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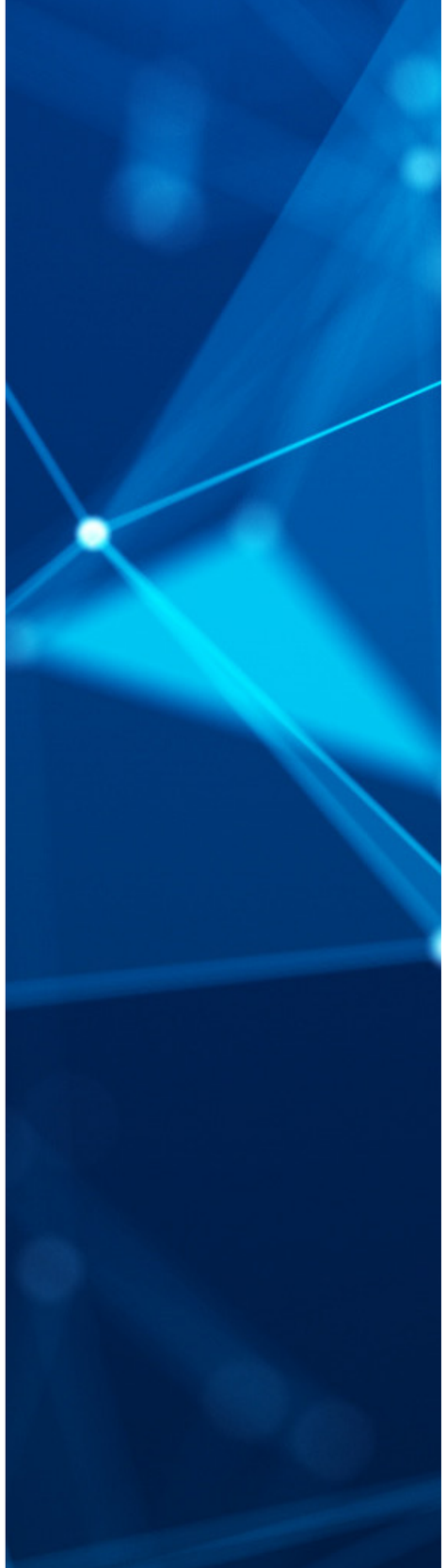

35 WV STaR Division

VOLUME 19 ISSUE 1

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ABOUT

STaR Division: Science, Technology & Research at the West Virginia Higher Education Policy Commission provides strategic leadership for the development of competitive academic research opportunities in science, technology, engineering and mathematics (STEM).

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FROM THE DIRECTOR

This issue highlights the impact of funding by the National Science Foundation's EPSCoR program on STEM research in West Virginia. West Virginia has received a total of four EPSCoR Track-1 grants from the NSF since 2001. EPSCoR is special funding that is available to specific states and U.S. territories to build up research infrastructure (facilities and human resources) to make them more competitive for general funding from the NSF and other federal agencies.

Currently, EPSCoR Track-1 grants are for $20 million dollars and last 5 years. West Virginia received its fourth Track-1 in May of this year for research, education, and workforce development in the field of neuroscience, data science, and informatics. These grants require collaboration between universities in the state and provide the money for important instrumentation and faculty hires. The goal of the program is that students are trained to use state-of-the-art instrumentation and that West Virginia will become nationally competitive in science and technology. The grants also allows researchers across the state to work more closely with each other and build a network.

Serafin

In addition to the critical Track-1 funding, Track-2 and Track-4 grants provide EPSCoR funds for collaborations between two universities in different ESPCoR states and for career development for faculty. Our feature article focuses on some of the Track-2 and Track-4 projects in our state.

Like research itself, the EPSCoR Track-1 program is evolving to fit the needs of the jurisdictions better. In 2024, the Track-1 program will be replaced by the E-CORE and E-RISE programs, which will allow states to have multiple types of research programs funded, instead of allowing only one Track-1 grant at a time.

Julie

Juliana Serafin, Ph.D.

Senior Director of Science & Research, West Virginia Higher Education Policy Commission, and Project Director, WV EPSCoR

News briefings


Lorimer


McLaughlin

WVU astronomers awarded prestigious Shaw Prize in Astronomy

The 2023 Shaw Prize has been awarded to West Virginia University Professors, **Duncan Lorimer** and **Maura McLaughlin,** for the discovery of fast radio bursts (FRBs).

The Shaw Prize is an international award to honor individuals who have recently achieved distinguished and significant advances in the fields of Astronomy, Life Sciences and Medicine, and Mathematical Sciences. Awardees are those who have made outstanding contributions in academic and scientific research or applications, or who in other domains have achieved excellence. The award is dedicated to furthering societal progress, enhancing quality of life, and enriching humanity's spiritual civilization.

FRBs are millisecond-duration pulses of cosmological origin first discovered by the team in 2007. While their origins are still not entirely understood, it is very likely that at least some fraction of them are produced by magnetars–– highly magnetized neutron stars–– which are known to emit powerful radio flares. Since the discovery of the first FRB, hundreds more have been detected by radio telescopes worldwide, leading to an entirely new area of astronomical exploration. In the future, studies of FRBs are expected to reveal unique insights into extremely energetic processes and the large-scale structure of our universe.

