FOCUS

UAH Research Magazine // Fall 2017

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THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

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VP for Research and Economic Development

We've come a long way...

Welcome to this edition of FOCUS, UAH's research magazine. I often hear from our alumni and others who have been in this community for a long time how UAH has changed and grown. Since our early beginning in 1949 as a University of Alabama extension center offering 10 freshman-level classes to 137 students to today's research-intensive, fully comprehensive university with record enrollments and highly applied research in support of DoD, NASA, industry, and many federal agencies, I think it's safe to say that we've come a long way and I'm very proud to be a part of this amazing university. I think Wernher von Braun would be proud of us. If you have not been on campus lately, I would invite you to drive though the campus and see the changes, new construction, and the beautiful facilities that our students, faculty, and staff enjoy.

This issue of FOCUS includes an article on our new LMI-UAH partnership. LMI began as a non-profit in 1961 and became a Federally Funded Research and Development Center (FFRDC) in 1985 – always working for the U.S. government. In 1998, LMI returned to a non-profit government consulting status. In 2011, LMI formed an "academic partnership" program with select universities providing structured, funded research projects that help bridge the gap between academia and industry. UAH is proud to be one of only eleven universities in the nation selected for this program. As an applied research university with significant DoD and NASA funding, we make an excellent partner.

Other articles in this issue focus on two of our highly productive research centers: the Information Technology and Systems Center and the Earth System Science Center. Centers at UAH provide an interdisciplinary approach to research and an infrastructure to support the researchers who work toward solutions for our customers. Please take a moment to read about these two centers and the outstanding work that they are accomplishing and the international impact they are making.

We are very proud of our alumni and like to focus on their successful careers. In each issue of this magazine, we select one such person as an example of the impact our graduates make. This issue highlights the accomplishments of Mr. John Honeycutt, who became the manager of NASA MSFC's Space Launch System (SLS) program in 2015. John is a Huntsville native and a 1990 mechanical engineering graduate of UAH.

UAH lost four highly respected and accomplished individuals this past year whom we recognize in our "In Memoriam" section: Dr. Charles "Chuck" Lundquist, Dr. S.T. Wu, Dr. Richard "Dick" Rhoades, and Dr. Joseph "Joe" Geary. These four researchers each influenced UAH significantly in their years of service to this institution, and we will miss them greatly.

It is our hope that this magazine helps to maintain our connection with the Huntsville community and our many sponsors. We are so privileged to do the work that we do, and at the same time, we are proud of the accomplishments that our faculty, staff, students, and alumni have achieved. My office is available to provide information on the efforts featured in this magazine or any other research project ongoing at UAH. ■

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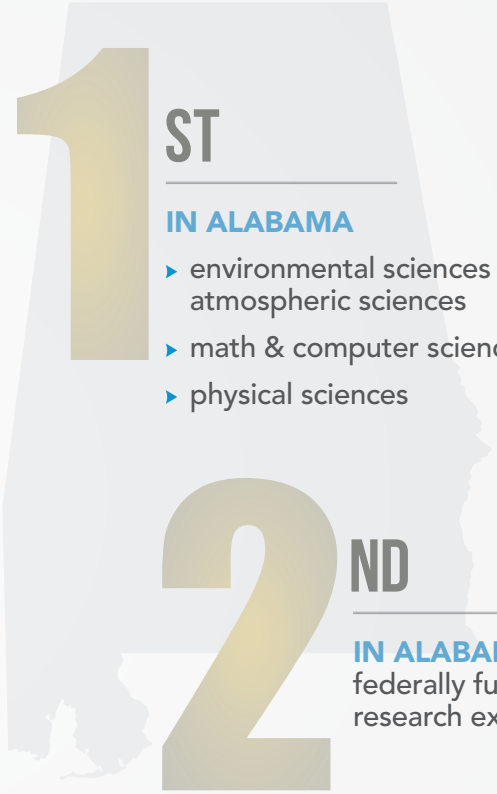
Cover photo credit: NASA MSFC

THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

A Tier 1 national university that is located within the second-largest research park in the United States, UAH is considered one of the nation's premier research universities.

IN ALABAMA



1ST

IN ALABAMA

- environmental sciences including atmospheric sciences
- math & computer sciences
- physical sciences

2ND

IN ALABAMA
federally funded research expenditures

NATIONALLY

- **6TH** Federally financed Aeronautical/ Astronautical engineering research
- **11TH** Federally financed Atmospheric Sciences research expenditures
- **11TH** Federally financed Computer Sciences research expenditures
- **14TH** NASA R&D expenditures
- **17TH** Federally financed Astronomy research expenditures
- **18TH** Federally financed Business & Management research expenditures
- **25TH** Department of Defense R&D expenditures

SOURCE: National Science Foundation

RESEARCH

$463 million
Five-year contract and grant research total

$5 million
Five-year license and royalty revenue total

$96.9 million
Fiscal 2016 research expenditure total

ISSUED PATENT TOTAL – 74

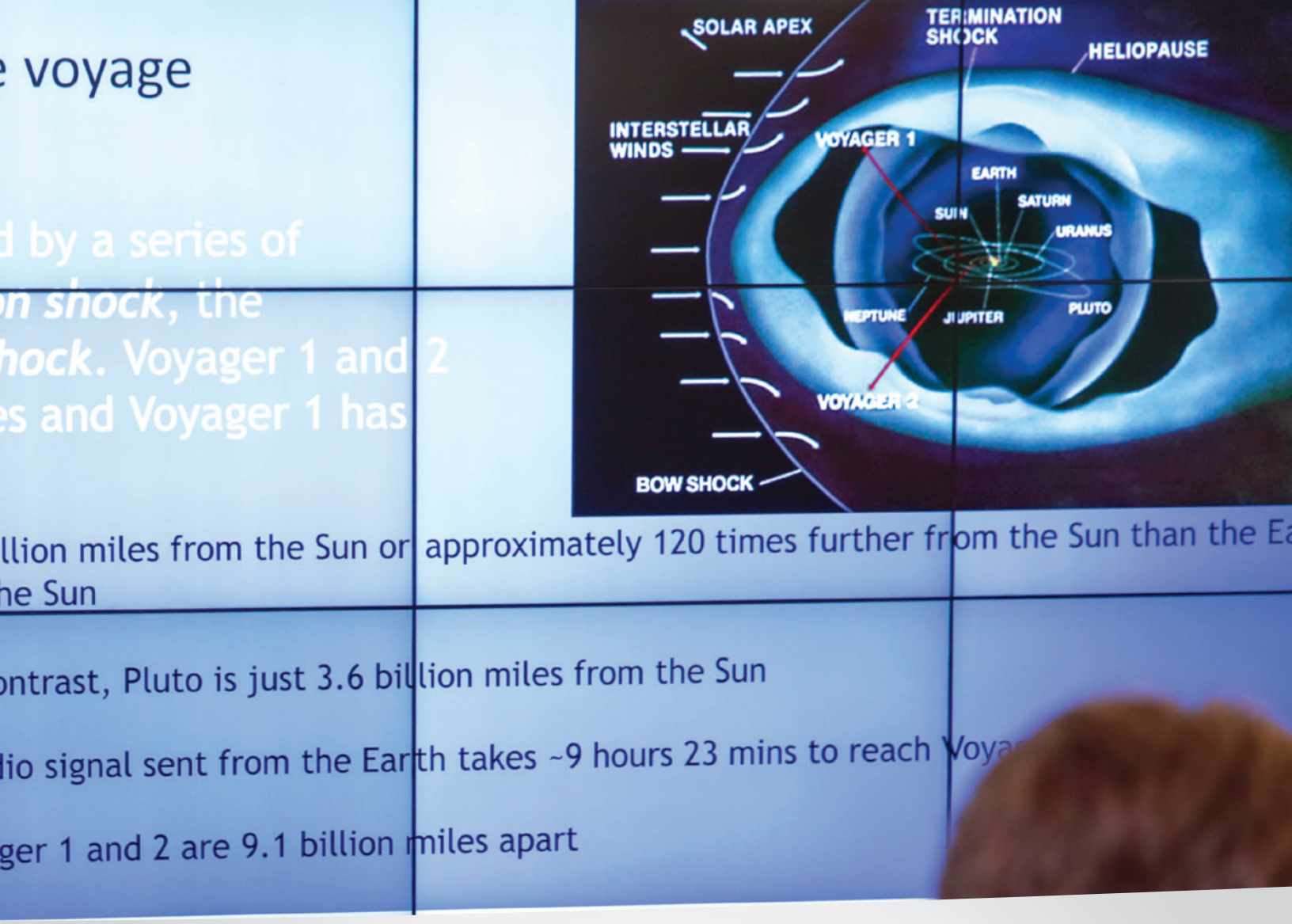
AWARD-WINNING RESEARCH

Dr. Gary Zank serves as principal investigator on a $20M five-year award to fund research on low-temperature plasma

A partnership comprising nine universities in Alabama, including The University of Alabama in Huntsville (UAH), has been awarded a $20 million, five-year grant by the National Science Foundation's Established Program to Stimulate Competitive Research (EPSCoR). The grant will fund the development of new predictive plasma-surface interaction technologies for the nation's aerospace, manufacturing, energy, environment, and agricultural sectors. Dr. Gary Zank, director of UAH's Center for Space Plasma and Aeronomic Research and chair of the university's Department of Space Science, serves as the project's principal investigator and was instrumental in shepherding the proposal through the process.

