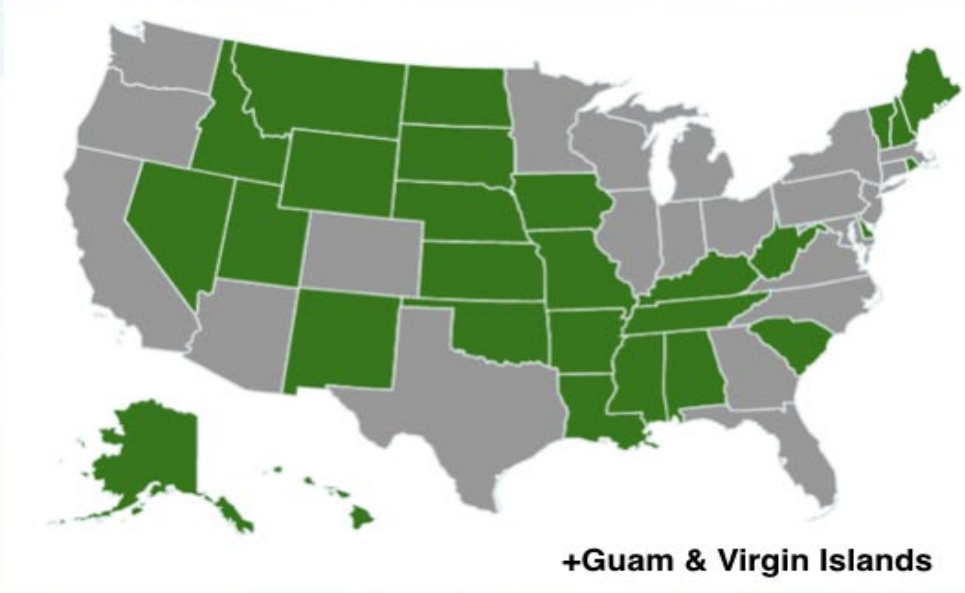
Materials Science

Introducing The Center for Advanced Surface Engineering

Arkansas NSF EPSCoR | Spring 2016

What is NSF EPSCoR?

It's a National Science Foundation grant program with nationwide participation of 30 states (jurisdictions) that funds scientific research and STEM education programs.



+Guam & Virgin Islands

Experimental Program to Stimulate Competitive Research

www.nsf.gov/epscor

ABOUT THIS ISSUE

Arkansas NSF EPSCoR just began a new five-year project called the Center for Advanced Surface Engineering (CASE). The researchers involved in this project are pretty amazing, and this issue features information on the Center leadership and what they hope to achieve through their research. If you want to read more about the researchers featured in this issue and their teams, check out this website:

http://asta.ark.org/ASSET_faculty.html

Look for this microscope icon throughout the newsletter for fun activites!

DIRECTOR'S FAREWELL: HAPPY RETIREMENT TO DR. MCCLURE

Dr. Gail McClure has served as the Arkansas NSF EPSCoR Program Director for the past ten years. During her tenure with EPSCoR, she helped Arkansas secure $53 million from the federal government for scientific research and education. The research has spanned renewable energy, nanomedicine, sustainable agriculture, and much more. She has devoted her entire professional career to bettering Arkansas education and society. In this profile, Dr. McClure describes her path through education, work, and family life, and why she joined EPSCoR.

Dr. McClure recently retired from the Arkansas Economic Development Commission, having formerly served as Arkansas NSF EPSCoR Program Director. She is currently enjoying life with her grandchildren, family, garden, and chickens. We thank Dr. McClure for her many years of dedicated service to Arkansas and congratulate her on her many accomplishments in life. We will miss her guidance, and her potluck cheesecakes.

"My career pathway was a bit convoluted. I graduated college initially with a bachelor's degree in zoology and a master's in natural sciences. I really didn't know what I was going to do next, and I decided to move back to my rural Arkansas hometown. I began looking for jobs and saw that the neighboring school district needed a high school teacher for biology and chemistry. I got my first teaching job there, and was married just a few years after that. My husband wanted to go to law school, so we moved to Northwest Arkansas and I taught K12 science there while he worked on his law degree. Then we moved back to Malvern, his hometown, and made a home there and started raising a family. I went back to teaching high school. For 16 years I taught science, biology, and chemistry, or whatever was needed in the school.

One day I took my advanced biology class on a field trip to the National Center for Toxicological Research (NCTR), where we went on a tour and participated in a career discussion. The purpose of this tour was to show the students that there are more career paths that they could pursue with a science degree, besides being a medical doctor, nurse, or veterinarian. One of the NCTR researchers presented that the University of Arkansas for Medical Sciences (UAMS) had advanced degree programs for Toxicology, and that they would pay you a salary while you earned your degree. I had wanted to get an advanced degree above my Master's degree, but I did not know that there were programs like this one that would provide salary. Since my Master's degree was not research-based, I couldn't enter a doctoral research program without some more background education. I also investigated educational leadership degrees, because I had been teaching for over a decade and I wanted to do something different.

I applied at UAMS at age 39, already with three young children. I received a Kellogg fellowship, so I started school again and for the next several years I commuted back and forth to Little Rock to go to class. I first received my Master's degree in Occupational and Environmental Health degree, which was very similar to the toxicology program. I immediately entered the doctoral research program. It took me five years to complete my studies by combining them, so I graduated in 1995 with a PhD in toxicology.

I had a home and a family already, so I really couldn't just get up and move across the country for a post-doc position. I was fortunate to be offered a postdoctoral position at Arkansas Children's Hospital in a clinical study on herbicide exposure, because I had previously studied some herbicides that are used in the Arkansas delta. We looked at immune function and took blood tests, working with farming families in the area.

Continued on next page....

"I did that for a year and a half. About the time that was being finished up I was offered a second postdoc position at the NCTR division of molecular epidemiology, which gave me the opportunity to expand my work in epidemiology and molecular biology. This background secured me a position back at UAMS to run their clinical translational trials for molecular epidemiology. There was a partnership between NCTR and the UAMS department of surgery, and they were looking at a lot of environmental factors related to development of breast cancer, colon cancer, prostate cancer and many others.

I continued this work for another ten years. I loved the work I was doing, but the hours were extremely long. Most days began at 5am when the patients were coming in for surgery, and lasted until 5 or 6 pm everyday. I did not have anytime for my family, and that is when my kids were growing up. My family definitely helped me along the way. It really was a family effort for me to get my degree because I was not a traditional student and I had a lot of other responsibilities with my family. My children learned to cook, and everyone cooked a meal one night per week and I cooked on the weekends.