Duncan Lorimer, Ph.D., is professor and interim chair in the Department of Physics and Astronomy at West Virginia University and serves as Associate Dean of Research for the Eberly College of Arts and Sciences. Lorimer's scholarly achievements have been recognized on several occasions: a Cottrell Scholar Award in 2008 from the Research Corporation for Scientific Advancement (RCSA) and both the Eberly College of Arts and Sciences and WVU's recognition for excellence in teaching (2009, 2010) as well as the Benedum Distinguished Scholar Award in the Physical Sciences in 2019. Since 1994, Lorimer has been a Fellow of the Royal Astronomical Society and in 2018 he was elected a Fellow of the American Physical Society (APS).

Maura McLaughlin, Ph.D., is the Eberly Family Distinguished Professor in Physics and Astronomy at West Virginia University, and the Director of the Center for Gravitational Waves and Cosmology. She also serves as co-Director of the NANOGrav Physics Frontiers Center. She has been named a 2020 Highly Cited Researcher by Web of Science, one of the world's top research awards. In 2023, she helped unearth evidence of never-before-observed ripples in spacetime, work that was funded by a Research Challenge Grant in 2007.

"McLaughlin and Lorimer's discovery of Fast Radio Bursts has revolutionized the understanding of several significant aspects of our universe. Their contributions have clearly placed the Astrophysics program within our college and WVU at the forefront of this scientific frontier," said Dean Gregory Dunaway, of WVU Eberly College of Arts and Sciences.

Michele Blatt named next West Virginia School Superintendent

The West Virginia Board of Education (WVBE) named **Michele Blatt** as the 34th State Superintendent of Schools during a special meeting in Charleston effective July 1, 2023. Blatt, who previously served as the Deputy State Superintendent, is a 17-year employee of the West Virginia Department of Education and managed many of the organization's executive functions and critical relationships.

News briefings


Gozal

Marshall University names Dr. David Gozal new school of medicine dean

Marshall University President Brad D. Smith recently announced that **Dr. David Gozal,** a pediatric pulmonologist and world-renowned pediatric sleep expert, has been named the incoming dean and vice president for health affairs at the Marshall University Joan C. Edwards School of Medicine.

The selection of Gozal is the culmination of a six-month national search. He comes to Marshall from the University of Missouri, where he served as the Marie M. and Harry L. Smith Endowed Chair and Chairman of the Department of Child Health, as well as the Physician-in-Chief of the University of Missouri Health Children's Hospital.

Gozal will officially join Marshall on July 31 and be introduced to the university community later this summer.

Manchin secures funds for Fairmont State aviation

Fairmont State University received $270,000 for its Aviation Center of Excellence (ACE) through a 2023 Congressionally Directed Spending (CDS) request. The ACE will use these funds to expand its capacity and increase its ability to serve students by purchasing aviation equipment.

Joel Kirk, director and chief instructor of the Aviation Center of Excellence spoke of the impact that receiving this request will have on ACE.

"These funds will allow us to provide more training positions, increase the throughput rate for student completion, and improve the safety, proficiency, and quality of our programs," Kirk said.

Senator Joe Manchin filed the CDS request in order to combat the shortage of workers in aviation nationwide and help West Virginia students excel.

"Fairmont State University's **Interim President Dr. Dianna Phillips** expressed gratitude to Senator Manchin for his contribution.

"We are extremely grateful for the advocacy and support Senator Manchin has provided Fairmont State's Aviation Center for Excellence," said Dr. Phillips. "By acquiring new training equipment and upgrading existing resources, Fairmont State will be able to educate more students and graduate more pilots, leading to a stronger airline workforce in West Virginia."

WVU Tech, Cornerstone/Belle Chemical Company partnering to provide opportunities to students

West Virginia University Institute of Technology (WVU Tech) and Cornerstone/Belle Chemical Company have partnered to bring real-world experiences and applications to WVU Tech students. This year, the partnership has allowed students to collaborate with engineers and employees from Cornerstone/Belle Chemical for design and capstone projects.

Dr. Nathan Galinsky, assistant professor of chemical engineering at WVU Tech, says, "The partnership between Cornerstone/Belle Chemical and the WVU Tech chemical engineering department offers students a chance to gain valuable experience working on projects that real companies face. Students also appreciate being able to work on something tangible by understanding a company's goal and how the project can impact the company side."

Student projects include: the potential of pursuing a biodiesel process for two of Cornerstone's manufacturing facilities to increase its use of renewable energy and reduce its overall carbon footprint; designing a biodiesel process; and designing a process to produce dimethylethanolamine (DEMA) to help meet the expected growth in the demand for this chemical.