"Alabama EPSCoR solicited proposals in the fall of 2015 for a state-wide competition, and after two rounds of review, Dr. Zank's proposal was selected to go forward to NSF EPSCoR on behalf of the state," says Dr. Christopher Lawson, Alabama EPSCoR executive director. "Through Dr. Zank's inspired leadership and tireless hard work, that proposal was then successfully selected for funding by NSF EPSCoR. Now it promises to develop new research capabilities in the state in plasma science; educate students in the plasma-related science, technology, engineering, and math fields; and create important high-technology jobs for Alabama."

But while Dr. Zank may be serving as principal investigator on the project, he is quick to share credit for the proposal's success. "Ray Vaughn and his team in UAH's Office for the Vice President for Research and Economic Development were outstanding in providing all of the



help and resources that we needed to pull the proposal together, and Alabama EPSCoR – led by Dr. Lawson – went out of their way to provide us with both assistance and expertise," says Dr. Zank, a member of the National Academy of Sciences and the 2017 recipient of the International Space Science Institute's Johannes Geiss Fellowship. "I view it as a real state-wide, team effort, as it's not something that could have been done by one person at all. All the co-principal investigators and the institutional leads were outstanding."

Along with UAH, the partnership includes the University of Alabama (lead: Dr. R. Branam), the University of Alabama at Birmingham (lead: Dr. Y. Vohra), Auburn University (lead: Dr. E. Thomas), Tuskegee University (lead: Dr. V. Rangari), the University of South Alabama (lead: Dr. E. Spencer), Alabama A&M University (leads: Dr. R. Mentreddy and Dr. E. Cebert), Alabama State University (lead: Dr. K. Vig), and Oakwood University (lead: Dr. A. Volkov), with additional assistance from CFD Research Corporation (lead: Dr. V. Kolobov), a computational fluid dynamics software company located in Cummings Research Park. These members bring " a range of expertise in space science, laboratory plasma physics, materials, biosciences, and manufacturing to this endeavor," says Dr. Zank. "And any gaps we may have in personnel expertise will be filled with the addition of five new faculty hires over the duration of the grant."

Entitled "Connecting the Plasma Universe to Plasma Technology in Alabama: The Science and Technology of Low-Temperature Plasma" (CPU2AL), the project seeks to understand, predict, and control the transfer of power from electromagnetic fields to electrons, ions, atoms, molecules and surfaces, and chemical reactions in plasma and on surfaces. "Most technologies based on low-temperature plasma are developed empirically, yet low-temperature plasma constitutes more than 90% of all matter in the universe, making it the bedrock of much of space physics, non-fusion plasma research, and plasma astrophysics," he explains. "It also underpins the entire information technology industry as well as most high-tech materials-related manufacturing industries."

By leveraging Alabama's strengths in fundamental low-temperature plasma science, the research team hopes to develop new predictive plasma-surface interaction technologies. "CPU2AL addresses two

Some of the project's leads share what the award means to their organizations and its potential to establish Alabama as a leader in low-temperature plasma research...

"This grant will have a transformative effect on the microwave plasma chemical vapor deposition research that is ongoing at UAB. The research infrastructure improvements it enables will allow us to transition from lab-based plasma systems to large-area plasma systems needed for industrial manufacturing. And there is a very real opportunity to combine in a synergistic manner plasma theory and modeling expertise, plasma diagnostics expertise, and plasma processing of materials expertise, leading to the development of new products that can be deployed in Alabama's aerospace, automotive, and biomedical industry."

– Dr. Yogesh Vohra, Professor & University Scholar, Department of Physics, UAB

"AAMU is uniquely positioned to introduce a diverse group of under-represented individuals to participate in this national research program. Introducing students to this multidisciplinary research across different universities will pose new challenges; however, such training will create a well-qualified workforce to address the scientific issues of the 21st century."

– Dr. Ernst Cebert, Plant Breeding & Genetics/Biofuels, Department of Biological & Environmental Sciences, AAMU

major challenges facing low-temperature plasma science today," says Dr. Zank. "The first is incorporating the full complexity of particle kinetics and energy flow into theory, models, and experiment, and the second is modeling the transfer of energy mediated by collective processes such as turbulence and self-organization. It's understanding and controlling these processes that ultimately determines the utility of low-temperature plasma."

The team plans to address these two challenges by developing three strategic research thrusts. The first is a basic understanding of plasma kinetics, which will determine how distribution functions of ionized and neutral species are formed and what the appropriate kinetic and fluid descriptions are of electrons, ions, and neutrals in low-temperature plasma space, laboratory, and industrial plasma. This in turn will enable the development of diagnostics that measure plasma properties in low-temperature plasma far from equilibrium.

The second is a basic understanding of collective processes in order to develop models of waves, instabilities, nonlinear processes, turbulence, and

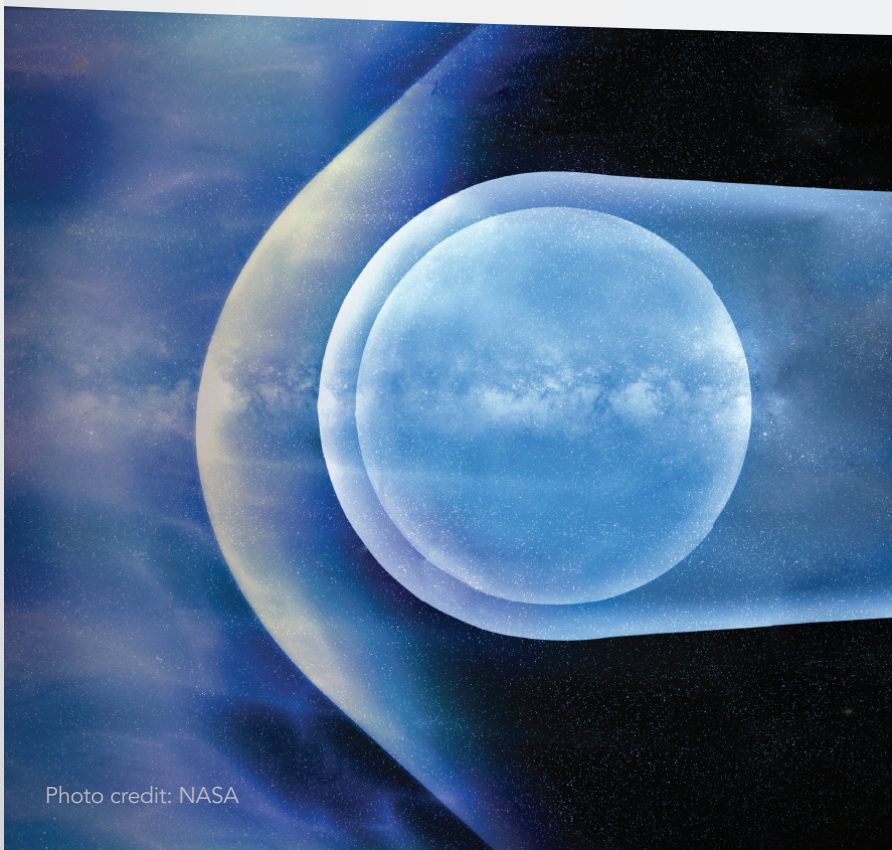


Photo credit: NASA

self-organization in low-temperature plasma that will enable the creation and control of large volumes of quiescent plasma or highly localized turbulent states for the manipulation of physical, thermal, electrical, and chemical processes. This, in turn, will facilitate the development of efficient numerical algorithms to model collective effects that influence microwave/THz/laser-produced plasma used in fast electronic devices, directed energy systems, plasmonic devices, and optoelectronic devices.

