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SYSTEMSOLUTIONS

THE INSTITUTE FOR SYSTEMS RESEARCH
A. JAMES CLARK SCHOOL *of* *ENGINEERING*

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Learning from robots

Students from many engineering disciplines benefit when they build and program robotic systems

Lessons learned

Serving as the director of the Institute for Systems Research these past eight years has been a great privilege for me. In my last "Director's Message," I would like to share with you a few of the lessons I have learned along the way.

Were you prepared to be ISR director?

Absolutely not! I walked into the director's office as a faculty member. Up until this point I had been going through my own promotion processes. The opportunity to become ISR director came about shortly after I was promoted to full professor.

In my favor, I did have a history of helping my community no matter where or at what level I was. I managed a lab when I was a graduate student, and large projects as a postdoc first and then as a research scientist. As a faculty member, I played an active role in the launch of new entities like the Maryland NanoCenter, the Maryland Energy Center and the initial discussions for forming the Robert E. Fischell Institute for Biomedical Devices, in addition to launching and running my own research lab. I also was used to collaborating with neighboring national labs and working with interdisciplinary colleagues across campus and elsewhere. This, at least, helped me get started.

But none of these things prepared me for the responsibilities that come with being in charge of an institute the size of ISR. I learned that just because you are a part of and are familiar with the environment of the university, it does not mean you understand its administrative processes. You have to figure out what these priorities are and how your unit fits within them.

Because the university had no formal program offering administrative mentoring, I had to come up to speed quickly and seek mentoring from those I trusted to help me move forward. *Mentoring is important!*

I would also say that *faculty should not be shy about trying out a period of administrative opportunity.* There is much to be learned from seeing the university from this perspective, and from growing in your professional life when you are in a position where your primary tasks are to serve your fellow faculty, students, staff, and the organization at large, rather than your own interests. Seek out opportunities on your own if they are not provided to you.

CREDIT: JOHN T. CONSOLI

What did you learn as director?

I am grateful for everything I learned as the ISR director, but perhaps the most important thing is this: *being an institute director or department chair mandates that you be completely selfless.*

This is not something we faculty members instinctively know, and it is certainly not something in which we are trained. As faculty, we are thinking all along about our own shops, what it is we need to do, and how we need to do it. We take pride in our own accomplishments and those of the students in our programs.

This is all meaningless in an administrative position! To be successful in this job, the accomplishments, failures, progress, and well-being of the community must be your priorities. Helping junior faculty overcome their problems, and encouraging senior faculty to let go of their ingrained habits requires you to be a selfless person who can make your unit's wellbeing the top priority, no matter what is at stake.

Sometimes this requires you to work with high-powered faculty members and administrators with their own agendas, or people with difficult personalities. It is all part of the diplomacy of the job, and it is a sure place of personal leadership growth. Remember, *it is not about your own success, it is about the success of your unit as a whole.*

Where will you go from here?

Thank goodness I no longer need to be promoted! I have been fortunate to keep my research group active during my years as ISR director. One benefit of the position is that I have been exposed to the breadth and depth of the research we conduct here. It has broadened the perspective I bring to my own research. I plan to steer my research group in a way that will be in tune with and focused on real societal, systems-oriented challenges, specifically in health care.

It would be foolish not to take advantage of these experiences and bring them forward! My advice to everyone is to *use what you have learned, technically and otherwise, in your next step*.

Best regards,

IN THIS ISSUE:

Bill Regli named sixth director of ISR

Clark School Dean Darryll Pines has named **William Regli** as the sixth director of the Institute for Systems Research, beginning in January 2018. Regli, an ISR alumnus, received his Ph.D. in Computer Science from the University of Maryland in 1995. He was advised by Professor **Dana Nau** (CS/ISR).

"It truly is exciting to have Bill return to ISR in a leadership role," said current ISR Director **Reza Ghodssi**. "I am sure under Bill's leadership ISR will continue to innovate, grow, and have an even greater research impact, both within the university and the nation."

Regli, on leave from the Computer Science Department at Drexel University, has been with the Defense Advanced Research Projects Agency (DARPA) since 2014 and presently serves in the role of Acting Director of the Defense Sciences Office.

During his time at DARPA, Regli led initiatives in advanced robotics, design and manufacturing, social systems, machine learning and human-machine teaming. His previous research spans a range of technical areas; most recently he has been focused on advancing the use of lightweight semantic models to solve problems in content-centric networking, metadata extraction and labeling, and supply-chain interoperability.

As professor of computer and information science and senior associate dean for research in the College of Computing and Informatics at Drexel University, he led Drexel's pursuit of the FAA Center of Excellence in Unmanned Air Systems and several successful technology transitions to the defense and public sectors (including two commercial spin outs and six patents). He also had leading roles in efforts to apply advanced computing and cyber-infrastructure to challenges in design and manufacturing.

Regli also has held positions with Lockheed Martin's Advanced Technology Labs, AT&T Laboratories, and Carnegie Mellon University. In addition to DARPA, his government service includes time with the National Institute of Standards and Technology as well as a scientific adviser role for the U.S. Department of Energy in the Defense Programs Office of the National Nuclear Security Administration. He is a life member of AAAI, ACM and Sigma Xi; a Senior Member of AAAI and ACM; and was recently named a Fellow of the IEEE Computer Society in 2017 for his "contributions to 3D search, design repositories and intelligent manufacturing."

"I'm thrilled to be returning to Maryland," Regli said. "This is a very special homecoming for me: from DARPA, which supported my work as a graduate student, to the Institute for Systems Research. Thanks to the stewardship of Reza Ghodssi, ISR is in a fantastic position to play a central role in the intellectual life of the campus during this exciting time in the life of the university and the Clark School."

Michael Rotkowitz is PECASE Award recipient

CREDIT: AL SANTOS

On Jan. 9, President Barack Obama named Assistant Professor **Michael Rotkowitz** (ECE/ISR) one of 102 recipients of the Presidential Early Career Award for Scientists and Engineers (PECASE).

This is the highest honor bestowed by the federal government on science and engineering professionals in the early stages of their independent research careers. The awardees come not only from academia but also from federal labs and agencies. Rotkowitz's award was one of 19 that were nominated by the National Science Foundation.

In his statement announcing the awards, President Obama said, "These innovators are working to help keep the United States on the cutting edge, showing that federal investments in science lead to advancements that expand our knowledge of the world around us and contribute to our economy."

The PECASE allows Rotkowitz to continue his research in the decentralized implementable control of massively interconnected systems. The world is becoming increasingly dependent on complex interconnected systems, such as smart building management, multi-vehicle systems and convoys, irrigation networks, large array telescopes, and the power distribution grid. The advent of these systems has created a need to design and analyze controllers that can observe information from only a small portion of a network but may ultimately affect a large portion of the network. This is a key challenge in many problems connected to cyber-physical systems.

Conventional controls analysis assumes that one centralized decision-maker can access all available measurements, and determine the usage of all possible means of actuation. Most methods of design and analysis are extremely fragile to this assumption, and break down when such centralization is not possible or is not desired, leading to the field of decentralized control.

Radhakisan Baheti, NSF program director in the NSF Directorate for Engineering, said, "Decentralized decision making and control has been one of the challenging and open problems in dynamical systems for over 40 years. Michael Rotkowitz has made pioneering contributions in the decentralized implementable control of massively interconnected systems. His work has been cited by over 1,200 researchers and has led to new insights and several important results. Michael has also contributed to the education of undergraduate and high school students using innovative engineering testbeds."

Maryland's reACT house takes second place at Solar Decathlon

The University of Maryland's reACT solar house took second place overall and first place among U.S. competitors in the U.S. Department of Energy's Solar Decathlon in Denver this October. First place went to a Swiss team representing four universities. The event challenged 12 collegiate teams from around the world to design and build energy-efficient, solar-powered houses.

Professor **Ray Adomaitis** (ChBE/ISR) was one of the faculty mentors working with the Maryland team. In addition, the ISR finance unit staff provided the team with procurement services throughout the Solar Decathlon's two-year process.

The reACT (resilient Adaptive Climate Technology) house was designed by an interdisciplinary team of students and included a hydroponic garden, "living walls" in its courtyard, predictive automation and design elements that will simplify future upgrades. The home's mechanical core features a high-performance, interactive, environmentally sensitive automated system. A solar oven in the attic can heat water, dry clothes, and dehydrate and cook food.

Maryland has competed in three Solar Decathlons. Its WaterShed house won first place in 2011, and the university placed second in both 2007 and 2017.

The Solar Decathlon process—in which teams move from concept drawings to the construction of a physical house—culminates in a nine-day, 10-contest competition in a "solar village" built especially for the event. The reACT house was built on campus in College Park, then partially disassembled and trucked cross-country to Colorado, where it was reassembled in the village along with the houses of other contestants.

