FOCUS

UAH Research Magazine // Spring 2020

DIRECTED ENERGY

UAH, SMDC collaborate in laser defense research

page 4

TARTARUS

Space Hardware Club's liquid-fueled rocket

page 12

THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

KEY CONTACTS

VICE PRESIDENT FOR RESEARCH AND ECONOMIC DEVELOPMENT
Dr. Robert Lindquist
(256) 824-2882
Robert.Lindquist@uah.edu

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

CONTRACTS AND GRANTS ACCOUNTING
Valarie King
Director
(256) 824-2231
Valarie.King@uah.edu

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

OFFICE OF ENVIRONMENTAL HEALTH AND SAFETY
Kristy Olive
Director
(256) 824-6053
Kristy.Olive@uah.edu

OFFICE FOR PROPOSAL DEVELOPMENT
Dr. Virginia (Suzy) Young
Director
(256) 824-3448
Suzy.Young@uah.edu

CENTER FOR APPLIED OPTICS
Dr. Pat Reardon
Director
(256) 824-2530
Patrick.Reardon@uah.edu

CENTER FOR CYBERSECURITY RESEARCH AND EDUCATION
Dr. Tommy Morris
Director
(256) 824-6576
Tommy.Morris@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 INFORMATION SYSTEMS
Rui Guo
Director
(256) 824-2648
Rui.Guo@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
David.R.Arterburn@uah.edu

SYSTEMS MANAGEMENT AND PRODUCTION CENTER
Dr. Gary Maddux
Director
(256) 824-2679
Gary. Maddux@uah.edu

INVENTION TO INNOVATION CENTER
Rigved Joshi
Director
(256) 824-6058
Rigved.Joshi@uah.edu

Dr. Robert Lindquist
VP for Research and Economic Development

UAH research is ready to serve

When it comes to our nation's defense, The University of Alabama in Huntsville (UAH) is always ready to serve. That's why the university's partnership with the United States Space and Missile Defense Command (SMDC) in the field of directed energy is evolving under a new $5 million Congressional addition to the contract in fiscal year 2019 to fund two state of the art laser labs in the Center for Applied Optics through fiscal year 2021.

SMDC and UAH scientists are co-located and working collaboratively in the Optics Building to develop lasers and the next generation of laser experts for roles in national defense. On page 4, we learn about the research effort, which complements UAH work in hypersonics and artificial intelligence, two additional top military priorities.

An amazingly multi-faceted research enterprise at UAH is grounded in the work of our faculty and staff, and on page 10 we find out about eight new tenure-track faculty who were awarded a total of $79,622 in 2019-20 New Faculty Research awards from the Office of the Vice President for Research and Economic Development.

Likewise, on page 8 we learn that a UAH pioneer in the field of wearable health monitoring has been selected as a Fellow by the Institute of Electrical and Electronics Engineers (IEEE) for his contributions. Dr. Emil Jovanov, an associate professor of electrical and computer engineering and an Alabama Inventor of the Year, was the first to propose Wireless Body Area Networks (WBAN) as a sensor system to communicate through the Internet for health monitoring.

On page 11, we find out about research to assist South Asian countries in air quality monitoring led by Dr. Aaron Naeger (MS, Atmospheric Science, 2010; Ph.D., Atmospheric Science, 2013), the science principal investigator, who also is a research scientist in UAH's Earth System Science Center (ESSC) and a lead aerosol and air quality scientist with NASA SPoRT. The work has attracted a three-year, $750,000 NASA Research Opportunities in Space and Earth Science (ROSES-19) grant.

Award-winning research by a UAH doctoral student shows that the undulating flight paths of Monarch butterflies are actually more energy efficient than a straight-line path, and on page 14 we learn that the discovery can be valuable in the bio-inspired design of long-range robotic miniature drones.

The UAH Center for Space Plasma and Aeronomic Research (CSPAR) is analyzing massive data streams from NASA's Parker Solar Probe and the European Space Agency (ESA) Solar Orbiter, and on page 16 we find that CSPAR director Dr. Gary Zank is looking ahead to NASA's Interstellar Mapping and Acceleration Probe (IMAP), set for a 2024 launch.

Coastal cities can be spared some wind destruction from intensifying hurricanes or tropical storms if functional wetland ecosystems and agricultural croplands are in the area, according to computer modeling research led by UAH associate professor of atmospheric science Dr. Udaysankar Nair that's on page 18.

Dr. Matthew Niemiller, a UAH assistant professor of biological sciences, found an Alabama Cave Shrimp, *Palaemonias alabamae*, during a biological survey of Fern Cave in summer 2018, and on page 20 we find that the endangered shrimp was only known before in six caves in Madison County.

In student research, a page 12 story says that new tests are underway for an ambitious liquid propellant rocket being engineered by UAH's Space Hardware Club (SHC), which hopes its vehicle will launch at the 2021 Spaceport America Cup competition for student rocketry teams in New Mexico.

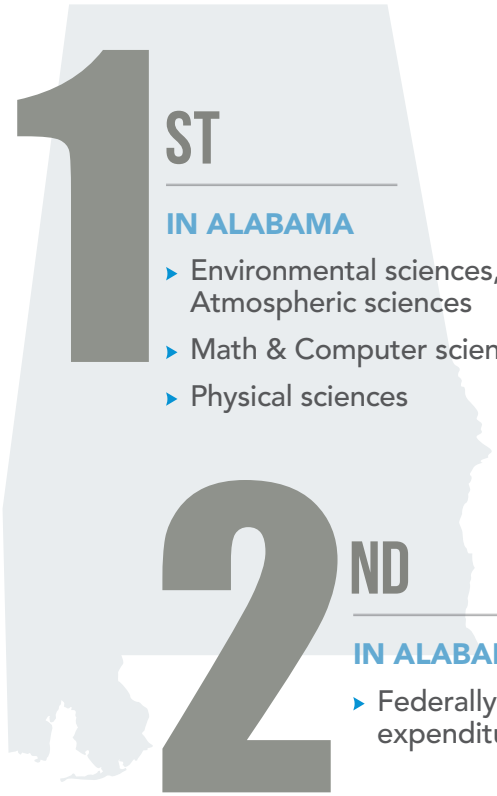
Why does psychological research show a jury bias toward believing jailhouse informants? On page 22, three UAH graduate students examine a fundamental question: How do juries weigh jailhouse informant testimony when deciding guilt or innocence?

We are proud of the accomplishments of our faculty, staff, students and alumni. We are excited about the future and welcome collaborative partnerships. Please contact the Office of Research and Economic Development to be provided more information on the efforts featured in this magazine or any other research project at UAH. ■

THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

A **RESEARCH INTENSIVE** national university that serves as the anchor tenant of 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

- **5TH** Federally financed Aerospace Engineering research
- **8TH** Economics research
- **11TH** NASA-sponsored research
- **11TH** Computer and Information Sciences research
- **12TH** Atmospheric Sciences research
- **12TH** Astronomy & Astrophysics research
- **28TH** Department of Defense R&D expenditures

SOURCE: National Science Foundation

RESEARCH

$489 million
Five-year contract and grant research total

Over $2 million
Five-year license and royalty revenue total

$109.7 million
Fiscal 2019 research expenditure total

ISSUED PATENT TOTAL – 112

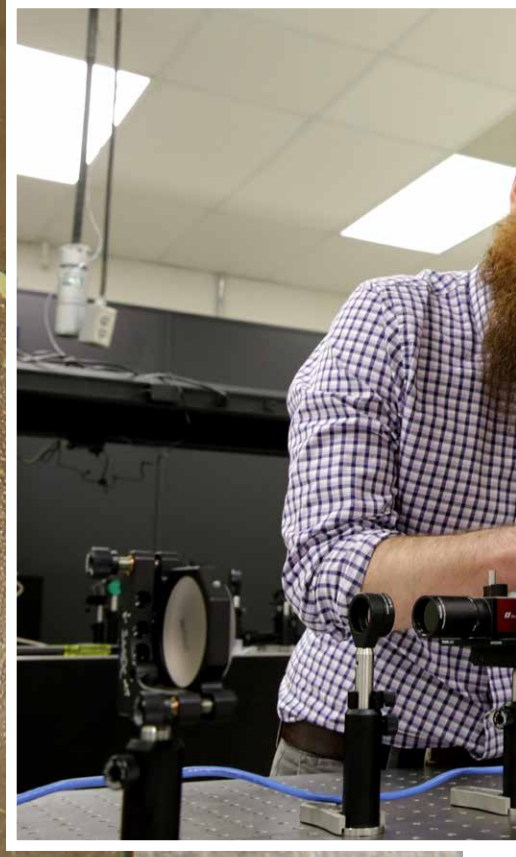
COVER

FACULTY FOCUS

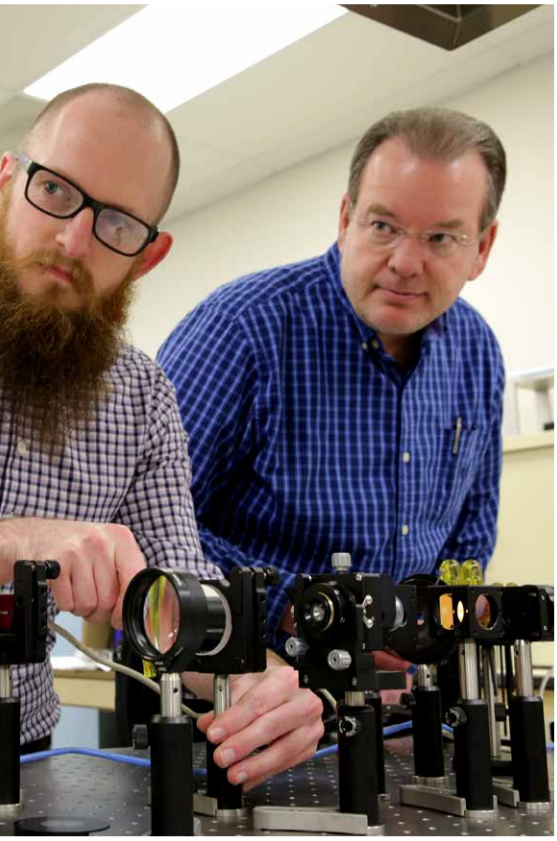
STUDENT FOCUS

RESEARCH FOCUS

- Cover: Amanda Clark, high-energy laser enabling technology lead for the U.S. Army Space and Missile Defense Command, with Dr. Robert Lindquist, UAH's vice president for research and economic development, in the Laser Source and Atmospheric Propagation Laboratory at the UAH Center for Applied Optics.