I took a position at what was formerly the Arkansas Science and Technology Authority, which I found to be extremely rewarding. I loved working in the lab, but a job in administration can be just as rewarding just in a different way. When one of my research teams has a success, I rejoice in that success. The other researchers may do the lab work, and they may receive the honor or award, but I was a part of what they accomplished. To see young researchers develop and become leaders is very rewarding. Our outreach efforts have also been really exciting; we generate interest in young people, teach them about many sciences and show them the opportunities available. Though we accomplished a lot, I think this is still lacking in some regions of the state. We still face the issue that in some of the rural areas in Arkansas and the country, some students really do not know what kind of opportunities are out there or how to reach them. I think that this type of outreach- raising awareness of job opportunities, and giving every student a chance and educational tools they need, is so important. I wish that someone had done that for me when I first graduated from college.

This most important thing that I think I have done for EPSCoR is bringing the different university campuses together in a strong, collaborative environment. For a number of years the campuses worked together, but they didn't really collaborate as teams. You had a team on one campus doing one thing, and a team on another campus doing another thing, and they were under the same award umbrella but it didn't seem like they weren't really collaborating. It has been really rewarding for me to see the effort expand in such a way that now we have multi-campus teams. You may have a team working on one particular topic, but it may be researchers from 5 different campuses and backgrounds working on the same team.

I am going to miss working with all the faculty and students. I have invested a lot of my life in these projects, and I know I will miss that, but I look forward to seeing their future successes and I am excited to see what comes out of the new project and how EPSCoR will continue to grow. I know that there is so much that will be accomplished in the future by these teams."

MATERIALS SCIENCE

Materials science is an increasingly important field of study. Almost everything is made of some kind of material. Materials researchers are now working to create new, stable, nanostructured materials. Sometimes researchers look to nature for inspiration, for example a lotus leaf (below). Lotus leaves are super hydrophobic- or water repellant- which gives them unique properties and the ability to float easily on water. The new fields of nanotechnology and biomaterials are providing materials scientists with new ingredients of molecular, organic, biological and inorganic building blocks to design and assemble nano-engineered materials with specific properties.

You are probably familiar with researchers like chemists, biologists, or physicists, but have you heard of materials researchers? Materials science spans so many different fields, including chemistry, biology and physics, so they are rarely called 'materials scientists'. Sometimes they are called ceramic or polymer engineers or metallurgists, and you can find them working in various industries, labs, and universities all over the world.

In the past, scientists used and changed materials by trial and error. Modern materials researchers manipulate and change materials based on fundamental understandings of how the materials are put together, often on the nanoscale level, which is too small to be seen with the human eye.

TEAMWORK MAKES THE DREAM WORK: CASE TEAMS

CASE consists of 4 research teams, plus a cyber infrastructure team and the central office. Each research team consists of 10 to 20 faculty (or reseachers), graduate students, and undergraduate students. Many people involved in the project are on more than one of the teams.

The Mechanical team's goal is to develop new surface materials with specific nano-engineered structure and properties.

The Tunable team's goal is to develop surface materials that have adjustable (tunable) properties that can change with the application of a stimulus.

The Cellulosic team is working to find new ways to extract cellulose from forestry by-products, then use the cellulose in materials for the other research teams, for example a cellulose water filter.

The Artificial Extracellular Matrix (aECM) team is trying to grow neurons on a variety of materials that could eventually be used as implants in the brains of people who have suffered brain trauma or stroke.

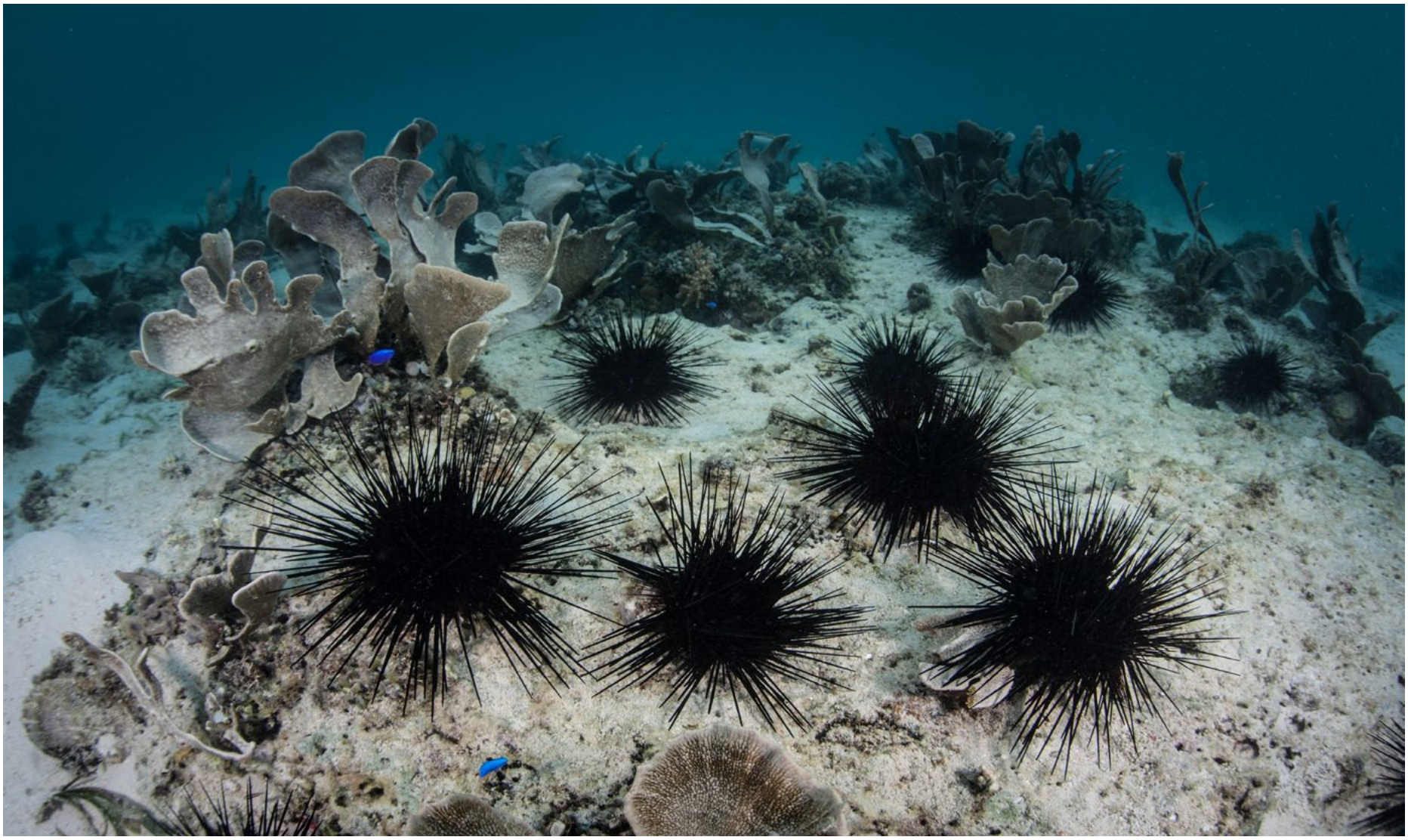
The Cyber Infrastructure team is working to connect the high-performance computing clusters around the state to the ARE-ON network so researchers all over the state can perform advanced 3D modeling of their work.

