FOCUS

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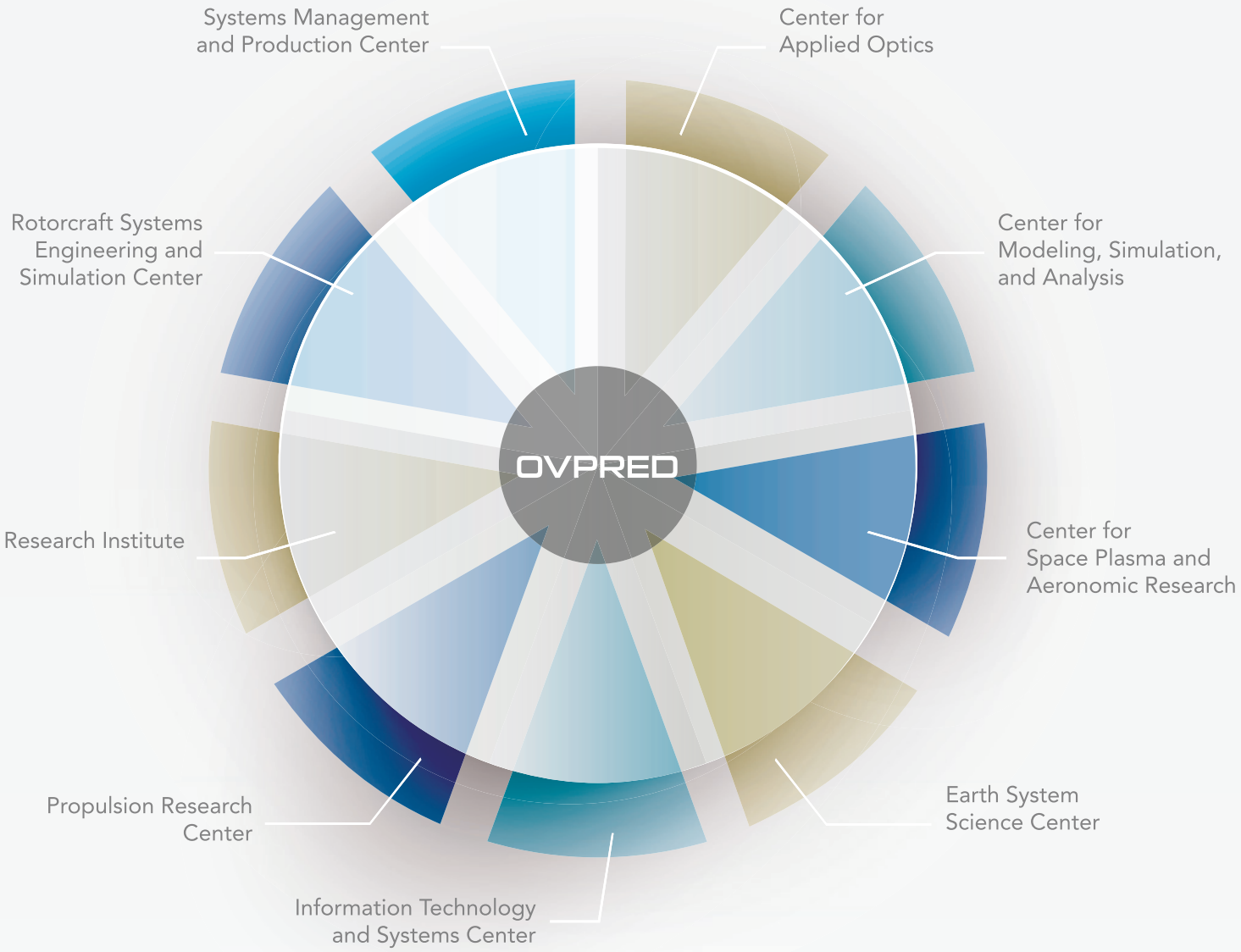

THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

cover story

RESEARCH CENTERS

UAH's innovation interface

KEY CONTACTS

VICE PRESIDENT FOR RESEARCH AND ECONOMIC DEVELOPMENT
Dr. Ray Vaughn
(256) 824-6100
Ray.Vaughn@uah.edu

ASSOCIATE VICE PRESIDENT FOR RESEARCH AND ECONOMIC DEVELOPMENT
Dr. Thomas Koshut
(256) 824-6100
Tom.Koshut@uah.edu

ASSOCIATE VICE PRESIDENT FOR RESEARCH AND ECONOMIC DEVELOPMENT
Dr. Robert Lindquist
(256) 824-6100
Robert.Lindquist@uah.edu

OFFICE OF RESEARCH SECURITY
Denise Spiller
Security Administrator
(256) 824-6444
Denise.Spiller@uah.edu

OFFICE OF SPONSORED PROGRAMS
Gloria Greene
Director
(256) 824.2657
Gloria.Greene@uah.edu

OFFICE OF TECHNOLOGY COMMERCIALIZATION
Kannan Grant
Director
(256) 824-6621
Kannan.Grant@uah.edu

OFFICE FOR PROPOSAL DEVELOPMENT
Dr. Virginia (Suzy) Young
Director
(256) 829-3448
Suzy.Young@uah.edu

CENTER FOR APPLIED OPTICS
Dr. Robert Lindquist
Director
(256) 824-6100
Robert.Lindquist@uah.edu

CENTER FOR MODELING, SIMULATION, AND ANALYSIS
Dr. Mikel Petty
Director
(256) 824-4368
Mikel.Petty@uah.edu

CENTER FOR SPACE PLASMA AND AERONOMIC RESEARCH
Dr. Gary Zank
Director
(256) 961-7401
Gary.Zank@uah.edu

EARTH SYSTEM SCIENCE CENTER
Dr. John Christy
Director
(256) 961-7763
John.Christy@nsstc.uah.edu

INFORMATION TECHNOLOGY AND SYSTEMS CENTER
Dr. Sara Graves
Director
(256) 824-6064
Sara.Graves@uah.edu

PROPULSION RESEARCH CENTER
Dr. Robert Frederick
Director
(256) 824-7200
Robert.Frederick@uah.edu

RESEARCH INSTITUTE
Dr. Steven Messervy
Director
(256) 824-6881
Steven.Messervy@uah.edu

ROTORCRAFT SYSTEMS ENGINEERING AND SIMULATION CENTER
Dave Arterburn
Director
(256) 824-6846
arterbd@uah.edu

SYSTEMS MANAGEMENT AND PRODUCTION CENTER
Dr. Gary Maddux
Director
(256) 824-0635
Gary.Maddux@us.army.mil

Dr. Ray Vaughn

At UAH, research centers provide delivery capability

Welcome to this edition of FOCUS, UAH's research magazine. In this issue we chose to highlight our major research centers. These centers report to my office and are highly capable organizations designed, structured and staffed to deliver scientific and engineering products to sponsoring organizations. Each center possesses focused strengths and capability that we have attempted to highlight for the reader. Our centers are staffed with faculty, research staff, students and administrative staff to facilitate the center's success and compliment the research done in the colleges. If you have interest in any additional detail related to a specific center, please let us know and we will be happy to provide it. The contact information for each center is included in this magazine.