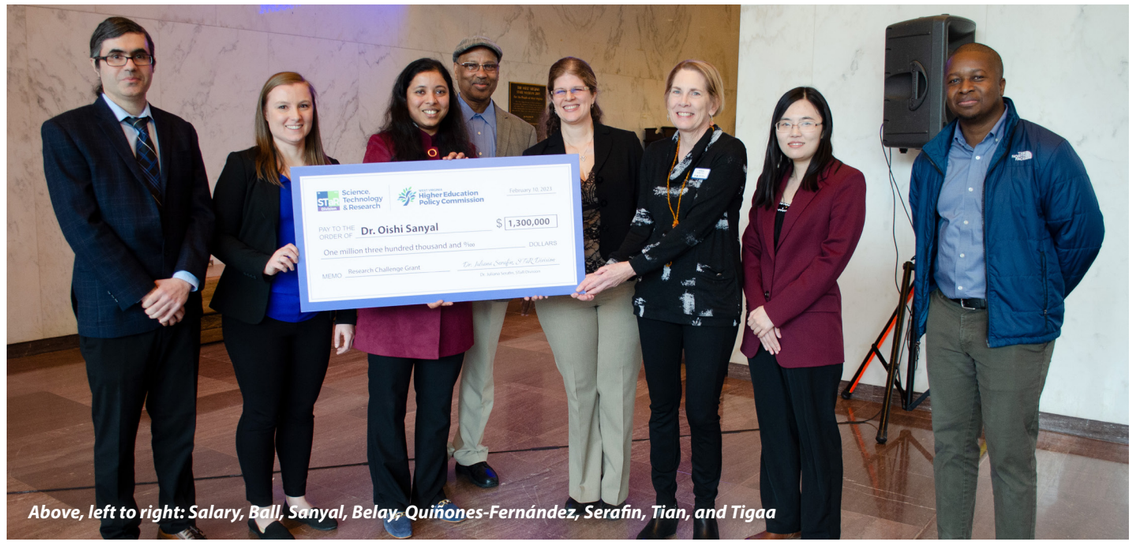
Research Challenge Fund

Established by the West Virginia Legislature in 2004 to support research and development projects at institutions of higher education in West Virginia

Opportunity Grants support robotics teams traveling to national competition

Multiple robotics teams in West Virginia benefitted from Opportunity Grants which allowed them to travel to Dallas, TX, for the 2023 VEX Robotics World Championship held April 25 - May 4. The grants helped to pay for each team's registration, travel, and other various expenses related to the event.

The teams awarded included: Bridge Street Middle School, DuPont Middle School, Martinsburg South Middle School, Princeton Middle School, Sherrard Middle School *(pictured above)*, Triadelphia Middle School, Wayne Middle School, Montcalm High School, South Charleston High School, Wheeling Park High School, St. Joseph Catholic School *(pictured below)*, and Girl Scouts Troop 4847.



Above, left to right: Salary, Ball, Sanyal, Belay, Quiñones-Fernández, Serafin, Tian, and Tigaa

Faculty awarded over $3.9 million for the creation of university-based research centers in West Virginia

Over $3.9 million in state funding will foster economic development and workforce advancement by supporting the creation of university-based research centers in West Virginia.

STaR Division: Science, Technology & Research (STaR) at the West Virginia Higher Education Policy Commission awarded three Research Challenge Grants (RCGs) worth approximately $1.3 million each to directly support research conducted by students and faculty at West Virginia higher education institutions. Research teams are comprised of faculty from Bluefield State University, Concord University, Marshall University, West Virginia University and West Virginia State University. The awards were announced on Friday, February 10 at the Culture Center on the West Virginia State Capitol complex.

"We are excited to be able to fund these three excellent research projects with Research Challenge Grants for 2023-27 cycle," said **Dr. Juliana Serafin**, senior director of STaR. "We look forward to the growth in research enterprise and economic development that will result from this investment by the state of West Virginia."

Research Challenge Grants are supported by the Research Challenge Fund, established by the West Virginia Legislature in 2004 to build research capacity and competitiveness at the state's colleges and universities. The fund is managed by STaR.

The RCGs promote statewide research collaboration among higher education institutions, an important factor when competing for federal funding, particularly from the National Science Foundation. Broadening the participation of first-generation college students and other underrepresented groups is also crucial.

Drs. Xin Li, V'yacheslav Akkerman, Lian Li, Wenyuan Li, Bin Liu and **Aldo Romero** of West Virginia University and **Drs. Xiaojuan (Judy) Fan** and **Huong Nguyen** of Marshall University were awarded $1,315,000 over five years for "Data Driven Autonomous Experiments for Energy Sciences Principles of Machine Learning."

Drs. Oishi Sanyal, Madelyn Ball, Jianli (John) Hu, Yuhe Tian, and **Carrie White** of West Virginia University; **Drs. Rosalynn Quiñones-Fernández** and **Roozbeh (Ross) Salary** of Marshall University; **Dr. Tesfaye Belay** of Bluefield State University; and **Dr. Rodney Tigaa** of Concord University were awarded $1,300,000 over five years for "Metal-Embedded Carbon-based Catalytic Membranes for Co-production of Ammonia and Ethylene."

Drs. Cosmin Dumitrescu, V'yacheslav Akkerman, Omid Askari, Jianli (John) Hu, Bingyun Li, Earl Scime and **Xueyan Song** of West Virginia University; **Dr. Rodney Tigaa** of Concord University; and **Dr. Eyas Mahmoud** of West Virginia State University were awarded $1,300,000 over five years for "Synergistic Conversion of Captured C02 and Green H2 to Value-Added Products for a Decarbonized Economy."

NSF EPSCoR

National Science Foundation Established Program to Stimulate Competitive Research

A program that enhances research competitiveness of targeted jurisdictions (states, territories, and a commonwealth) by strengthening STEM capacity and capability through a diverse portfolio of investments from talent development to local infrastructure

Grant No. OIA-1458952

Biberdorf

"Kate the Chemist" visited Charleston in May for two presentations at the Clay Center

The STEM Speaker Series welcomed **Dr. Kate Biberdorf,** known as "Kate the Chemist," to Charleston for dual presentations on Thursday, May 18 at the Clay Center for the Arts & Sciences of West Virginia.