▲ A test piece from a different lab shows the power of laser directed energy.



Wesley Barnes, left, and UAH lab lead Dr. James Hadaway work on laser setup in the Beam Control System Integration Laboratory.

DIRECTED ENERGY

UAH and Space and Missile Defense Command collaborate on key future defense component

Directed energy (DE) has been identified as an integral part of future United States defense capabilities by the U.S. Department of Defense (DoD). DE is the capability to harness the power of the electromagnetic spectrum to effectively and affordably strike critical targets at the speed of light. Rather than bullets or projectiles, the two classes of DE rely on high-energy lasers and high-powered microwave systems to neutralize threats.

The DoD is interested in DE technologies because they offer the warfighter the attributes of speed, range, flexibility and precision. DE weapons can strike at the speed of light, engage multiple targets and deliver a deep magazine of microwave or kinetic ammunition with exceptional accuracy and reduced logistical support.

As part of the effort to develop such capabilities, two High Energy Laser Research Laboratories in the Center for Applied Optics (CAO) in UAH's Optics Building represent an evolution in the DE laser research collaboration between UAH and the U.S. Army Space and Missile Defense Command (SMDC). The partnership began in 2011 and the first research was conducted on UAH's campus in 2013.

Under a $47 million, five-year Advanced Technology, Test and Development contract that SMDC has with UAH, the Laser Source and Atmospheric Propagation Laboratory and the Beam Control System Integration Laboratory will conduct research and development, experimentation, and evaluation of High Energy Laser (HEL) components, subsystems and supporting phenomenology. Both labs bring world-class, state-of-the-art capabilities to the UAH campus.

U.S. Sen. Richard Shelby was instrumental in obtaining a $5 million Congressional addition to the contract in fiscal year 2019 to fund the labs through fiscal year 2021.

The Laser Source and Atmospheric Propagation Laboratory is home to a 3-kilowatt laser and researches a variety of optical fiber cable, including ytterbium-doped fiber amplifiers.

"These high-power fiber amplifiers are capable of producing kilowatts of output power without resorting to multimode operation, which is important when the laser will be used in conjunction with a beam control system and propagated over long ranges," says Carl Sanderson (BSE, Optical Engineering, 2013), the principal investigator for the SMDC HEL Division's laser source and atmospheric propagation efforts at UAH and a research engineer with UAH's Systems Management and Production (SMAP) Center.

"This is applied research that will help improve capabilities for next-generation directed energy systems."

Lasers work by creating a high-energy kinetic effect to concentrate intense heat on a targeted area, so it's important to accurately aim that energy. In the Beam Control System Integration Laboratory, research includes target acquisition, target tracking, pointing of the high-energy laser and correction of atmospheric turbulence effects. The lab has new state-of-the art optical metrology instruments that will be used to test optical components needed for its beam control work.

"The goal is to investigate new hardware and control algorithms in our laboratory to determine which ones show enough promise to move on to further development and testing," says Dr. James Hadaway (Ph.D., Optical Science & Engineering, 2004), the lab's UAH lead. "As with any weapon system, it is paramount that any potential target is firmly established as a threat, and that the weapon is accurately aimed at the intended target, without endangering friendly assets, before the high-energy laser is actually fired at the target. And all of that must occur in a very short amount of time."

Much has been done to advance the technology to the point that reliable laser weapons can be put into regular use on the battlefield, Dr. Hadaway says, but research continues to refine and perfect aiming accuracy.

"One of our main goals is to make significant contributions to this advancement," he says. "We are also evaluating methods to safely abort high power laser operations when the laser beam goes astray."

According to Dr. Robert Lindquist, UAH's vice president for research and economic development, the collaboration with SMDC complements other UAH research efforts underway in hypersonics and artificial intelligence, all of which are high defense priorities.

"The partnership UAH has with SMDC on directed energy provides opportunities for the university to contribute significantly to the research," says Dr. Lindquist.

Collaborating with the university gives SMDC a boost on directed energy research and fits well with the CAO's mission, Dr. Lindquist says.

"Basically, the idea was for SMDC to get a research jump start before getting their own facilities on Redstone Arsenal," he says. "To get the jump start on the technology they needed a lab, and UAH had the facilities and the funding."

At the CAO, SMDC researchers co-locate and team with UAH researchers, faculty and graduate students. That environment emulates the intermingling of complementary workforces and students between UAH and NASA that's been successful at UAH's Cramer Research Hall, the home of the National Space Science and Technology Center (NSSTC).

"Now SMDC will have a research presence at UAH," says Dr. Lindquist.

The research is vitally important for future defense strategies, says Dr. Steven Messervy (BSBA, Management, 1975; Master of Administrative Science, 1976), director of the UAH Research Institute, which manages the SMDC contract.

"Creating an integrated team of subject matter experts (SMEs) from the DoD and from UAH research provides the best possible combination of knowledge and experience for furthering HEL science," Dr. Messervy says.

Each team member brings unique expertise and research background to the effort, he says.

"Together, they not only optimize HEL power and efficiency but also are able to mature the technology for ultimate transition into weaponized operational capabilities," Dr. Messervy says. "Additionally, DoD's investment and participation in the HEL lab at UAH promotes increased interest and education of the next generation of SMEs. The integrated team's goal is to excite, attract and educate UAH students into the field of high-energy lasers."

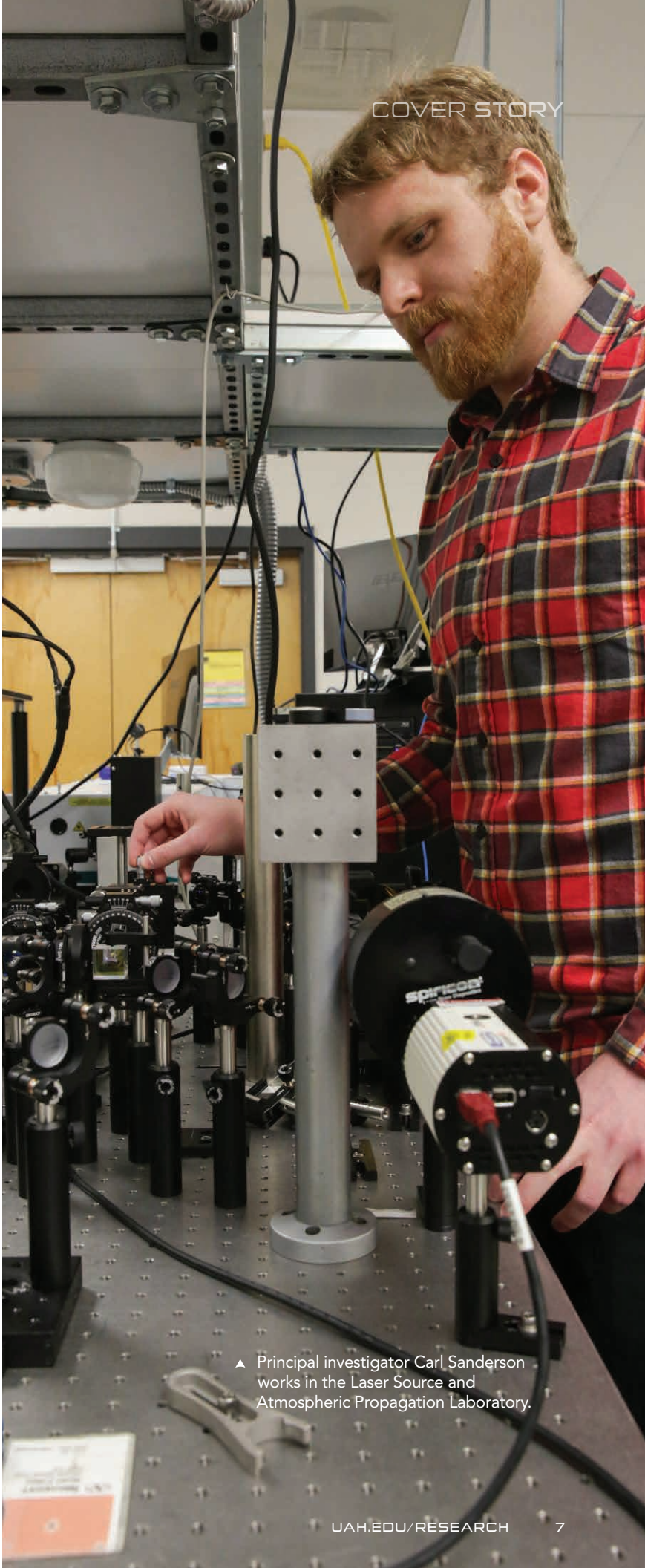
Amanda Clark (BS, Computer Science, 2005; MSE, Electrical & Computer Engineering, 2014), SMDC's high-energy laser enabling technology lead, heads the effort with Tommy Lum, SMDC enabling technology program coordinator.