Additional detail is given on two specific organizations – our Reliability and Failure Analysis Laboratory (RFAL) within the Research Institute, and our Information Technology Systems Center (ITSC). The RFAL is heavily used by its customers due to its wide range of equipment assets and the expertise of its staff to test and validate performance characteristics of items under a variety of conditions. ITSC has excellent capability in software engineering, data mining, algorithm development, data warehousing, big data and data management.

Our Office of Technology Commercialization strives to facilitate and support entrepreneurship within our faculty and students. We are proud of the success stories that occur at UAH and one such story is included in this issue. Mark and Eric Becnel, twin brothers with a UAH connection, founded the startup company RadioBro. Their success is worthy of note and is featured in this issue in our "Student Focus" section.

We are certainly proud of our faculty achievements too, and in this issue we feature Dr. Lori Lioce, a clinical professor in our College of Nursing. Lori is the executive director of the Learning and Technology Resource Center which was formed within the College to consolidate its use of technology and lifelike patient simulators to train students and to further research in healthcare simulation education. While this center is primarily in support of the nursing program, its facilities offer opportunities for other types of interdisciplinary research for faculty and research staff.

We also include two human interest stories – one concerning Dr. S.T. Wu, who has spent some 36 years developing an observation-based model that predicts the occurrence and timing of coronal mass ejections, which are important to the study of space weather. Also, the story of Dr. James Blackmon's visit with Dr. Wernher von Braun in 1956 which led to a career in aerospace systems, pursing a passion that began as a teenager. Both stories are inspiring.

Please take a few moments to look through this snapshot of UAH research contributions and contact our office for additional information if needed. My office is always available to provide information on the efforts featured in this magazine or any other research project ongoing at UAH. **Go Chargers!**

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COVER: UAH's highly capable research centers report to the Office of the Vice President for Research and Economic Development and deliver scientific and engineering products to sponsoring organizations.

The University of Alabama in Huntsville has the largest research expenditures among public universities of its size.

IN ALABAMA

1ST

IN ALABAMA
in expenditures in the environmental sciences including atmospheric sciences

2ND

IN ALABAMA
in federally funded engineering research expenditures

RESEARCH

$449 million
Five-year contract and grant research total

$5 million
Five-year license and royalty total

$101 million
Fiscal 2014 research total

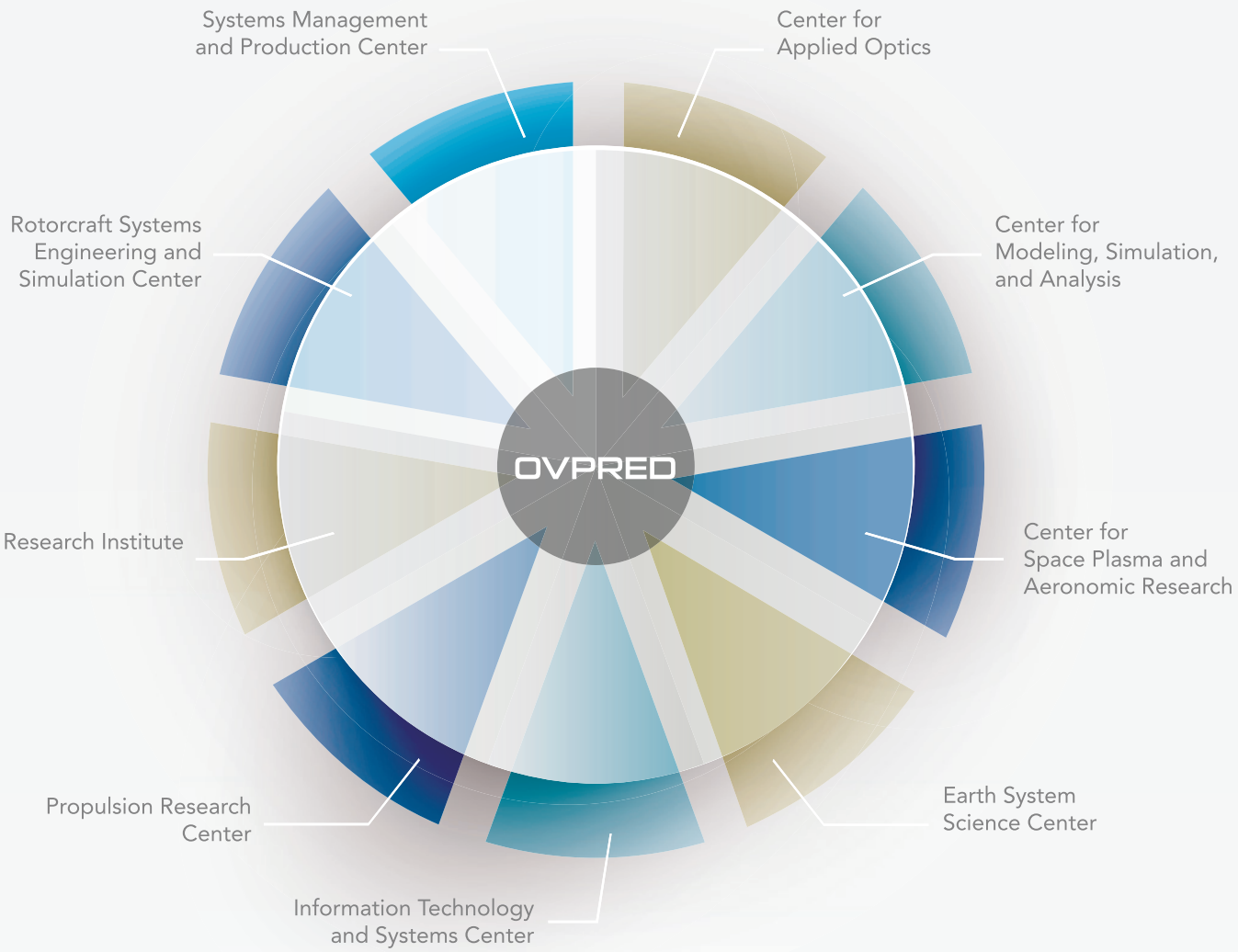
ACTIVE PATENT TOTAL – 51

NATIONALLY

- **4TH** Federally financed aeronautical/ astronautical engineering research
- **10TH** Federally financed business and management research
- **16TH** Department of Defense R&D expenditures
- **15TH** NASA R&D expenditures
- **10TH** Federally financed computer sciences research expenditures
- **15TH** Federally financed atmospheric sciences research