Dr. Biberdorf is a chemist, science entertainer, and professor at The University of Texas. Through her theatrical and hands-on approach to teaching, she is breaking down the image of the stereotypical scientist, while reaching students who might otherwise be intimidated by science. Biberdorf is the author of the bestseller "The Big Book of Experiments," "The Awesome Book of Edible Experiments for Kids," the fiction series "Kate the Chemist," and the nonfiction book "It's Elemental: The Hidden Chemistry in Everything."

West Virginia GEAR UP hosted the 2023 STEM Academy that morning in the Maier Foundation Performance Hall. The keynote was preceded by an industry career exploration fair that took place in the Clay Center lobby for students wanting learn more about potential STEM jobs in the state.

STaR Division: Science, Technology & Research (STaR) hosted an evening performance for the public in the Clay Center's Walker Theater with a book signing from Taylor Books. This event was supported by a grant from the National Science Foundation and was free to registered guests.

West Virginia awarded $20 million in scientific research funding from National Science Foundation (NSF) Established Program to Stimulate Competitive Research (EPSCoR)

West Virginia has been awarded a highly competitive, five-year $20 million grant from the National Science Foundation's (NSF) Established Program to Stimulate Competitive Research (EPSCoR) that will boost academic scientific research and upgrade infrastructure at West Virginia University (WVU), Marshall University (MU), West Virginia State University (WVSU) and Shepherd University. EPSCoR is facilitated by the West Virginia Higher Education Policy Commission's Division of Science, Technology & Research (STaR).

This funding establishes the WV Network for Functional Neuroscience and Transcriptomics (WV-NFNT), a statewide collaboration of neuroscientists and bioinformaticists working to position West Virginia as a center for impactful neuroscience research.

Project leadership includes: Principal Investigator **Dr. Juliana Serafin**, senior director of science and research at the West Virginia Higher Education Policy Commission; Co-Principal Investigator **Dr. Suzanne Strait,** associate director of science and research at the West Virginia Higher Education Policy Commission; Co-Principal Investigator **Dr. Randy Nelson**, chair and professor of the WVU Department of Neuroscience at West Virginia University; Co-Principal Investigator **Dr. Nadja Spitzer**, associate professor of biological sciences at Marshall University; and Co-Principal Investigator: **Dr. Umesh Reddy,** professor of genetics and genomics at West Virginia State University

"Neuroscience researchers and STEM education leaders in West Virginia are honored by NSF's selection of the WV-NFNT project for funding," said Dr. Serafin. "We are looking forward to significant growth in neuroscience and related STEM fields during the grant period."

Neuroscience and data science were identified as areas of existing strength with high potential for growth in the West Virginia Science & Technology Plan, published in 2021. The overall scientific goal of this project is to elucidate the structural underpinnings for functional connectivity and plasticity in diverse neural circuits. To track these very small changes in the connections among neurons, novel instrumentation in both ultra-microscopic imaging and spatial transcriptomics are required. This grant makes those investments possible.

"WVU, in collaboration with its colleagues, will play a central role in developing and deploying new technologies such as stimulated emission depletion microscopy and single-cell or spatial transcriptomics — gene transcription — to understand the plasticity of synapses, glia, neurons and circuits in animal models," said Randy Nelson.

The project focuses upon two themes: circuit plasticity during development and adulthood and synaptic structure and plasticity associated with altered function.

"The WV-NFNT award will transform neuroscience research and education at Marshall University (MU)," said Dr. Nadja Spitzer. "It will build research capacity through the addition of a state-of-the-art super-resolution confocal microscope and related equipment, and the development of a spatial transcriptomics pipeline to facilitate use of this cutting-edge technique by MU researchers. Along with the growth these infrastructure additions will bring to our existing strengths in these areas, MU will hire two neuroscientists."

As part of the research goals of this project, MU researchers will use novel approaches including super-resolution confocal microscopy and spatial transcriptomics to answer questions about how the nervous system responds to adverse conditions at the smallest levels. Neurons communicate with one another in highly controlled ways at synapses which are structurally and functionally specialized. In addition to the two neuron partners at a synapse, supporting cells called astrocytes interact closely and contribute to signaling, forming the tripartite synapse.

West Virginia has now received more than $105 million from NSF EPSCoR as funding or co-funding over the past 22 years.

The National Science Foundation's Established Program to Stimulate Competitive Research (EPSCoR) enhances the research competitiveness of targeted jurisdictions by strengthening science, technology, engineering and mathematics (STEM) capacity and capability through investments, from talent development to local infrastructure. West Virginia's most recent EPSCoR-funded Track-1 project was awarded in 2015 and wrapped up this year.