Competitions included evaluations of each home's performance, design, sustainability, and market appeal. This is the first year teams are eligible for cash prizes; Maryland brought home $225,000.

Maryland's team includes students from the A. James Clark School of Engineering, the School of Architecture, Planning and Preservation, the College of Agriculture and Natural Resources, the College of Education, and programs in several other disciplines across campus.

The reACT house has returned to campus, where it will continue to be used as a research and education center.

— Thanks to Melissa Andrechek and Chris Hinojosa for the original reporting.

Learn more. Visit the university's Solar Decathlon website at *2017.solarteam.org*.

Otomagnetics' drug delivery system will combat chemo hearing loss

The company Otomagnetics is developing a magnetic drug delivery system to prevent a major side effect of chemotherapy in children—hearing loss. The company has been awarded a $2.3 million Fast Track National Institutes of Health National Cancer Institute Small Business Innovation Research contract for the project.

Otomagnetics began in Professor **Benjamin Shapiro**'s (BioE/ISR) laboratory, through collaborations with ISR Associate Research Scientist **Didier Depireux**, and with co-founders Dr. Irving Weinberg and David Beylin.

"We are honored and excited to be working closely with NIH to address this pressing clinical need," said Shapiro, the company's president and CEO. "There shouldn't have to be a choice between effective chemo and lifelong hearing loss. Our technology has the potential to allow treatment by chemotherapy without the attendant risk of hearing loss."

Platin-based chemotherapy drugs, such as cisplatin and carboplatin, can cause significant hearing loss, particularly in children. This can have a dramatic impact on subsequent quality of life and lead to substantial cognitive and speech development deficits in pediatric cases.

Otomagnetics' drug delivery technique will enable application of a topical therapy to the ear's cochlea to prevent the toxins' damage. Pre-clinical studies have shown that magnetic delivery even of a common off-the-shelf anti-inflammatory steroid can substantially reduce hearing loss from cisplatin regimens, and magnetic delivery of newly-emerging therapies could provide an even greater benefit. Furthermore, topical and non-invasive magnetic delivery of a small dose of an otoprotective drug to the cochlea would not interfere with the intended systemic anti-tumor action of the chemotherapy.

"A lot of progress has been made recently in understanding the causes and mechanisms that lead to hearing loss, tinnitus and balance disorders and what should be done to reverse these," Depireux said. "But getting drugs, genes and their carriers to the inner ear and the inner ear only, in humans, remains a mostly unsolved

challenge. We are working to address that challenge."

The new device acts like a syringe that uses non-invasive magnetic forces instead of a needle to safely and effectively deliver therapy to hard-to-reach targets. The company plans to use funding support to help the system progress through Food and Drug Administration milestones so it can eventually reach patients.

Otomagnetics also is developing magnetic delivery to reach middle ear and eye targets, enabling treatment of other conditions.

ISR faculty part of $8M NIH grant to combat hearing loss in older people

Trying to hold a conversation in a noisy restaurant can be an incredibly frustrating experience, especially for older adults. Even if you can hear the other person, understanding what they're saying can be difficult. Such everyday communication requires a coordinated effort between the ears and the brain. Frustratingly, most available devices designed to enhance hearing, such as hearing aids, increase the volume of incoming sounds without increasing the clarity, especially in noisy environments.

The National Institute on Aging, part of the National Institutes of Health, has awarded more than $8 million to the University of Maryland to develop an approach for addressing hearing loss and communication challenges that affect millions of older people.

The goal of this project is to improve speech understanding in challenging conditions for older listeners, focusing on the use of training programs rather than devices like hearing aids or cochlear implants. These training programs are designed to target the parts of the brain, both auditory and cognitive neural systems, that are critical for successful speech understanding in challenging conditions but that degrade with age.

Five ISR faculty are part of the effort: Professor **Shihab Shamma** (ECE/ISR), Professor **Jonathan Simon** (ECE/Biology/ISR), ISR Research Scientist **Jonathan Fritz**, ISR Associate Research Scientist **Didier Depireux** and ISR-affiliated Professor **Patrick Kanold** (Biology).

Baras wins IEEE Simon Ramo Medal; AACC Richard E. Bellman Control Heritage Award

In 2016, Professor **John Baras** (ECE/ISR) received two major professional awards and was named an associate fellow of a professional society.

Baras received the American Automatic Control Council's (AACC) 2017 Richard E. Bellman Control Heritage Award, which he accepted at the 2017 American Control Conference Awards Ceremony in May.

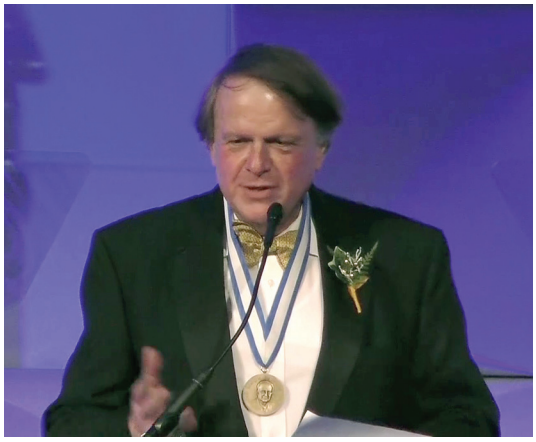
The Bellman Award is given for distinguished career contributions to the theory or application of automatic control and is the highest AACC recognition of professional achievement for U.S. control systems engineers and scientists. The citation reads, "For innovative contributions to control theory, stochastic systems, and networks and academic leadership in systems and control."

Baras also was the recipient of the 2017 Institute of Electrical and Electronics Engineers' (IEEE) Simon Ramo Medal, given "for exceptional achievement in systems engineering and systems science." Baras accepted the medal at the 2017 IEEE Honors Ceremony Gala, part of the IEEE Vision Innovation Challenges Summit event, in May.

The citation reads, "For exceptional contributions to the conception and commercialization of Internet-over-satellite systems, and for leadership in model-based engineering, systems science and engineering research."

This is one of the major IEEE-wide medals, and is the highest IEEE-wide recognition for exceptional achievement in systems engineering and systems science. It was established in 1982 and is named in honor of the distinguished engineering contributions of Dr. Simon Ramo, former vice chairman of the board and chairman of the executive committee of TRW, Inc. The award consists of a gold medal, bronze replica, certificate, and an honorarium. It is sponsored by Northrop Grumman Corp.

In the event program, IEEE noted: *Recognized worldwide as a visionary leader of systems engineering, John Baras' development, commercialization and advancement of Internet-over-satellite (IoS) systems created a new industry that is bringing fast Internet services to tens of millions of people who may otherwise not have access. Baras also provided innovations for secure operation of IoS, such as layered encryption security, which has become an international standard.*



JOHN BARAS GIVING HIS ACCEPTANCE SPEECH FOR THE IEEE SIMON RAMO MEDAL IN MAY

As founding director of the University of Maryland's Institute for Systems Research (ISR), Baras has championed the development of model-based systems engineering (MBSE) with a foundational framework that has been successfully applied to industrial applications. He has demonstrated MBSE methodologies to be essential for addressing challenges in software-intensive systems; modular product development in the automotive, aerospace and energy industries; cyber-physical systems; and smart manufacturing.

In addition, in October Baras was named an Associate Fellow of the American Institute of Aeronautics and Astronautics (AIAA). AIAA Associate Fellows are individuals of distinction who have made notable and valuable contributions to the arts, sciences, or technology of aeronautics or astronautics.

Learn more. You can learn more about these awards and view videos of Baras receiving them and giving acceptance speeches. For the AACC award, visit *www.isr.umd.edu/news/news_story.php?id=10655*. For the IEEE award, visit *www.isr.umd.edu/news/news_story.php?id=10656*.

Kanold: Autism may begin early in brain development

Autism is not a single condition, but a spectrum of disorders that affect the brain's ability to perceive and process information. Recent research suggests that too many connections in the brain could be at least partially responsible for the symptoms of autism, from communication deficits to unusual talents.

New research from ISR-affiliated Professor **Patrick Kanold's** (Biology) research group published in the journal *Cell Reports* suggests that this overload of connections begins early in mammalian development, when key neurons in the brain region known as the cerebral cortex begin to form their first circuits. By pinpointing where and when autism-related neural defects first emerge in mice, the study results could lead to a stronger understanding of autism in humans—including possible early intervention strategies.

The work suggests that the neural pathology of autism manifests in the earliest cortical circuits, formed by a cell type called subplate neurons. No one has looked at developing circuits this early, in this level of detail, in the context of autism before.