SOURCE: UAH Office of the Vice President for Research and Economic Development

UAH RESEARCH CENTERS



RESEARCH INSTITUTE

Steven Messervy
Director

The Research Institute carries out applied research and engineering programs, principally to meet the needs of Dept. of Defense customers, but with significant related work for NASA and private industry. Some Research Institute efforts are carried out in close cooperation with customers, on site at government laboratories. The Institute staff has expertise in covering the life cycle of aerospace and defense systems. These include systems engineering and project management, technical risk assessment, software engineering, reliability and physics of failure and modeling of business processes, including supply chains. In addition, the Research Institute staff has expertise in the development and management of international projects and in organizational design and the management of technical professionals. The Institute operates an impressive laboratory for studying the interactions of a vehicle with its environment at high velocity and has the capability to measure high velocity impact phenomena. The RI's Reliability and Failure Analysis Laboratory contains a wide variety of test equipment for evaluation of materials and structures.

CENTER FOR SPACE PLASMA AND AERONOMIC RESEARCH

Gary Zank
Director

The Center for Space Plasma and Aeronomic Research (CSPAR) is dedicated to fostering excellence in research and

graduate education in the field of space science, from the furthest reaches of the universe to the boundaries of the heliosphere, to our sun and the Earth's geospace environment. CSPAR explores the role plasmas play in the universe and galaxy, stars, in space and in planetary atmospheres. CSPAR uses advanced theory, modeling and computation, observations and experiments onboard satellites and interplanetary probes to explore topics as diverse as cosmic and terrestrial gamma-ray flashes, the physics of the solar wind, the local interstellar medium, solar physics and energetic particles. CSPAR has instrument development programs for both space-based and in-situ observations.

CENTER FOR MODELING, SIMULATION & ANALYSIS

Mikel Petty
Director

Work at the Center for Modeling, Simulation, and Analysis (CMSA), a cutting-edge research center, focuses on modeling and simulation and systems engineering. CMSA has broad capabilities in both of those disciplines, with special areas of expertise. In modeling and simulation, CMSA's expertise includes physics-based modeling, model validation methodologies, spacecraft propulsion modeling, simulation interoperability and composability, discrete event simulation, mathematical modeling and analysis, finite element modeling and computational fluid dynamics, and modeling and simulation graduate education. In systems engineering, CMSA's expertise includes system-level modeling for design analysis and trade studies, using modeling and simulation in the systems engineering process, systems engineering methods, technical team performance, and systems-level spacecraft propulsion system design.

EARTH SYSTEM SCIENCE CENTER

John Christy
Director

UAH's Earth System Science Center (ESSC) was created to encourage interdisciplinary study of the Earth as an integrated system across traditional boundaries. It has a diverse scientific staff, including atmospheric scientists, biologists, geologists, engineers, mathematicians and computer scientists.

The ESSC is involved in several areas of Earth System research focusing on the basic science of the earth-atmosphere system. Scientists are involved in the evaluation of global-scale climate models, regional studies of the coupled atmosphere/ocean/ice systems, regional severe weather detection and prediction, measuring the local and global impact and transport of aerosols and pollutants, measuring lightning from space and the general development of remotely-sensed data bases. A strength of ESSC scientists is the application of remote sensing data, both space and ground-based, to the myriad of scientific questions related to the Earth System.

SYSTEMS MANAGEMENT AND PRODUCTION CENTER

Gary Maddux
Director

The UAH SMAP Center was established in 1988 to provide expertise, leadership and support to the U.S. Army, NASA, other government agencies and private sector organizations. The center has evolved into the largest research center at UAH, and is the largest single employer of students at the university. It serves the Army by providing knowledge to resolve current issues and as a critical link between local university students and the future roles they will eventually fill. Some of the many fields in which the Systems Management and Production Center is making a difference include Students Working at the Army in Parallel (SWAP) Program; engineering management training and support; technical workshop administration; homeland defense/campus security applications; threat evaluation and sensor systems; Foreign Military Sales (FMS) support; engineering analysis; computer networking administration and support; web-based and database application development; advanced modeling, visualization and animation; unmanned systems integration; and military testing and logistics support.

INFORMATION TECHNOLOGY AND SYSTEMS CENTER

Sara Graves
Director

The Information Technology and Systems Center (ITSC) performs multidisciplinary information technology research. ITSC's research portfolio includes large-scale distributed information systems, data mining and knowledge discovery, cyber security and resilience, semantic technologies, data analysis and visualization. ITSC research has involved the creation of large heterogeneous online data stores in support of interoperable distributed data processing solutions. The center also develops data utilization tools and

technologies. The center develops new techniques and systems that ultimately solve real-world problems. ITSC serves as the focal point for UAH research endeavors in information technology and systems and provides leadership in applications of information technology for multiple disciplines and computational environments.

PROPULSION RESEARCH CENTER

Robert Frederick
Director

The Propulsion Research Center (PRC) conducts research, produces publications and mentors students in advanced propulsion technologies and their applications. The PRC connects the academic research community and propulsion community through interdisciplinary collaboration. The PRC's state-of-the-art laboratories provide detailed assessments of liquid, solid, electric and air-breathing propulsion devices, including cryogenic propellants. The PRC provides further assistance through basic research grants, contracts and Small Business Innovation Research/ Small Business Technology Transfer (SBIR/STTR) programs, and it can operate in an International Traffic in Arms Regulations (ITAR) or proprietary environment upon request.

ROTORCRAFT SYSTEMS ENGINEERING AND SIMULATION CENTER

Dave Arterburn
Director

The Rotorcraft Systems Engineering and Simulation Center (RSESC) is a multifaceted research center focused on applied engineering and the Systems Engineering techniques to enhance project success. RSESC provides proven capabilities in systems engineering, rapid prototyping, system analysis, integration and fabrication. RSESC skills include system design and development, analytical analysis in computational fluid dynamics (CFD) and mechanical fields, reverse engineering, data analysis, trade studies, systems engineering, systems integration, non-destructive testing and independent verification, analysis and review.