NSF INCLUDES

National Science Foundation Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science

A comprehensive national initiative to enhance U.S. leadership in science, technology, engineering and mathematics (STEM) discoveries and innovations focused on NSF's commitment to diversity, inclusion, and broadening participation in these fields

Grant No. HRD-1834586

First2 Network congratulates the 2023 spring graduates

Elizabeth Lowe. Bachelor's degree in information systems from West Virginia University Institute of Technology

Alyssa Pettry. Bachelor's degree in forensic science, minors in chemistry and criminal justice, from Fairmont State University

Amber Meadows. Bachelor's degree in biology, minors in chemistry and psychology, from Fairmont State University

Gabby Broski. Bachelor's degree in forensic science, minors in chemistry and biology from Fairmont State University

Holli Bragg. Bachelor's degree in exercise science and chemistry from West Virginia Wesleyan College

Jordan Means. Bachelor's degree in immunology and microbiology, minor in psychology, from West Virginia University

Aubrey Cumberledge. Bachelor's degree in biology, minors in psychology and philosophy, from West Virginia University

Autumn Rogers. Bachelor's degree in immunology and medical microbiology from West Virginia University

Rachel Morris. Bachelor's degree in biology from West Virginia University

Egon Mamboleo. Bachelor's degree in mechanical engineering from West Virginia University

First2 Network has been working since 2019 to change the system for first generation students in West Virginia. Increasing student success is the goal.

First2 Network (First2) is targeting systems in higher education to increase science, technology, engineering and mathematics (STEM) student success. First2 has collectively identified change ideas as having the highest potential for impacting the system. These high impact change ideas are centered around the four Drivers in the theory of change. The First2 partner institutions recently shared results regarding the implemention of change ideas on their campuses as carried out in Plan, Do, Study, Act (PDSA) cycles by individual institutional teams. Participating schools included: Blue Ridge Community and Technical College (BRCTC), Glenville State University (Glenville), Fairmont State University (Fairmont State), Marshall University (Marshall), West Virginia University (WVU), and West Virginia University Institute of Technology (WVU Tech).

Driver 1 Stories: STEM students succeed academically

STEM majors need math to succeed so First2 worked to help them embrace it. WVU has engaged in math anxiety training for a few years. Analysis found that self-efficacy and self-compassion were predictive of reduced math anxiety and that mindfulness also correlated negatively with math anxiety, though not predictive. Glenville held math anxiety workshops for 65 students. WVU Tech focused on developing study habits with students agreeing that the module on prioritization was most beneficial. Fairmont State faculty planned three refresher sessions on math and connecting math to other science courses. Marshall offered an eight day workshop for incoming freshmen reviewing basic concepts for math and chemistry with 77 attending.

Driver 3 Stories: STEM students feel connected to STEM research, understand STEM career options and feel competent enough to pursue them.

First2 studied the impact of student research experiences on STEM student persistence. First2 institutions have piloted course based micro-research experiences involving industry, academic year programs for first and second-year students and summer immersive experiences for rising freshmen. Surveys show significant improvement in students' reported school belonging, knowledge about research, personal skills, STEM identity, and research skills. Evaluators developed plans for a "Sophomore Experience" consisting of a mentoring support system and mock interview cycle. This new PDSA was presented at the First2 Spring conference in May 2023 and is under development this summer for implementation in fall 2023.

Driver 2 Stories: STEM students are meaningfully connected with faculty, staff, and peers in ways that promote belonging (fit), wellness, resilience, and financial stability.

Campus clubs offered connection for First2 students statewide. Fairmont State's club, led by student directors and co-chairs, met regularly during the semester to share experiences and identify barriers to success and to suggest possible solutions. Marshall's club held bi-weekly meetings during the semester, in which group activities were planned to help students meet their academic goals. WVU students centered their club activities around reading the book "Your Time to Thrive." WVU Tech's club met throughout the semester with faculty-student social events being particularly well-attended. BRCTC student directors and co-chairs planned a networking dinner with the dean and a STEM Showcase Social to connect students and faculty.

Driver 4 Stories: STEM students engage in leadership experiences that identify systemic issues impeding students' success in STEM, and co-create new solutions to these issues.

High Rocks Educational Corporation conducted a two-day training workshop for students focused on leadership skills and techniques within First2. College Readiness Ambassadors, a network-wide change idea designed to build leadership skills in undergraduate STEM students and improve the college readiness of high school students, engaged 24 student directors and scholars in creating presentations that shared their personal STEM story, educating high school students on the behaviors and skills needed to succeed in college.

AI is Having a Moment

How NSF-funded researchers utilize artificial intelligence to solve problems that directly affect West Virginians

By Angela Sundstrom

Artificial intelligence (AI) has been everywhere recently. Whether it be the newest software or bold warnings about the future of human existence, the buzz seems almost inescapable. But how will this technology affect the daily lives of people in the Mountain State? Three West Virginia University professors, funded by the National Science Foundation (NSF), have answers to that question. The mainstream focus on AI is new, but the technology has been in use for a long time.

Expanding AI in digital health

Traditional healthcare is often expensive and complex. Diagnosing a patient's symptoms takes time. Access to qualified medical professionals is scarce in many areas. Human error and ego can keep people from seeking aid at all. Digital health applications might be able to ease the burden while providing additional tools to benefit both patients and healthcare providers.

Dr. Donald Adjeroh, professor and associate chair in the department of computer science and electrical engineering at West Virginia University (WVU), was awarded an NSF Established Program to Stimulate Competitive Research (EPSCoR) Track-2 grant in 2019 to study how digital health can improve overall health outcomes and reduce healthcare costs. Titled "Multi-Scale Integrative Approach to Digital Health: Collaborative Research and Education in Smart Health in West Virginia and Arkansas," the goal of the EPSCoR project is to develop and disseminate computational methods to maintain privacy while analyzing large datasets, develop and disseminate measures and methods to increase the transparency of data analysis and thus increase trust in the analysis results, and develop and disseminate methods to measure and reduce bias in big data sets.