"This is applied research that will help improve capabilities for next-generation directed energy systems," says Clark.

"This is how we are trying to develop future laser experts," she says. "These are world-class laboratories that can also be available for evaluation of other types of high-energy lasers."

Dr. Messervy says that with the support of Congress, SMDC has invested in the establishment of the UAH labs with a long-term vision for a sustainable and valuable resource for all DoD departments and services.

"UAH may submit proposals for a variety of DoD solicitations for HEL scientific research tasks," he says. "Given this capability, UAH is in an excellent position to participate in collaboration efforts with other academia, with other national labs, and to compete for renowned grants." ■



▲ Principal investigator Carl Sanderson works in the Laser Source and Atmospheric Propagation Laboratory.

IEEE SELECTS **EMIL JOVANOV** AS FELLOW FOR WEARABLE HEALTH MONITORING CONTRIBUTIONS

The Institute of Electrical and Electronics Engineers (IEEE) has selected Dr. Emil Jovanov, a UAH associate professor of electrical and computer engineering, as a Fellow for his contributions to the field of wearable health monitoring.

"This is a huge honor for me and a huge honor for the university and for the work we are doing here," Dr. Jovanov says. "I was really very happy and humbled that some of the best people in the world gave me recommendations."

In 2000, Dr. Jovanov was the first to propose Wireless Body Area Networks (WBAN) as a sensor system integrated on or in bodies to communicate through the Internet for health monitoring.

"This is for me recognition of 20 years of work that I did mostly here at UAH," he says. "Of course, now mobile health is all common sense, but everybody knows what it means to have proposed that back in 2000 and implemented in 2002. I believe that the concept of mHealth definitely changed, and continues to change, the lives of people."

The IEEE Grade of Fellow is a distinction reserved for IEEE members selected from nominees by a committee for extraordinary accomplishments in any of the IEEE fields of interest. Nominees must have accomplishments that have

contributed importantly to the advancement or application of engineering, science and technology, bringing the realization of significant value to society.

The honor is conferred by the board of directors and the number of Fellows selected in any one year does not exceed one-tenth of one percent of the total voting Institute membership.

Dr. Jovanov was supported globally in his nomination by engineers and academics in Australia, Britain, China and the United States.

"I am extremely blessed that I was selected the first time that I was nominated," he says.

Dr. Jovanov is currently working on using artificial intelligence and the Internet of Things to further his mHealth system for personalized medicine. The mHealth system uses wireless wearable sensors connected to smartphones, the cloud or wireless networks to collect health information.

He envisions a future in which commonly used items can be embedded with monitoring devices so that they become unobtrusive sentinels of health.

"I am currently very excited about the opportunity to have all these devices working together," he says. "Through the synergy of all intelligent devices around us you can have much more comprehensive information, and even new parameters that you can't get with the devices operating separately."

Without any extra effort from its user, the network creates a personalized protective bubble of health information managed by a smartphone or smartwatch. The system would advise and facilitate the early detection and prevention of disease.

"That bubble can be your digital guardian angel," he says. "The advantage of this approach is that you can monitor individual health parameters every time the individual interacts with the intelligent device."

The mHealth system he introduced in 2000 has resulted in numerous patents.

In 2015 he invented and patented with UAH a smart water bottle that makes it easy for users and medical personnel to track consumption of fluids by using a cellphone, the cloud or a wireless network. The device was a finalist in the Alabama Launchpad Start-up Competition.

Dr. Jovanov was named the Alabama Inventor of the Year in 2014 for a smart pill bottle he invented that monitors patient medication compliance by real-time tracking of the number of pills taken and when they were consumed. The patent is commercialized by AdhereTech in New York, NY, the world leader in smart adherence monitoring solutions.

In cooperation with the Mayo Clinic, Dr. Jovanov and Dr. Aleksandar Milenkovic implemented the first low power wearable wireless body monitor 15 years ago, introducing the era of mobile health or mHealth. He invented the wearable wireless pilot stress monitor 18 years ago. Dr. Jovanov invented the wearable wireless remote heart monitor 20 years ago.

Among his other inventions, Dr. Jovanov also developed an mHealth suite of phone apps that uses smartphones to monitor the physical mobility and balance of older people.

He believes the personalized health monitoring future holds promise.

"I believe we are yet to see the convergence of all these technologies," he says, "and that is a convergence that will change the world." ■

EIGHT NEW TENURE-TRACK FACULTY RECEIVE RESEARCH AWARDS

Eight new tenure-track faculty at UAH have been awarded a total of $79,622 in 2019-20 New Faculty Research (NFR) awards from UAH's Office of the Vice President for Research and Economic Development (OVPRED).

The program was originally funded at $60,000. Additional money for the NFR program was provided by the OVPRED on the strength of the proposals received, says Dr. Robert Lindquist, vice president for research and economic development.

"The proposals submitted this year from UAH's new faculty were outstanding," Dr. Lindquist says. "We're delighted to be able to make these awards and we hope that the seed funding provided will result in more external funding opportunities for the faculty who are supported."

The NFR program is intended to assist UAH's new tenure-track faculty in securing external funds in support of their scholarly interests. The NFR funds are competitively awarded and require that the faculty write full proposals, which are then assessed by a committee comprised of senior faculty and research staff.

"The innovative ideas brought forward by our excellent young faculty members impressed our review committee," Dr. Lindquist says.

Tenure-track professors who had been at UAH less than three years at the time of proposal submission were eligible. The funds must be spent within one year of the award and the maximum award is $10,000. Awards were limited to one award per faculty member.

Award winners, their college, center or department and their proposal title:

- Aubrey Beal, Electrical and Computer Engineering, "Naturally Compressive Noise Sonar Using Solvable Chaos for Multi-user Applications"
- Jennifer Bruzek, Education, "Teaching Young Children How to Approach Dogs Safely Using Behavioral Skills Training"
- Zachary Culumber, Biological Science, "Conserving Biodiversity by Understanding Animal Personality"
- Ahmed Lawan, Biological Science, "Regulation of Hepatic Cholesterol Metabolism by MAP Kinase Phosphatases"
- Rui Ma, Civil and Environmental Engineering, "Leveraging Shared Rides to Relieve Commuting Traffic Congestion by Applying a Guidance Strategy to the Ridesharing Travelers"
- Nathan Tenhundfeld, Psychology, "Robot Design Impacts on High Risk Environment Use"
- Isaac Torres Diaz, Chemicals and Materials Engineering, "Magnetic Assembly of Anisotropic Binary Colloidal Superstructures"
- Ying Zou, Center for Space Plasma and Aeronomic Research, "Heating of Terrestrial Ionospheric Ions by Aurora Borealis" ■

BREATHING EASIER

South Asian satellite air quality tracking attracts NASA grant

▲ Dr. Aaron Naeger is the science principal investigator for the South Asia aerosols and air quality grant.

Research to assist countries in South Asia in monitoring air quality to provide accurate and timely air-quality alerts to the public has attracted a three-year, $750,000 NASA Research Opportunities in Space and Earth Science (ROSES-19) grant.

The grant to track atmospheric aerosols and air quality in the region was presented to NASA's SERVIR Global team. The project also involves NASA's Short-term Prediction Research and Transition Center (SPoRT). Both programs are managed by NASA's Marshall Space Flight Center and operate from the National Space Science and Technology Center in Cramer Hall at UAH.

Common components of smog and air pollution, atmospheric aerosols are suspensions of fine solid particles or liquid droplets in air. These fine particles can easily enter the lungs and cause health hazards.

"The goal is to work with the Hindu Kush-Himalaya regional SERVIR hub – known as the HKH hub – which is located in Kathmandu, Nepal, to improve their use of aerosol and air quality information from new generation satellites," says Dr. Aaron Naeger (MS, Atmospheric Science, 2010; Ph.D., Atmospheric Science, 2013), the science principal investigator for the effort. Co-principal investigator for the project is Dr. Michael Newchurch, UAH professor of atmospheric science.

The HKH hub will in turn work closely with the International Center for Integrated Mountain Development (ICIMOD), a regional intergovernmental learning and knowledge sharing center serving the eight regional member countries of the Hindu Kush Himalaya – Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal and Pakistan – and also based in Kathmandu.

"Their overall aim is to improve the well-being of the mountain environment and people, and help the region adapt to climate change," says Dr. Naeger, who also is a research scientist in UAH's Earth System Science Center (ESSC) and a lead aerosol and air quality scientist with NASA SPoRT.

Scientists plan to use data collected from South Korea's Geostationary Environment Monitoring Spectrometer (GEMS) satellite once it launches in early 2020. A geostationary scanning ultraviolet-visible spectrometer, GEMS will provide hourly daytime monitoring of pollution events over South Asia and the Asia-Pacific region.

GEMS data will be used to assess regional aerosol and air quality conditions, Dr. Naeger says, as well as to improve the ability of the involved countries to disseminate air quality forecasts and issue public health warnings.

"They have really poor air quality in that region," he says. "Our plan is to use real-time satellite data from geostationary orbiting satellites to improve their ability to track and monitor the rapidly varying emissions that govern the air quality conditions across South Asia."

The data will also be used to introduce the participating countries in the South Asia region to the SERVIR air quality monitoring interface, so that they can use it to better understand what's in play affecting the air quality of the region.

As the deputy program applications lead of the TEMPO mission, Dr. Naeger will be the person who will directly interface from UAH's Cramer Research Hall with TEMPO data users globally. ■

Space Hardware Club team members with parts of the Tartarus rocket in the UAH Engineering Design and Prototyping Facility.

TARTARUS

AMBITIOUS LIQUID FUEL ROCKET READIES FOR NEW TESTS

The new year brings new tests for an ambitious liquid propellant rocket being engineered by UAH's Space Hardware Club (SHC).