CENTER FOR APPLIED OPTICS

Robert Lindquist
Director

The Center for Applied Optics (CAO) advances optical science and engineering research and development in support of high technology educational, industrial and government interests and requirements. The CAO provides optical and optomechanical design and analysis, optical fabrication including diamond turning and both standard and CNC polishing, optical metrology, holography and testing and prototyping of state-of-the-art optical components and systems. Center researchers are exploring unique applications of optics for numerous space, military and industrial uses. Experienced research personnel and extensive laboratory resources make the CAO uniquely qualified to perform state-of-the-art research. The Optics Building was carefully designed and built specifically for optics research. There are four floors, a building within a building, with the central core of laboratories vibration isolated from the external office and student space. The building contains many research laboratories, classrooms, meeting rooms and offices.

CENTER FOR CYBERSECURITY RESEARCH AND EDUCATION

The Center for Cybersecurity Research and Education is an interdisciplinary center with faculty and staff participation from multiple colleges at UAH, including Engineering, Science, Liberal Arts and Business Administration. Faculty and staff focus on a wide variety of research problems that include SCADA or industrial control system security; cloud security; social engineering/insider threat; modeling and simulation; identity management; trustworthy systems; policy development; supply chain security; risk management; vulnerability analysis; situational awareness; privacy; Federal Information Security Management Act (FISMA) compliance; intrusion detection; digital forensics; safety systems (particularly rail and unmanned systems); medical device security; and automotive system security. The center is capable of performing research at both the classified and unclassified levels and activity participates in several national programs. UAH is certified as a National Center of Academic Excellence in Information Assurance Education (CAE/IAE) and in Cyber Defense (CAE/CD). The university is also a recipient of the prestigious National Science Foundation Scholarship for Service program (also known as the "Cyber Corps") which allows UAH to award "full ride" scholarships to undergraduate and graduate students to study cybersecurity in exchange for government service upon graduation. The UAH Center for Cybersecurity Research and Education is active in national, state and local cybersecurity activities. ■

TWIN BROTHERS START UAH-NURTURED TECHNOLOGY FIRM

Twin brothers Mark and Eric Becnel started the 1½-year-old RadioBro, a Madison space and aviation technology company, while UAH graduate students. Mark, (MS, aerospace engineering, Dec. '14) is president and Eric (MS, aerospace engineering, '13) is vice president and chief engineer. RadioBro's first product is a mini-satellite communications transceiver called MiniSatCom, now being offered in a variety of kits. Next in development is a cube satellite core that saves developers six months to two years of time normally required to make various products work together to serve that function. For cubesats built to accepted standards, the core will be plug and play. RadioBro wants to become a low-cost supplier of comprehensive solutions to companies that manufacture the tiny spacecraft. Also in the product pipeline at RadioBro is an aircraft data logging system that is being developed while supporting test pilots. Supported by UAH's Office of Technology Commercialization, RadioBro has strong connections with UAH and the university's Space Hardware Club for future engineering talent. "We're in a position now – having released our first product – where we are about to grow," says Mark, "and we will have need for more talent in engineering, development and marketing." ■

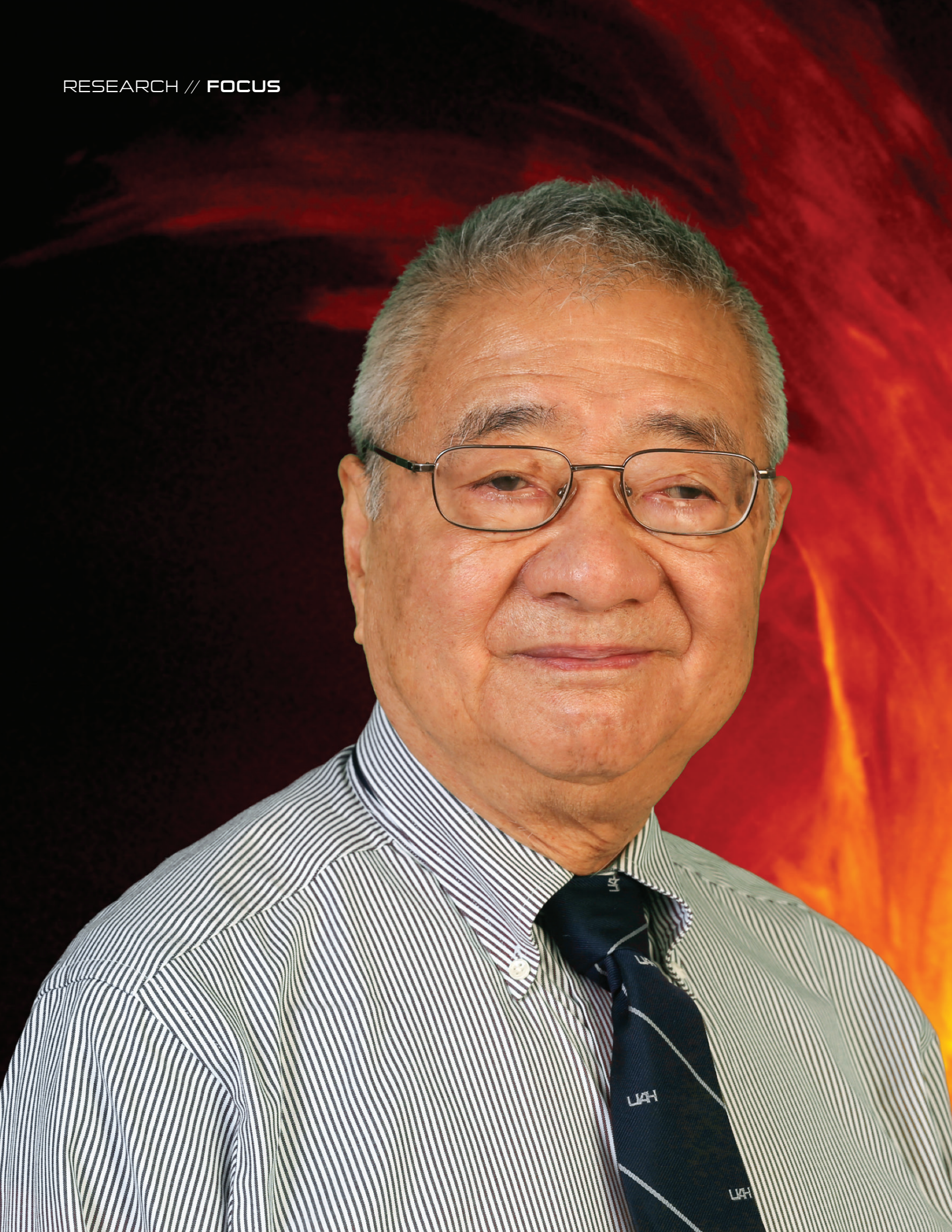
SIMULATORS IMMERSE NURSING STUDENTS IN EDUCATION