"Our results suggest that we might have to interfere quite early to address autism," Kanold said. "The fetal brain is not just a small adult brain, and these subplate neurons are the major difference. There may, in fact, be other developmental disorders we can tackle using this information. This is truly a new discovery and potentially represents a new paradigm for autism research."

— Story by Matthew Wright, UMD College of Computer, Mathematics and Natural Sciences

Learn more. Read "Abnormal development of the earliest cortical circuits in a mouse model of Autism Spectrum Disorder" *at www.cell.com/cell-reports/fulltext/S2211-1247%2817%2930024-4.*

SecondWrite LLC receives $100K TEDCO investment

ISR-affiliated Professor **Rajeev Barua's** (ECE) company, SecondWrite LLC, is among 10 companies receiving $100K seed investments from the Maryland Technology Development Corporation (TEDCO).

SecondWrite LLC is a Phase II, NSF SBIR-funded company with a next-generation sandbox that detects advanced malware including APTs, targeted attacks and zero-day evasions that defeat other solutions. Its patent-pending technology identifies hidden paths in malware and forcibly executes them, achieving complete code coverage. It also can detect sophisticated anti-analysis malware that cannot be detected by other solutions, using deep program introspection.

ISR faculty part of three NSF neural and cognitive systems awards

ISR researchers are part of three grants in the National Science Foundation's (NSF) Integrative Strategies for Understanding Neural and Cognitive Systems program awards.

Professor **Jonathan Simon** (ECE/Biology/ISR) and ISR-affiliated Assistant Professor **Behtash Babadi** (ECE) have received a $900,000 grant for research that will take advantage of recent technological advances in noninvasive neuroimaging to learn more about how the brain's neural mechanisms work in adaptive auditory processing. "Extracting Functional Cortical Network Dynamics at High Spatiotemporal Resolution" will use modern signal processing techniques to combine high temporal resolution, non-invasive recordings with high spatial resolutions.

"Our work will bring new insight as to the dynamic organization of cortical networks at unprecedented spatiotemporal resolutions, and can thereby impact technology in the areas of brain-computer interfacing and neuromorphic engineering," says Babadi. "It also will allow for the creation of engineering solutions for early detection and monitoring of cognitive disorders involving auditory perception and attention."

ISR-affiliated Professor **Cynthia Moss** (Johns Hopkins University), ISR Assistant Research Scientist **Susanne Sterbing-D'Angelo,** JHU Associate Professor **Mounya Elhilali** (ECE Ph.D. 2004), and JHU Professor **Rajat Mittal** received $948,000 in funding for "Active Listening and Attention in 3D Natural Scenes." The work leverages innovative engineering tools, cutting-edge neuroscience methods and neuroethological modeling to pursue a multidisciplinary investigation of dynamic feedback between 3D scene representation, attention and action-selection.

Associate Professor **Sarah Bergbreiter** (ME/ISR) and two colleagues from Northwestern University, Professor **L. Catherine Brinson** and Professor **Mitra Hartmann,** were awarded a $1 million grant to better understand how animals gather information through the sense of touch and then use this information to perform complex behaviors. At Maryland, Bergbreiter will be developing artificial, modular, reconfigurable whiskers that imitate the functions of animal whiskers. The University of Maryland's portion of the grant is $320,000.

These NSF awards have been issued to U.S. cross-disciplinary teams to conduct innovative research focused on neural and cognitive systems. The awards contribute to NSF's investments in fundamental brain research, in particular support of Understanding the Brain and the BRAIN Initiative, a coordinated research effort that seeks to accelerate the development of new neurotechnologies.

"It takes insight and courage to tackle these problems," said Ken Whang, NSF program director in the Computer and Information Science and Engineering Directorate. "These teams are combining their expertise to try to forge new paths forward on some of the most complex and important challenges of understanding the brain. They are posing problems in new ways, taking intellectual and technical risks that have huge potential payoff."

Espy-Wilson technology in new Alcatel MOVE TIME smart watch

OmniSpeech LLC's OmniClear™ technology is included in the latest Alcatel MOVE TIME smart watch. OmniSpeech, founded by Professor **Carol Espy-Wilson** (ECE/ISR), delivers superior voice quality in communication devices through proprietary speech enhancement and noise reduction software.

The MOVE TIME smart watch is a wearable device for active people. In addition to fitness tracking, email and SMS functionality, users can make and receive phone calls. That's where OmniSpeech comes in.

"Our technology is being employed in Alcatel's MOVE TIME smart watch to enable high-quality voice communications," says Espy-Wilson. The technology has the potential to add significant, game-changing performance value to every phone, hearing aid, computer and car in the world.

The distinct, single-microphone OmniClear™ software reduces dynamic noise in communication devices, performing on par with competing dual-microphone solutions. In addition to enhancing speech, OmniClear™ lowers the volume of noise, which is often distorted by other solutions. These advantages come from proprietary technology, which leverages decades of research on speech production, acoustics and perception.

The OmniClear™ software focuses on speech first.

"Our algorithm knows what speech looks like. It has specific characteristics," Espy-Wilson explains. "We use subtraction techniques and what is special about speech to recognize the speech signal and reduce everything that is not speech."

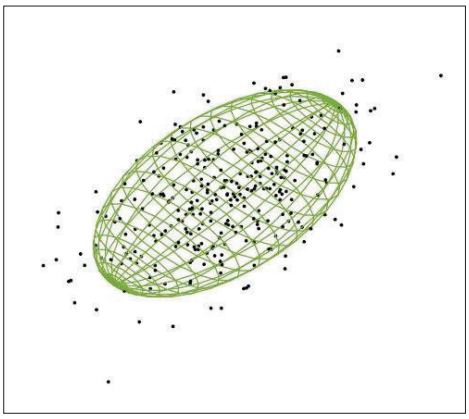
Espy-Wilson developed OmniSpeech's technology at the University of Maryland. She received an Invention of the Year Award from the University of Maryland Office of Technology Commercialization in 2010 for the technology, which the university later licensed to OmniSpeech.

Flocks and form

Picture a flock of birds in the sky—a migrating cohort of geese, a patch of swifts, or a murmuration of starlings. You notice patterns and changing forms—a one-dimensional undulating rope of geese, or a 3D deformable solid suggested by a point cloud of starlings. The imagined solid may rotate as a whole and change orientation, scale, density, or transform from an ellipsoid to something more elaborate in the blink of an eye. Can one provide effective descriptions of form, and suggest ways to capture the essential kinematic modes that govern transformations of form?

Questions along similar lines had been posed and explored by chemists. Molecules of matter display symmetries in the configuration of individual atoms held together by chemical bonds. For instance, each molecule of the greenhouse gas Methane (CH_4) has four Hydrogen atoms occupying the vertices of a platonic solid, the tetrahedron, and a Carbon atom located at the dead center. But this is a nominal structure which is subject to vibrations (hence change of shape) and rigid motions, as thermal energy is absorbed from and re-emitted to the environment—the domain of infra-red molecular spectroscopy. Quantum mechanics governs the frequencies of modes of vibration; in general there are 3n-6 such modes in a molecule made up of n atoms. Vibration co-exists with rotation and attempts at decoupling them failed, and as we now know thanks to the insights of mathematician Alain Guichardet, for reasons that lie in the geometry of fiber bundles (spaces with a certain local product structure).

One difficulty with the chemists' tools lies in the high dimension of the shape space of a complex molecule, thus rendering them unwieldy for tackling large flocks. In "Geometric decompositions of collective motion," appearing April 26 in the *Proceedings of the Royal Society A*, the authors devise a new fiber bundle structure to describe the changing forms of flocks and underlying kinematic modes. The journal website includes supplementary material that provides details on how the concept of ensemble inertia tensor described by just six parameters, is the key to the new structure. Under certain generic conditions, flock data can be factored into such a tensor and coordinates on a Stiefel manifold, a space that has played an important role in various areas of mathematics and applied science. The modes are arrived at



ENSEMBLE INERTIA TENSOR OF A COLLECTIVE (POINT CLOUD) VISUALIZED AS AN ELLIPSOID LOCATED AT THE CENTER OF MASS (FIGURE 1 OF PAPER; COPYRIGHT ROYAL SOCIETY)

in a principled manner via modern tools from the field of differential geometry. Using notions of energy attributed to various types of collective movement, the authors shed new light on data obtained by previous researchers from small flocks of pigeons in free flight over large distances.

The paper was written by Howard Hughes Medical Institute Janelia Research Campus Scientist **Matteo Mischiati** (EE Ph.D. 2011), and University of Maryland Professor **P. S. Krishnaprasad** (ECE/ISR). The top-down approach of this paper complements their earlier collaboration based on the abstraction of agents in a collective as self-steering particles interacting according to strategies such as mutual motion camouflage.