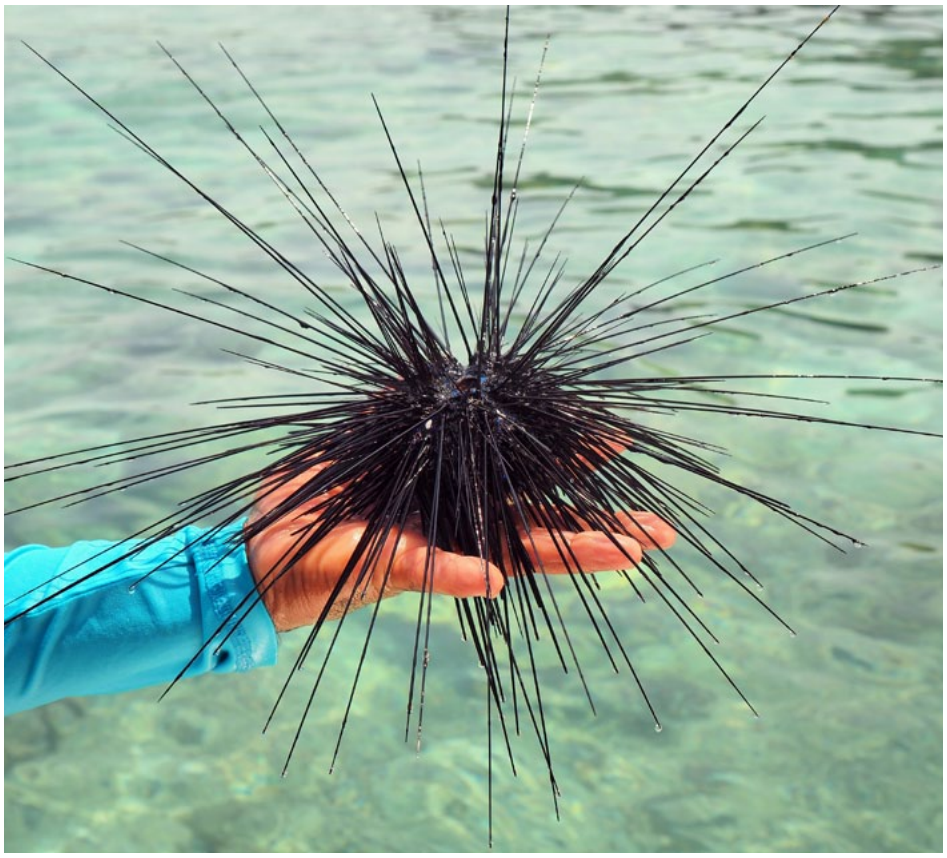
The Central Office team consists of the program director, administrator, education/outreach/diversity coordinator, and a couple of great interns.

ACTIVITY: BUILD YOUR OWN FLASHLIGHT

What happens inside a flashlight that makes the bulb light up? Why do we need a switch to turn on a flashlight? When engineers design electrical equipment, they figure out the optimum circuitry design for the situation, whether it is the installation of solar panels, the design of electric cars, the behavior of traffic signals, a hair dryer's on/off switch, the turn indicator lights on a vehicle or even a simple flashlight.

Activity link: http://tinyurl.com/hkbezv6





BIO-INSPIRED RESEARCH: LOOKING TO NATURE

One of the goals CASE hopes to accomplish is improving manufacturing processes. Around the world, manufacturers spend large amounts of money replacing tools and machinery that becomes too dull after use. The researchers believe if we can develop surface coatings that will keep tools sharper longer, it will impact the global economy and the environment.

Sea urchin teeth (above, right) are self-sharpening and continuously replace material lost through abrasion. They are such excellent grinding tools that sea urchins can chew on rocks continuously, and the teeth never become dull. CASE researchers are examining sea urchin teeth on a nanoscale level to determine what makes the teeth so sharp, and then will try to replicate it in the lab. Sea urchins are not the only biological inspiration for this team, look for the next newsletter edition to learn more!

DR. MIN ZOU: CASE DIRECTOR & CO-LEAD, MECHANICAL TEAM
MECHANICAL ENGINEERING, UNIVERSITY OF ARKANSAS FAYETTEVILLE

Dr. Zou currently serves as the Director of the Center for Advanced Surface Engineering, which focuses on developing multifunctional and tunable surfaces for product innovations that will impact Arkansas manufacturing, aerospace and defense, agriculture, forestry, oil and gas, food packaging, and healthcare industries.

"During my childhood in China, science and engineering became increasingly important fields. My mother was a teacher and my father was an aerospace materials engineer, so I was interested in science and especially engineering from an early age. I quickly realized that there were strides to be made in this field, and after scoring highly on aptitude exams I was placed in science and mathematics classes in school. After grade school I went to Northwestern Polytechnic University in China and received my Bachelor of Science and Master of Science degrees in Aerospace Engineering.

After this I began my career at the Shanghai Aircraft Research Institute, but I have a thirst for knowledge and wanted to continue my education. I found a professor that was working on an emerging field that I became interested in, tribology, at the Georgia Institute of Technology (GIT) here in the United States. Tribology is the cross-disciplinary study of surfaces interacting in relative motion. Tribology research often involves studies of reducing friction on surfaces, especially during manufacturing processes. I entered the graduate program at GIT and received a Master of Science and a PhD in Mechanical Engineering.