Dr. Lori Lioce, executive director of the new 10,000-square-foot UAH College of Nursing Learning and Technology Resource Center (LTRC), says, "The new generation of learners really learns hands-on and with a lot of interaction with technology." Dr. Lioce researches the use of simulators in nursing education. Her research has been published in "Nurse Educator" ("Implementing the Standards of Best Practice for Simulation," March/April 2015; Vol. 4, Issue 2; p. 96-100) and she has written in "The American Nurse" ("New validation for simulation education," July-August 2014), where she is a past editorial board member. "Before the simulators, we had no way to standardize the educational experience so that every student could realize the same core clinical experiences." Formerly the college's simulation coordinator, Dr. Lioce is a clinical associate professor and doctor of nursing practice (DNP), family nursing practitioner (FNP), Certified Healthcare Simulation Educator (CHSE) and Fellow of the American Association of Nurse Practitioners (FAANP). Since 2010, UAH has built a comprehensive program where students interact with robotic patients. UAH has simulators for adult care, obstetrics and pediatrics (infant and neonatal care). Video cameras record interactions and a microphone allows clinical experts in the control room to speak for the patient or the healthcare provider. In debriefing sessions, students self-evaluate their own and others' performance, guided by a trained facilitator. Immersive learning boosts learning engagement, provides evidentiary performance feedback and heightens satisfaction and confidence, according to Dr. Lioce's research. She wants to open a 24-hour complete mock training hospital in LRTC for a week each semester. ■

TECHNOLOGY EXECUTIVE RETURNS TO TOUR ALMA MATER

Stanton J. Rowe (BS, biological sciences, '75), the corporate vice president for advanced technology and chief scientific officer at Edwards Lifesciences LLC in Irvine, Calif., recently returned to his alma mater for a campus tour. Rowe, who has been awarded 15 patents and has 32 pending, joined Edwards in 2004 when Edwards acquired Percutaneous Valve Technologies (PVT), a company Rowe helped to found in 1999 and where he served as president and CEO. At PVT, he headed a team that developed an innovative stented heart valve for patients with aortic stenosis that can be implanted using a catheter instead of major heart surgery. In 2012, Rowe gave a TedX Orange Coast talk about making big decisions without all the facts, discussing the process that led to his decision to select a particular patient for the first procedure using the new valve. "This is what I do for a living, and it doesn't happen just once, it happens a lot," he told Dr. Ray Vaughn, UAH vice president for research and economic development, while visiting. "I exist in that space between the business world, the medical world and the technological world."

Being back on the campus where he played on UAH's first rugby club team also elicited memories for Rowe, whose father was a Huntsville NASA engineer and whose cousin, local attorney Dag Rowe, is a member of the UAH Foundation Board. "It's always fun to be back and to see how far things have come," Rowe says. "Whenever I drive by the lake, I think of taking my one-year-old daughter there 40-some years ago to feed the ducks." And he recalled one interesting summer of study. "I think it was in 1973 when the Psychology Dept. got together a program where over a summer you could do a simulated NASA mission," he said. "And to simulate the workload of the astronauts, you took a full semester course in 10 days, and the course was statistics." Perhaps a harbinger of things to come, Rowe was a quick study, completing the course in five days. ■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PREDICTING SOLAR WEATHER

Scientists now have an observational framework to help predict solar weather and how it will affect Earth, thanks to research led at The University of Alabama in Huntsville's Center for Space Plasma and Aeronomic Research (CSPAR) by a UAH distinguished professor emeritus.

An observation-based model that for the first time predicted the occurrence and timing of solar eruptions – known as coronal mass ejections (CMEs) – was presented by UAH's Dr. S.T. Wu at the Scientific Committee on Solar-Terrestrial Physics' (SCOSTEP) 13th Quadrennial Solar-Terrestrial Physics Symposium in Xi'An, China.

Dr. Wu, a physicist, is a distinguished professor emeritus of mechanical and aerospace engineering who founded CSPAR in 1986 and served as its director until he retired in 2005. He maintains a campus office in UAH's Dept. of Mechanical and Aerospace Engineering.

"Now it's possible that we can have a space weather model that's like Earth's meteorology," Dr. Wu says.

Prediction is important because a powerful direct hit by a CME is like a huge hurricane from space that can deform Earth's magnetic field, which can generate electric currents that can damage the electronics systems of orbiting satellites and disrupt terrestrial power grids. An extreme solar storm could impact cellular phone service, air traffic control, traffic control lights, and the heating and cooling of buildings.

Solar radiation created by large CMEs can directly affect human health too, Dr. Wu says. Predicting these phenomena is important since, for example, airplanes that use polar routes can be delayed or rerouted to avoid the harmful effects that solar activity can have on passengers.

The new predictive model is the culmination of decades of work at CSPAR by Dr. Wu, who wrote his first research paper on CME modeling in 1978. In the late '70s and early '80s, Dr. Wu headed the Solar-Terrestrial Thrust Group at UAH, the progenitor of CSPAR. The creation of CSPAR joined together faculty members from the College of Science and the College of Engineering and it became the umbrella organization for UAH solar to terrestrial research.

"I wanted to do research on everything from the sun down to the Earth's upper atmosphere, the troposphere," says Dr. Wu.

The new observational solar model advances previous CME research by Dr. Wu and a global scientific group that includes his former students and post-doctoral students.

"S.T. Wu's work focuses on achieving a deep understanding of the highly dynamical atmosphere of our Sun," says Dr. Gary Zank, the current director of CSPAR. "Such an understanding has a profound impact on modern technology. CSPAR is becoming recognized as one of the leading centers for the study of solar and heliophysics, especially in understanding the impact of space weather on our increasingly technological society."

In previous work, Dr. Wu's team devised a model for the development of CMEs that was tested and proven against CMEs observed in the past. The scientists also modeled conditions related to solar magnetic shear that can cause a CME. The shear is related to a sigmoidal twisting of the sun's magnetic field, flux emergence, null formation, torus instability, reconnection and free energy.