"Our ultimate goal is to carry a nine-pound payload to 30,000 feet using a student researched and developed liquid propulsion system," says McKynzie Perry, the project's manager. The SHC hopes its vehicle will be ready to launch at the 2021 Spaceport America Cup competition for student rocketry teams in southern New Mexico.

The Tartarus project began in 2017. The rocket is fueled by nitrous oxide and ethane, which are propellants with high vapor pressure and similar pressure-temperature curves. That significantly lowers complexity by allowing the team to use a blow-down engine cycle and store both propellants at the same temperature, according to Perry.

"It's one of the largest projects physically that SHC has produced, and I think it has one of the longest parts lists in recent memory," she says.

"As of our most recent simulations, the rocket will stand 15 feet tall and 6 inches in diameter," Perry says. The launch rail will be 30 feet tall and the ground system footprint is a 30-foot equilateral triangle. For the first engine firing, the team will station itself 500 feet away behind blast shields.

The team is currently focusing on a short duration inaugural test of the engine.

"This past semester has been focused on tying up all the loose ends required for us to static fire, such as proof pressure testing, system integration testing, and final critical design review of the static fire test stand," Perry says.

The coming test will assess the functionality of the ground system, the viability of SHC's injector design and the team's capability to safely perform hazardous operations.

"We are on track to perform this test this semester but have contingencies set into next semester," Perry says. "By the end of the year we would like to perform a full duration firing of the system. Once the propulsion system is better characterized, we can begin the process of integrating with our vehicle design for the competition."

The significant safety concerns accompanying static fire tests are new to the SHC and have improved the organization's safety practices.

As SHC's first liquid propulsion project the engineering challenges in Tartarus are immense, Perry says.

"We entered this academic year with a complete injector cold flow, heat-treated propellant tanks and most of our manufacturing complete," she says.

The challenges of liquid propulsion for the SHC team are matched by the challenges of developing its own test stand and ground system in addition to the final vehicle. The payload mission is still undetermined.

"The rocket propulsion system and ground system have plenty of instrumentation onboard to measure the conditions of the propellant and flight properties as the vehicle flies," Perry says. "Currently for the static fire configuration, we have 22 instruments on the system."

NOE-1W, the inaugural test campaign, will be conducted off campus to ensure the required safety radius.

"Our goals for the test are to deliver propellant from the ground system to the vehicle to the engine, ignite the engine, and shut down the engine," Perry says. "While we will gather some preliminary performance data on the engine, this test is mainly a chance for the team to walk before we start running in a full duration test of approximately 20 seconds."

SHC is advised by Department of Mechanical and Aerospace Engineering associate professor Dr. Gang Wang and lecturer Dr. Richard Tantaris. The club is sponsored by UAH, the Alabama Space Grant Consortium and individual donors.

The team has benefited from the expertise at UAH's Propulsion Research Center (PRC) in developing various aspects of the system, especially safety.

"They have been very kind in donating their advice and time to help the team," Perry says. "Recently, they allowed us use of their spray facility to perform hydrostatic proof pressure testing of our pressure vessel. The future for the team is much brighter with their technical support and we are incredibly thankful for the relationship we've been able to build with them."

Additionally, the team relies on many technical mentors from the aerospace industry who have been vital to progression towards static fire. The five-year challenge has paid numerous dividends, Perry says. ■

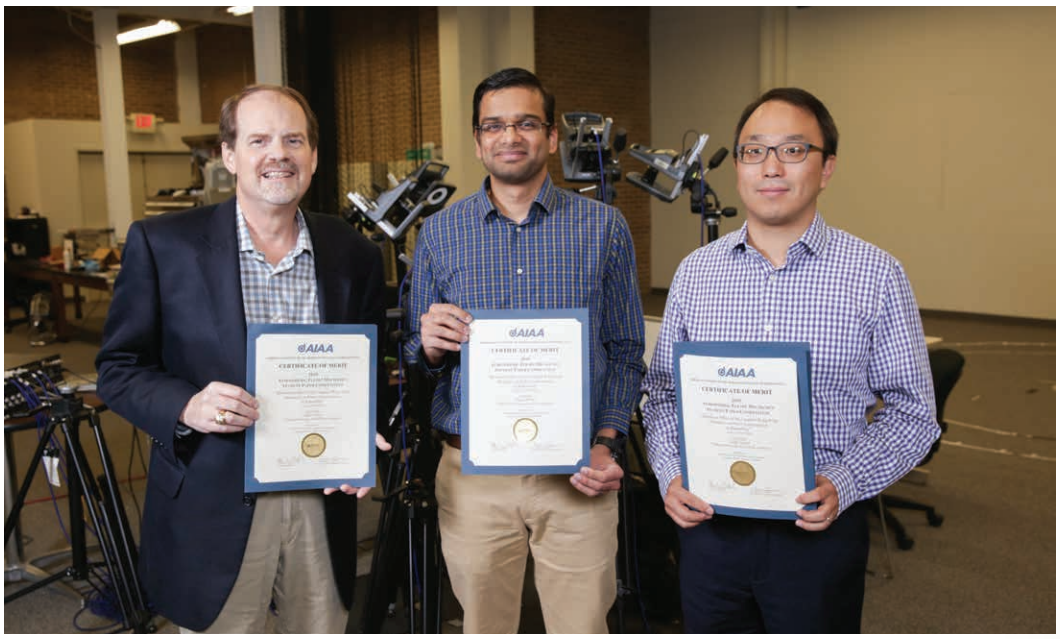
Team members are:

- McKynzie Perry, project manager; senior; Murfreesboro, Tenn.
- Erik Korzon, ground support equipment lead; graduate student; Anchorage, Alaska
- Mike Zaluki, ground support equipment; senior; Marlborough, N.H.
- Michael Angeles, ground support equipment; senior; Rockford, Ill.
- Rodney Luke, vehicle propulsion, ground support equipment; senior; Pleasant Grove, Ala.
- Mio Toida, vehicle propulsion; sophomore
- Aaron Hunt, vehicle propulsion; senior; Terrysville, Conn.
- Ben Shashikanth, controls; junior; Rapid City, S.D.
- Elizabeth Dorsett; controls; junior; Huntsville, Ala.
- Lina Parker, controls; sophomore; Covington, Ga.
- Cameron Adams, controls; sophomore; Waynesville, Ohio
- Sawyer Bryson, vehicle propulsion; sophomore; Gadsden, Ala.
- Thomas Bennett, flight avionics; senior; Charleston, S.C.
- Shelby Tull, outreach coordinator; sophomore; Nashville, Tenn.
- Spencer Christian, ground support equipment; freshman; Nixa, Mo.
- Noah Adams, vehicle propulsion; freshman; Vestavia Hills, Ala.
- Alex Mohs, ground support equipment; freshman; Saugatuck, Mich.
- Garett Ellis, vehicle propulsion; freshman; Bakersville, Calif.
- Jack Slayden, vehicle propulsion; freshman; Lewisville, Texas
- Jackson Miles, ground support equipment; freshman; Wausau, Wis.
- Sean Rabbitte, ground support equipment; freshman; Evergreen Park, Ill.
- Michelle Kuns, vehicle propulsion; sophomore; Goshen, N.Y.
- Kenton Suplee, ground support equipment/controls; freshman; Sevierville, Tenn.
- Hughston Turner, vehicle propulsion; freshman; Ellaville, Ga.
- Manav Dave, ground support equipment; freshman; Herrin, Ill.

TARTARUS

Take the Long Way Home

MONARCH'S ENERGY-SAVING FLIGHT MAY HELP IN DRONE DESIGN



From left, Dr. Brian Landrum, Madhu Sridhar and Dr. Chang-kwon Kang with their AIAA awards.

Award-winning research by a UAH doctoral student shows that the undulating flight paths of Monarch butterflies are actually more energy efficient than a straight-line path, a finding that can be valuable in the bio-inspired design of long-range robotic miniature drones.

Madhu Sridhar's paper won the 2019 American Institute of Aeronautics and Astronomics (AIAA) Atmospheric Flight Mechanics Graduate Student Paper Competition and he was awarded at the 2020 AIAA SciTech Forum held recently in Orlando, Fla. The AIAA Scitech Forum is the largest annual aerospace conference and focuses on research and technology findings in the aerospace community.

Sridhar modeled and analyzed the power consumption of Monarch butterflies while working in UAH's Autonomous Tracking Optical Measurement (ATOM) Laboratory under Dr. Chang-kwon Kang, an associate professor in the Department of Mechanical and Aerospace Engineering, and Dr. Brian Landrum, an associate professor and the associate chair of the Department of Mechanical and Aerospace Engineering.

"One of the underlying goals of our study is to develop a drone that can fly as long as a migrating Monarch," Sridhar says. "The annual migration of Monarch butterflies is the longest among insects. It can be 3,000 kilometers long! Even the state-of-the-art drones cannot show these long ranges."