It is estimated that a third to a half of the world's energy production is used to combat friction and wear ($500B/year in US alone). Our research in advanced surface engineering aims to reduce friction and wear in mechanical systems, which will impact many industries in Arkansas and globally. Machinery and tools involving moving parts are used heavily in agriculture, manufacturing, aerospace, defense, as well as oil and gas industries. My team and I are working to develop surface engineering technologies that can be applied to machinery components, like rolling parts, bearings, piston rings, and cylinder parts in engines to reduce maintenance cost, increase service life, and improve fuel-efficiency. If we achieve our research goals, we will drastically impact the economy and the environment."

DR. ALEXANDRU BIRIS: CASE CO-LEAD, TUNABLE TEAM
NANOTECHNOLOGY, UNIVERSITY OF ARKANSAS AT LITTLE ROCK

Dr. Biris has been the Chief Scientist of the Center for Integrative Nanotechnology Sciences since its beginnings in 2005, and has served in the Director role since 2009. Dr. Biris leads the research at CINS, exploring the science of nanostructures that can be used to alter the properties of other substances at the atomic level. The key to Dr. Biris' vision for CINS is its aggressive outreach program to train and educate young people and other world class scientists who will serve and attract business and industry to Arkansas from the region and the nation. Dr. Biris is also Professor in the Systems Engineering Department at the Donaghey College of Engineering and Information Technology, and is the Sturgis Endowed Chair for Excellence in NanoSciences.

His areas of expertise include Nanotechnology, Raman Spectroscopy and X-Ray Diffraction, Planetary Instrumentation (Mars Dust Analyzer), Particulate Science, Nanoparticle and Carbon Nanotube Generation, Nanomedicine, Nanocomposite Materials for Space Exploration, Surface Technology, Nano-Sensors and Bio Nano-Sensors, Materials Science and Engineering, Coating Technology, Hydrogen Interaction with Metals, Alloys, and Carbon Nanostructures.

ACTIVITY: BUILD YOUR OWN TERRARIUM

Learn about photosynthesis, the water cycle, and water conservation by designing and building a unique terrarium in your home or classroom. Terrariums demonstrate evaporation, condensation, and precipitation through an enclosed or partially enclosed ecosystem.

Activity link: http://www.kidsgardening.org/node/96823

DR. MALATHI SRIVATSAN: CASE CO-LEAD, ARTIFICAL EXTRACELLULAR MATRIX TEAM
NEUROBIOLOGY & MOLECULAR SCIENCES, ARKANSAS STATE UNIVERSITY

"As a child I was very shy and not very good at sports, so I spent most of my time reading. I grew up in India, in a lower middle class neighborhood with my parents and five siblings. We did not have many of the things that most people take for granted, such as electricity or running water. I had to have all of my homework completed by dark because it was too difficult to read by kerosene lamp. If I didn't finish by sunset, I would walk to the nearest street lamp and finish it there. As I learned and observed the world around me, I realized very early on that people think and behave very differently from one another, even family members. This is why I became interested in studying the human brain; I wanted to unlock its secrets.

Neuroscience has always interested me. Millions of people in the world suffer directly and indirectly from neurodegenerative diseases, like Alzheimer's, dementia, and brain trauma or damage. That's why my team and I are currently studying neurons. Unlike skin cells and other cells in the body that are replaced after damage or aging, neurons are never replaced naturally, and any damage to neurons is permanent. If we can find a way to repair or replace bad neurons, it would help millions of people suffering from brain trauma or disease around the world. I am trying to find ways to replace the bad neurons, and to help remaining neurons make new connections in the brain to replace or assist neural connections that are broken. I also want to find ways to protect neurons from further damage, so that we can prevent the progress of diseases like Alzheimer's.

I have always wanted to make a difference in the world, especially with medicine and education. That's why I am a college professor and researcher. I want to help people all over the world affected by brain disease get as close as possible to a normal life, and teach and pass along everything I've learned to the next generation of scientists. Learning about the brain has always fascinated me, and teaching others about it gives me a great feeling."

DR. GREG SALAMO: CASE CO-LEAD, MECHANICAL TEAM
NANOTECH & PHYSICS, UNIVERSITY OF ARKANSAS AT FAYETTEVILLE

"When I was young, I was always interested in taking things apart and trying to put things back together. I had a curiosity of how things work, and I chose to study physics because it focused on how things work. Physics explains exactly why things work the way they do, from human beings to inanimate objects, engines, everything. Physics is about the rules that govern how things work. If you understand how things work, you can make new things that work differently.

One time I took a clock apart to see how it works. I had pieces all over the place, without my parents permission. When I tried to put it back together, it went together just fine, but there were extra parts left over... I couldn't figure out where they went. The clock was definitely broken, but thankfully my parents weren't mad. Another time, a lamp that my brothers and I made for my mom fell and broke. I worked so hard to figure out how it would go back together. We somehow managed to glue this lamp back together, and my parents never noticed!

There's never been a better time to go into science. The opportunity to ask questions, for example to ask what is life? What makes something living or not living? Those are the kind of questions that will be answered in the next generation's lifetime. Physics, chemistry, bioology, sociology... the lines between these fields are disappearing. Everything is important to something else. When we change the size of an nanoparticle, the chemistry and the properties change. This is true also for tissues- maybe we can make tissues made out of nano-segments of tissues that have different properties. Maybe we can reconstruct bone, or reconnect nerves like Malathi Srivatsan (above) and Michael Borrelli (next page) are working to do. The possibilities are endless. The communications, learning tools, and the Internet are just the beginning. As devices get smaller and more multifunctional, you will be able to do 10 times more in the next decade. Science and engineering are the fields that will drive our culture in the years ahead."

DR. MICHAEL BORRELLI: CASE ASSOCIATE DIRECTOR & CO-LEAD, AECM TEAM
RADIOLOGY & NEUROLOGY, UNIVERSITY OF ARKANSAS FOR MEDICAL SCIENCES

"What really solidified my interest in medical science was a summer science program for high school students sponsored by the National Science Foundation. It was held at Hahnemann Hospital and led by Dr. Satinsky, a well-known cardiologist (even mentioned on a M*A*S*H episode). We attended didactic lectures, participated in lab sessions and demonstrations. Later as a freshman in college at the University of Illinois Urbana-Champaign, I went around to labs asking if I could work there for extra cash. The professors shrugged me off at first, but I told them about my experiences and the NSF summer program, and ended up getting lots of lab experience during my undergraduate education.