The mathematics of fiber bundles underlying this paper has roots in twentieth century efforts to build new geometric foundations for physics, guided by the pioneers Elie Cartan and Charles Ehresmann. The authors use the kinetic energy quadratic form to construct velocity splittings, or connections in the sense of Ehresmann, that pave the way for computing kinematic modes of a flocking event. There are other threads that suggest steps to exploit the analytical tools of this paper in synthesizing algorithms for motion planning for collectives of robots. A different concern for the biologist may be posed:

Just as spectroscopic read-outs provide chemical signatures of molecules in a sample being interrogated, could one speculate that energy splits amongst kinematic modes in the course of a flocking event yield some tell-tale signatures of the event? Further experience in analyzing large flock data may help answer this question.

New grants

Fritz, Shamma part of $8.5M DARPA Targeted Neuroplasticity Training Program

ISR Research Scientist **Jonathan Fritz** and Professor **Shihab Shamma** (ECE/ISR) are research collaborators in a Defense Advanced Research Projects Agency (DARPA) Targeted Neuroplasticity Training program to study the effect of peripheral nerve stimulation on second language acquisition and brain plasticity. The University of Maryland will receive up to $8.58 million from DARPA for the research.

Led by researchers from the Center for Advanced Study of Language (CASL), the project seeks to examine whether stimulating the vagnal nerve improves adults' brain plasticity to help them learn a second language. The principal investigators are **Henk Haarmann, Stefanie Kuchinsky, Polly O'Rourke**, and **Gregory Colflesh**, all cognitive neuroscientists at CASL. Fritz, Shamma, and **Jamie Tyler** from Arizona State University's School of Biological and Health Systems Engineering are additional researchers.

The researchers will use behavioral and neuroimaging methods to examine the effects of vagnal nerve stimulation (VNS) on auditory, acoustic, and speech perception learning, vocabulary and grammar learning for written language, and short- and long-term neuroplasticity in the brain. The stimulation is delivered via an earbud that transmits a safe, low-voltage electrical signal to a peripheral branch of the vagal nerve.

The research team will map the dynamic neural networks activated during VNS and learning. Studies on auditory learning will address the neural basis for enhanced neuroplasticity with vagal nerve stimulation, which leads to the targeted release of neuromodulators that improve the brain systems for attention, learning and memory.

Ulukus is PI for new NSF information-theoretic physical layer security grant

Professor **Sennur Ulukus** (ECE/ISR) is the principal investigator for a three year, $500,000 National Science Foundation (NSF) grant: "Alignment for Secrecy: One-Time-Pads in the Air without Keys." This research will advance information-theoretic physical layer security to address practical issues arising from user misbehavior, conflicting user interests, and a lack of complete network state information. Practically implementable codes will be devised. Ulukus will investigate deviating users who do not follow agreed-upon optimum protocols, as well as combat helpers and selfish users who have conflicting interests. It also will address vector channels arising from use of multiple antennas and associated channel state information issues, as well as explicit code design using polar codes and relating polar alignment and signal alignment.

ISR researchers win 2017 BBI seed grants

ISR researchers are involved in three of the nine seed grants announced by the University of Maryland's Brain and Behavior Initiative for fiscal year 2017. The program promotes collaborations among faculty from research areas that are traditionally exclusive.

Professor **Pamela Abshire** (ECE/ISR) and Professor **Jonathan Simon** (ECE/ISR/Biology) will be working with **Karen Bradley** (Dance), **Adrianne Fang** (Theatre) and **Brad Hatfield** (Kinesiology) on the project, "Dance and EEG: Neural correlates of expressive movement."

Research Scientist **Jonathan Fritz** (ISR) and **Bill Idsardi** (LING) are teaming for "New representations in neuronal ensembles during initial language acquisition."

ISR-affiliated Professor **Patrick Kanold** (Biology) and **Joshua Singer** (Biology) will explore "Control of cross-modal sensory plasticity by intrinsically photosensitive retinal ganglion cells."

Ghodssi, Bentley receive NSF EAGER grant for medical diagnosis capsules

ISR Director **Reza Ghodssi** (ECE/ISR) is the principal investigator and **William Bentley** (BioE) is the co-PI for a two-year, $150,000 NSF Early Concept Grants for Exploratory Research (EAGER) grant, "Gut-Nav: A Gut Navigator for Real-Time Diagnostic Reporting on Gastro-Intestinal Health."

This research will demonstrate a new generation of ingestible capsules for region-targeted *in situ* detection of GI analytes. Targeted applications include pancreatic adenocarcinoma screening and inflammatory bowel disease. While capsule technologies do exist, no swallowable technology is currently available that allows for sensing of specific biomolecular analytes within targeted regions inside the gut. The proposed system could serve as a platform for a variety of other sensing applications and could inform the development of smaller ingestible or implantable systems for use within the body.

Schonfeld, Ryzhov win NSF EAGER grant

Professor **Paul Schonfeld** (CEE) is the principal investigator and Associate Professor **Ilya Ryzhov** (BMGT/ISR) is the co-PI for a new one-year, $150,000 NSF EAGER grant, "Optimization with Data Acquisition in Transportation Engineering."

The work looks to determine the amount of data that should be purchased for statistically estimating the coefficients of optimization models. The researchers will examine the tradeoffs between the cost of data used for calibrating optimization models and the quality of solutions obtained with those models. Such tradeoffs will be explored mainly for problems relevant in transportation, such as vehicle assignment to tasks, vehicle routing, fleet sizing, and network flow models. The results should help transportation agencies and companies across the world allocate resources and improve their professional practice. Beyond transportation problems, this work may yield methods that would be valuable in other applications, industries and disciplines, including engineering, operations research, economics and management.

CoolCAD receives NASA contract

The National Aeronautics and Space Administration (NASA) has awarded CoolCAD Electronics, LLC, a $750,000 Phase II Small Business Innovative Research contract.

ISR-affiliated Professor **Neil Goldsman** (ECE) and ECE graduate and Research Professor **Akin Akturk** founded the company in 2009.

CoolCAD will develop silicon carbide-based (SiC) wide bandgap electronics. This new semiconductor will allow for electronics to work at temperatures above 500°C (932°F), voltages higher than 10,000V and

light wavelengths in the ultraviolet range.

The company began as a computer-aided design (CAD) house that developed electronic circuits for use at cryogenic temperatures found in outer space or in the new field of quantum computing. Soon this expertise was applied to the wide bandgap semiconductor material SiC. CoolCAD began producing SiC-based electronics, and later, processing, fabricating, and designing its own SiC electronic chips.

NASA will use CoolCAD expertise to develop high-temperature electronics for space missions such as the exploration of Venus; for imaging stars that emit both ultraviolet and visible light; and for monitoring Earth's ozone layer.

Other markets for CoolCAD's high-temperature electronics include the automobile industry, energy generation, geothermal development and industrial furnace control. CoolCAD's SiC ultraviolet optoelectronics can provide monitoring for water purification using ultraviolet light.

—Thanks to ECE's Kara Stamets for this story

ISR faculty news

Fellows

Professor **Shihab Shamma** (ECE/ISR) has been elected a Fellow of the Institute of Electrical and Electronics Engineers "for applications of signal processing to auditory neuroscience."

Professor **Pamela Abshire** (ECE/ISR) has been elected a Fellow of the Institute of Electrical and Electronics Engineers "for contributions to CMOS biosensors."

ISR-affiliated Professor **Min Wu** (ECE/UMIACS) has been elected a Fellow of the American Association for the Advancement of Science "for distinguished contributions to the field of signal processing, particularly for multimedia security and forensics."

ISR-affiliated Professor **Miao Yu** (ME) has been named a Fellow of the American Society of Mechanical Engineers.

Plenary and invited speakers

Professor **Gang Qu** (ECE/ISR) delivered a keynote speech on "How Hardware are Made Insecure and Untrusted" at the 26th IEEE Wireless and Optical Communication Conference (WOCC 2017) in Newark, N.J.

ISR-affiliated Professor **Steven Gabriel** (ME) gave the keynote address at the First International Conference on the Economics of Natural Gas, New Research Perspectives for a Rapidly-Changing World in Paris. His talk was titled, "A Market Equilibrium Approach to Modeling Gas Markets Using the World Gas Model."

Best paper award

"Distributed System Behavior Modeling of Urban Systems with Ontologies, Rules and Many-to-Many Association Relationships," a paper by Ph.D. Student **Maria Coelho** (Civil Systems), Associate Professor **Mark Austin** (CEE/ISR) and Research Associate Professor **Mark Blackburn** (Stevens Institute of Technology) won the Best Paper Award at the 12th International Conference on Systems (ICONS 2017) in Venice, Italy.