The nature of the NSF EPSCoR Track-2 is to facilitate collaboration between states. Adjeroh partnered with researchers in Arkansas. One of the key aspects is developing AI skills for early career faculty of which 11 have participated, or are currently participating, with six from West Virginia and five from Arkansas. Involving multiple departments at WVU as well as West Virginia's primarily undergraduate institutions is also important to maintain collaboration on such an expansive topic.

Adjeroh's research focuses on developing data structures and algorithms for searching large quantities of information. His background in computer science allows

him to move theory into potential real-world solutions. This involves looking for patterns to represent information efficiently.

"I do work in computer vision and image analysis," Adjeroh said. "We apply that to problems connected to health. For instance, analyzing different types of medical images."

Computer vision is a type of artificial intelligence used for identifying and understanding objects and people in images and videos to perform and automate tasks. His work with the Track-2 involves looking at problems related to the heart.

"What we are doing is analyzing cardiovascular images - and the specific one is called echocardiography or echocardiograms - and we try to analyze them to look for patterns that might tell us specific problems," Adjeroh said. "You can look at the image. You can also look at measurements and signals, like how the heart is beating, and analyze those patterns to see whether it's healthy or not."

Another part of the work involves adverse drug events. This means reviewing medications used for heart problems or other non-cardiovascular medicines and how they interact which involves searching for patterns in many different types of statistics, including health records and genomic data.

The AI applications utilized for digital health can be especially beneficial in rural regions like West Virginia. In a state that struggles to find and keep qualified healthcare professionals, AI can fill the gap. Initial screenings can be conducted with AI to analyze certain characteristics, such as a patient's blood pressure or exercise habits, to hypothesize whether that person is likely to have or develop an illness. This can even be accomplished with a FitBit, an idea Adjeroh's team has studied.

"AI could detect something missed or not easily observed by physicians, such as a rare form of cancer or whether or not a patient is likely to contract a post-surgery site infection," Adjeroh said.

Health misinformation is also a major problem. One part of the Track -2 project, headed by Dr. Nitin Agarwal, a project collaborator in Arkansas, involves analyzing social networks and observing any patterns that might be relevant to misinformation. Adjeroh said all of this can potentially be predicted with the use of AI.

"We think that if you're able to do this in a way that can help doctors make decisions earlier, that can certainly improve healthcare and the cost of healthcare in rural regions or rural areas."


Maxwell

Predicting landslides in a historically industrial state

West Virginia is known for its coal mining history. Prior to the 1977 Surface Mine Reclamation Act (SMCRA), many of these mines were not obligated to recontour the landscape back to its original condition. The prevalence of these former mining sites has led to an increasing occurrence of landslides throughout the Mountain State. Local geographic information systems (GIS) experts have been trying to solve this issue.

Dr. Aaron Maxwell, assistant professor of geography at WVU, specializes in digital mapping technology and remote sensing. This involves figuring out ways to extract useful information from resources like aerial photos, satellite images or digital terrain data.

"AI technologies like machine learning and deep learning allow us to do that because they can recognize patterns in data and then apply what it's learned about those patterns to new data so we can train an algorithm or generate a model to represent or to understand what a certain landscape feature looks like," Maxwell said.

Maxwell was awarded an NSF CAREER grant in 2021 for "Mapping Anthropocene Geomorphology with Deep Learning, Big Data Spatial Analytics, and Lidar." Geospatial data - like aerial and satellite imagery, digital elevation data and weather observations - are generated at an astounding rate. For example, Maxwell highlighted in his grant proposal how the NASA/USGS Landsat Program – a longtime collaboration between the National Aeronautics and Space Administration and the U.S. Geological Survey to provide a continuous space-based record of Earth's land - collects hundreds of images daily. That amount of data makes it almost impossible to extract actionable information efficiently. This is where artificial intelligence and machine learning are useful.

Maxwell and his colleagues make use of convolutional neural networks, a type of deep learning that analyzes imagery. These networks learn how to recognize patterns, textures and context which is very effective compared to the traditional method of manual sketches created by humans.

"If an analyst draws boundaries around every single house or building in an image, then the algorithm can use those examples, plus the characteristics of the image, to understand what a house is versus everything else in the image extent," Maxwell said. "Once it has built up that understanding, or that model, then that model could be applied to another data set or another image of another location so that the mapping could be done in a more automated way as opposed to someone having to hand draw everything."

The team is specifically interested in mapping landform features created by natural processes, like river erosion or glaciers, or something human-induced, like recontouring of the landscape from mining or for development.

Maxwell's team uses a technology called Lidar (Light Detection and Ranging). Lidar is a remote sensing method that uses light in the form of a pulsed laser to measure variable distances to the Earth. These light pulses—combined with other data recorded by the airborne system — generate precise, three-dimensional information.

"You can make a very detailed 3D image of the ground surface that can then be used the same way an image is used. An analyst can draw features that are obvious on the landscape and then the computer can use those examples plus the terrain surface to try to find similar objects in other locations from that same data set," Maxwell said.

The algorithms must be trained or see examples of many features to make models that can generalize or can be applied to new locations. It's common to develop thousands or even millions of examples before the models begin accurately predicting new locations.