"I view it as a real state-wide, team effort, as it's not something that could have been done by one person at all. All the co-principal investigators and the institutional leads were outstanding."

And the third is a basic understanding of plasma interactions with solid, liquid, and soft matter (biomaterials) and bio-matter (seeds and food) surfaces, which has a twofold purpose. It will determine what plasma species, concentrations, spatial distributions, and gas/electron temperatures are associated with the synthesis of novel covalently-bonded 2-D and 3-D super-hard structures in the C/N/O/B system, as well as how large-area deposition of these super-hard materials can be achieved. And it will determine the processes responsible for the plasma activation of prosthetic biomaterials, plants, and seeds that do not affect their bioactivity for use in prosthetic biomaterials, tissue scaffolds of complicated geometry, and seed disinfection and food safety.

▸ Dr. Gary Zank

Alabama is one of only 27 jurisdictions (24 states plus 3 U.S. territories) eligible to compete for

ZANK AWARDED

THE ISI'S JOHANNES GEISS FELLOWSHIP

DR. GARY ZANK was named the 2017 recipient of the International Space Science Institute's Johannes Geiss Fellowship, which is awarded annually and provides one international scientist of stature with funding for a limited-duration visit to the Institute, which is located in Bern, Switzerland. "I was greatly honored to receive this fellowship," says Dr. Zank. "Johannes Geiss was an inspirational scientist who did groundbreaking work in developing our current understanding of the elemental composition of the solar corona and solar wind and even the interstellar medium."

The fellowship, which is named after the Institute's founder, Swiss physicist and Albert Einstein medal recipient Dr. Johannes Geiss, was established in 2015 to honor Dr. Geiss' contributions to the space science discipline. As this year's Johannes Geiss Fellow, Dr. Zank will spend a few weeks at the Institute this October, followed by two shorter visits in the spring. He plans to spend much of his time working on his book, "Physics of the Outer Heliosphere," which explores the interaction of the sun with the galaxy.

"The EPSCoR project will have a significant impact on our institution as this project enables us to initiate research on the agricultural applications of low-temperature plasma. Our research at AAMU will aim at a better understanding of low-temperature plasma mediated antimicrobial efficacy and proposed mechanisms of action of the technology on food safety, quality, and nutritional variables. We are thankful to Dr. Zank for inviting us to participate in this multidisciplinary, multi-institutional research project."

– Srinivasa Rao Mentreddy, Professor and Program Coordinator, Plant Biotechnology, Department of Biological and Environmental Sciences, AAMU

"The EPSCoR project will boost development of plasma technologies in the state of Alabama by integrating existing capabilities of the participating institutions, improving infrastructure and interactions with leading national centers for plasma research, and accelerating workforce development in this field. CFDRC will play an important role by sharing accumulated capabilities and expertise among the team members, further developing its technologies with active academic participation, and bridging university research and workforce development with industrial applications of low-temperature plasma."

– Vladimir Kolobov, CFDRC/Principal Research Scientist at CSPAR

"This EPSCoR grant will be transformational at Auburn. With it, we will have new resources to expand the intellectual capabilities of our programs and we'll have new opportunities to look outward – beyond our local research efforts to establish partnerships throughout the state. To accomplish this, we are looking forward to collaborating with our colleagues around the state to create new partnerships that will help to advance the development low-temperature plasma science in Alabama."

– Dr. Edward Thomas, Charles W. Barkley Endowed Professor of Physics, Associate Dean for Research and Graduate Studies, College of Sciences and Mathematics, AU

funding through EPSCoR, which was established in 1978 to "advance excellence in science and engineering research and education in order to achieve sustainable increases in research, education, and training capacity and competitiveness that will enable EPSCoR jurisdictions to have increased engagement in areas supported by the NSF." As such, the partnership's proposal had to prove that CPU2AL would improve Alabama's academic research infrastructure in the areas of science and engineering and contribute to the state's existing science and technology plan before it could be considered for funding.

"The broader impact of CPU2AL is that it will advance theory and models scaled from space to laboratory low-temperature plasmas and apply them to new plasma technologies and industrial low-temperature plasma systems that map directly to the Alabama EPSCoR Science & Technology Roadmap and Alabama's overall economic development," says Dr. Zank.

The hope, he continues, is that the partnership will ultimately transform the state's low-temperature plasma research capabilities, expand its workforce capabilities in low-temperature plasma science and technology, and grow student numbers and diversity in plasma science through a combination of educational and outreach programs with national and international partners, scientific exchange programs, workshops, and internships between partner institutions and with national labs and industrial partners.

For Dr. Ray Vaughn, Vice President for Research and Economic Development at UAH, the prestigious award not only reflects the "deep technical abilities" of the university, but it also offers the institution an extraordinary leadership opportunity in a cutting-edge field of research. "Dr. Zank was able to put together a winning team by leveraging the strongest researchers across the state in the area of plasma research," he says. "We are very much looking forward to executing this project." ■

IMPROVING **OUTCOMES** IN AMPUTEES

When it comes to the direction her research has taken over the past year, Dr. Shannon Mathis has former student Eli Walls to thank. "He was in my course on exercise testing and prescription for special populations, and as part of his class project, he gave several presentations about amputees," says Dr. Mathis, an assistant professor in the Department of Kinesiology of the College of Education. "That sparked my interest in reading about the current research on the amputee population."

At the same time, the Department had just purchased an underwater treadmill in support of research being done by her colleague, Dr. Ryan Conners. "Ryan was measuring the effects of underwater treadmill walking in persons with Type II diabetes, one of the leading causes of lower limb amputations," she says. "So I began thinking about the success he's had and how I might be able to do the same among lower limb amputees."

She ultimately decided to conduct a three-part research study, "Improving Outcomes for Amputees," which kicked off in the fall of 2016 with a $5,000 Cross-College Faculty Research award from UAH's Office of the Vice President for Research and Economic Development.

Part one, "Improving Outcomes for Amputees: A Study of Predictors of Pain, Disability, and Quality of Life," focuses on the prevalence and permanence of mobility apprehension among lower limb amputees classified as level K2 on the Medicare Functional Classification scale, which ranges from those who are wheelchair bound (K0) to those who are runners (K4).

"Mobility apprehension can take root during a lengthy recovery from surgery – a deconditioning occurs that can make returning to an active lifestyle difficult," says Dr. Mathis. "As a result, amputees are at risk for developing avoidance behaviors, which can lead to greater pain, depression, and even the possibility of the amputation of their second leg. I want to figure out the cause of these fears as well as the discrepancies between the actual and perceived fall risk."

To that end, she recently attended the Amputee Coalition 2017 National Conference in Louisville, KY, to gather psychometric data from the conference's 1,000-plus attendees. "Once we have an idea of the prevalence of mobility apprehension, we can begin to look for the causes," she says. She now plans to apply for a grant from the Patient-Centered Outcomes Research Institute to determine whether balance and core strength further predict self-perceived mobility apprehension.

"The information will be compiled to inform a precision medicine model for customized healthcare for amputees," she says. "My hope is that this will enable clinicians to better direct patients into either physical therapy or neurotherapy to ultimately improve quality of life following lower limb amputations."

Part two, "Improving Outcomes for Amputees: The Feasibility and Efficacy of an Underwater Treadmill Training Program," seeks to demonstrate the effectiveness of an aquatic walking protocol in lower limb amputees. It is funded by a $25,000 grant from the American Academy of Orthotists and Prosthetists and builds upon Dr. Conners work with persons with Type II diabetes. "We are essentially applying the same approach to lower limb amputees with limited ambulation potential to show that an underwater treadmill walking program will improve physical function, improve quality of life, and reduce disability," says Dr. Mathis, who is partnering with Dr. Conners on the study.

▲ **Dr. Shannon Mathis** conducts a test to measure outgassing as part of her exercise science class.