In 2001 I had a brain aneurysm and stroke. It impaired my ability to read and write, and it took me 5 or 6 years to recover fully. When I came to UAMS in 2005, one of my colleagues, William C. Culp, M.D., was doing stroke research with ultrasound, which I was interested in because of my background in physics and ultrasound. Another UAMS colleague, Kevin Phelan, Ph.D., introduced me to a new neuron staining method, Fluoro-Jade, which had been developed in Arkansas at the National Center for Toxicological Research. Previously we had used a metabolic stain to look at portions of the brain that were still alive after a stroke. With the Fluoro-Jade staining method we could see individual neurons that died as a result of the stroke. We noticed that no matter the size of the stroke and no matter if we tried to preserve neurons with different protectants, neurons died. When neurons die, neural tracks are broken, neural networks are broken, and people will have deficits during recovery, like I did. That's when I realized, what if we also replaced some of the neurons instead of just trying so hard to protect them? What if we could have implanted some neurons in my brain, would that have made my recovery faster?

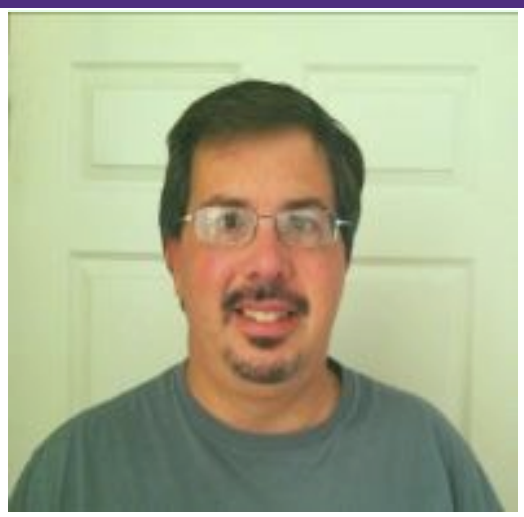
The best possible result of my research with EPSCoR is that we could develop the potential to grow specific types of neurons on these aECMs (outside the brain), implant them into the brain, and restore the neural networks that are lost during stroke or trauma. Lots of people are affected by stroke either personally or in their immediate family. Arkansas used to have the highest rate of stroke morbidity or mortality, now we are behind Mississippi on that statistic. I hope that I can help others who have had strokes or brain trauma recover more quickly and more effectively than I did. Mine was a fairly minor stroke, but it affected a critical part of my brain, part that I needed for my work and livelihood. Imagine an artist or a mechanic that loses control of their arm, you want to help them fully recover so they can really live again."

PARTNER PROGRAM SPOTLIGHT: THE ARKANSAS DISCOVERY NETWORK

Established in 2006, the Arkansas Discovery Network is a statewide initiative purposed to bring inquiry learning opportunities to the children of Arkansas, especially in rural and under-served areas. Five years later, a second grant was provided to fund the continuation and enhancement of this vital program. A statewide initiative, the Network represents a partnership of Arkansas museums strategically located across the state for maximum impact. It's purpose is to bring inquiry learning opportunities to the children of Arkansas, especially in rural and under-served areas. On behalf of the Network, the museum operates a mobile science museum and sponsors educational programs and exhibits at the partner museums and other educational venues.

Check out the website for more information, a calendar of events, and other resources: www.arkansasdiscoverynetwork.org

DR. DON PERRY: CASE ASSOCIATE CENTER DIRECTOR
CHEMISTRY, UNIVERSITY OF CENTRAL ARKANSAS



"During my postdoctoral fellowship I got very interested in material science, and I ended up at the University of Central Arkansas (UCA) as a surface science guy. Surface material science and nanotechnology are closely related and emerging as important fields. I met one of my current EPSCoR teammates, Dr. Alex Biris, while he was still a student. Alex was about to graduate and he wanted to set up a nanotechnology center at the University of Arkansas in Little Rock (UALR). He received a grant to purchase a Raman spectrometer, a piece of equipment that can identify things on a molecular level. I started visiting Alex at the new Center for Integrative Nanosciences at UALR at least once per week for almost two years to use the Raman spectrometer. Working with him and the many other members of the CASE team who really want to accomplish something worthwhile is very inspiring. At UCA I teach physical and environmental chemistry. My teaching is very interdisciplinary, like my research. That's what attracted me to EPSCoR & our new project CASE. The project has a lot of different people with a lot of different backgrounds. It was not easy to bring to fruition; it can be difficult to merge so many ideas together. Team science is always a struggle, but I'm excited and hopeful for what we can achieve.

In CASE there is not a particular component that I think is more important or stronger than the other. My hope is that over time, one of the projects will really start to stand out. For example, a better water filter. Is our water filter going to be the one to really make a difference? We have lots of natural resources in Arkansas like forestry by-products, so making filters made out of wood, which already has natural filtration properties, makes a lot of sense to me. Imagine if we could design something that interacts with light in a different way, or putting little particles in coatings to make things stronger or more robust. One problem with nanotech research is that it's difficult to explain possible broad impacts, so when I research things, I write up reports of how (in theory) knowledge of what I discovered will change other things. For example, if I'm studying an antibiotic embedded with a metal nanoparticle, both of these things are good at killing germs. If you put them together, the resulting product should be much better at killing germs.

It's not just about the research. We want to attract more students. We want to train the next generation, and give them opportunities. We want to teach. It helps the economy, the state, the students, and society. That's one of the reasons I do what I do. We could all be working in the private sector. In the chemistry department here at UCA, we have a group of people that are really great teachers. I think I'm a good teacher, but I work with some amazing teachers. I really enjoy mentoring research students. I try to get them involved in the work, give them as many opportunities as possible. I work mostly with undergraduates on campus. I like looking for students who are a bit like I was, maybe struggling or feeling lost but that have real potential. You start learning things in school or doing things and end up on a certain path, and you follow it. For some people that process is deliberate, for some it's not. And that's okay. That's what I want students to know."

DR. ANINDYA GHOSH: CASE CO-LEAD, CELLULOSIC TEAM
CHEMISTRY, UNIVERSITY OF ARKANSAS AT LITTLE ROCK

Dr, Ghosh is an Associate Professor of Chemistry at the University of Arkansas at Little Rock (UALR). He has developed an international reputation for his research efforts in inorganic chemistry with particular emphasis on "green chemistry." Prior joining to UALR, he worked as a senior research scientist at Halliburton Energy Services. He teaches Inorganic and Organic Chemistry courses and his research interest lies on synthesizing novel catalysts and materials for numerous applications. Use of renewable reagents and polymers for synthesizing novel chemicals and materials is also a focus of his research.