The work describes a new approach to behavior modeling of large-scale urban systems with combinations of ontologies, rules and message-passing mechanisms. The authors explore ways in which city behaviors can be modeled as networks of domain-specific networks and, in particular, how failures in one urban domain might cascade to other domains.

Promotions/new positions

Four ISR faculty members were promoted to the rank of full professor this year.

Pamela Abshire (ECE/ISR) joined the university in 2001. She received an NSF CAREER Award in 2003 and the Clark School's E. Robert Kent Junior Faculty Teaching Award in 2011. Abshire specializes in the fields of VLSI circuit design and bioengineering. She directs the Integrated Biomorphic Information Systems Laboratory.

Nuno Martins (ECE/ISR) joined the university in 2005. He received the 2006 American Automatic Control Council O. Hugo Schuck Award, a National Science Foundation CAREER Award in 2007, and the 2008 IEEE CSS Axelby Award for the best paper in *IEEE Transactions on Automatic Control*. His research interests are in distributed control, team decision, optimization, networked control and communications. Martins directs the CPS and Cooperative Autonomy Laboratory.

Derek Paley (AE/ISR) became an ISR joint appointment faculty member in 2012. He is the director of the Collective Dynamics and Control Laboratory and the recipient of the PECASE Award (2013) and the NSF CAREER Award (2010). Paley conducts research into nonlinear dynamics and controls, cooperative control of autonomous vehicles, autonomous underwater vehicles, and modeling of animal aggregations.

Alumna and ISR-affiliated **Miao Yu** (ME) (ME Ph.D. 2002) joined the Mechanical Engineering faculty in 2005. She directs the Maryland Robotics Center and the Sensors and Actuators Laboratory, where her research focuses on optical sensors, sensor mechanics and material behavior at special scales and micro/nano sensor systems. She won the NSF CAREER Award and the AFOSR Young Investigator Award in 2007.

ISR's **Jonathan Fritz** has been promoted to the position of Research Scientist. Fritz, a member of ISR's research faculty since 2004, is well known for his ongoing work in neuroscience research within the Neural Systems Lab.

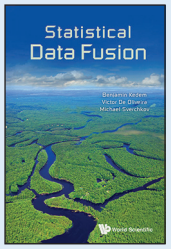
New positions

Professor **Elisabeth Smela** (ME/ISR) is the Associate Dean for Faculty Affairs in the A. James Clark School of Engineering. Professor **Ankur Srivastava** (ECE/ISR) is the Clark School's first Associate Dean for Graduate Affairs.

New joint appointment

Ilya Ryzhov has been granted tenure by the University of Maryland and a joint appointment in the Institute for Systems Research and the Robert H. Smith School's Department of Decisions, Operations and Information Technology. Previously, Ryzhov was an affiliate faculty member in ISR.

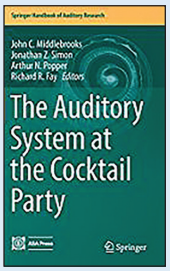
Books



Statistical Data Fusion, a book for graduate students, researchers, practitioners of statistics, engineers, scientists, was co-written by ISR-affiliated Professor **Benjamin Kedem** (Math); his former student **Victor De Oliveira** (Math Ph.D. 1997), a professor at

the University of Texas at San Antonio; and **Michael Sverchkov** of the U.S. Department of Labor Bureau of Labor Statistics' Mathematical Statistics Research Center.

Because the world is awash with data obtained from numerous and varied processes, there is a need for appropriate statistical methods, which in general produce improved inference by taking as input the information from many sources. This book comes up with estimates or decisions based on multiple data sources as opposed to more narrowly defined estimates or decisions based on single data sources.



Professor **Jonathan Simon** (ECE/ISR/Biology) is one of the editors of *The Auditory System at the Cocktail Party,* published by Springer. In addition to Simon, the editors include John Middlebrooks, Arthur Popper and Richard Fay. The book points to the serious challenge faced by listeners in everyday environments: how to hear sounds of interest amid a cacophony of competing sounds. The volume presents the mechanisms for bottom-up object formation and top-down object selection that the auditory system employs to meet that challenge.

Honors and awards

ISR Director **Reza Ghodssi** (ECE/ISR) was honored by the University of Wisconsin's Electrical and Computer Engineering Department as one of its "125 People of Impact." The list honors alumni and faculty who have made significant contributions to the department, university and industry. Ghodssi earned his Ph.D. in Electrical Engineering at Wisconsin in 1996, advised by Denice D. Denton. The list is part of the department's 125th anniversary celebration.

Associate Professor **Alireza Khalig**h (ECE/ISR) is the 2017 recipient of the Outstanding Young Alumnus Award from the Illinois Institute of Technology. The award is given to an individual age 40 or younger who has advanced rapidly over the course of his or her career and has displayed significant achievement in the areas of leadership and professional success.

Alumni news

Clark School names Hamid Jafarkhani 2017 IHOF Inductee

The A. James Clark School of Engineering has named alumnus **Hamid Jafarkhani** (EE Ph.D. 1997) as the 2017 inductee to its Innovation Hall of Fame. Jafarkhani is a chancellor's professor in Electrical Engineering and Computer Science at the University of California, Irvine, where he also directs the Center for Pervasive Communications and Computing and Conexant-Broadcom Endowed Chair. He has been on the UC Irvine faculty since 2001. At Maryland, Jafarkhani was advised by former University of Maryland Provost **Nariman Farvardin** (ECE/ISR), now president of the Stevens Institute of Technology.

Jafarkhani is being honored for "pioneering different space-time methods and algorithms for multi-antenna wireless communication systems and networks." He was a primary contributor to the development of space-time block codes, which are used to improve wireless transmission quality. The codes have created an active area of research and are used in billions of wireless devices worldwide. His collective work has profoundly influenced the commercialization, standard specifications, and fundamental advancement of the theory of space-time processing and multiple-input multiple-output (MIMO) for wireless communications.

Serban Sabau wins NSF CAREER Award

Alumnus **Serban Sabau** (EE Ph.D. 2011) has received an NSF CAREER Award for "Novel Representations for Distributed Control of String Networks in Vehicle Platooning and Supply Chain Management." Sabau will develop a novel mathematical description of dynamical networks capable of simultaneously capturing both the dynamics and the topology of a given network. He is an assistant professor in the Department of Electrical and Computer Engineering at the Stevens Institute of Technology in Hoboken, N.J. At Maryland, Sabau was advised by Professor Nuno Martins (ECE/ISR).

Ravi Tandon wins NSF CAREER Award

Alumnus **Ravi Tandon** (EE Ph.D. 2010) has received an NSF CAREER Award for "Communication-Efficient Distributed Computation: Information-Theoretic Foundations and Algorithms." Tandon will design scheduling, data movement and data shuffling algorithms for efficient processing of data among multiple processors in big data applications such as healthcare analytics, cybersecurity, and scientific computing. Tandon is an assistant professor of electrical and computer engineering at the University of Arizona. At Maryland, he was advised by Professor **Sennur Ulukus** (ECE/ISR).

Domenic Forte wins NSF CAREER Award

Alumnus **Domenic Forte** (CE Ph.D. 2013) has received an NSF CAREER Award for "Transformative Approaches for Hardware Obfuscation Protection, Attacks, and Assessment." Forte is an assistant professor in the Department of Electrical and Computer Engineering at the University of Florida. At Maryland, Forte was advised by Professor **Ankur Srivastava** (ECE/ISR).

Matthew McCarthy gains tenure at Drexel

Former ISR postdoctoral researcher **Matthew McCarthy** has been promoted to associate Ppofessor with tenure at Drexel University in Philadelphia. McCarthy is a faculty member in the Mechanical Engineering & Mechanics Department where he directs the Multiscale Thermofluidics Laboratory. He is a former postdoctoral researcher of ISR Director **Reza Ghodssi** (ECE/ISR). At Maryland, McCarthy used the Tobacco mosaic virus (TMV) to create materials with a "superhydrophobic" surface that mimics the water-resisting properties of wetland plant leaves. In 2015 McCarthy

received an NSF CAREER Award for another project involving TMV, "Investigation of Boiling Heat Transfer Mechanisms and their Enhancement using Biotemplated Nanostructures."

Leonard, Tan speak at AAAS public lecture

Two ISR alumni recently were featured speakers at a public lecture on robotics sponsored by the American Association for the Advancement of Science and Halcyon.

Naomi Leonard (EE Ph.D. 1994) is the Edwin S. Wilsey Professor in the Department of Mechanical and Aerospace Engineering, Princeton University. **Xiaobo Tan** (EE Ph.D. 2002) is the MSU Foundation Professor in the Department of Electrical and Computer Engineering at Michigan State University.

The pair spoke at AAAS Headquarters in Washington, D.C., on June 16. Their topic was "Pathfinders of the Abyss: Exploring the frontiers of marine science and autonomous systems through underwater robotics."