A total of 12 participants will be expected to complete three underwater treadmill training sessions per week for eight weeks, with a progressive increase in walking speed and duration. "Outcome variables are being collected at baseline, after treatment, and after three months and include physical function tests such as the 10-meter walk test, a balance test, timed up and go, and questionnaire data," she says.

Long term, the pair hopes to provide a data-driven rationale to extend the use of water-based treadmills to lower limb amputees as a safe exercise medium that will potentially enable them to achieve K3 status. "If a patient is able to demonstrate an increased mobility level, Medicare will often cover the cost of a prosthetic device that allows for a higher energy return, greater stability, and greater range of motion," says Dr. Mathis. "That, in turn, can further help reduce any physical, functional, and psychological barriers to reintegrating into community and leisure activities."

Part three, "Improving Outcomes for Amputees: The Definition of Lower Limb Kinematics," attempts to define a more robust, repeatable method to measure the kinematics of walking with a prosthetic to replace the current K-level test. The study pairs Drs. Mathis and Conners with two professors in UAH's Department of Mechanical and Aerospace Engineering: Dr. Chang-kwon Kang and Dr. Brian Landrum.

"Right now, K level is determined by a brief – and often subjective – physical function test, and yet it's the primary tool used to determine the prosthesis needed," says Dr. Mathis. "Our plan is to use motion-capture technology to not only analyze the gait of amputees and determine reliable outcome measures but also help patients improve their gait and achieve a higher K level."

Essential to the study is the College of Engineering's Autonomous Tracking and Optical Measurement (ATOM) lab, which provides high-speed, low-latency, real-time, three-dimensional tracking of objects using 33 infrared cameras capable of tracking 50 unique objects at up to 370 frames per second. Testing patients in the ATOM lab at regular intervals, she says, "will allow us to define repeatable kinematics and determine differences in gait across K levels."

And by involving UAH students, they will also be able to submit an external proposal to the National Institutes of Health's Academic Research Enhancement Award program. "This award supports research with student involvement to strengthen the research environment of the institution," says Dr. Mathis.

Together these three studies have the potential to add up to tangible changes in the lives of lower limb amputees. Those who may benefit from the use of underwater treadmill training can be identified through the collection of data on the fear-avoidance model. They can then undertake underwater treadmill training and improve their mobility, thereby achieving a higher K level. That, in turn, increases their eligibility for a better prosthesis, leading to not just a greater range of motion and energy return but also to a more active life and a reduction in the likelihood of having a second amputation.

"I would not have gone down this path had Eli not been in my class, but knowing that we have the potential to make a small difference in people's lives with the research that we're doing is really fulfilling," says Dr. Mathis. As for Walls himself, he's embarked on a career path that will allow him to continue improving outcomes for amputees. Currently employed in the Huntsville office of Fourroux Prosthetics and assisting Dr. Mathis with her research, he will head to Northwestern University this fall to earn a master's degree in prosthetics and orthotics. ■

TO INFINITY AND BEYOND

Photo credit: NASA MSFC

UAH alumnus John Honeycutt is at the forefront of the nation's deep-space exploration efforts

An engineering family, an inclination to tinker with cars, and a childhood spent in the Rocket City led John Honeycutt ('90, Mechanical Engineering, BS) from the UAH campus to his current position as program manager of NASA's Space Launch System (SLS) program at Marshall Space Flight Center. He now oversees an annual budget of $2.15 billion and a nationwide workforce of more than 4,200 civil servants and contractors tasked with designing, building, testing, and flying what will be the most powerful rocket ever built.

"I'm in charge of all facets of the program – planning, procurement, development, testing, evaluation, production, and operation of the SLS," Honeycutt says of the rocket, which will carry human explorers and robotic spacecraft on ambitious new missions to the moon, Mars, and the outer planets. "I couldn't do that without an incredibly talented team. It's a challenging job, but it's also an exciting time to be part of what I believe will be NASA's greatest adventures yet."

Honeycutt joined NASA in 1999, serving in leading roles in propulsion design, systems integration, and test planning. During the space shuttle Columbia accident investigation, he was the NASA lead for the External Tank Working Group Interface Team and subsequently led the redesign effort, an experience that would catapult him into jobs as deputy and then manager of the external tank project for the final shuttle missions. Most recently, he served as deputy manager of the SLS stages office, SLS deputy chief engineer, and SLS deputy program manager before being appointed to the top rocket job.

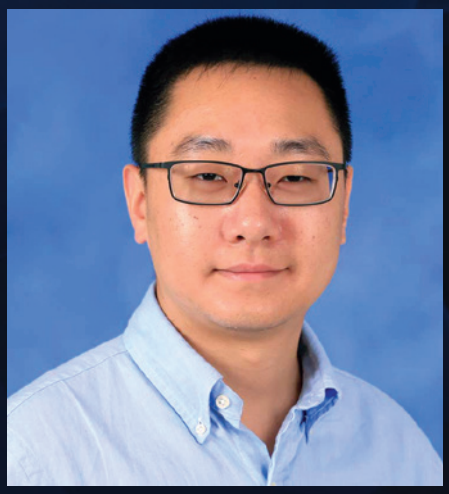
While he's seldom required to do any of the engineering for which he was trained in his management role today, the knowledge and the discipline instilled at UAH remains the foundation for Honeycutt's ability to probe into issues. He sees himself as an integrator, challenging his hardware teams to coordinate more closely as individual components start coming together. "There's nothing like managing the design, manufacturing, and operation of space hardware to introduce even the smartest person to the concept of life-long learning," he says. "So I've had the chance to continue the education that began at UAH."

> *"I've had the chance to continue the education that began at UAH."*

Honeycutt, who lives in Huntsville with his wife Terri and their son, has received numerous awards for his work. These include a NASA Exceptional Achievement Medal in 2011, a Space Flight Awareness Award in 2004, a Center Director's Commendation in 2000, and a Silver Snoopy Award in 1999. This July, he received NASA's Exceptional Service Medal for his leadership critical to the success of both the space shuttle and SLS programs, and in August, he was recognized as a 2017 UAH Alumni of Achievement. ■

NASA FELLOWSHIP

WILL FUND UAH SPACE SCIENCE STUDENT'S RESEARCH ON SOLAR WIND



▲ UAH doctoral candidate **Bofeng Tang**, whose advisor is National Academy of Sciences member Dr. Gary Zank, is the third student in UAH's Department of Space Science to receive a prestigious NASA Earth and Space Science Fellowship.

Bofeng Tang, a Ph.D. candidate in UAH's Department of Space Science, received a 2017/2018 NASA Earth and Space Science Fellowship (NESSF) to fund his research into the transport of electrons and electron heat flux in the solar wind. The prestigious fellowship includes a $30,000 award and can be renewed for a total of three years.

Tang earned his master's degree in physics in China before coming to the U.S. in 2013 to attend UAH. Since then, he has been working under the supervision of National Academy of Sciences member Dr. Gary Zank, who serves as both chair of the department and director of UAH's Center for Space Plasma and Aeronomic Research (CSPAR). "He is my role model," says Tang. He's also received invaluable assistance from Dr. Vladimir Kolobov, a principal research scientist at CSPAR and a fellow of the Institute of Electrical and Electronics Engineers.

"Dr. Kolobov is one of the world's foremost experts in the numerical solution of the kinetic equations for electrons in the presence of collisions," says Tang. Together, the pair are hoping to further scientists' understanding of the connection between strahl and halo electrons by developing a theoretical transport equation model that incorporates wave-particle scattering in the energy regime appropriate to electrons' population. "We want to extend numerical simulations of electron transport including wave-particle interactions and collisions based on direct numerical solutions of the Vlasov equation."

Tang's was one of only nine NESSF applications accepted by NASA's Heliophysics Division, which helps further the space agency's research objective of investigating the sun and its interactions with the solar system, including space weather events. He joins two other UAH students in the Department of Space Science who have received an NESSF in the last three years; Parisa Mostafavi, whose research focuses on how the sun mediates the fundamental forces that affect space weather, was a 2016/2017 recipient of the fellowship, and Anthony DeStefano, whose research focuses on the trajectories of heavy atoms from the interstellar medium into the heliosphere, was a 2015/2016 recipient.