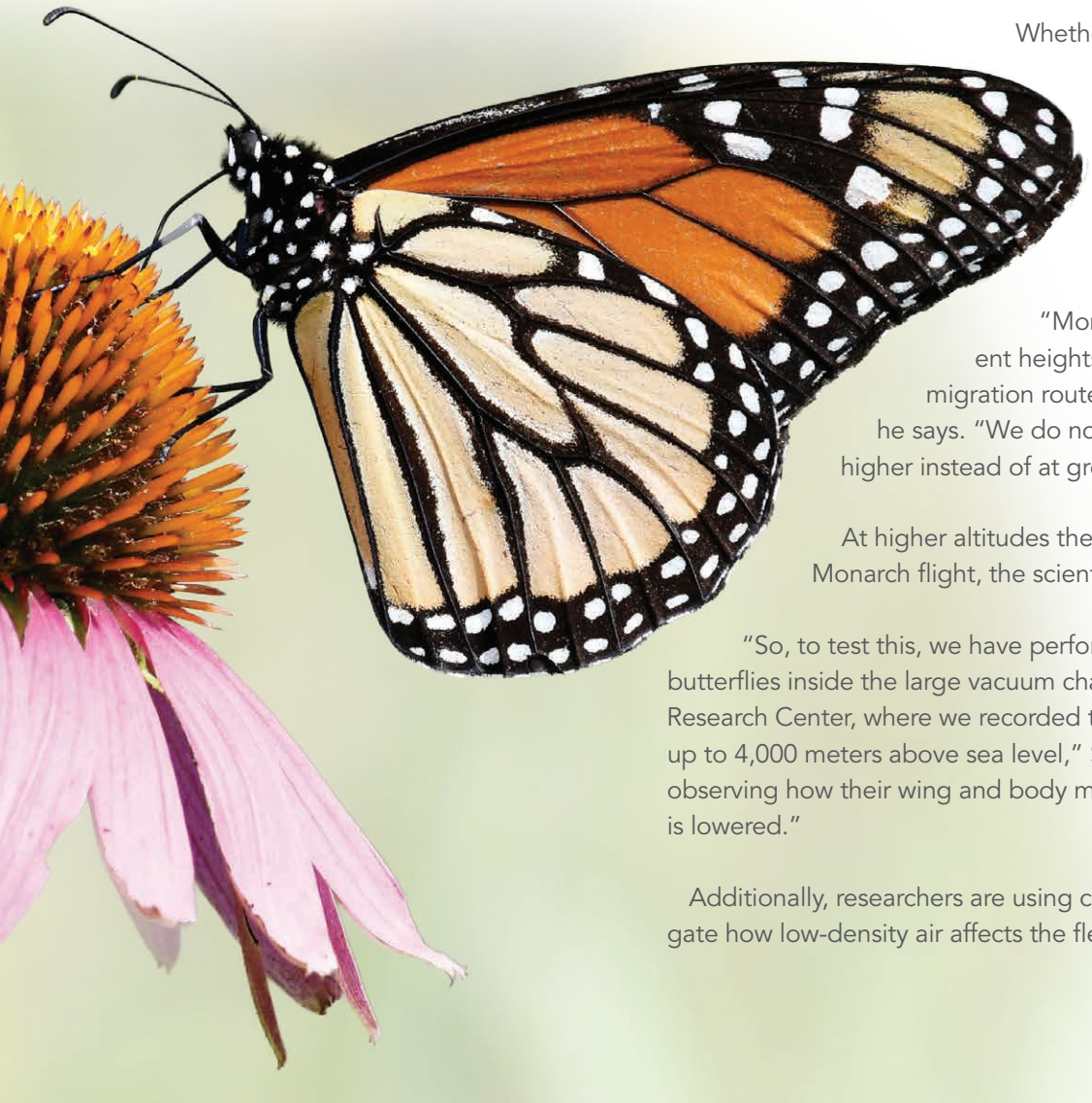
Researchers used a simplified analytical butterfly model in the study, focusing on the dynamic interplay between the wing aerodynamics and body dynamics, says Sridhar, who is from Bangalore, India.

"One of the underlying goals of our study is to develop a drone that can fly as long as a migrating Monarch,"

"This paper shows that this model agrees reasonably well with experimental data," he says. "We used motion-tracking cameras to record a series of flight trajectories and wing and body motions of freely flying Monarch butterflies in our ATOM Lab."

If there are advantages to the undulating trajectory that butterflies use, why don't bees or flies use it?

"This study shows that the coordinated wing and body motions following a bumpy trajectory require lower power for a flapping wing at the Monarch scale," he says. "For smaller insects this power benefit reduces, which is probably why they fly on a straight trajectory."



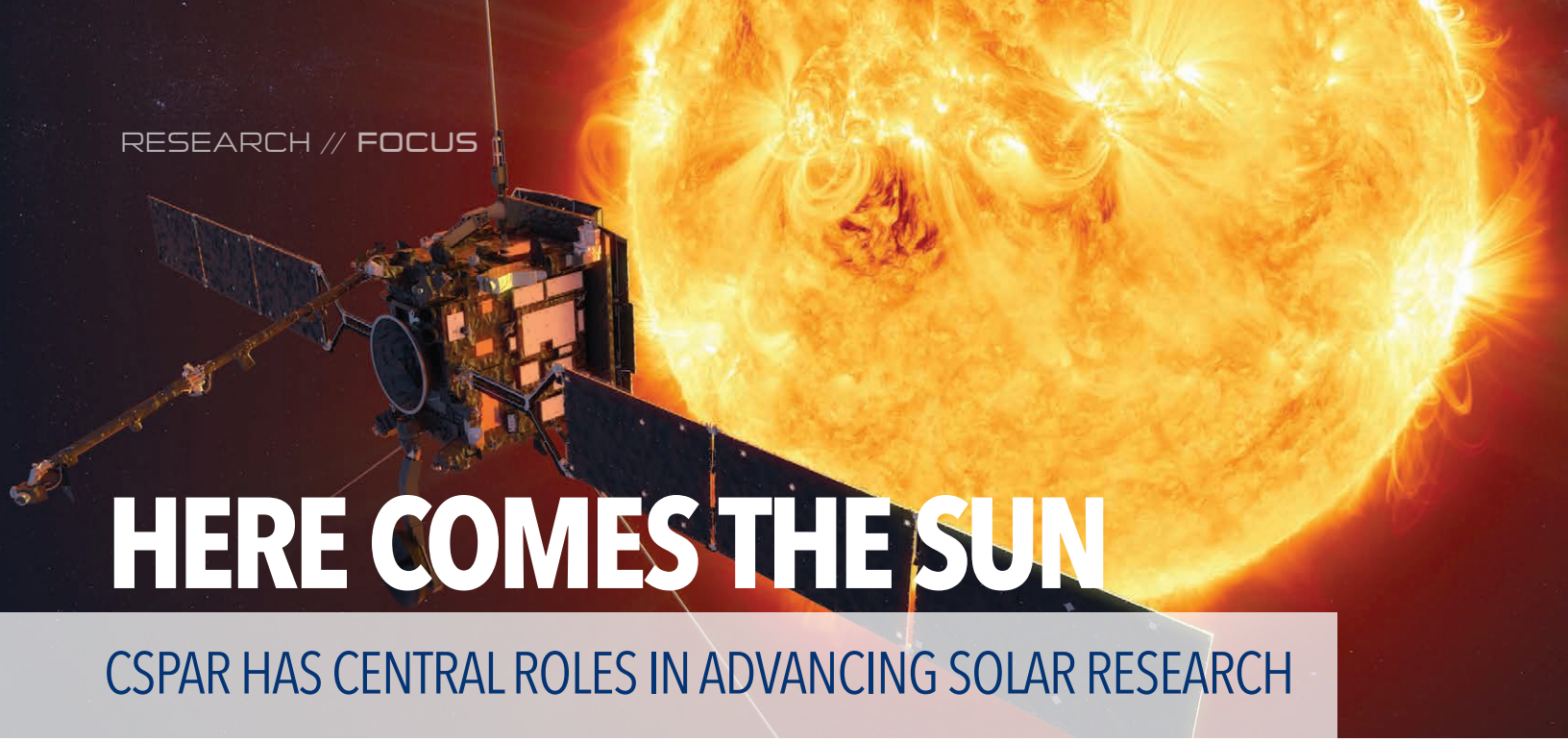
Whether butterflies utilize a biologically predetermined pattern of flight, or simply random undulations, is one of many questions for future research. Sridhar is also looking into how the butterflies select flight altitudes.

"Monarchs are known to fly at different heights from ground level along their migration route, which we find very interesting," he says. "We do not know why they choose to fly higher instead of at ground level heights."

At higher altitudes the reduced air density may benefit Monarch flight, the scientists theorize.

"So, to test this, we have performed experiments with Monarch butterflies inside the large vacuum chamber at UAH Propulsion Research Center, where we recorded the flights at lower density air up to 4,000 meters above sea level," Sridhar says. "This helps us in observing how their wing and body motions change as the air density is lowered."

Additionally, researchers are using computer simulations to investigate how low-density air affects the flexibility of Monarch wings. ■



HERE COMES THE SUN

CSPAR HAS CENTRAL ROLES IN ADVANCING SOLAR RESEARCH

As the Center for Space Plasma and Aeronomic Research (CSPAR) at UAH begins to analyze and model a massive data stream from the European Space Agency (ESA) Solar Orbiter, CSPAR director Dr. Gary Zank is looking ahead to another solar mission set to launch in 2024.

Now approaching the sun, the ESA Solar Orbiter (SO) will fly over the sun's poles, and Dr. Zank is a co-primary investigator on the magnetometer team. With NASA as a strong ESA mission participant, the mission is expected to help scientists understand how the sun creates and controls the giant bubble of plasma that surrounds the whole solar system and influences the planets within it.

Looking ahead, Dr. Zank anticipates another major data and modeling role for CSPAR when NASA's Interstellar Mapping and Acceleration Probe (IMAP) mission launches in 2024. IMAP entered the preliminary design work on the mission, spacecraft and instruments called Phase B on Jan. 28. Dr. Zank, who is also the Aerojet Rocketdyne chair of the UAH Department of Space Science, is an IMAP mission co-investigator and theory lead.

IMAP will study the interaction of the solar wind with the ancient cast-off winds of other stars, and the fundamental process of particle acceleration in space.