Maxwell's work focuses on geohazards. West Virginia has a very high per capita, per person landslide occurrence, says Maxwell, partly because of erodible weakly consolidated rocks.

"We obviously have really steep slopes in places. We have a pretty humid climate. We also have people augmenting the landscape or excavating. We actually have a lot of landslides across the state. Other than flooding, that's the big hazard that people deal with from the environment."

This summer, Maxwell's team is working to teach algorithms how to find those historic 'unreclaimed' mine sites across the state that are not mapped or categorized, looking at the historic landscape impacts and recent geohazards that could impact property owners.

"It's not really feasible to map everything and update maps regularly if it's purely reliant on humans, like having to manually interpret or manually draw over top of images," Maxwell said. "The only way that we can really do it that can keep up with the data that's being generated and changes on the landscape is to make use of artificial intelligence systems that actually understand that data and generate maps we can then turn into information that people need to make decisions."


Mehta

How geospace can disrupt technology we depend on

The average person does not often dwell on space weather. Yet, it is something that can influence our everyday routines in a monumental way. **Dr. Piyush Mehta**, assistant professor of mechanical aerospace engineering at WVU, studies it for this very reason.

Mehta was awarded an NSF EPSCoR Track-4 award in 2019 for "Investigating Solar Wind-Magnetosphere Coupling." The sun drives almost all fluctuations in geospace, or near-Earth space, Mehta says in the proposal. The energy from the sun, carried by solar wind, is transferred to geospace at the edge of the Earth's magnetic field, or magnetosphere, through an interaction process called magnetic reconnection. The geospace fluctuations caused by this energy transfer can adversely impact critical national infrastructure like satellites and power grids. It can even endanger astronauts. Mehta utilizes his data science and machine learning expertise to develop a new model for the magnetosphere that will help improve our understanding of this energy transfer process as we do not yet completely know how the different solar wind conditions affect the amount of energy transferred.

Earth's atmosphere is divided into multiple layers. Mehta is an expert in thermosphere, one of these layers. In order to branch out into magnetosphere, he partnered with a

What is EPSCoR?

EPSCoR stands for the Established Program to Stimulate Competitive Research. It is a research funding program that exists in four federal agencies: U.S. Department of Energy, U.S. Department of Defense, the National Aeronautics & Space Administration (NASA) and the National Science Foundation (NSF).

Within these programs are tiers of awards. NSF offers Track-1, Track-2 and Track-4. Track-1 awards are for improving the academic research infrastructure in areas of science and engineering that are critical to a state's science and technology plan. Track-2 awards promote collaboration between researchers in different states working in scientific areas considered NSF priorities. Track-4 awards build research capacity in institutions and transform the career trajectories of investigators and further develop their individual research potential through collaborations.

The mission is to enhance the research competitiveness of targeted jurisdictions - state, territory or commonwealth - by strengthening science, technology, engineering and mathematics (STEM) capacity and capability through a diverse portfolio of investments from talent development to local infrastructure. The EPSCoR program envisions its jurisdictions as recognized contributors to the national and global STEM research enterprise.

collaborator at the Los Alamos National Laboratory (LANL) in New Mexico. This partnership between the combined expertise of WVU and LANL is to develop a new model for geospace and magnetosphere that will help to improve the understanding of the energy transfer process. Mehta and his collaborators are developing an emulator, also called a clone or digital twin, using AI and machine learning to serve as a much cheaper model.

"Everything is kind of connected, right?" Mehta said. "Space weather has an impact on everything we generally do as humans. For example, if you want to go from Point A to Point B, your directions very commonly rely on GPS. This GPS depends on satellites in space. Now, if things change very quickly and drastically and significantly in the space environment, they can negatively impact your satellite. They could impact the signals that you use to get the directions. They could impact the satellites themselves, in the sense that they could potentially destroy the satellite."

Space is connected, said Mehta, but because it's difficult to solve a connected problem it is frequently broken up into multiple domains. For example, NOAA Space Weather Prediction Center uses what they call the geospace model to predict those domains between the sun and Earth. Mehta emphasizes that forecasting should be probabilistic, not deterministic.

"Deterministic forecast is somebody very confidently telling you, 'Oh, it's going to be exactly 65 degrees and it's going to be beautiful and sunny,' but if you've ever looked at the forecast for weather, they never tell you that. They say 80 percent chance that it's going to be sunny or 20 percent chance it's going to be rain. That percentage they provide is how confident they are in their prediction or forecast. They always give you what their confidence is in that forecast because no scientist in their right mind would tell you that they have the capacity to say exactly what is going to happen in the future. It's always a very educated guess based on our understanding of the system," Mehta said.

In the Track-4 project, Mehta is trying to leverage machine learning to reduce the computational complexity and cost of the models that are used for forecasting and to add dimension for providing a probabilistic forecast. Basically, he wants to help provide more confidence in the prediction.

Mehta reinforces that space weather is a big deal. It has gained attention in the federal government, with space weather preparedness bills making their way through Congress. With the EPSCoR Track-4 project, Mehta and his team are shaping West Virginia into a venue of space weather expertise. This includes developing the next generation workforce by training students, post docs and early career researchers.

"We are building up the capabilities in the state of West Virginia, but also contributing to a scientific domain that has the potential to significantly impact West Virginians on a day-to-day basis," Mehta said.