For his efforts in Green and Sustainable chemistry, he was a co-awardee of the Presidential Green Chemistry Challenge Award. He is a recipient of the Kenneth G. Hancock Memorial award from the American Chemical Society and Teresa Heinz Environmental Scholarship from Heinz Foundation for his contributions on Sustainable Chemistry.

GREEN Mobile Sighting: The GREEN Mobile was recently spotted at the 2016 EAST Initiative National Conference. Students and facilitators toured the bus and learned about solar energy and EPSCoR. Bring the GREEN Mobile to your school or organization: GREENMobile@uapb.edu

Million Women Mentors Kick-Off Event: We recently attended the Million Women Mentors Kick-Off Event at the Ron Robinson Theater in Little Rock. Arkansas First Lady Susan Hutchinson spoke about the importance of this organization, which aims to provide mentors to one million young women across the country.

DR. JIN-WOO KIM: CASE CO-LEAD, CELLULOSIC TEAM
NANOTECH & BIOLOGICAL ENGINEERING, UNIVERSITY OF ARKANSAS AT FAYETTEVILLE

Dr. Kim's primary research focus is in the area of Bio/Nano Technology, or biologically inspired nanotechnology, which spans interdisciplinary fields of biological engineering, biomedical engineering, biology, chemistry, and nanotechnology. Learning from biological systems in nature, his research aims to develop more effective and efficient ways to translate nanoscale design to larger scale applications, by building hierarchical structures for advanced materials and devices that are bio-inspired.

His research specifically focuses on designing programmable self-assembling structures technology to construct more complicated and controlled multifunctional materials with "customized" shapes and functions for specific applications. Applications could be biomedical, for example medical therapies, diagnostics, and drug delivery, or photovoltaics (solar cells).

ACTIVITY: WETLANDS IN THE CLASSROOM

Wetlands act as a buffer zone between dry land and bodies of water. In this activity, students will learn about the relationships among precipitation, runoff, and wetlands, then relate the importance of wetland functions to their own needs and daily lives.

Activity link:
http://ecosystems.psu.edu/youth/sftrc/lesson-plans/water/6-8/wetland

DR. BRANDON KEMP: CASE CO-LEAD, CYBER INFRASTRUCTURE TEAM
ENGINEERING & ADVANCED MODELING, ARKANSAS STATE UNIVERSITY

"As part of this EPSCoR project, my role is actually more science-based. Not only modeling scientific problems but also engineering systems as well. The primary focus of my research has to do with the fundamental interactions of light or electromagnetic fields and waves of materials.

This was a program that I got involved with when I was a PhD student at MIT. I worked on it at night and on weekends, and had some collaboration at Lexmark, MIT, and in China. We worked on problems like, how do you describe invisibility cloaks? So when I came to ASU, the idea was to develop this new Master's program and research center. I really wanted to take these ideas further and answer a lot of unanswered scientific questions about how light interacts with matter and the forces that it exerts. Really what we are dealing with is, how do you calculate forces that electromagnetic fields exert on matter, and what is the distribution of those forces of matter? Are they surface pressures, are they volume forces, those sorts of things. I developed a NSF career project shortly after coming to Arkansas State and so now we are trying to determine how to model these things but also what kind of interesting applications come out of it.

The EPSCoR program was a natural extension of my past work, because CASE is working with surface engineering. How do you use external stimuli to change properties of surfaces, how can you exert an electrostatic field to a surface and change its properties in some way? That inherently deals with the energy and momentum of light stresses of electromagnetic fields, and how that interacts with matter. I also do a lot of analytical modeling and simulations, so it just seems like a really good fit to be involved in the CASE project and the Cyber Infrastructure team.

GLOBAL LEADERS IN VIRTUAL REALITY

The Emerging Analytics Center (EAC) at UALR has joined the EPSCoR project's cyber infrastructure team. The center's director, Dr. Carolina Cruz-Neira, and her team of faculty and students recently demonstrated several prototypes that are being developed there. Virtual reality modeling and simulations are extremely useful and effective ways to visualize data and help us understand complex systems. Currently these simulations use a large amount of data, which is difficult to share among different institutions or groups.

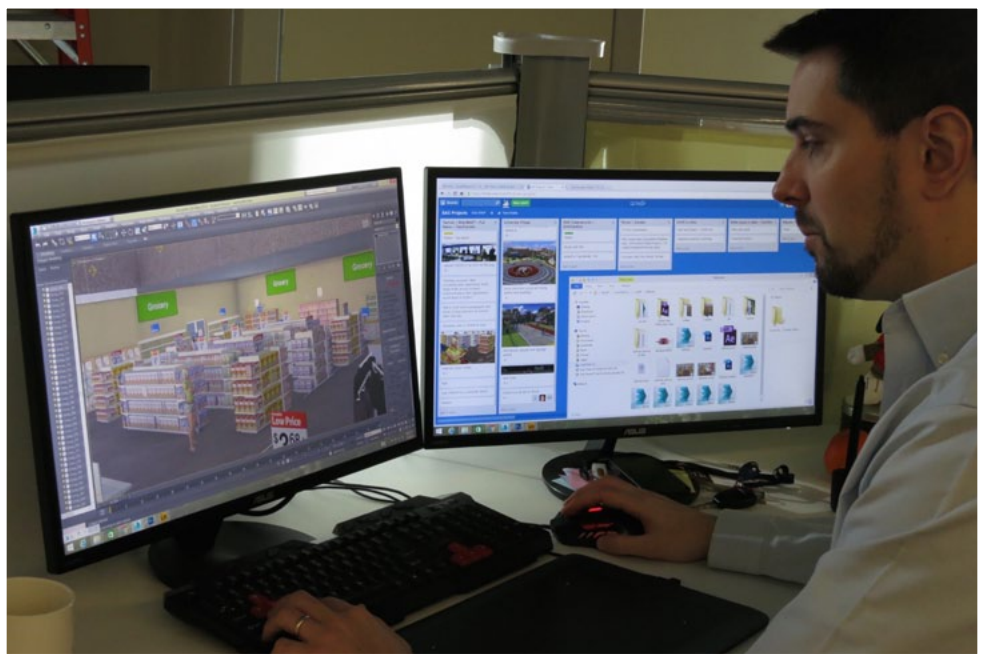
The cyber infrastructure team plans to connect the few high performance computing clusters around the state to the ARE-ON network. Once completed, any student or researcher at any higher education institution in Arkansas will be able to access this extremely advanced system and easily share data and modeling simulations with each other. We believe that this acheivement will open a floodgate of new ideas and research, which will benefit not just students and teachers, but everyone in Arkansas.