"This is a well-deserved award. Bofeng is working very hard on his project, which is challenging and represents one of the important unsolved mysteries of the solar wind," says Dr. Zank. "I am especially pleased that the Department of Space Science students have managed to capture three NESSF awards in the past three years. It's an outstanding record and is a testament to the caliber of the students working in the Department. I look forward to more successes in the coming years." ■

VISIT FROM LMI LEADERSHIP FOLLOWS UAH INVITATION TO JOIN FIRM'S ACADEMIC PARTNERSHIPS PROGRAM

UAH's Office of the Vice President for Research and Economic Development was pleased to welcome Mr. Ed Stanton, senior vice president of strategic growth at LMI, for a daylong tour of the UAH campus and its research facilities in early June.

Mr. Stanton's visit followed UAH's recent invitation to join LMI's Academic Partnerships program, which was launched by LMI Research Institute in 2011 to provide universities with structured, funded research projects that expose students to real-world challenges faced by the federal government. Currently, the partnership comprises 10 academic institutions in addition to UAH, all of whose coursework and research align closely with LMI's strategic research interests and expertise in the areas of acquisition and financial management, infrastructure management, information management, organizational improvement, and policy and program support.

"We are honored to be invited as an academic affiliate of LMI Research Institute. There are only a few formal affiliates that have been invited to partner with LMI since the program's inception, and UAH is the only one in Alabama," says Dr. Ray Vaughn, UAH's vice president for research and economic development. "Given the applied nature of UAH's work and its long-standing support of the Department of Defense and NASA, the affiliation is a strategic partnership opportunity. We are pleased that Mr. Stanton took the time to visit UAH and to do a deep dive into our capabilities."

Mr. Stanton's visit included a working lunch with Dr. Gary Zank, director of UAH's Center for Space Plasma and Aeronomic Research; Dr. John Christy, director of UAH's Earth System Science Center; and Dr. Sara Graves, director of UAH's Information Technology and Systems Center; as well as dinner with UAH president Dr. Robert Altenkirch.

Throughout the day, Mr. Stanton also toured the majority of UAH's research centers and labs, including the Reliability and Failure Analysis Lab, the Rotorcraft Systems Engineering and Simulation Center, the Propulsion Research Center,

the Center for Space Plasma and Aeronomic Research, the Information Technology and Systems Center, the Severe Weather Institute – Radar and Lightning Laboratories, the Center for Cybersecurity and Research Education, and the Aerophysics Research Center, which is a subordinate of UAH's Research Institute located on the Redstone Arsenal.

"UAH represents a fantastic partner for LMI as we both have decades behind helping solve government's most complex problems and some of the smartest folks developing what's possible in the future," says Mr. Stanton, a retired lieutenant general of the U.S. Army whose current responsibilities include implementing LMI's strategic growth initiatives while strengthening client relationships in the financial and resource management community. "I was prepared to be impressed, but after spending a full day looking, I am simply amazed at UAH's breadth of experience and capabilities helping government develop advanced solutions."

LMI's invitation to UAH was extended earlier this spring, solidifying several years of warm relations between the university and the firm's Southeast headquarters.

More recently, Dr. Vaughn attended the program's 2017 Government–University Forum, which was held May 24 at LMI Tysons. The forum provides insight into the challenges facing government clients, informs LMI's academic partners about LMI, allows LMI's academic partners an opportunity to discuss their work and share ideas for exploration, and makes connections among LMI staff, academic researchers, and government representatives. "LMI's Government–University Forum is becoming a premier conference to bring the leading minds and practitioners together," says Mr. Stanton.

Going forward, UAH will compete with the program's other academic partners in an annual competitive funding process. Once funding is awarded, staff members of LMI Research Institute will collaborate with university teams to ensure that the work is applicable to their clients' needs. "LMI's approximately $250 million in annual revenue affords many opportunities for UAH engagement, and their business areas align closely with UAH's strengths," says Dr. Vaughn. "We look forward to working with LMI." ■

ACADEMIC PARTNERSHIP

THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

LMI

LMI and the University of Alabama Huntsville (UAH) announce their agreement to become academic partners to engage in research, mentorship, and professional experiences. The UAH–LMI partnership will feature specific joint projects and aims to

- *build and enhance strategic partnerships with LMI and the UAH faculty,*
- *leverage academic expertise to accelerate research and development and support a strong technology base,*
- *obtain access to cutting-edge research in areas aligned to LMI's program groups and client needs and UAH's research projects,*
- *grow LMI and UAH talent in new and existing research areas, and*
- *introduce leading university faculty and students to LMI and its mission.*

LMI is a not-for-profit research and consulting firm founded in 1961 by Secretary of Defense Robert S. McNamara, who foresaw that a special organization of talented business management specialists would serve as an invaluable resource for the federal government. LMI's academic partnership program combines the cutting-edge ideas and research endeavors of leading universities with LMI's own groundbreaking programs for research funding, mentoring, and real-world work experience.

UAH is one of the nation's premier research universities, offering a challenging hands-on curriculum that ensures graduates are prepared to become tomorrow's leaders. UAH is engaged in the pursuit of new knowledge and the creative application of that knowledge to solve critical challenges in the national interest. UAH provides a robust and collaborative research environment, demonstrated by this new partnership.

Signed March 24, 2017.

▲ The agreement was formalized earlier in the year and ensures a long and productive partnership between the two organizations.

◀ **Dr. Ray Vaughn**, UAH's vice president for research and economic development, is presented with UAH's formal invitation to LMI Research Institute's Academic Partnerships program by (l-r) **Ms. Donna Norfleet**, manager of LMI Research Institute; **Mr. Rich Eastham**, LMI's regional director of Huntsville; and **Mr. Ed Stanton**, LMI's senior vice president of strategic growth. (Credit: LMI)

Dr. Gary Maddux, director of UAH's SMAP Center, and **Norven Goddard**, a SMAP Center research scientist, have spent the last few years creating a culture that encourages center staff to give back to the state through educational outreach.

The SMAP Center's "Formalized Informal" Mission:
Building interest in STEM careers among Alabama's youths

By any measure, UAH alumnus Dr. Gary Maddux has enjoyed a successful professional career, culminating in his present position as director of the university's Systems Management and Production (SMAP) Center. But he hasn't forgotten his roots as a boy growing up in Jackson County, which like many rural areas of Alabama offers youths limited access to and participation in the science, technology, engineering, and math (STEM) fields. So a few years ago, he partnered with SMAP research scientists Norven Goddard and Dr. William Sabados to create an outreach program dedicated to building interest in STEM careers among the state's youths.

"Our Center's mission is to conduct research and support the U.S. Army, but we have some discretionary funds, so we have chosen to invest those in giving back to the region and the state through outreach," says Dr. Maddux, who still lives in his hometown of Scottsboro. "I call it a 'formalized informal' system, a sort of loose affiliation with a lot of schools from the elementary to the college level, that grows by word of mouth. And we have done it for so long now that our schedule already goes well into 2018 – and we're still adding to it!"

The program's earliest iteration tended toward more individual efforts, with undergraduate students employed at the SMAP Center returning to their old high schools to meet with their near-peers and show them what they were working on. Over time, however, it has evolved into what is now known as the STEM Road Show, where the Center's research staff travels to schools in rural counties throughout the state to display emerging technologies and promote STEM education. "We started out in the high schools and junior colleges, but now we're pushing down into the kindergarten arena," says Dr. Maddux, who credits his wife Kita, a retired English teacher, with encouraging him to "build a good foundation" among the state's youngest residents.

The result is an 18-year pipeline that begins with Club Wildcat, an after-school program for K-6 students in the Scottsboro City school district. "The kids' teacher came to us and said 'I want something that will keep these kids engaged without knowing they're learning,' and so we developed this pilot program," says Mr. Goddard. "It offers a fun atmosphere to expose these kids to simple STEM lessons, such as squishy circuits, static electricity, and LED technology."

ON-CAMPUS OUTREACH:
Tech Trek Alabama

Thanks to a $150,000 grant from the Toyota USA Foundation, more Alabama girls now have an opportunity to explore education in the science, technology, engineering, and math (STEM) fields. The donation, announced earlier this summer, will help grow Tech Trek Alabama, an annual residential camp for rising eighth-grade girls that provides intensive hands-on experiments and STEM-based activities. The camp, which is offered in partnership by UAH and the Huntsville branch of the American Association of University Women, costs only $50 per person for the entire week and serves more than 65 girls from 39 schools across the state.