At Maryland, Leonard was advised by Professor **P. S. Krishnaprasad** (ECE/ISR). Tan was co-advised by Krishnaprasad and Professor **John Baras** (ECE/ISR).

Nima Ghalichechian gains tenure-track position at Ohio State

Alumnus **Nima Ghalichechian** (ECE Ph.D. 2007) is now a tenure-track assistant professor in the Department of Electrical and Computer Engineering at Ohio State University. He is a former student of ISR Director **Reza Ghodssi**. At Maryland he developed electrostatic micromotors supported on microball bearings. From 2007 to 2012 he was with the Research Department of FormFactor Inc., Livermore, Calif., as a senior principal engineer. He joined Ohio State as a research scientist in September 2012. Since January 2016 he has been a research assistant professor in ECE and the ElectroScience Laboratory, and leads the RF Microsystems Research Group. He has been a PI or co-PI of several new programs at Ohio State sponsored by NSF, DARPA, and Northrop Grumman.

CREDIT: REBECCA COPELAND

FUMIN ZHANG PROMOTED TO FULL PROFESSOR AT GEORGIA INSTITUTE OF TECHNOLOGY

Alumnus Fumin Zhang (EE Ph.D. 2004) has been promoted to full professor in the School of Electrical and Computer Engineering at the Georgia Institute of Technology. At Maryland, Zhang was advised by Professor P.S. Krishnaprasad (ECE/ISR). In the above photo, Fumin (at left) visits ISR's Intelligent Servosystems Laboratory. Left to right next to Fumin: Postdoctoral Researcher Dr. Yunlong Huang (EE Ph.D. 2017) and current graduate students Vidya Raju and Udit Halder.

CREDIT: JEFF CORIALE

Alumni reception held in Tysons Corner, Va.

ISR held its sixth alumni networking reception in October in Tysons Corner, Va. ISR alumnus **Raj Mittu** (MSSE 1985) sponsored this evening for ISR alumni, industry colleagues, ISR faculty and current students. The reception is a great way for alumni in the Maryland, Virginia and D.C. region to reconnect and share news of their research and careers. ISR's current director, Reza Ghodssi, and incoming director, Bill Regli, were on hand to talk with everyone. If you are an alum local to the area, watch your email this coming spring for an invitation to the next reception!

Tsiropoulou joins University of New Mexico

Former ISR Postdoctoral Researcher **Eirini Eleni Tsiropoulou** has joined the University of New Mexico's Department of Electrical and Computer Engineering as a tenure-track assistant professor in computer networking with emphasis on the internet of things and wireless communications. She worked with Professor **John Baras**' (ECE/ISR) research group and won the first Susan Frazier Postdoctoral Researcher Travel Award in May. Tsiropoulou also was recently named to the IEEE Communication Society's N2Women: Rising Stars in Networking and Communications list, which annually focuses on 10 women to be aware of at the beginning of their careers.

Petnga joins University of Alabama Huntsville

Leonard Petnga (Civil Systems Ph.D. 2016) has become an assistant professor in the Department of Industrial and Systems Engineering and Engineering Management at the University of Alabama Huntsville. His research interests are in ontologies for cyber-physical systems (CPS); model-based system integration for CPS with application to transportation, energy, buildings; semantics for model-based systems engineering; and OWL and SysML integration. At Maryland, he was a student of Associate Professor **Mark Austin** (CEE/ISR).

Student news

Khaligh student groups win in two competitions

Associate Professor **Alireza Khaligh** (ECE/ISR) led teams of graduate and undergraduate students to prizes in two different competitions this year.

His "MPEL-EV Tech" team of graduate students designed a prototype integrated onboard charger for electric vehicles. The invention is the subject of U.S. and international PCT pending patents. They finished in third place in the Allegheny Region Cleantech University Prize Collegiate Competition, held at Carnegie Mellon University.

Khaligh's undergraduate team won the Best Presentation Award at the 2017 IEEE International Future Energy Challenge at Virginia Tech in Blacksburg, Va. This was the team's first year in competition; 23 international teams participated. The team competed to build a high-efficiency, high-density isolated DC-DC converter. Such converters are increasingly important for computer, telecommunication, data center, battery charger, industrial and aerospace applications.

Salami wins UMD graduate research prize

Hossein Salami, a ChBE Ph.D. student in Professor **Raymond Adomaitis'** (ChBE/ISR) Semiconductor Material Processing Laboratory group, won first place at the University of Maryland's 2017 Graduate Research Appreciation Day. The prize was given for his presentation "Using reaction network graphs to study the dynamic behavior of chemically reactive systems: Application to chemical vapor deposition processes."

Chu, Maity, Miran win Outstanding Graduate Assistant Awards

Electrical and Computer Engineering graduate students **Sangwook Chu, Dipankar Maity** and **Sayyed Sina Miran** are among the 80 winners of the University of Maryland Graduate School's 2016–2017 Outstanding Graduate Assistant Award. The award recognizes the outstanding contributions graduate assistants provide to students, faculty, departments, administrative units and the university as a whole. Chu is advised by ISR Director Reza Ghodssi (ECE/ISR), Maity is advised by Professor **John Baras** (ECE/ISR), and Miran is advised by ISR-affiliated Assistant Professor **Behtash Babadi** (ECE).

Pearse wins Dean's Doctoral Research Award

Materials Science and Engineering graduate student **Alexander Pearse** won the 2017 Dean's Doctoral Research Award competition for "Development of Vapor-Phase Deposited Three Dimensional All-Solid-State Batteries." Pearse is advised by Distinguished University Professor **Gary Rubloff** (MSE/ISR).

Danny Kim wins third ARCS award

Computer Engineering Ph.D. student **Danny Kim** has been selected as an ARCS Lockheed Martin Scholar for 2017–2018. This is the third year that Danny has won this award. His research is in malware detection and he is advised by ISR-affiliated Professor **Rajeev Barua** (ECE).

George Banis wins Global Grand Challenges Summit poster award

George Banis, a bioengineering Ph.D. student in ISR Director **Reza Ghodssi's** (ECE/ISR) research group, won a poster design award in the student poster competition at the 2017 Global Grand Challenges Summit for "Encapsulated biomaterial-enabled microsensor for pancreatic health monitoring." The event was jointly organized by the U.S. National Academy of Engineering, the U.K. Royal Academy of Engineering, and the Chinese Academy of Engineering.

Congratulations, ISR grads!

Congratulations to these 2017 graduating students who were advised by ISR faculty.

PhD

Alborz Alavian, EE
Ahmed Arafa, EE
Eduardo Arvelo, EE
Chongxi Bao, EE
Andrew Berkovich, EE
Francisco Constantino, NACS
Parastoo Delgoshaei, CivSys
Lauren Field, BioE
Yunlong Huang, EE
Abbas Kazemipour, EE
Hyun-Tae Kim, ME
Frank Lagor, AE
Joshua Langsfeld, ME
Wentao Luan, EE
Van Sy Mai, EE
Ren Mao, EE
Mahshid Najafi, EE
Alexander Pearse, MSE
Ivan Penskiy, ME
Leonard Petnga, CEE
Krishna Puvvada, EE
Mustafa Sahin, BMGT
Daigo Shishika, AE
Ganesh Sivaraman, EE
Deepa Sritharan, ME
David Ward, EE
Thomas Winkler, BioE
Chau-Wai Wong, EE
Min Ye, EE
Zhijian Zhang, ME

MSSE

Adeola Awowale
Cara Chuang
Jessica Rae Lieberman
Jacob Moschler
Michael Morency
Akshay Prasad
Edward Zontek-Carney

MS

Brett Barkley, AE
Maria Coelho, CivSys
Weisheng Ding, EE
Brooks Muller, AE
Liangchen Xi, EE

MEng

Ahmad Uzair, SE
Miguel Zambrana

MEng in Robotics

Banuprathap Anandan
Pranav Bende
Shanmukha Bhumireddy
Aditya Earanky
Kajal Gada
Kanishka Ganguly
Vishakha Goyal
James Grimplin
Prudhvi Gurram
Ankur Mahendra Jain
Gregory Lee Jenkins
Lakshman Nandhakumar
Chirag Ashok Majithia
Dennis John Nesline
Patrick Nolan
Chethan Parameshwara
Vivek Prayakarao
Aldrin Racelis
Aaron Sirken
Meghav Verma
Durga Yakkala

Grad Certificate in Robotics

Michele Hoefer
Alexander Klinger

BS

Adam Berger, BioE
Anurupa Bhonsale, Math
Julia Downing, MSE
Tom Schmitt, MSE
James Williams, Biology

Ryan Huiszoon wins two awards at 2017 Bioscience Day

Ryan Huiszoon, a Bioengineering Ph.D. student in ISR Director **Reza Ghodssi's** (ECE/ISR) research group, won the Best Pitch and Audience Choice Awards at the University of Maryland's 2017 Bioscience Day for the invention, "Smart Catheter." Huiszoon, Ghodssi and Postdoctoral Researcher **Pradeep Rajasekaran** are the co-inventors of this microsystem device that can both track and treat bacterial biofilm in urinary catheters.