SOLAR ORBITER

ESA's SO mission is similar to that of NASA's Parker Solar Probe (PSP), a mission in which CSPAR is also centrally involved, although SO will not go as close to the sun as PSP. The spacecraft and its 10 instruments will make a close approach to the sun every five months.

In-situ instruments aboard are an energetic particle detector, a magnetometer, radio and plasma waves detector and a solar wind plasma analyzer. The remote sensing instruments are an extreme ultraviolet imager, a coronagraph, a polarimetric and helioseismic imager, a heliospheric imager and an instrument for spectral imaging of the coronal environment.

"Solar Orbiter has similar instrumentation as PSP, but of course it was developed by different groups and scientists," says Dr. Zank, who is a member of the National Academy of Sciences.

"What is unique about SO is its trajectory, which will take it over the polar regions of the sun. By contrast PSP, although it will fly closer to the sun than SO, remains in the ecliptic plane – the plane in which the planets and the sun lie."

Because of its orbit, PSP can't explore in detail the huge polar coronal holes that form during the period of solar minimum, a time of least solar activity in the 11-year cycle of the sun. For the first time, SO will take high-resolution images of the solar poles, as well as collecting other data.

"The polar orbit is important because the sun during solar minimum is dominated by a very steady high-speed solar wind of about 700-800 kilometers per second (km/s) that emanates from the northern and southern coronal holes," Dr. Zank says.

The coronal holes are long lasting and become larger as the solar cycle progresses. They eventually dominate much of the solar wind except in the ecliptic, which retains a slow solar wind of 350-400 km/s.

◂ UAH is analyzing and modeling data from the European Space Agency (ESA) Solar Orbiter, which launched in February. *(NASA)*

"The acceleration mechanisms for these two classes of winds are thought to be quite different," Dr. Zank says. "So, SO complements PSP in that the combination provides a full 360-degree coverage of the sun and allows us to investigate the different physical processes thought to be responsible for forming the solar wind. This will allow us to answer that critical question for both missions. This makes the combination of the two spacecraft enormously exciting, and it's why I am very happy to be on both teams."

Dr. Zank's SO magnetometer team will use that instrument to measure the magnetic fields in the solar wind and corona. On PSP, he is involved in the plasma data.

IMAP MISSION

A focus for NASA's IMAP is to explore the very boundaries of the heliosphere – the space filled with plasma from the sun that envelops all the planets of the solar system. When the heliosphere meets interstellar space, the outpouring of solar material collides with the local interstellar medium that fills the space surrounding the heliosphere. This interaction forms a critical barrier for high-energy cosmic rays located about 10 billion miles from the sun.

"The primary mission for IMAP is to explore and discover more about the boundaries of the region separating the solar wind from the local interstellar mission," says Dr. Zank. "This is the region that is being investigated by the Voyager 1 and 2 spacecraft in situ and remotely by the IBEX mission, on which I'm also a co-investigator."

From the vicinity of Earth, IMAP will investigate these regions remotely.

"It will use energetic atom instrumentation that is of unparalleled fidelity and cadence and range of energies," says Dr. Zank. "This will open up regions of the energy spectrum that have not been explored. And whenever you begin to explore energy regions that have not yet been investigated, invariably surprising discoveries emerge."

The IMAP instrumentation will reveal the detailed physics underlying the interaction of very distant solar wind with the encroaching interstellar medium across the entire sky, he says, unlike Voyager 1 and 2 that take just two one-dimensional cuts through a very complex system of boundaries.

"The second part of the mission is critical to both the larger mission of exploring the interaction boundary regions and continually monitoring the state of the solar wind near the Earth," Dr. Zank says.

"Since we need to know the solar wind conditions well in order to interpret energetic neutral observations at the spacecraft, we need to measure the plasma and magnetic properties of the solar wind," he says. "However, these same measurements are critical to our basic understanding of the physics of the solar wind, including plasma populations created or found near the Earth that are of interstellar origin, such as cosmic rays and so-called pickup ions."

The spacecraft is the fifth mission in NASA's Solar Terrestrial Probes (STP) Program portfolio, a fleet of NASA heliophysics missions seeking to understand how the sun affects the space environment near Earth and across the solar system. Heliophysics spacecraft studying the sun, near-Earth space and the boundaries of the heliosphere form a system observatory.

IMAP will examine the fundamental processes that accelerate particles throughout the heliosphere and beyond. The resulting energetic particles and cosmic rays can harm astronauts and space-based technologies. Both cosmic rays and pickup ions will be studied in great detail with very advanced instrumentation, Dr. Zank says.

"The continual measurement of solar wind properties is a crucial ingredient in understanding space weather, which is the impact that the solar wind and sun have on the Earth," Dr. Zank says. "The IMAP mission will serve also as a monitor of solar wind conditions and thereby further both our understanding and even act as warning beacon for incipient space weather conditions."

Dr. Zank's CSPAR team at UAH will perform a central role in interpreting and modeling IMAP's observations and UAH will be heavily engaged in exploring the data stream from the craft.

The mission, which includes 24 universities and other institutions from across the country and around the world, is led by Principal Investigator David J. McComas of Princeton University. The Johns Hopkins Applied Physics Laboratory in Laurel, Md., leads the design, builds the spacecraft and one of the instruments, and also manages the mission. ■

WETLANDS, CROPS CAN MITIGATE COASTAL CITY STORM DAMAGE

Coastal cities can be spared some wind destruction from intensifying hurricanes or tropical storm systems if they have functional wetland ecosystems and agricultural croplands in the area, according to new computer modeling research led by UAH.

"Our study was about how changing land cover in coastal areas affects rain from tropical storms," says Emily Foshee, co-author of the research and a research associate at UAH's Earth System Science Center who analyzed the models. Dr. Eric Rappin from Western Kentucky University ran the numerical model experiments.

UAH teamed with Western Kentucky University, the University of Nebraska, the University of Georgia, the University of Colorado Boulder, Purdue University, NASA's Marshall Space Flight Center and NASA's Goddard Space Flight Center to conduct the study.

Scientists used the model with a simulation of a flooding storm over Baton Rouge as a control and then modified the type of land the storm passed over to assess the effect. They modeled three land types: healthy coastal marshland, marshland that had become saturated or turned to open water, and coastal land that had been converted mostly to agricultural use.

The ground moisture and vegetative buffering of healthy marsh impede storm intensification but increase rainfall in the model.

"If you want to keep the marsh ecology intact because you don't want to lose all the other benefits of marshland such as preventing soil erosion and the wildlife and aquatic life benefits, and if you are concerned about how to have less damage from storm winds, then you must keep the wetlands," says Dr. Udaysankar Nair, UAH associate professor of atmospheric science and the lead author of the paper published in Scientific Reports. The research was funded by the National Science Foundation.

"When you have a landfalling hurricane, if you have wetlands there, then there is a greater chance that the storm or hurricane will weaken," Dr. Nair says.

Scientists modeled the effects on the Baton Rouge, La., region by using NASA land surface model data and data from an actual large flooding storm. Study findings, which support preservation and restoration of healthy marshes, may be especially important in Louisiana, which loses the equivalent of a football field of land to water every hour.

Agriculture continues to convert wetland in Louisiana to crop uses, and those practices tend to dry soils. Cut off from a source of water

Changing land cover and use affect hurricanes, according to research by Dr. Udaysankar Nair, left, and Emily Foshee with other collaborators.

vapor, storms in the model that passed over cropland were less intense and windy. But there's a tradeoff. Single crop agricultural lands don't possess the erosion control and biodiversity benefits of marshland, Dr. Nair says.

The combined effect of healthy wetlands transitioning to cropland reduced storm intensity in the model no matter what soil moisture conditions were present.

The research says that if current trends continue, a substantial portion of Louisiana wetlands will transition to open water in coming decades, likely making the studied region even more vulnerable to heavy rain events from future tropical systems.

Marsh that has become super-saturated or has turned to open water, known as a brown ocean, produces the most damaging winds in the model, while at the same time spreading out rainfall. That's because saturated wetlands or open water continue to feed energy into a hurricane's system.

Air spirals in toward the eye of a hurricane, and as it does it has a tendency to cool, Dr. Nair says. While the storm is over warm open ocean, over open water resulting from conversion of wetlands, or over the brown ocean of a saturated marsh, the energy from the wet and warm surface offsets the cooling effect with warm humid air and the storm can continue to grow stronger.

"What happens when a hurricane comes ashore is that the land cuts off that source of energy," Dr. Nair says. "Different forms of land cover affect the storm. What we found out is that it's not just the water vapor that affects storms."

The natural vegetation in healthy marsh has more buffering friction than if it has been converted to open water or agriculture, he says.

"If all these marsh regions are instead filled with water, essentially that is like the open ocean coming right to land," Dr. Nair says. "Then you see more wind and more spread out rain, and more damage out of the storm. The storm will continue to intensify as it comes in."

The work points to other areas for further study.

"If we do more of these kinds of studies," Dr. Nair says, "then we can potentially be able to say something about how the patterns of land use change and land management affect landfall in hurricanes." ■

HOW'D THAT GET HERE?

Endangered species found in a well-known cave

You'd think there'd be no way someone could newly discover an endangered species hanging out in Fern Cave in the Paint Rock River Valley of Jackson County, so close to the Huntsville home of thousands of spelunkers exploring every cave, nook and cranny.

But Matthew Niemiller and colleagues did.

In a discovery documented in a paper in the journal "Subterranean Biology," Dr. Niemiller, a UAH assistant professor of biological sciences, found a specimen of the Alabama Cave Shrimp *Palaemonias alabamae* while doing a biological survey of Fern Cave in summer 2018 as part of a team of four.