Tom Coffin gives us a tour of a virtual zoo exhibit in the EAC's cave. Tom is the EAC's Senior Visualization and Operations Manager.

You Tube

Visit our YouTube channel (@arepscor) for videos about virtual reality and the Emerging Analytics Center.

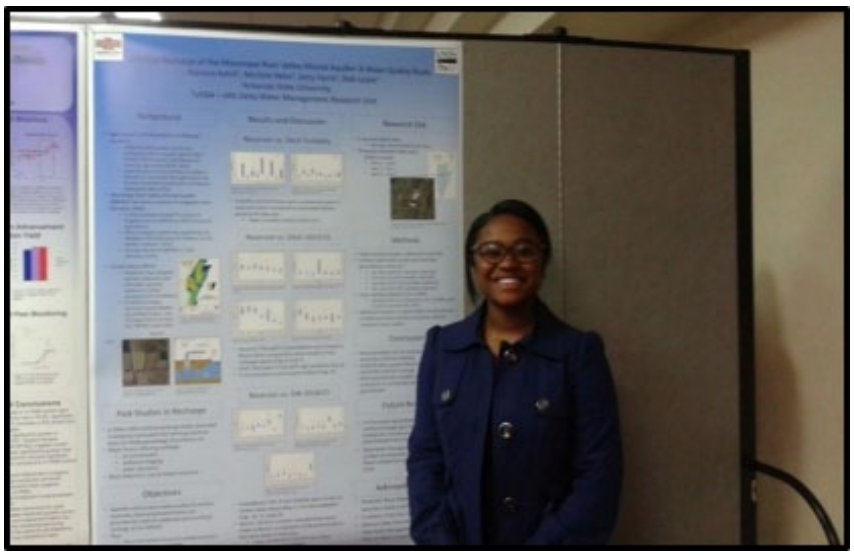
Graduate student Patricia Covington uses an Oculus Rift to control a virtual pottery wheel, created by EAC doctoral student Juan Sebastian Muñoz.



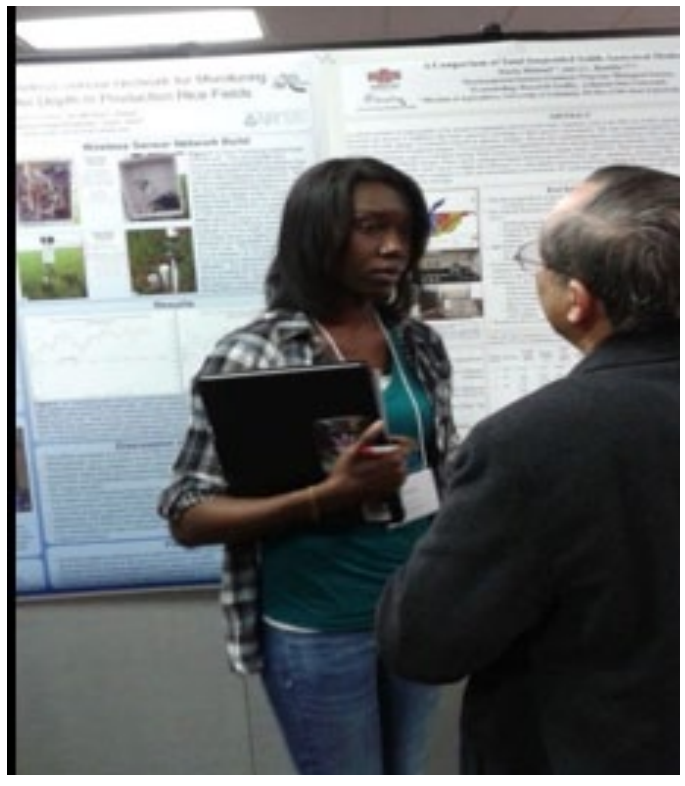
The EAC's lead artist Jason Zak walks us through a virtual retail store.

GRADUATE STUDENTS HELP FARMERS & ENVIRONMENT THROUGH RESEARCH

An Update from Bridging The Divide (NSF EPSCoR Track-3)

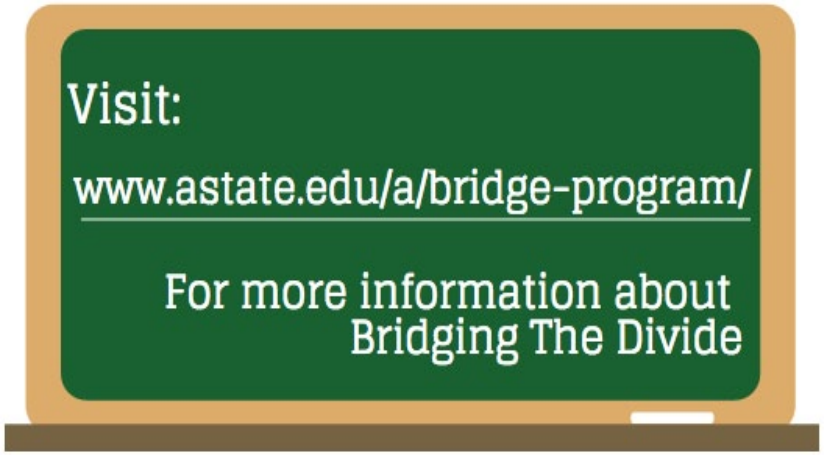


Klarissa Kahill and Marla Moland are both graduate students in the EPSCoR Track III program, "Bridging the Divide: A Program to Broaden Participation in STEM Ph.D." commonly referred to as the Bridge Program. Both students are enrolled in the Masters in Environmental Sciences program at Arkansas State University in Jonesboro. On Wednesday, January 27th, they presented their research at the 18th Annual Soil and Water Education Conference which was held at the Convocation Center in Jonesboro, Arkansas. The conference was widely attended by scientists from universities as well as federal agencies such as EPA and USDA, and farmers from Arkansas. Both research presentations attracted much attention since both of their research projects are application-focused.