"We are committed to investing in students and helping to provide them with the best opportunity to succeed," says Toyota Alabama president David Fernandes. "We want to support programs that provide students with exciting opportunities in STEM to help cultivate the next generation of engineers, researchers, and science leaders." Adds UAH president Dr. Robert Altenkirch, "With its generous donation, the Toyota USA Foundation is helping to expand the horizons of even more deserving young STEM enthusiasts as they congregate on the UAH campus each summer."

For more information, contact Dr. Rhonda Gaede at gaeder@uah.edu or 256.824.6573.

Tech Trek
A program of AAUW

SMAP OUTREACH

At the middle and high school levels, students are introduced to the STEM fields through not just the STEM Road Show, but several other programs as well, including:

- REALIZING ALTERNATIVES AND MULTIPLE PATHS BY UNLOCKING YOUR POTENTIAL (RAMP UP) – RAMP UP provides project-based learning experiences that ensure portability, flexibility, and compatibility with state course of study standards.
- HIGH-ALTITUDE BALLOON SATELLITE (HABSAT) – Participants in the HABSat program study the science behind these specialized balloons, with students in each grade level assigned a specific focus that is ultimately integrated into the whole experience.
- GENCYBER CYBERSECURITY SUMMER CAMPS – Jointly funded by the National Security Administration and the National Science Foundation (NSF), these camps are open to students (including those who are deaf and hard of hearing) and public school teachers.
- INNOVATIVE SYSTEM PROJECT FOR THE INCREASED RECRUITMENT OF EMERGING STEM STUDENTS (INSPIRESS) – Administered by Drs. P.J. Benfield and Matt Turner, principal research engineers at the SMAP Center, InSPIRESS challenges high school students to develop and design a scientific payload for a spacecraft designed by undergraduate students in UAH's Integrated Product Team class, which the pair also teaches.

RECENT SMAP CENTER OUTREACH EFFORTS have included attending the Blount County Career Expo, participating in the Pickens County Career Fair, and visiting the Cullman Area Technology Academy in Cullman County, Hamilton Middle School in Marion County, and Cold Springs High School in Cullman County.

At the college and graduate level, the Center offers STEM employment opportunities through its Students Working at the Army in Parallel (SWAP) program. "The SWAP program is an ongoing effort to hire the best and brightest students from across the region, regardless of where they're studying, and mentor them as they pursue a career in the STEM fields," says Dr. Maddux, adding that those same students are often enlisted to participate in the Center's outreach trips. "We give that younger group experience and training so that, when they get to Redstone Arsenal, they're ready to go." Since its inception, over 600 students have gone through the SWAP program, with the vast majority finding employment with the Army or another government contractor after graduation.

Concurrent with all of this, the Center's research staff is conducting a three-year, NSF-funded "State of STEM" project that will help determine methods to improve STEM education in economically distressed regions of Alabama, with an emphasis on school systems in the state's Black Belt. "We are a state of 'haves' and 'have nots,' so we want to go to those rural counties and work with school systems that do not have the resources we have in here Madison and Huntsville," says Dr. Maddux. "And there are a bunch of hungry kids in this state who need jobs. If you want to go to Pickens County or North Jackson High School, you'll find we don't have any shortage of talent."

Should these rural residents eventually end up as students at UAH – and employees at the SMAP Center – that would be a welcome outcome. But that's not the metric that Dr. Maddux himself is using to gauge the program's success. "We just want more people fired up about STEM education and interested in pursuing careers in the field," he says. "We can't know how many kids will be inspired to do that as a result of our efforts, but you don't worry about that. You just have to be patient and wait, and 20 years from now, some young person will come up to us and say, 'I remember when you came to our middle school and talked about drones, and now I just graduated with my degree in engineering.' You don't plant apple seeds and get apples the next day."

EARTH SYSTEM SCIENCE CENTER

Encouraging an interdisciplinary study of the Earth as an integrated system across traditional boundaries

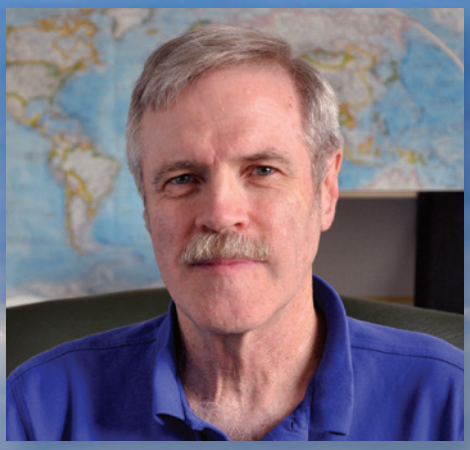
This past year has been a full one for UAH's Earth System Science Center (ESSC), with scientists traveling to Panama for a project looking at lightning's effects on tropical trees and to Argentina to do onsite planning for UAH's part in a major international weather research campaign. ESSC scientists and students also studied the effect of August's solar eclipse on the atmosphere, while a lightning sensor that the Center's staff had a major role in designing, constructing, and testing was launched into orbit. Perhaps most notable, UAH's Atmospheric Science Department – the ESSC's affiliated academic unit – was recognized as a Center of Academic Excellence by the National Geospatial-Intelligence Agency and the U.S. Geological Survey.

But for a center created to encourage the interdisciplinary study of the Earth as an integrated system not limited by traditional boundaries, a packed calendar is par for the course. "I've had a front row seat in a lab of terrific people who are motivated to find out new things about the Earth," says Dr. John Christy, a distinguished professor of atmospheric science and the Center's director since 1999. "In general, we're just very curious about how the physical world works and how that affects the way we live."

Funded by an annual budget of more than $13 million, the ESSC has a diverse staff of over 85 people, including atmospheric scientists, biologists, geologists, engineers, mathematicians, and computer scientists, as well as a political scientist and an archaeologist. Then there are the many students, both undergraduate and graduate, who help fulfill the Center's mission. Approximately 50 graduate students in UAH's Department of Atmospheric Science are supported by the ESSC's research funding every year, and each semester, UAH students join peers from around the world to work on projects in NASA's SERVIR (Spanish for "to serve") laboratory and through NASA's DEVELOP program.

Just as varied as its staff are the ESSC's areas of research, which comprise climate change, severe weather, air pollution and atmospheric chemistry, detecting and studying lightning, using geospatial information systems and remote sensing to monitor and study the environment, and developing databases of information collected by remote sensors – especially space-based sensors.

One of the longest running projects in the ESSC is the weekly Saturday launch of a helium weather balloon carrying a sen-