The researchers successfully simulated the intiation of a realistic CME using a data-driven magnetohydrodynamic (MHD) process, a step that helped lead to the predictive model and to better understanding the precursors to these solar storms.

"Last time, we only modeled a coronal mass ejection," Dr. Wu says. "Now, we have put that eruption result into our propagation model. We have integrated what we did before into a global propagation model."

The predictive model can foresee the development and impact of a CME from its genesis on the Sun through its journey in the interplanetary medium and to its interaction with Earth.

The presentation was well received by the scientists at the conference because "I didn't use any theoretical inputs," says Dr. Wu.

"Others are doing this work, but they are still using theoretical models. Our work is observational, and that is the difference," he says. "It is more realistic because we start out from the Sun and what you can see there, and then we work our way out."

The model provides important information to other scientists working on solar storm prediction.

"I've got the framework that says it can be done, so now everybody can do it," says Dr. Wu. Further development of an accurate solar weather prediction system, he says, will take supercomputers and the efforts of many researchers and universities. ■

INFORMATION TECHNOLOGY AND SYSTEMS CENTER IN FOREFRONT OF NEXT-GENERATION RESEARCH

WHAT IS THE NEXT GENERATION OF SCIENTIFIC RESEARCH?

Dr. Sara Graves will tell you the foundation for the future is being created in information technology and computational systems at UAH's Information Technology and Systems Center (ITSC), which she directs.

"We seek to revolutionize knowledge discovery and integration of data at multiple scales and in multiple disciplines by performing basic and applied research in technologies to access, manage, analyze and visualize data, information and knowledge more easily and effectively, enabling the next generation of applications in science and engineering," says Dr. Graves. "Ultimately, we solve real-world problems with the transfer of innovative technologies and knowledge."

Also a University of Alabama System professor and a UAH computer science professor, Dr. Graves has been the principal investigator on more than $60 million in research projects with the U.S. Dept. of Defense, Dept. of Energy, NASA, the National Oceanic and Atmospheric Administration (NOAA), the National Science Foundation (NSF) and others.

ITSC researchers, she says, possess unique and specialized skills in information technology and in the integration of information technologies with a variety of science and engineering domains.

"Large-scale distributed information systems, data mining and knowledge discovery, cyber security and resilience, semantic technologies, data analysis and visualization are ITSC focus areas," Dr. Graves says.

More than 40 faculty, research staff, and graduate and undergraduate students do research at ITSC in computer science, atmospheric science, engineering and related fields.

ITSC laboratories provide the computational, network and data resources necessary for successful research and development of complex computational and advanced networking applications and are instrumental in ITSC's information technology research objectives.

With facilities at Olin B. King Technology Hall and at the National Space Science and Technology Center (NSSTC) in Cramer Hall on the UAH campus, Dr. Graves says that ITSC has a rich environment with geographically distributed resources, providing an optimal development and testing ground for applications with demanding computational, storage and network requirements.

For example, at the Data Mining Laboratory, ITSC researchers have been at the forefront of applying data mining and other information technologies to scientific research domains. Dr. Graves says the Algorithm Development and Mining (ADaM) system, used worldwide as an underlying component in a number of scientific analysis systems, was developed by ITSC in response to the need to mine large scientific data sets for phenomena detection and feature extraction.

"ITSC researchers are developing new methods to allow scientists and engineers to interactively visualize and analyze multidimensional data, detect patterns within data, and to interpret and verify results of complex data mining operations in order to gain new understanding and knowledge," Dr. Graves says.

Within the Global Hydrology Resource Center (GHRC), a NASA Earth Science Distributed Active Archive Center managed jointly by the Earth Science Office at NASA's Marshall Space Flight Center and ITSC, researchers conduct all aspects of data management applications, from ingest and archival to processing and quality control, and from configuration management and documentation to data publication and user satisfaction. GHRC capabilities include near-real-time processing to generate data products within three hours of observation and provenance tracking for selected data sets.

At the High Performance Computing Laboratory (HPCL), advanced computational hardware and software are available to support research with very large volumes of data and high performance computational requirements. Multiple parallel platforms are available for testing, with varying configurations of processors, memory and storage systems.

Computational and visualization resources in the ITSC Collaborative Technologies Laboratory provide an environment for research to enable knowledge sharing and integration in multiple domains, Dr. Graves says. This is where "ITSC researchers are working toward making the vision of next-generation science into reality."

ITSC is actively researching novel approaches and methods of exploiting big data from both traditional and non-traditional sources. The research and development of event-based technologies is an emphasis of ITSC's applied research, which also involves developing technologies to improve the optimized visualization and utilization of geospatial data. For event-based processing, ITSC has developed a framework for

Event-Driven Data Delivery (ED3) that provides a subscription-based infrastructure to automatically execute user-defined data workflows in response to event occurrences. The ED3 framework is generic to allow the adaptation to any type of event, and to integrate with existing situational awareness and decision support systems.

The use of non-traditional sources of data, such as information from social media networks, is an active area of research and development at ITSC. ITSC researchers are working on ways to determine the geospatial and contextual relevance of social media messages as a way to extract useful event-specific information from very large streams of otherwise irrelevant information. Using subject matter ontologies, ITSC is researching the ability to pick out relevant contextual references, such as storm-related damage for severe weather events, as well as location identification through textual references to addresses, roads and place names. Use of relevant unsolicited social media messages can be helpful to decision-makers when deciding where and how to best deploy limited response resources.

A complement to event-based processing is the use of Data Album technology to aggregate disparate event-relevant data products and information into a comprehensive collection for use by decision-makers and researchers, removing the time and resources typically expended in tracking down information in response to events.

ITSC has developed Spyglass to rapidly index and mine large repositories of text documents based on semantic information and subject matter expertise on various topics. Advanced visual analytics provide many ways to find relationships and linkages for further investigation in millions of documents in a very timely manner.

In many cases the explosion of available data, sometimes called big data, has outpaced the ability of many analysis and visualization tools to provide timely response. ITSC has developed capabilities that make use of parallel resources to provide instant visualization and analysis capabilities for extremely large datasets. These capabilities have been successfully used with large Earth science remote sensing data sets in a system called Polaris, and are applicable to many other large data needs such as geospatial imagery.

ITSC has also been actively collaborating on the use of serious gaming technology for use in military training and generating predictive intelligence. By adapting strategic war game engine technologies, ITSC researchers have applied rule-based approaches to provide highly detailed scenarios that can easily be varied for ensemble modeling of situations involving, political situations, environmental concerns and military assets. ■

NEW PARTNERSHIP AIMS TO BOOST STEM INTEREST

A new five-year National Science Foundation (NSF) grant is powering a partnership between The University of Alabama in Huntsville (UAH) and the HudsonAlpha Institute for Biotechnology to attract high school students to the science, technology, engineering and math (STEM) fields.