Bioscience Day is a showcase of advances in the biological sciences and biotechnology at Maryland that features research talks, the inventor pitch competition, a poster session, networking panels and a keynote lecture.

CREDIT: BRIANA THOMAS

ISR POSTDOCTORAL RESEARCHER **EIRINI ELENI TSIROPOULOU** AND ISR DIRECTOR **REZA GHODSSI** CELEBRATE EIRINI WINNING THE FIRST SUSAN FRAZIER POSTDOCTORAL RESEARCHER TRAVEL AWARD. THE NEW ANNUAL AWARD HELPS ISR POSTDOCS DEFRAY TRAVEL EXPENSES OF PRESENTING RESEARCH AT ACADEMIC WORKSHOPS AND CONFERENCES.

Three receive new ISR Graduate Student Travel Award

Thanks to ISR's generous alumni, faculty, staff and friends, enough funding has been secured for ISR to launch a new Graduate Student Travel Award. This award will be given every year to deserving graduate students to help defray the travel costs of attending a conference to present their research.

The Institute has secured enough funding to annually bestow this award. The three 2017 award winners are:

- **Bhaskar Ramasubramian** (ECE), advised by Professor **Steve Marcus** (ECE/ISR) and Professor **Rance Cleaveland** (CS/ISR)
- **Hossein Salami** (ChBE), advised by Professor **Ray Adomaitis** (ChBE/ISR)
- **Sayyed Sina Miran** (ECE), advised by ISR-affiliated Assistant Professor **Behtash Babadi** (ECE)

Khaligh and colleagues hosting REU program in transportation electrification

National Science Foundation Research Experiences for Undergraduates (REUs) are summer residential programs that provide undergraduates with collaborations for solving challenges and encourage them toward future research careers in industry or academia. Students develop research projects, attend technical tutorial seminars, visit local government labs involved in bioinspired robotics research, attend professional and academic development seminars, and tour Maryland's labs and facilities. Lunch discussions provide an informal setting for students and mentors to discuss technical and non-technical topics.

ISR faculty currently are hosting two REU programs, in transportation electrification (described here) and in bio-inspired robotics (see page 14).

Associate Professor **Alireza Khaligh** (ECE/ISR) is the principal investigator for the REU in transportation electrification. Faculty advisors include Professor **Richard La** (ECE/ISR), ISR-affiliated Assistant Professor **Behtash Babadi** (ECE), UMERC Director **Eric Wachsman**, Professor **Patrick McCluskey** (ME), Assistant Professor **Marina Leite** (MSE) and Associate Professor **Liangbing Hu** (MSE).

Projects include packaging and reliability for power electronics in transportation electrification, development of packaging materials for wide bandgap power electronics for automotive applications, *in-situ* degradation monitoring of automotive power modules, and an integrated charger and auxiliary load DC-DC converter for electric vehicles. Also, effect of bond parameters on shear strength of copper wire bonds for automotive applications, the application of the hidden Markov model in the determination of optimal battery and capacitor usage in electric vehicles, three-phase integrated onboard chargers for electric vehicles, auxiliary power supplies for more electric aircrafts, high power density batteries, and solid oxide fuel cells.

Bergbreiter, Mallik, Jenkins win ISR awards

Associate Professor **Sarah Bergbreiter** (ME/ISR) is the 2017 winner of the ISR Outstanding Faculty Award. She is a gifted and talented researcher; known for quality scholarship, advising and mentoring; and a highly active member of the robotics and microsystems communities. She is especially known for interdisciplinary collaboration and contributions to the systems nature of research, as well as for her leadership, service and outreach.

Ayan Mallik is the 2017 winner of ISR's George Harhalakis Outstanding Systems Engineering Graduate Student Award. He is a student in Professor Alireza Khaligh's (ECE/ISR) research group. Mallik's research is in power engineering and energy systems for electric vehicles and "more electric" aircraft. This includes modeling, simulation, design and development of power electronics interfaces. He has both extensive knowledge in control systems and excellent hands-on experience. Khaligh says that this is vital for someone conducting power electronics research.

Alexis Jenkins is the 2017 recipient of the ISR Susan Frazier Outstanding Systems Engineering Staff Award. She received the award for her work in payroll, visas, parking, benefits, visitors and appointments. She is attentive, detail-oriented, dependable and very efficient, always willing to help and answer questions from faculty, staff and students.

Northrop Grumman renews partnership

Northrop Grumman has renewed as an ISR Associate Partner for the third consecutive year. Dr. R. Eric Reinke, VP and CTO of Northrop Grumman Mission Systems, is a member of ISR's Strategic Advisory Council. The company also sponsors the Northrop Grumman Microsystems Seminar Series.

Maryland Robotics Center provides students with multiple education and research opportunities

REU program in bio-inspired robotics

As described on the previous page, NSF REU programs are summer residential programs that provide undergraduates with collaborations for solving challenges and encourage them toward future research careers in industry or academia.

The REU in bioinspired robotics offers a truly interdisciplinary systems research challenge that encompasses biology, materials, mechanical design, control, sensors and actuators, power and electronics. Professor **Hugh Bruck** (ME) is the principal investigator and Associate Professor **Sarah Bergbreiter** (ME/ISR) is the co-PI. Both are faculty in the Maryland Robotics Center.

Projects include cube satellite scale dexterous manipulators; dynamic morphing wings for flapping wing MAV; determining factors casing flow of propylene carbonate in millimeter scale channels; heavy leg inverted pendulum model for milligram-scale quadrupedal robot locomotion; compliant touch sensing skins for collaborative robots; microrobot mechanism designs in a mobile Helmholtz coil system; quadcopter lateral thrust control; the effects of mass, stiffness, and geometry on wing performance for Robo Raven; soft robots; an efficient periodic gait for the starfish robot; and actuation of acoustic metamaterials for biomimetic robotic applications.

In addition to Bruck and Bergbreiter, faculty advisors include Professor **Elisabeth Smela** (ME/ISR), Professor **Derek Paley** (AE/ISR), and ISR-affiliated Professor and Maryland Robotics Center Director **Miao Yu** (ME), Associate Professor **David Akin** (AE), and Associate Professor **Timothy Horiuchi** (ECE).

Many options for systems engineering graduate education

ISR offers a number of ways to obtain graduate education in systems engineering through our partnership with the Clark School of Engineering. There are two systems engineering masters degrees: the Master of Science in Systems Engineering (MSSE) and the Master of Engineering in Systems Engineering (MEngSE). The college also offers a Graduate Certificate in Engineering (CGEN) in Systems Engineering.

Students in both the MSSE and MEngSE programs take the same six core courses, but there are differences in admission requirements, electives and tuition.

ISR administers the **MSSE**, a research-oriented degree that requires completion of 30 credits (usually 10 courses). The student may opt to produce either a master's thesis or scholarly paper that reflects their systems engineering-related research. Students work under the guidance of a faculty advisor on a topic of mutual interest. Full-time students enrolled in this program are eligible for graduate research assistantships (GRAs), MSSE-specific internships, and possibly teaching assistantships (TAs). This degree program is particularly well-suited to students who are interested in research and who may be considering the possibility of pursuing a Ph.D. in an engineering-related field. In-state tuition rates for the MSSE program are lower than those for the MEngSE program, which makes the degree attractive for Maryland residents.

The **MEngSE** is a professional degree offered through the Clark School's Office of Advanced Engineering Education. It requires completion of 30 credits (usually 10 courses) and does not require either a master's thesis or scholarly paper. It is particularly well-suited for working professionals who are likely to be taking only one or two courses a semester. Students enrolled in this program are not eligible to be GRAs or TAs, or to receive MSSE-specific internships. Since the MEngSE tuition is lower than out-of-state MSSE tuition, international and out-of-state students may find this program more attractive.

If a student in either of the masters programs and decides to switch to the other program, they may apply to the other program. If accepted, any core systems engineering courses they have taken will transfer to the other program. Credit for electives will be evaluated with respect to the policies of each program. Admission and degree requirements for each program may be found on their respective websites.

The **CGEN in Systems Engineering**, offered through the Clark School's Office of Advanced Engineering Education, requires completion of four approved courses (12 credits total). It is designed for engineering professionals who would like to obtain added credentials in systems engineering.