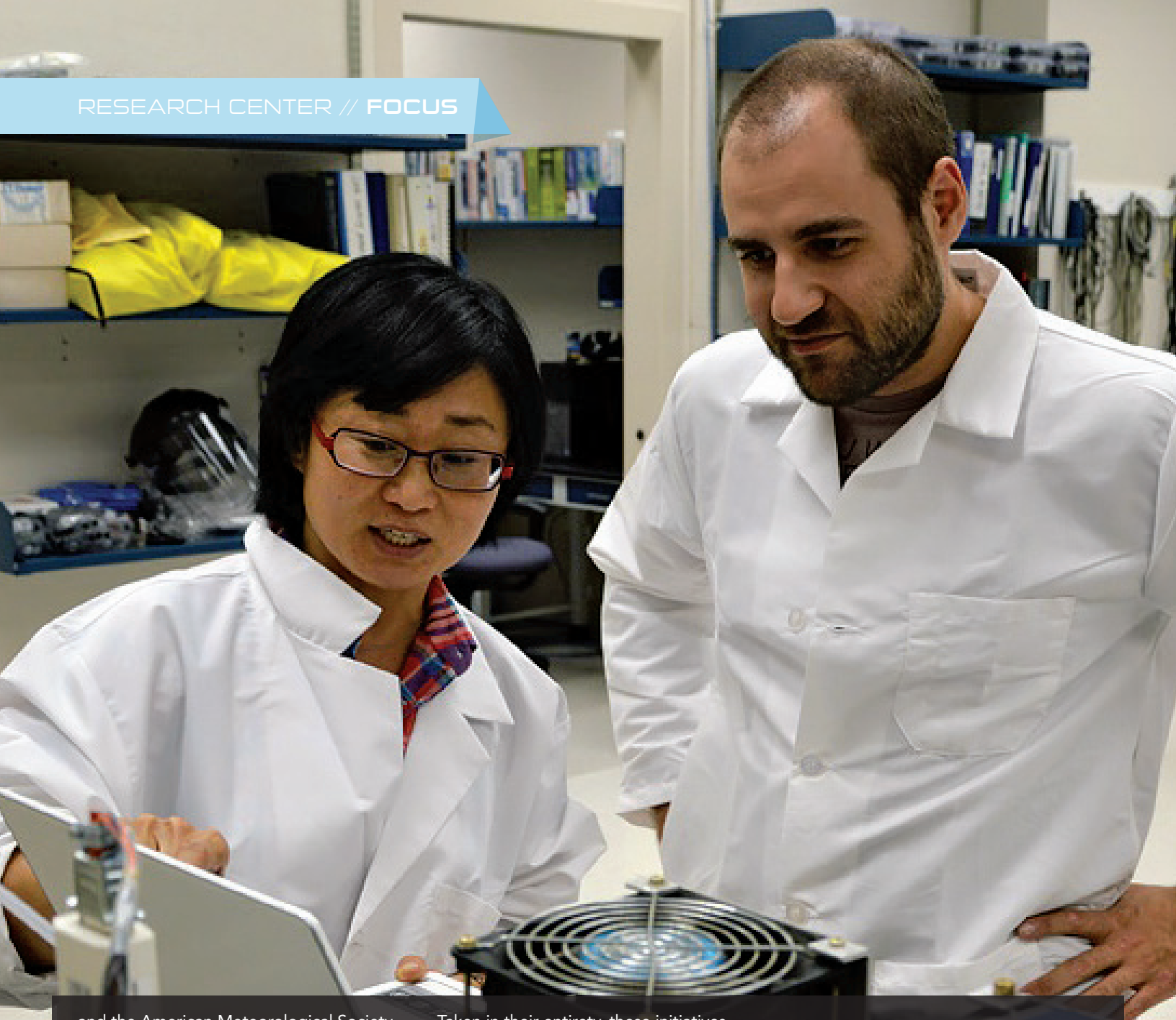
▲ **Dr. John Christy** is a distinguished professor of atmospheric science and the director of UAH's Earth System Science Center.

sor that detects ozone. Since April 1999, the Regional Atmospheric Profiling Center for Discovery has done "over 1,000 balloon flights," says founder Dr. Mike Newchurch, a professor of atmospheric science. The balloons were a first step toward developing laser-based sensors, or lidars, to measure ozone pollution in the troposphere and ultimately led to the creation of the Tropospheric Ozone Lidar Network, which Dr. Newchurch leads. Those lidar instruments are now being transitioned onto a mobile platform for a multi-agency research campaign entitled Fire Impacts on Regional Emissions and Chemistry. "We're going to calculate ozone production from forest fires and agricultural fires," he says.

In the meantime, the ESSC's severe weather research has gathered momentum with the addition of the Severe Weather Research Radar and Lightning Laboratories (SWIRLL) in 2014. Its high-tech resources have enabled Dr. Kevin Knupp, professor of atmospheric science and leader of UAH's severe weather research effort, and his team to conduct studies of convection storms in the Midwest, air pollution caused by Alabama forest fires, and lake effect snow in upstate New York. They have also allowed Dr. John Mecikalski, an associate professor of atmospheric science, to track convective cloud growth via satellite to forecast pop-up storms before they show up on radar.

Just as active is the ESSC's Global Hydrology and Climate Center's lightning team. Led by Dr. Hugh Christian, the team played a major role in the conception, design, assembly, and testing of both the Geostationary Lightning Mapper (GLM), which was carried into geostationary orbit aboard NOAA's GOES-17 weather satellite in November 2016, and the Lightning Imaging Sensor 2 (LIS2), which was installed aboard the International Space Station in early 2017. A third instrument, a lightning sensor carried aloft by NASA's ER-2 high-altitude research aircraft, was built at UAH and used to test whether GLM and LIS2 were seeing all of the lightning they should see.

A smaller team, led by Dr. Christy, is using microwave sensors on NOAA and NASA satellites to track temperature changes in the Earth's atmosphere. In the late 1980s, he and Dr. Roy Spencer – then a NASA scientist and now an ESSC principal research scientist – developed techniques that let them use the microwave sensors as a nearly global atmospheric thermometer, an accomplishment for which they were honored by both NASA



▸ **Dr. Shanhu Lee** and UAH graduate student **Lee Tiszenkel** test equipment that will be used to study isoprene reactions in the atmosphere.

and the American Meteorological Society. Now, they maintain and use a dataset of atmospheric temperature anomalies from late 1978 to the present to test the accuracy of numerical models attempting to predict climate change.

This ties into Dr. Christy's work as Alabama's state climatologist, a position he's held since 2000. Within this capacity, he is developing tools to share real-time crop-stress information with farmers in Alabama and beyond. He is also partnering with other state scientists on the Alabama Irrigation Initiative, which seeks to grow rural income by increasing the amount of farmland in Alabama through legislation and tax incentives for using irrigation.

Taken in their entirety, these initiatives – along with many others – have led to a significant growth spurt for the Center, which has more than doubled both its staff and its funding since 2000. And that trend looks set to continue in 2018. Next year, the Center's scientists plan to take a laser-based sensor to the Great Plains to study how forest and farm fires influence the ozone. The aforementioned Argentina campaign will also kick off, with researchers studying the weather that sweeps over the Andes Mountains into the country's central plains between Mendoza and Córdoba. And instruments funded by a grant from the National Science Foundation will be installed on and near an island in the Panama Canal to take the study of lightning and trees to a new level.

"What's particularly enjoyable is that almost all of our research can be explained to ordinary people because they all are affected by the things we study, such as severe weather, hot and cold days, and air pollution," Dr. Christy says. "We have a strong connection to the people we serve with our particular kind of science." ■

INFORMATION TECHNOLOGY AND SYSTEMS CENTER

HARNESSING DATA IN A DYNAMIC ENVIRONMENT

The field of information technology has changed enormously in the two decades since the establishment of UAH's Information Technology and Systems Center (ITSC). One thing that remains the same, however, is the Center's mission to apply its well-established expertise to solving real-world problems through the transfer of innovative technologies and knowledge.

"We have been involved in data initiatives with high impacts for many years," says Dr. Sara Graves, who serves as the director of ITSC and a professor for UAH's Department of Computer Science. "The rapidly changing nature of the field has provided opportunities for applying the unique capabilities of ITSC."

Among ITSC's many research thrusts, which include distributed information systems, software systems interoperability, and modeling and simulation, several others have moved to the forefront in recent years: artificial intelligence (AI) and deep learning, geospatial technologies, wargaming, data analytics, and cybersecurity. This is in large part a response to the growing demand for assistance in analyzing and using the large volume of data in these areas from across academia, government, and industry.

"Deep learning," says Dr. Graves, "is an exciting and fast-growing technology that represents a leading edge in machine-learning research." Also known as deep structured learning or hierarchical learning, deep learning is the application of an artificial neural network to "learn" features from a large system of data neurons arranged in several hidden layers. And while the concepts behind deep learning approaches are not new, recent advances in computer hardware such as graphical processor units and large data storage handling capabilities have allowed deep learning to become very important in data analytics.

"Until recently, conventional machine-learning approaches – including neural networks – have required careful engineering, skill, and effort to extract and select informative features from the data," says Dr. Graves. "But recent advances in machine learning have led to the development of deep neural networks that employ a cascade of many layers for automated learning." These networks are able to use millions and millions of input data sets with little or no pre-processing for accu-

▲ **Dr. Sara Graves**, director of ITSC, and **Dr. John Beck**, a principal research scientist at the center.

rate classification and can handle a wide variety of tasks, including natural language processing, acoustic modeling, bioinformatics, and image classification. "In fact," she adds, "recent research has shown that deep-learning approaches often outperform conventional approaches."

Like deep learning, geospatial technologies have evolved considerably from the first maps that human beings created centuries ago. Now the term is used to describe a suite of advanced equipment and software tools that provide users with the ability to map, measure, visualize, and analyze the Earth, as well as human interactions with the Earth. "There are now a variety of types of geospatial technologies," says Dr. Graves. "These include remote sensing, geographic information systems, global positioning systems, and internet mapping technologies."