The NSF Scholarships in Science, Technology, Engineering and Mathematics (S-STEM) grant funds the UAH-HudsonAlpha Outreach Partnership (UHOP) to combat declining interest by high school students in STEM degrees and careers.

"They think that science is hard, that a degree in the STEM fields is unreachable," says Dr. Debra Moriarity, chair of UAH's Department of Biological Sciences and a co-principal investigator for the grant. "Well, we don't think it's hard. And we're here to show them that it's very attainable."

Ironically, the decline in student interest comes while STEM job gains over the next decade are expected to far outpace national average job growth.

"I think it's going to be a big step for us because it will allow us to identify those students who are interested in the STEM fields early on and to really see how a complete immersion into the scientific world works at retaining them and improving their success," says Dr. Moriarity. "We will focus on trying to recruit women and minorities, who are not typically as well represented in this area of study, so that we have a diverse group of students."

Joining Dr. Moriarity as UAH co-principal investigators are Dr. Joseph Ng, professor of biological science and director of the Biotech Science & Engineering Program, and Dr. Luciano Matzkin, assistant professor of biological science and director of the biology Master's Graduate Program. Both have strong ties to HudsonAlpha. Dr. Ng is the founder of a HudsonAlpha associate company, iXpressGenes, and both he and Dr. Matzkin are adjunct faculty members there. Dr. Neil Lamb, vice president for educational outreach, is the grant's co-principal investigator from HudsonAlpha.

As an undergraduate, Dr. Matzkin took part in the University of California Louis Stokes Alliance for Minority Participation.

He will assist in the UAH diversity effort.

"We're going to do targeted outreach to bring these traditionally underrepresented students into the program," Dr. Matzkin says. "We want them to realize that we're here and that we're an institution that involves undergraduates in high-caliber research."

HudsonAlpha's role draws together the institute's expertise in genomic sequencing and analysis and its passion for educational outreach experiences, says Dr. Lamb.

"We will provide UHOP students with their first real-world, in-depth laboratory opportunity," Dr. Lamb says. "The goal is to acclimate an undergraduate into the practice and culture of research."

That experience will be vastly different from the lab component of an academic course, he says, adding that most academic labs involve well-trodden protocols with known outcomes and little opportunity for variation.

"During our lab sessions, students will sequence and analyze the genome of bacteria naturally present in local buildings and outdoor spaces," says Dr. Lamb. "This microbiome analysis will introduce them to cutting-edge laboratory and computational technologies. Much of the work is performed in small groups or independently, at the student's own pace, with unpredictable outcomes or results. Students will face unexpected challenges and need to modify protocols mid-stream."

Simultaneously, through HudsonAlpha professional development seminars, students will learn about appropriate scientific conduct, ways to communicate complex topics, and the role of the scientist in the larger community.

"Our goal is that by they end of their time at HudsonAlpha, students will have gained a comfort with and enthusiasm for the research arena and will be equipped to join UAH or HudsonAlpha research labs as their undergraduate training progresses," Dr. Lamb says.

The NSF believes students can be hindered in their first year or two of university academics by the need to work to support themselves, and that can ultimately make it more difficult for them to stay in school and graduate, says Dr. Moriarity. The grant will provide about a dozen scholarships each year for first-time freshman starting in the fall.

"We'll also work with them to find additional money for the following years, but the focus is mainly on the first year," she says. In return, scholarship students will be expected to meet required obligations.

The UHOP program starts STEM students in hands-on biotechnology research at HudsonAlpha right away, as freshman and sophomores. Early exposure enables students to form strong relationships with faculty and professional researchers.

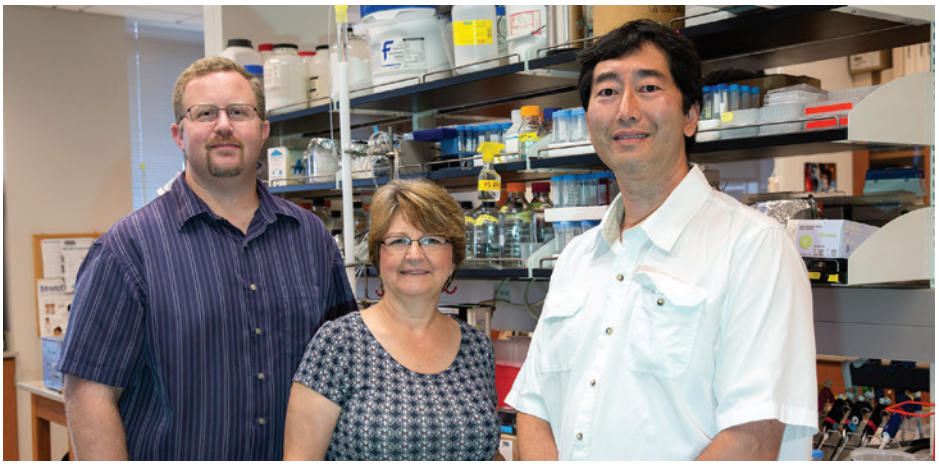
"We think this combination will give them the context for all the courses they're required to take so that they'll have motivation to take more courses," says Dr. Moriarity. The program is structured to instill a sense of belonging, connection and collaboration.

"We've built it so we have cohorts coming in each year who can learn from each other," says Dr. Matzkin. "We want to create this kind of extended family of research-minded undergraduates."

The goal is for a significant portion of UHOP students to pursue advanced biotechnology degrees.

"My focus is on encouraging students to pursue advanced studies," says Dr. Ng, "and UHOP is another mechanism that allows them to stay here and go into a master's or Ph.D. program."

"If this works as well as we think it will for biotechnology, it's something we'd like to make larger and institutionalize," Dr. Moriarity says. "It's really more of a pilot program, because if it works for us, it could work for many disciplines." ■



◀ UAH Dept. of Biological Sciences Chair **Dr. Debra Moriarity**, left, with students **Crissy Tarver** and **Laurel Brandsmeier.**

▶ **Dr. Luciano Matzkin**, **Dr. Debra Moriarity** and **Dr. Joseph Ng** were co-principal investigators of the five-year grant to recruit, retain and graduate students in the STEM fields.