The endangered shrimp had previously only been discovered in six caves in four cave systems in Madison County.

"Fern Cave is the longest cave in Alabama, with at least 15 miles of mapped passage and five to seven distinct levels," Dr. Niemiller says. The cave features a 437-foot deep pit and exploring most of its lower levels is reserved only for the very fittest, since the trip involves an arduous journey including drops to be rappelled.

Dr. Niemiller and team's route to their discovery was no easy feat, either. The team entered the cave's bottom level via the Davidson Entrance at the base of Nat Mountain on the Fern Cave National Wildlife Refuge. The section of Fern Cave is only dry enough for exploration without scuba gear at the height of summer. Otherwise, it takes a dive to explore its flooded passages.

"You go in that entrance, and immediately you are in water up to your chin," Dr. Niemiller says. From there, the journey twists and turns through tight spots and chambers, and the team sloshed through plenty of water at times.

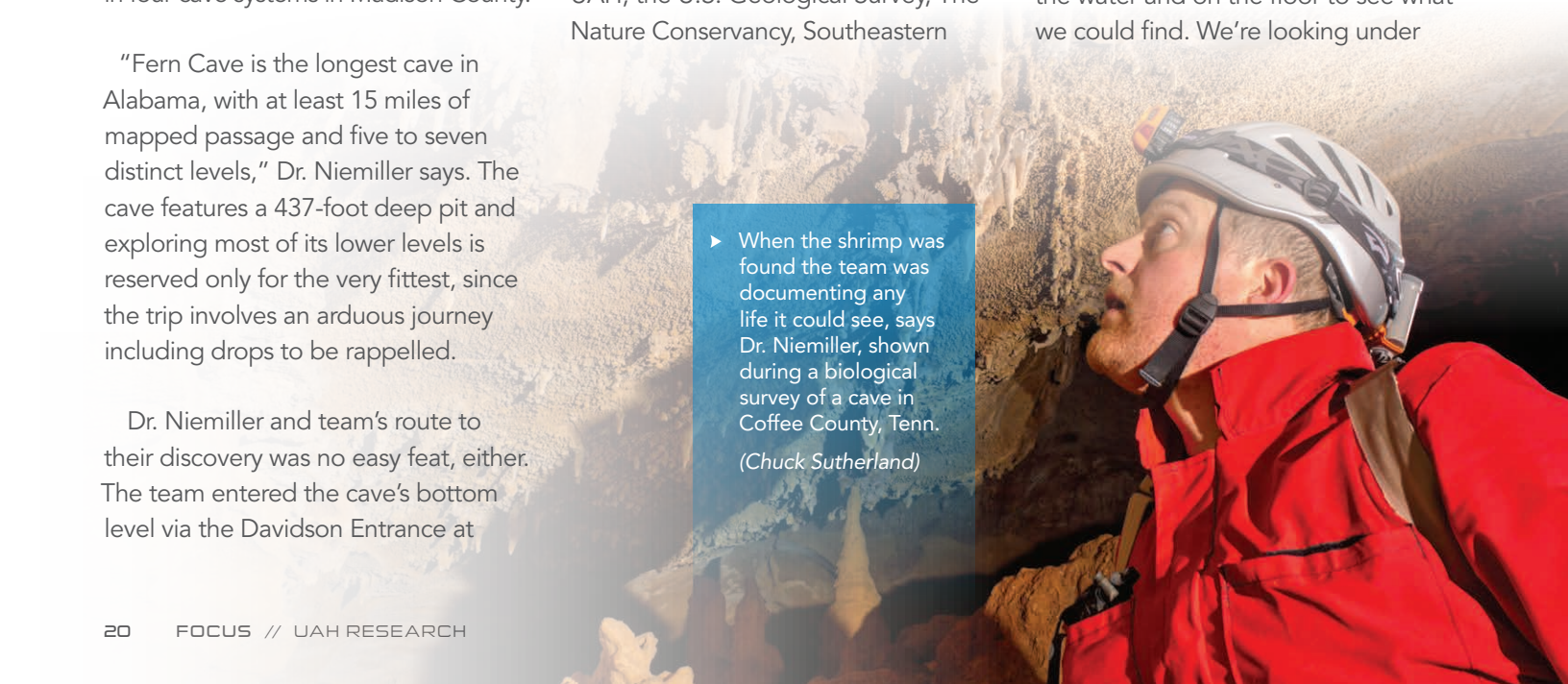
The biological surveys of Fern Cave are part of a two-year project funded by the U.S. Fish and Wildlife Service (USFWS) that has involved over 20 biologists, hydrogeologists, and cavers to date from several organizations, including, USFWS, UAH, the U.S. Geological Survey, The Nature Conservancy, Southeastern Cave Conservancy Inc., Kentucky Geological Survey, Huntsville Grotto and Birmingham Grotto.

The scientists relied on the knowledge and expertise of Steve Pitts who has mapped much of Fern Cave and is its guardian for the Southeastern Cave Conservancy Inc. "He has visited the cave more than any person alive, more than 450 times. Without Steve, this project wouldn't be possible," Dr. Niemiller says.

"We went there to look for everything," he says. "It's the biggest cave in Alabama, but really, we didn't know much about it from a biological perspective."

The cave houses the largest winter colony of federally endangered gray bats (*Myotis grisescens*), and there are other commonly found cave dwellers, like salamanders and millipedes.

"We were working on documenting any life we could see," Dr. Niemiller says. "We're looking at the ceiling, in the water and on the floor to see what we could find. We're looking under



When the shrimp was found the team was documenting any life it could see, says Dr. Niemiller, shown during a biological survey of a cave in Coffee County, Tenn. *(Chuck Sutherland)*

rocks and into crevices, as well – every nook and cranny."

Team members meticulously documented their findings in notebooks and took photos of specimens. In cases where the species was not readily identifiable, they collected voucher specimens for later study.

"We came up on this passage where we could see there was a muddy bank, a place that maybe at other times of the year you didn't want to be, an area that was clearly underwater for most of the year," Dr. Niemiller says.

At this spot there were vestigial pools left after water receded in the dry summertime. Dr. Niemiller peered into one.

"We are finding cave crayfish, cavefish and sculpin in this pool. Then I looked down and saw this weird thing, this little white crustacean swimming toward me, and I said, 'That's a cave shrimp!'"

The team collected a live sample because at the time it was unsure if the specimen was actually the endangered shrimp or possibly a new undescribed species. After leaving the cave, Dr. Niemiller called USFWS and got permission to retain the specimen, which is now housed in the Auburn University Museum of Natural History.

The team found three other cave shrimp on that day in August 2018 and observed another two on a return trip in July of this year. The little animals pose some interesting questions for science.

First of all, there's the Fern Cave location, in the Paint Rock River watershed, which led Dr. Niemiller to wonder if the shrimp was an undescribed species. However, the shrimp found at Fern Cave have been morphologically and genetically linked to those found in Madison County, a different watershed area.

"Fern Cave is in a different county and a different location than the other caves where this species has been found," Dr. Niemiller says. How did the Alabama Cave Shrimp make it there?

Little is known about the shrimp's ecology. How does it breed, what is its lifespan, how does it survive and what foods does it eat? And why and when did the shrimp lose its eyesight and live in caves?

"Does this species represent something that went underground a million years ago? Two million? Five million?" Dr. Niemiller asks.

What are its closest relatives? "We need to explore the genetics of the species in more detail to find that out."

Perhaps the most interesting question is, what is the actual range of the shrimp, since it was newly found in a distinct watershed.

"We have to get a better understanding of the distribution of the shrimp," Dr. Niemiller said. "We're hoping to get additional funding to survey other sites in Alabama for the presence of the cave shrimp and other cave species of conservation concern."

After all, perhaps the Alabama Cave Shrimp is doing better than scientists think, even though a population has disappeared in one cave in Huntsville, where it was seen in the early 1970s.

Caves in this region of the country are far more extensive than they are amenable to human exploration, and here the tiny shrimp has had scientific impact. Dr. Niemiller's team has developed a genetic assay that uses the shrimp's environmental DNA. Shed in the normal course of living, this DNA could be detected in water samples taken from caves and springs by the assay, allowing science to peer into inaccessible areas in search of *Palaemonias alabamae*.

In northern Alabama and southern Tennessee, cave systems often are so extensive that anyone could be standing atop a habitat for the Alabama Cave Shrimp and not even know it.

"It could be right under your feet," Dr. Niemiller says. "It could be in a cavity, a well or a cave system underground."

Tiny cave passages too small to explore link together with underground gravel deposits flowing with water to offer lots of species habitats and opportunity for dispersal, and most of them science as-yet knows nothing about. In this respect, biological cave exploration is much like exploring the deepest recesses of the oceans.

"That's what draws me to it," Dr. Niemiller says. "Every cave is different, and differently populated. We're making many new discoveries." ■

Why believe a snitch?

Students probe how juries weigh jailhouse informant testimony

Jailhouse informant testimony in a legal trial seems to exist at the intersection of two old TV shows, "Law and Order" and "Let's Make a Deal." There's almost always a reward for it, and you'd think that should mitigate against accepting its truthfulness.

Yet, false testimony from jailhouse informants is one of the leading causes of wrongful convictions, according the Innocence Project, and it is the leading cause of wrongful convictions in capital cases.

So, why does psychological research show a jury bias toward believing snitches?

The history of jailhouse informant testimony and how it relates to the administration of justice are the subjects of a chapter written by two graduate students in psychology at UAH for a forthcoming book.

Based on research they did, along with graduate student Lexi Mecikalski, Baylee Jenkins and Alexis Le Grand co-authored a chapter in "Advances in Psychology and Law" by Dr. Stacy Wetmore, a tenure-track professor at Roanoke College in Salem, Va., who earned her bachelor's and master's degrees at UAH.