Each has its own unique and specific purpose. Remote sensing describes data and imagery collected from either airborne or space-based camera and sensor platforms, while global positioning systems rely on a network of satellites to give precise coordinate locations. Geographic information systems, by contrast, provide software tools for mapping and analyzing data that has been georeferenced. And internet mapping technologies allow researchers to view and share geospatial data via the internet.

Under Dr. Graves' leadership, the ITSC team has been actively engaged in conducting state-of-the-art geospatial technology research focused on the following areas: geospatial data storage, management, and distribution; cybersecurity for geospatial data; geospatial data cloud processing; imagery applications from unmanned aerial systems; geospatial-enabled databases; geospatial data integration with modeling and simulation software; and web mapping services and visualization tools. "With increasing interest in the spatial aspects of problem solving, ITSC is exploring more applications in this dynamic area," she says.

As for the research thrust in cybersecurity, Dr. Graves can sum up the current state of the field in four words: "Situations are constantly changing," she says wryly. Whereas a relatively short time ago, it was possible for someone to look at a computer monitor and spot a hacker on the network, now there is simply too much data moving over modern computer networks for them to examine. As a result, an intrusion can be virtually impossible to spot. "Making matters worse," she continues, "modern hackers use tools that leave very few clues. What were previously telltale signs of an attack are now sprinkled in and lost among the terabytes of regular data that travel across computer networks every hour."

▲ ITSC is staffed by 45 full-time employees – many of whom are UAH alumni – and 15 students at the undergraduate and graduate levels.

To address this, the ITSC team relies on advanced AI and data analytics. "The Center's researchers are experimenting with new forms of AI that are capable of locating hackers and isolating them from the rest of a network," says Dr. Graves, adding that ITSC receives a lot of requests from local employers to help prepare tomorrow's workforce to tackle cyberbreaches. "ITSC is also focusing on security issues in software and data as the need for expertise in these topics increases."

Undoubtedly, as the field of information technology and systems continues to grow and change, tomorrow will bring even greater challenges. But just as undoubtedly, ITSC will grow and change to keep up, as it has for the last 20 years. "Harnessing the data revolution presents continuing challenges and opportunities that make our jobs even more exciting as we look toward the future," says Dr. Graves. ■

A REMEMBRANCE

DR. CHARLES "CHUCK" LUNDQUIST, DR. S.T. WU,
DR. RICHARD "DICK" RHOADES, AND DR. JOSEPH "JOE" GEARY

Dr. Charles "Chuck" Lundquist

1928 – 2017

Dr. Lundquist graduated from South Dakota State University and completed his doctorate in physics at the University of Kansas in 1953. He then served as an assistant professor of engineering research at Pennsylvania State University before being drafted into the U.S. Army in 1954. He was sent to work at the Army missile development activity at Redstone Arsenal, beginning his professional association with Dr. Wernher von Braun's team. He returned to civilian status in 1956, but continued to work at Redstone for the Army until 1960. Dr. Lundquist left Huntsville from 1962 to 1973 to be the assistant director for science at the Smithsonian Astrophysical Observatory in Cambridge, MA, but continued as a member of the NASA Group for Lunar Exploration Planning that informed the Apollo missions. In 1973, he returned to Huntsville to serve as the director of the Space Sciences Laboratory at NASA's Marshall Space Flight Center. In 1981, he joined UAH as researcher before his retirement. In 2015, Dr. Lundquist authored "Transplanted Rocket Pioneers," which chronicles 218 scientists transplanted from Europe who became vital to U.S. rocketry and space programs.

"Chuck's contributions to the scientific and space programs are well known in this community, but I will remember him as a gentleman scholar, always ready to help in any way he could and very passionate about passing on to future generations the history of the early days of Dr. von Braun."

– Dr. Steve Messervy, Director of UAH's Research Institute

Dr. S. T. Wu

1933 – 2017

Dr. Wu received his doctorate in aerospace engineering from the University of Colorado in 1967, after earning his bachelor's and master's degree in mechanical engineering from the National Taiwan University and the Illinois Institute of Technology, respectively. He joined UAH in 1967, becoming the founder and first director of both the Center for Space Plasma and Aeronomic Research and the Institute for Space Physics, Astrophysics, and Education. He later served as distinguished professor emeritus for the Department of Mechanical & Aerospace Engineering. During his tenure at UAH, Dr. Wu was affiliated with numerous national and international committees, including becoming a member of the Scientific Committee on Solar Terrestrial Physics from 1986 to 1996 and of the President's Advisory Committee on University Relations from 2004 to 2011, and serving as the chairman of the Technical Committee on Plasmadynamics and Lasers from 1991 to 1994 and as the vice president of the Scientific Committee for Solar-Terrestrial Physics from 2004 to 2008.

"S.T. Wu was a scholar of international standing, recognized across the world for his seminal contributions to both solar physics and interplanetary physics. S.T., as almost everyone called him, was also known throughout the world for his kindness and generosity of spirit. I was deeply saddened by S.T.'s passing."

– Dr. Gary Zank, Director of the Center for Space Plasma and Aeronomic Research

Dr. Richard "Dick" Rhoades

1938 – 2016

Dr. Rhoades graduated with his bachelor's degree in chemical engineering from Rensselaer Polytechnic Institute in 1960, returning for his doctoral degree in 1964, and later earning a master's in management from the Massachusetts Institute of Technology in 1977. From 1963 to 1965, he served as an ordnance officer in the U.S. Army and then became a civilian propulsion research engineer and technology program manager before being selected for his first Senior Executive Service position as director of propulsion in 1973. He subsequently served as the associate director of the Missile Research Development and Engineering Center, first overseeing technology from 1981 to 1989 and then managing the center's weapon system development, acquisition, and sustainment from 1989 to 1997. In October 1997, Dr. Rhoades became director of UAH's Research Institute, which has a staff of over 40 and an annual revenue of approximately $6 million, and was appointed professor of engineering management. In April 2013, he stepped down to become the Research Institute's principal research engineer; he also taught courses in UAH's MBA program as a research professor of management.

"Dick was a person who worked and led by example. He had a huge impact on the engineering and business communities here and was active in many organizations until his death. He was a mentor to not only students here at UAH but to many peers in the Huntsville and North Alabama communities. I will always call him a mentor and friend of mine."

– Dr. Steve Messervy, Director of UAH's Research Institute

Dr. Joseph "Joe" Geary

1945 – 2017

Dr. Geary received his bachelor's degree in physics from LaSalle College in 1966, and his master's and doctoral degrees in optics from the University of Arizona in 1975 and 1984, respectively. He spent 18 years in government service, including 8 years in aerial reconnaissance at the Naval Air Development Center, 2 years in medical imaging at the Bureau of Radiological Health, and 8 years at the Air Force Weapons Laboratory's Airborne Laser Lab. In 1985, Dr. Geary left the government to join the staff of United Technologies Optical Systems, where he worked on advanced optical metrology and high-energy laser beam diagnostics for the mid-infrared advanced chemical laser. In 1991, he joined Swales Aerospace to become manager of their optics group, and five years later, he joined UAH's Center for Applied Optics, becoming interim director in the fall of 2003. His principal activities were in the areas of optical testing, optical metrology, wavefront sensors, and lens and optical system design; he also taught graduate courses in optical testing and lens design. Dr. Geary authored three books, published over 43 papers in peer-reviewed journals, and held 10 patents. He was a member of the International Society for Optics and Photonics.

"Dr. Joe Geary was both a world-class optical engineer and a kid at heart. His quirky humor and his passion for optics were infectious to students and colleagues. He inspired a new generation in developing optical technologies to turn his beloved science fiction into physical realities. Joe will be remembered for his discoveries and truly missed as a friend and colleague."

– Dr. Robert "Bob" Lindquist, Associate Vice President for Contracts and Grants

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At UAH, education and research collide. Our high-tech research centers, academic colleges, and research investments are responsible for over **$96 MILLION** in R&D funding, while graduates of our academic programs consistently reenforce the region's professional workforce. That's why supporting research at UAH really means supporting the institution as a whole. By joining the President's Corporate and Foundation Partners, you can ensure UAH continues to push the boundaries of knowledge – not just in the classroom, but also well beyond.

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