Klarissa presented her research titled, "Artificial Recharge of the Mississippi River Valley Alluvial Aquifer: A Water Quality Study by Klarissa Kahill and Michele Reba; A-State Environmental Sciences Graduate Program and USDA-ARS Delta Water Management Unit". Klarissa collects and analyzes water quality of farm reservoirs and their associated drainage ditches to nearby groundwater wells for use as potential source water for artificial recharge of the Mississippi River Valley Alluvial Aquifer. Her research is supported by the Delta Water Management Research Unit of the USDA- Agricultural Research Service whose mission is to preserve water quantity and quality for agriculture in the Lower Mississippi River Basin.

Marla presented her research titled, "A Comparison of Total Suspended Solids Analytical Methodology by Marla Moland and Jennifer Bouldin; Environmental Sciences Graduate Program and Biological Science, Ecotoxicology Research Facility, Arkansas State University". Her research is supported by the Ecotoxicology Research Facility. Since the concentration of suspended material in water is a main measure to determine water quality, Marla evaluates the differences between the most common water quality analytical methods, total suspended solids (TSS) by filtration and suspended sediment concentrations (SSC) through evaporation, and between sub-sampling techniques, hand-stirred and automated subsamples. Results of these different methods are also compared for the various soil types (sand; silt; and clay) to determine which of these methods will produce reliable results with regards to determining water quality.



Check out our YouTube channel (@arepscor) for videos about other Bridging The Divide Students.

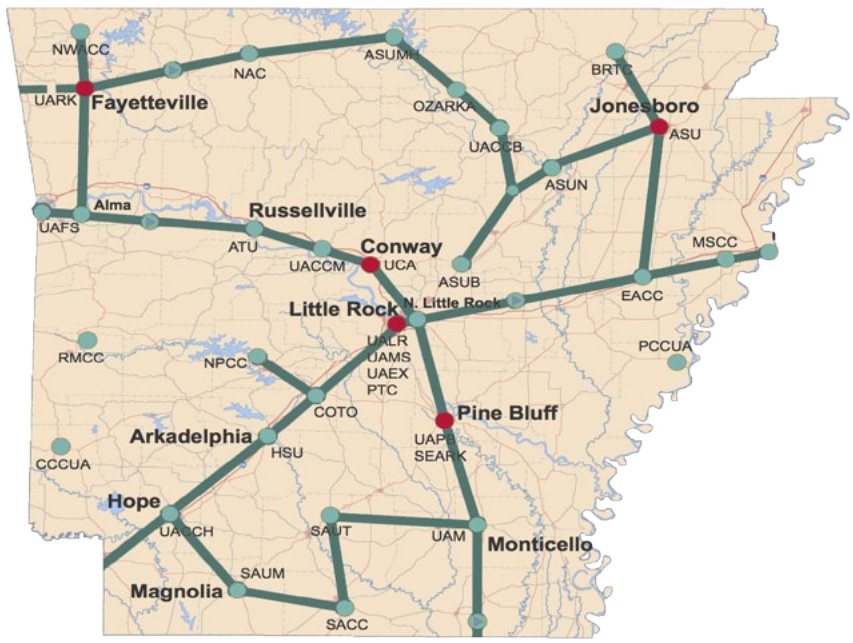
DR. JACK COTHREN: CASE CO-LEAD, CYBER INFRASTRUCTURE TEAM
GEOSCIENCES & ADVANCED MODELING, UNIVERSITY OF ARKANSAS AT FAYETTEVILLE

Dr. Cothren is director of the Arkansas Research and Computing Collaborative which includes both the Arkansas High Performance Computing Center and the Center for Advanced Spatial Technologies. His research interests include various aspects of digital photogrammetry including sensor modeling, DEM extraction, feature extraction and matching for orientation, integration of LIDAR point-clouds, reliability analysis of adjustment models and integration with enterprise-scale Geospatial Information Systems.

"A lot of the problems that we have to solve in the geosciences, like many other sciences, are enabled by high performance computing. So you need some general knowledge about high performance computing and cyber infrastructure just to approach some of the problems. When I was in the Air Force, we were involved with lots of computing and technology, which has led me over to the computing side a bit more than the science side of what we are working on.

I am a native Arkansan, and I am really interested in seeing the Arkansas economy succeed and improve. I am very happy to be involved in efforts within the research community that will benefit our state, so I am glad to be a part of CASE. This project could have a significant impact for Arkansas in so many ways. Growing up in a small rural community has had a huge influence on me, which is why I want to help Arkansas grow."

The map to the right depicts the ARE-ON fiber network. The red dots on the map indicate where the high performance computing (HPC) clusters exist currently. Dr. Cothren & Dr. Kemp are leading the cyber infrastructure team to connect the HPC clusters to the ARE-ON network so that every college student, professor, and researcher can use this super advanced technology for 3D modeling, visualization, rendering, algorithms, and much more. Learn more about ARE-ON at www.areon.net



PARTNER PROGRAM SPOTLIGHT: THE ARKANSAS STEM COALITION

The Arkansas Science, Technology, Engineering and Math (STEM) Coalition is a statewide partnership of leaders from the corporate, education, government and community sectors which plans, encourages, coordinates and advocates policies, strategies, and programs supportive of excellence in science, technology, engineering, and mathematics (STEM) teaching and learning in order to expand the economy of Arkansas and produce higher paying jobs.

Check out the website for more information, a calendar of events, and other resources: www.arkansasstemcoalition.com

INNOVATION STATION

The Arkansas Regional Innovation Hub recently hosted a grand opening event, featuring lots of neat stuff, including this Oculus Rift driving demonstration (above) to promote safe driving. R2D2 (below) and Darth Vader also were in attendance.

The Innovation Hub is housed in a former police station in downtown North Little Rock that has been divided into four main sections: the Launch Pad, the STEAM Lab, the Silver Mine, and Art Connection.

The Launch Pad is a makerspace with cutting edge technology and equipment like 3D printers, laser engraving machines, and machines for wood and metal working. The STEAM lab is a computer lab where individuals can create computer software or practice general computer skills such as graphic design, coding, or even creating a video game. The Silver Mine is a place where individuals can discuss ideas and collaborate with individuals to create profitable business ventures. This space even includes small meeting rooms. The Art Connection is where teens can paint, make pottery, and use silk screening equipment to make and sell art.

Check out arhub.org to learn more about this amazing place and see a calendar of upcoming events!

Join the EPSCoR community online!
You can find us here:

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