal year 2013: $6.4M

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

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

PROGRAMS
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.

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.

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).” 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
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**


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.”

Huzea Rangwala, “Annotating the Microbiome using Machine Learning Methods.”


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.”
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**


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**

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


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


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

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


Selected Publications


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**


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**

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 Evolutionary Computation, and the recipient of the Institute of Electrical and Electronics Engineers Pioneer award in evolutionary computation.

**Selected Publications**


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

**Selected Publications**


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

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
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

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
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

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
Jana Košlecká 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**


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**

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


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


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


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 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**


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**


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


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

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 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


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


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


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

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
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

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
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

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
Avinash Srinivasan is a 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**


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**


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

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
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


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


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


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.

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 the Year for his contributions. He also serves as Chair of the Computer Science Industrial Advisory Board.

Ritchey was the 2013 Volgenau School Alumni of the Year and Serves as Chair of the Computer Science Industrial Advisory Board.
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 multinational 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
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,
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 that 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 Wijesker.
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.

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ROBOTICS: RESEARCH FOR RESULTS

continued on page 40...
Košćeká’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.

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.

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<td></td>
<td>National Science Foundation</td>
</tr>
<tr>
<td></td>
<td>PI: Kenneth De Jong, Co-PI: Giorgio Ascoli (Krasnow Institute)</td>
</tr>
<tr>
<td></td>
<td>05/01/2013 – 04/30/2017</td>
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<tr>
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<td>$474,996.15</td>
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<table>
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<tr>
<th>DEJONG</th>
<th>Multidisciplinary Agent-based Modeling of a Conflict</th>
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<tbody>
<tr>
<td></td>
<td>Office of Naval Research (ONR)</td>
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<tr>
<td></td>
<td>PI: Claudio Cioffi (Center for Social Complexity), Co-PI: Kenneth De Jong, Sean Luke</td>
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<tr>
<td></td>
<td>08/01/08 – 08/31/13</td>
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<td>$4,523,571</td>
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<table>
<thead>
<tr>
<th>DOMENICONI</th>
<th>Doctoral Student Forum and Student Travel at the 2010 SIAM Data Mining Conference</th>
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<tr>
<td></td>
<td>National Science Foundation</td>
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<td>05/01/2010–04/30/2012</td>
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<tr>
<th>KOSSECA</th>
<th>CAREER: Geometric and Appearance Based Methods for Model Acquisition</th>
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<td>National Science Foundation</td>
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<tr>
<td></td>
<td>2/1/04-1/31/12</td>
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<td>$500,000</td>
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<table>
<thead>
<tr>
<th>KOSSECA</th>
<th>MobiSynt: Enhancing Virtual Environments Through Motion Imagery Analysis</th>
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<tr>
<td></td>
<td>National Geospatial-Intelligence Agency/Office of Naval Research</td>
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<tr>
<td></td>
<td>PI: A. Stefanidis (Dept. of Geography and Geoinformation Science), Co-PI: Kosecka</td>
</tr>
<tr>
<td></td>
<td>10/22/11–10/24/12</td>
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<td>$300,321</td>
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</table>
# EXTERNAL FUNDING