Learn more about graduate systems engineering education options, including admission and degree requirements, at *www.isr.umd.edu/education/systems-engineering-education.*

Miao Yu named robotics center director

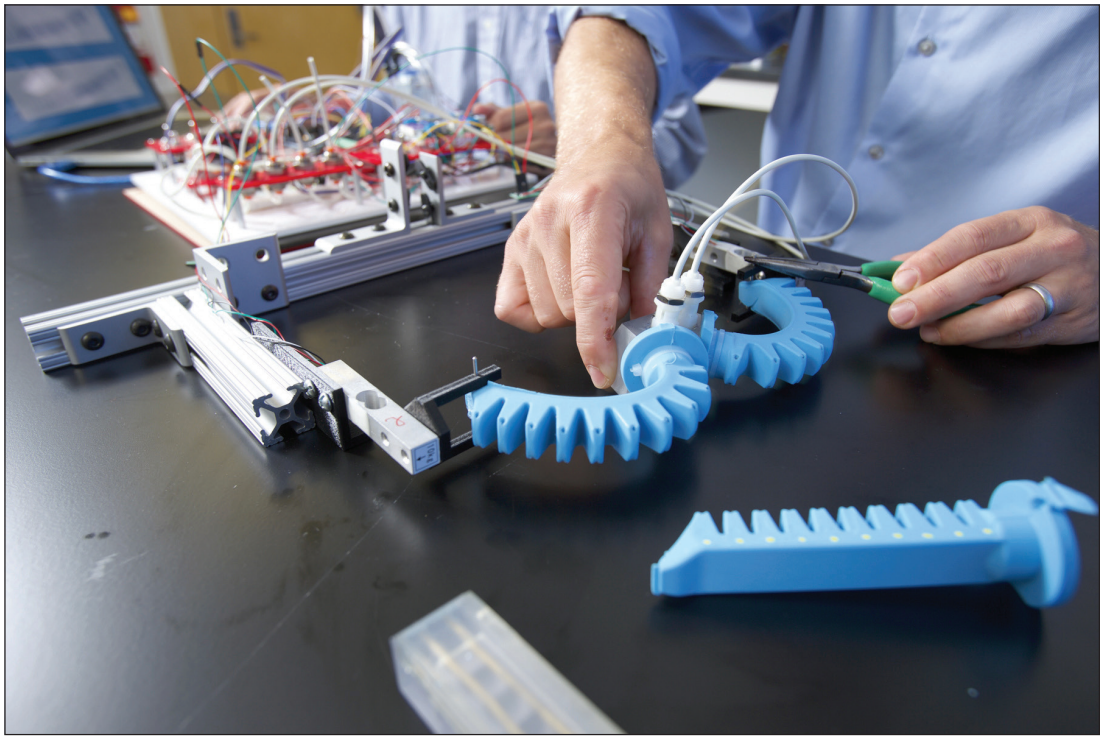
ISR-affiliated Professor **Miao Yu** (ME) was named director of the Maryland Robotics Center this summer. She follows Associate Professor **Sarah Bergbreiter** (ME/ISR) in the position.

The Maryland Robotics Center is an interdisciplinary research center housed in ISR within the Clark School. Its research activities include all aspects of robotics, including development of component technologies (e.g., sensors, actuators, structures, and communication), novel robotic platforms, and intelligence and autonomy for robotic systems. Research projects in the center are supported by federal funding agencies including NSF, ARO, ARL, ONR, AFOSR, NIH, DARPA, NASA, and NIST.

SEA-STAR

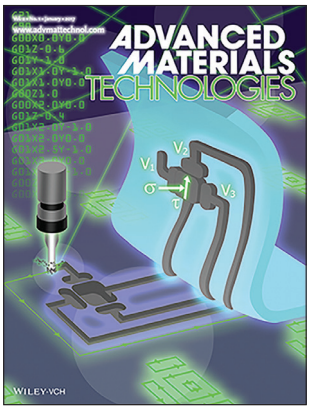
It might not look like a robot yet, but Professor **Derek Paley** (AE/ISR) is working on "SEA-STAR," Soft Echinoderm-Inspired appendages for Strong Tactile Amphibious Robots.

Paley, Aerospace Engineering Chair **Norman Wereley**, James Weaver and Robert Wood (Harvard) and Carmel Majidi (CMU), are creating soft underwater robot appendages that mimic functionality found in sea stars, brittle stars and basket stars—"radially symmetrical echinoderms." The appendages will be controlled by a network of embedded sensors and hydraulic actuators. These will provide shape proprioception (grasping) and local closed-loop control.



CREDIT: JOHN T. CONSOLI

Robotic tactile sensors featured on journal cover



Research by Associate Professor **Sarah Bergbreiter** (ME/ISR) and her former student **Alexi Charalambides** (M.E. Ph.D. 2016) was featured on the January 2017 cover of *Advanced Materials Technologies*.

Their paper, "Tactile Sensors: Rapid Manufacturing of Mechano-receptive Skins for Slip Detection in Robotic Grasping," presents a rapid manufacturing process using computerized numerical control milling to create a robot skin with normal and shear force tactile sensing. The skin is made entirely of elastomer and contains tactile pixels with microscale features distributed over a large area. Using this approach, the robot skin is integrated with a one degree-of-freedom gripper for closed-loop grasping and slip detection.

Charalambides currently is a postdoctoral researcher in Carnegie Mellon University's Integrated Soft Materials Laboratory.

Advanced Materials Technologies features technology-related materials applications research, with particular focus on advanced device design, fabrication and integration, as well as new technologies based on novel materials, and bridges the gap between fundamental laboratory research and industry.

Learn more. Read the paper at *onlinelibrary.wiley.com/doi/10.1002/admt.201770001/full.*

Maryland part of Advanced Robotics Manufacturing Institute

The University of Maryland is among 231 academic, industry and government partners in the new Advanced Robotics Manufacturing Institute (ARM). ARM is headquartered at Carnegie Mellon University in Pittsburgh and has received $80 million from the U.S. Department of Defense and an additional $173 million from other funding sources.

At Maryland, ARM efforts are led by the Maryland Robotics Center. "Maryland brings a particularly strong group of researchers in the area of perception and sensors for collaborative robotics," says Associate Professor **Sarah Bergbreiter** (ME/ISR). "In addition, Maryland contributes state of-the-art facilities and educational opportunities to train the next generation of robot developers."

The use of robotics in manufacturing is widespread, but robots are typically expensive, singularly purposed, challenging to reprogram, and require isolation from humans for safety. In addition, while robots are increasingly necessary for defense and other industrial manufacturing needs, their capital cost and complexity of use limits their use by mid-size and small manufacturers.

ARM will make industrial robotics more affordable for businesses of all sizes, adaptable for many uses, and able to achieve more. ARM will create a new generation of robots in the aerospace, automotive, electronics, fulfillment and logistics industries, creating large numbers of new jobs in the U.S. and to fuel the country's economic growth through advanced manufacturing.

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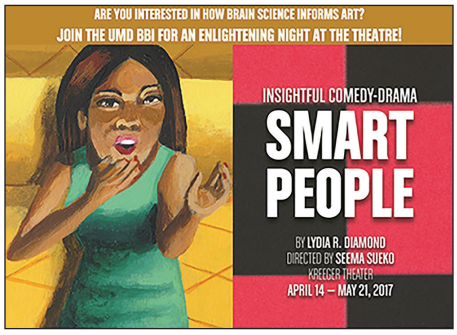
Brain and Behavior Initiative partners with Arena Stage



Building a culture that includes both brain research and the arts, the University of Maryland's Brain and Behavior Initiative was involved in a unique partnership this spring—working with Arena Stage in Washington, D.C. Arena was presenting *Smart People* by Lydia R. Diamond, a play that explores the unavoidable nature of implicit cultural bias through the lenses of neuroscience, psychology, medicine and the arts.

Two special events marked the innovative partnership: a "Smart Talk" panel discussion on March 13 and a free night out for 200 UMD students to view the play on May 4.

The panel discussion was led by Seema Sueko, the director of *Smart People*. It featured two panelists from the University of Maryland, ISR Director **Reza Ghodssi** (ECE/ISR) and **Kelsey Leigh Canada**, a graduate student in the Neurocognitive Development Lab; as well as Soyica Colbert, an African-American and Theater and Performance Studies professor from Georgetown University; Chris Denby, the executive vice president of the Advisory Board Company; and Tiffany Townsend, who directs the Office of Ethnic Minority Affairs at the American Psychological Association.

At the May 4 play performance, the 200 students came from disciplines across the university. Seema Sueko led a discussion before the play, and the students talked about the play afterwards with the cast members in a discussion led by **Sheri Parks**, the UMD Associate Dean of Research, Interdisciplinary Scholarship and Programming in the College of Arts and Humanities.