Dr. Robert Frederick, left, director of the Propulsion Research Center, and **Dr. James Blackmon** with Blackmon's teenage rocketry project shortly after it was uncrated.

▲ Redstone Arsenal personnel examine young **Jimmy Blackmon's** rocket during a 1956 visit. Blackmon is second from left. *top left*

▲ **Dr. Wernher von Braun** discusses technical papers with young **Jimmy Blackmon.** *bottom left*

▶ Young **Jimmy Blackmon** gets instructions on the control box for an Army missile at Redstone Arsenal. On the right is **Gen. Holger Toftoy**. *at right*

UAH'S PROPULSION RESEARCH CENTER is preparing for its 25th anniversary next year, and the experimental roots of its faculty run even deeper. In 1956, 16-year-old Jimmy Blackmon did a very unusual thing for that time. He built a rocket from scratch in the basement of his home in Charlotte, N.C., predating even the well-known Homer Hickam and the Rocket Boys. The resulting news coverage got him on the radar screen of the nation's No. 1 rocket man, Dr. Wernher von Braun. Blackmon and his father, Bert Blackmon, spent three days in Huntsville with von Braun, General Toftoy, Army engineers and other officials as the rocketry pioneer mentored the teen. Now a UAH PRC research professor for 15 years, Dr. Jim Blackmon has conducted research and development on advanced solar power, propulsion, propellant management and thermal management systems, and various other projects involving support to industry, DOE, NASA, U.S. Air Force and U.S. Army programs. He still has that original rocket he built as a teenager which, because a Federal Aviation Administration ruling and the admonitions of Dr. von Braun, he never flew – although a second iteration did successfully launch and fly. His design that used the nucleic cooling of ice keep engine temperatures down was never tested. But test firing a replica of that engine is something Dr. Blackmon still would like to see happen today. ■

Paul Marshall, left, and Daniel Sillivant running the Autoclave

RELIABILITY AND FAILURE ANALYSIS LAB SOLVES REAL-WORLD PROBLEMS

Solutions to the real-world problems that occur during the life cycle of a product can be found behind the doors of the Reliability and Failure Analysis Lab (RFAL) located in the UAH Research Institute.

"The answers to the difficulties that are presented to us may be as simple finding a better light bulb or as complex as redesigning a component," says Chris Sautter, managing director of RFAL.

The research conducted at the lab has both local and worldwide impact. The span of the work has included assisting the UN with a sensor suite supporting the Nuclear Test Ban Treaty to developing a new environmentally friendly rayon fiber necessary for the manufacture of crucial carbon fiber required for rocket engines.

The concept of the RFAL came from an idea proposed to the university and the Redstone team members eight years ago by the current technical director, Dr. Bill Wessels, and Sautter. The idea grew in support and resulted in a $600,000 grant to acquire the necessary equipment to establish the lab. Rounding out the core staff of RFAL, Mark Gauldin joined the team five years ago as lab manager, bringing a strong background in reliability testing and project management.

"Our goal was to create a 'virtual staff' that allowed us to reach out to the entire UAH community, providing expertise across many disciplines to address the complex questions we receive from our customers," Sautter related. "We take the tech side and academic side and put it all together in the hopes of establishing a 'one-stop shop' to address customer needs."

"At present, we're talking to one of the companies in town that needs a Reliability Centered Maintenance (RCM) analysis of their shop floor to optimize the maintenance schedule for the manufacturing machines," Gauldin says. "The goal is to raise the production rates while avoiding costly down-time."

A similar investigation is being conducted for another local company. RFAL has been asked if the company should purchase warranties on its equipment or rely on internal assets to perform maintenance. Such questions allow the lab to utilize its reliability expertise and to reach out to the process engineers within the university faculty to provide the necessary skill-set to address customer questions.

"Reliability and, its partner, maintainability, are key issues in the marketability of any product. They should take a prominent place for any industry in the design phase of the system. However, these two aspects of a product are too often overlooked until late in the developmental cycle. If ignored, the cost of the life cycle of the product can increase dramatically," Gauldin says. "Designing for reliability and maintainability will enable optimized maintenance actions, such as condition-based maintenance or time-directed maintenance practices, to be easily implemented and ensure that the design and cost criteria will be met."

It takes expertise and specialized lab equipment to make it all work. This year, Sautter says that RFAL has exceeded the $4 million mark in acquired equipment to support the lab. This breadth of test capabilities allows the lab to address the increasing needs of its customer base. With these capabilities, both analytical and experimental, RFAL can support a project from cradle to grave.

The ultimate goal of RFAL is to give the customer an overall "system reliability understanding." The tools that RFAL uses to gain this understanding are being shared and taught to its customers so that they can utilize the process to design a reliable product.

Gauldin adds that a key goal of RFAL is workforce development to feed the needs of the manufacturing and Dept. of Defense sector with quality engineers. Graduating students with hands-on experience in reliability analysis and testing are highly sought after as job candidates.

By working in the lab, students find themselves graduating with a diploma plus a strong resume. The valuable experience RFAL students gain means that all RFAL alumni are employed upon graduation at starting salaries that exceed national averages.

◀ **Hunter Bray**, left, and **Greg Doud** running the altitude chamber
top left

▲ 1196 - **Chris Sautter**, left, and **Mark Gauldin** with Dynamic Vibration System in foreground and Environmental Chambers in the background.
top right

▼ **Dr. William Kaukler** inspecting ionic Liquid Rayon fiber.
bottom

Dr. Ray Vaughn, vice president for research and economic development, and Kannan Grant, director of the Office of Technology Commercialization, at the new patent display.

ENCOURAGING AND HONORING UAH PATENTS

The University of Alabama in Huntsville (UAH) patent holders are honored in a new display near the Office of Technology Commercialization in the Von Braun Research Center.

"We wish to recognize our faculty and researchers who also become inventors and the patent wall is a good way to accomplish that," says Dr. Ray Vaughn, vice president for research and economic development. The display is intended to be both acknowledgement and encouragement.

"The wall serves to display our faculty and researcher patent accomplishments for others to see, and to serve as a constant reminder of their achievements," he says. "Patents are often the foundation for a start-up company and in our economic development role we wish to promote their success."

UAH Office of Technology Commercialization Director Kannan Grant says the university has been awarded over 16 patents since 2010, with half of them coming in 2014 alone. "Together," Grant says, "our goal is to find ways to have the fruits of their labor be made available commercially for public consumption."

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VICE PRESIDENT FOR RESEARCH
AND ECONOMIC DEVELOPMENT
301 Sparkman Drive
Huntsville, Alabama 35899

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