That work is part of the trio's broader research examining a fundamental question: How do juries weigh jailhouse informant testimony when deciding guilt or innocence?

Their insights have proven valuable to defense attorneys, says Dr. Jeffrey Neuschatz, their advisor and a distinguished professor of psychology.

"Not only do they do the research, but they are applying it to inform the legal system," Dr. Neuschatz says, "They actually consult in criminal trials that are going on now."

They've consulted on trials and retrials, some with histories going back as far as 1974.

In those consultations, they examine past inconsistencies in informant testimony and check whether statements made by an informant align with case facts. They also examine the discovery process, checking to see if the informant could have had access to news coverage or phone calls that would have provided relevant information that could be used to manufacture testimony.

For the book, the students explored how the law applies to jailhouse informant testimony.

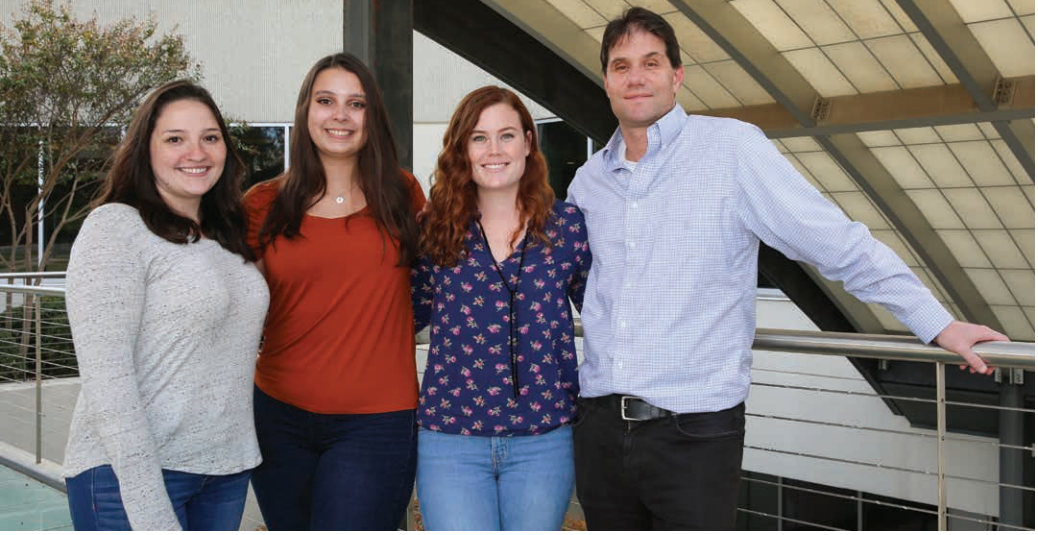
"We discuss reforms that have been suggested in recent years from different organizations, such as The Justice Project, as well as what some states have changed in their laws," says Jenkins.

"Some of these recommendations have included reliability hearings for jailhouse informants, as well as the provision of an enhanced discovery" to lawyers, she says. "The enhanced discovery would include the criminal background, the incentives given and the testimonial history of the jailhouse informant."

In their research, actual trial transcripts are presented to mock juries of test subjects. The researchers manipulate aspects of the trial and measure the impact on the jurors.

When it comes to jailhouse snitches, they've found that jurors generally have a bias toward believing them and are more inclined to accept the lawful explanation offered by the informant at trial. Their research says that jurors tend to discount the fact that the informant is in jail, is breaking the code of the prison by snitching and is receiving payment in the form of time off their sentence or extra privileges.

"People think that they're coming forward to testify because they feel bad for the family, or any other moral reason," Le Grand says.



From left, psychology graduate students Lexi Mecikalski, Alexis Le Grand and Baylee Jenkins with their advisor, Dr. Jeffrey Neuschatz.

It is extraordinary that jurors have these beliefs because jailhouse informants by definition are in jail for breaking the law, she says.

According to their research, many informants have testified for the prosecution in several trials and have long criminal records.

Dr. Neuschatz and his students are exploring prosecutorial vouching as an explanation for why jurors believe jailhouse informants.

Prosecutorial vouching is the idea that jurors have faith in the justice system and believe that a prosecutor would only call a witness to trial if he or she had already confirmed that the testimony was truthful. That belief could add credibility and believability to prosecution witnesses, and most jailhouse informants testify for the prosecution.

"We know from research that people come in with a bias to believe the prosecution, so they accept that narrative and this influences their interpretation of the evidence," Dr. Neuschatz says.

As a legal matter, juries are often informed about the details of any deal offered to a jailhouse informant. It would seem that jurors would be suspicious of how offers of leniency in exchange for testimony might influence its truth.

So, why does research show that jurors still tend to believe informants?

"That's the million-dollar question and we're still trying to figure that out," says Le Grand.

"It could be that, as a juror, you might want to believe in the fairness of the criminal justice system that we have, and you think that the prosecutor won't put someone up there on the witness stand who isn't legitimate," says Jenkins. "We're doing a study on how far can you push the credibility of the jailhouse informant before mock juries stop believing them."

That study is based on Darryl Moore, a career jailhouse informant from Chicago whose mother testified for the defense at one trial that she wouldn't believe anything he said. At what point will a jury think that the informant is lying?

For her thesis, Le Grand is investigating how a jailhouse informant's previous history of testimony may impact jury decision making.

"How many times can an informant have testified before the jury starts to take that into consideration?" Le Grand asks.

She's probing how disclosure of an informant's past history might influence a jury. Does telling a jury that an informant has testified in other trials have an impact?

"I want to find out how the jury evaluates that information in making its decision," she says.

Mecikalski's thesis explores the reward side of the informant equation. Does a larger reward for jailhouse snitch testimony affect the ultimate verdict?

"My thesis looks at the incentive size and immediate release of the informant from jail, and how that affects the general outcome of the trial," she says.

Meanwhile, Jenkins is researching whether informant testimony about a confession can impact how a jury perceives other evidence offered at trial.

"It involves whether considering an informant as a reliable source then makes the evidence more credible and acceptable to a jury, or how it taints other evidence that contradicts that," she says.

The research is being done in collaboration with Dr. Jonathon Golding, a professor of developmental, social and health psychology at the University of Kentucky, who stages the mock jury trials and then has the jurors debate the trial and how they assess the primacy of jailhouse informant testimony. ■

CONSORTIUM'S INTERNSHIP CONNECTS STUDENTS WITH ALABAMA INDUSTRY

A Low Temperature Plasma (LTP) internship program led by UAH connects undergraduate and graduate students in STEM fields from nine Alabama partner universities with Alabama-based industries.

The Corporate Internship Program on Plasma Technology Applications (CIPPTA) is one of four different summer internship programs under a $20 million, five-year grant by the National Science Foundation (NSF) Experimental Program to Stimulate Competitive Research (EPSCoR) known as Connecting the Plasma Universe to Plasma Technology in Alabama: The Science and Technology of Low-Temperature Plasma (CPU2AL).

"The ultimate goal of the CPU2AL internship program is to engage a diverse, educated and skilled pool of scientists and engineers to promote long-term relationships between students, academia and industry to enhance the Alabama workforce," says Patrick Hambloch, CPU2AL project manager.

CPU2AL is an integrated, statewide collaborative effort that 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 in LTP environments. The program's principal investigator is UAH's Dr. Gary Zank, who is director of UAH's Center for Space Plasma and Aeronomic Research (CSPAR), the Aerojet Rocketdyne chair of the university's Department of Space Science and a member of the National Academy of Sciences.

UAH leads a consortium of nine Alabama universities, including Auburn University, the University of Alabama at Birmingham, Tuskegee University, the University of Alabama, Alabama A&M University, the University of South Alabama, Alabama State University and Oakwood University, together with an industrial partner, Computational Fluid Dynamics Research Corp. As the lead institution, UAH interfaces directly with the NSF and all other institutions receive funding through subcontracts with UAH.

For CIPPTA, CPU2AL sponsors a 10-week internship for students pursuing degrees in science, technology, engineering and mathematics (STEM).

"The program provides students at the nine CPU2AL partners with quality experiences on plasma technology applications at private companies and allows students the opportunity to establish connections with industry and university professionals," Hambloch says. "It is open to undergraduate and graduate students in a broad spectrum of disciplines."

Applicants must be fully enrolled at a partner institution as graduate students or as a sophomore, junior, or senior and must plan to be enrolled at a CPU2AL partner institution during the term after the internship. Students graduating before the internship are not eligible to apply unless they have an established research relationship with a CPU2AL investigator prior to the internship appointment.

Applicants must have a cumulative GPA of 3.0 or higher and be 19 years old by the start date of the appointment.

"The intention is to develop both the student workforce and the industry in the field of Low Temperature Plasma," Hambloch says. "The companies can define their own projects related to Low Temperature Plasma in a wider sense, and then students can apply for the positions."

CPU2AL has established partnerships with Alabama companies, is reaching out to companies that are past partners and seeks new partners that the researchers of the partner institutions have worked with. Any company that has ties to LTP can contact CPU2AL for project proposals, Hambloch says. ■

TOGETHER

WE CAN PUSH THE BOUNDARIES OF KNOWLEDGE…

At UAH, education and research collide. Our high-tech research centers, academic colleges, and research investments are responsible for over **$109 MILLION** in R&D funding, while graduates of our academic programs consistently reinforce 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.

Learn more at **UAH.EDU/GIVING**.

THE UNIVERSITY OF
ALABAMA IN HUNTSVILLE

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

UAH.EDU/RESEARCH

Nonprofit Org.
U.S. Postage
PAID
Huntsville, AL
35899
Permit No. 283