<table>
<thead>
<tr>
<th>Grant Title</th>
<th>Sponsor</th>
<th>Duration</th>
<th>Amount ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acquiring semantically meaningful models for robotic localization, mapping and target recognition</td>
<td>US Department of the Army ARO</td>
<td>9/13/11-9/12/14</td>
<td>$309,183</td>
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<tr>
<td>Geometric and Semantic Techniques for Geolocation</td>
<td>Object Video, Inc./ Intelligence Advanced Research Projects Activity (IARPA)</td>
<td>3/8/12-7/7/14</td>
<td>$274,404</td>
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<tr>
<td>Semantic Mapping</td>
<td>Google</td>
<td>12/20/11-12/31/14</td>
<td>$31,613</td>
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<tr>
<td>Integrating chip reliability in designing energy-saving scheduling algorithms</td>
<td>National Science Foundation</td>
<td>09/01/2011-08/31/2013</td>
<td>$69,872</td>
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<tr>
<td>Algorithmic approaches to energy-efficient computing</td>
<td>National Science Foundation</td>
<td>09/01/2012-08/31/2015</td>
<td>$128,325</td>
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<td>Online scheduling algorithms for networked systems and applications</td>
<td>National Science Foundation</td>
<td>08/01/2009-07/31/2014</td>
<td>$220,359</td>
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<table>
<thead>
<tr>
<th>Grant Title</th>
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<tr>
<td>VASTO - Evolutionary Agent System for Transportation Outlook</td>
<td>Federal Highway Administration (FHWA)</td>
<td>06/01/11-01/01/14</td>
<td>$384,666</td>
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<tr>
<td>Acquisition of a Light Detection and Ranging (LiDAR) Scanner System</td>
<td>National Science Foundation</td>
<td>PI: Jyh-Ming Lien; Co-Pls: D. Wong (Dept. of Geography and GeoInformation Sciences), J. Chen, F. Camelli (School of Physics, Astronomy, Computational Sciences), J. Kosecka</td>
<td>06/01/2012 – 05/31/2015</td>
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<tr>
<td>Multi-field Responsive Origami Structures - Advancing the Emerging Frontier of Active Compliant Mechanisms</td>
<td>National Science Foundation</td>
<td>08/01/2012 – 07/31/2016</td>
<td>$255,000</td>
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<td>Shape Representation of Large Geometries via Convex Approximation</td>
<td>National Science Foundation</td>
<td>09/01/2009-08/31/2013</td>
<td>$295,652</td>
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<td>LIN Neurophysiological Correlates of Extremely Low Birth Weight Outcomes at 12 Months Corrected Age</td>
<td>INOVA</td>
<td>09/01/10-08/31/12</td>
<td>$49,770</td>
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<tr>
<td>Neuroanatomical correlates &amp; biomarkers of Extremely Low Birth Weight Outcomes at 18 Months Corrected Age</td>
<td>INOVA</td>
<td>12/15/09-12/14/11</td>
<td>$10,000</td>
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<td>Finding and Exploiting Hierarchical Structure in Time Series Using Statistical Language Processing Methods.</td>
<td>National Science Foundation</td>
<td>09/01/2012-08/31/2015</td>
<td>$250,000</td>
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<td>Proactive Data Analysis and Knowledge Sharing</td>
<td>Semiconductor Research Corporation</td>
<td>07/01/2011-06/30/2014</td>
<td>$240,000</td>
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<tr>
<td>Discovering Latent Relationships and Ontological Structures in Massive Spatiotemporal Datasets</td>
<td>US Department of the Army</td>
<td>09/30/2012-09/29/2015</td>
<td>$232,484</td>
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<tr>
<td>LIEN Cyber-Enabled Understanding of Complexity in Socio-Ecological Systems via Computational Thinking</td>
<td>National Science Foundation</td>
<td>PI: Claudio Cioffi-Revilla (Center for Social Complexity), Co-Pls: Paul Schopf (Dept. of Atmospheric, Oceanic and Earth Sciences), Sean Luke, and Dan Rogers (Smithsonian Institution)</td>
<td>9/1/2011 - 8/31/2015</td>
</tr>
</tbody>
</table>

**LI** Integrating chip reliability in designing energy-saving scheduling algorithms

**LIEN** DDDAMS-based Urban Surveillance and Crowd Control via UAVs and UGVs
Workshop on Enhancing a Large-scale Multi-agent Simulation Tool
National Science Foundation
Pl: Sean Luke, Co-Pls: 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
$949,065

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

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
Pl: D. McCoy, Co-Pl: H. Homayoun (Dept. of Electrical and Computer Engg.)
5/25/13-11/24/15
$241,608

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

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

Mining the Execution History of a Software System to Infer the Best Time for its Adaptation
National Science Foundation (NSF)
2/1/2013-1/31/2018
$451,481

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
$51,000.00

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
09/01/2013-02/28/2018
$331,537, REU Supplement: $8000

Career Mentoring Forum and Student Travel Support for 2012 IEEE International Conference on Data Engineering
National Science Foundation
09/01/2013-02/28/2013
$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
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

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. Au (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-Pls: Mihai Boicu (Dept. of Applied Information Technology), David Schum (Dept. of Systems Engineering and Operations Research)  
09/24/2009-09/23/2015  
$750,000

TIACRITIS User Interface Improvement Roadmap: From TIACRITIS to COGENT  
Intelligence Community  
PI: G. Tecuci, Co-Pls: 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-Pls: 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  
09/01/2013-2014  
$49,994

Critical Thinking Tool Project: nSpace2 - TIACRITIS Service Integration  
Oculus Info, Inc. and Department of Defense  
PI: G. Tecuci, Co-Pls: Mihai Boicu (Dept. of Applied Information Technology), Dorn 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  
$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 Wijesekera  
$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 – 09/30/2009  
$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
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

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

OUR IDEAS TAKE FLIGHT