Summary and analysis

Despite such impressive artificial intelligence work happening, all three researchers also understand the concerns. Since the introduction of ChatGPT at the end of 2022, the risks of such AI have grown ever more present in the public consciousness. Fears that humans could be entirely replaced by artificial intelligence and that entire swaths of jobs will disappear has reached a fever pitch. Even leading experts – including Sam Altman, CEO of OpenAI, the Microsoft-backed AI research lab behind ChatGPT, and Geoffrey Hinton, often known as the 'godfather of AI' who left Google this year – have been very vocal in their concerns that we are moving too fast towards automating our world with artificial intelligence.

Maxwell believes using AI in his own field of GIS allows researchers to make better decisions and generate better data. The concerns are real, he says, but the uses in fields such as healthcare, mapping, surveying, self-driving cars and more are, in his opinion, necessary steps that allow humans to continually develop.

"I think that these AI technologies are actually a very important component of how we're going to continue to succeed and manage problems such as climate change and sustainability and resiliency," Maxwell said.

Mehta also reiterates that the fears are not irrational.

"I think because there is so much buzz around it, a lot of times proper practices are not followed and things get lost in a negative way, in a negative connotation."

However, when AI is used with the care and expertise it was meant to have, he believes the good outweighs the bad.

"Basically, if you do it right, I think it has the potential to make a big difference, but we have to be very careful to make sure that we actually do it the right way. You don't want to blindly do something just because there is a buzz around it, take something that resembles machine learning and throw it at things that are not suitable," Mehta said.

Adjeroh compares this moment in time to the introduction of the personal computer. In 1977, Apple introduced the personal computer and throughout the 1980s, software improved enough to allow the average person to begin utilizing such devices. Flash forward several decades and most people now carry devices like smartphones that are even more powerful than those initial personal computers.

"The way I see it is that people should just prepare that there's going to be some change," Adjeroh said. "The way we used to do things may not be the way we're going to be doing it in the future with AI."

The influence of ChatGPT is one example. Adjeroh believes this was most people's introduction to generative AI, but it is not new. Deep fakes, media manipulated through artificial intelligence to mimic a real person, are one example of generative AI that has been a problem for years now. The generation of fake documents is also not a new concern. He believes there is going to be a change in the way we teach students and the way we assess knowledge on a topic. For example, the use of calculators by middle school and high school students used to be frowned upon but has now become more accepted as a useful technology integrated into normal life. ChatGPT and AI might be the same.

"Human beings are going to be kind of reeducated, even though they may not be ready for it," Adjeroh said.

> "AI is here to stay. My own suggestion is that we better be prepared for the future, instead of trying to hide from the future."
>
> *- Dr. Donald Adjeroh*

While Adjeroh does believe people will grow more accepting of things like ChatGPT, he concedes that it and similar artificial intelligence technologies will change the nature of jobs.

"The way people train for jobs is going to be different," Adjeroh said. "There is going to be, I would say, redistribution of jobs because some areas will get more attention, others will lose attention, but overall more people are going to get employed because there will be more opportunities."

There is a lot of discussion about regulating AI, from researchers to lawmakers and everyone in between. Many industries will be motivated to use such technology to reduce inefficiencies. The spread of misinformation or disinformation could blow up with these new technologies. Adjeroh says the most important aspect is for researchers to make sure their work can be trusted and, hopefully, the potential harm caused to individuals by using AI results or AI generated content can be reduced.

"AI is here to stay. My own suggestion is that we better be prepared for the future, instead of trying to hide from the future."

Commentary
Jordan Ferrell

Ferrell

Science on a Sphere (SOS) at the West Virginia Regional Technology Park (WVRTP) is an incredibly innovative tool that is revolutionizing the way West Virginia students learn about science, technology, engineering, and math (STEM) topics. SOS uses projectors to display high-resolution images and data of the earth, moon and other planets in stunning detail. This technology allows students to explore the universe and gain a greater understanding of earth system science including weather patterns, hurricanes, earthquakes, migratory patterns, and so much more. SOS is an excellent way to engage students and provides them with an opportunity to visualize data in ways that are unachievable on a screen or tablet. By providing a visually stunning and immersive learning experience, this tool can help capture students' imaginations and spark their curiosity about the world around them.

Advancing STEM education in youth is important for a myriad of reasons. In today's increasingly technological world, STEM careers are in high demand, and will continue to be in the future. By introducing students to STEM topics at a young age, we can inspire students to pursue STEM and help prepare them for these careers. As West Virginia continues to seek economic diversification, early STEM education is essential, and can lead to the creation of new industries, job opportunities, and higher wages for residents.

STEM education is also critical for addressing some of the most pressing challenges facing our world today, from climate change to disease outbreaks to cybersecurity threats. By equipping students with the knowledge and skills they need to tackle global challenges head-on, we can create a brighter future for everyone.

At the West Virginia Regional Technology Park, we believe STEM education is essential for developing the next generation of innovators and problem-solvers. Science on a Sphere is a powerful tool that can help make this a reality, by providing an engaging and immersive way for students to learn about the world of science and technology. By investing in STEM education, we can create a brighter future for everyone.

***Jordan Ferrell** is the director of communications and park programs at the West Virginia Regional Technology Park and the current chapter president of the Public Relations Society of America West Virginia Chapter. She is a lifelong resident of West Virginia and a graduate of West Virginia University.*

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