



Sandia  
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## NM Partnerships Report

EXTERNAL NEWS

June 2020

POC: [Diane Peebles](#)



### Welcome to the NM Partnerships Newsletter

This quarterly newsletter from Sandia National Laboratories' Academic Alliance program features recent news and accomplishments resulting from the partnership between Sandia and the following universities: University of New Mexico (UNM), New Mexico State University (NMSU), and New Mexico Tech (NMT).

Feel free to share this newsletter with anyone interested in understanding more about these partnerships. Contact [Diane Peebles](#) to be added to the distribution list.

### Announcements from the NM Partnerships Program

- We encourage students involved in Sandia funded research to get connected with Sandia's talent community! We especially want to ensure we reach all of our students involved in research on LDRD's. Please share the [Sandia Talent Community link](#) with students involved in Sandia LDRD projects. When students join the Sandia Talent Community, it helps Sandia to stay in touch and share career opportunities.
- In response to COVID-19, Sandia will not bring summer interns onsite for 2020. The decision minimizes exposure risks and complies with shelter-in-place and work-from-home directives. Most summer interns will be able to join Sandia this summer in a virtual capacity. Current year-round interns can telecommute (until further notice) if they have work, the ability to work from home, and management approval.
- **The New Mexico Higher Education Department (NMHED)** is providing an opportunity for minority and women doctoral students, which offers a [Minority Doctoral Loan Repayment Assistance Program](#). This program may repay at least one year of student loans for a minority or woman U.S. citizen who earns a PhD in a STEM field from an out-of-state university and returns to NM as a tenure-track faculty member at any of NM's public colleges and universities. The application period is open from October 1 through November 2, 2020. The maximum annual award is \$25K, and students can apply for renewal for four years. Preference is given to those students who completed a post-secondary degree at a NM college or university.

### Program Accomplishments

#### MARCUS Project with Sandia and UNM

Sandia demonstrated drone swarm coordination coupled with target intercept capability which were developed under Aerial Suppression of Airborne Platforms, a Laboratory Directed Research and Development project. Sandia coordinated a swarm of four unmanned aircraft systems flying in unison, each carrying one corner of a net. Acting together, the four units intercepted a flying target,

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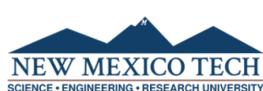
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trapped it mid-air in the net, and safely lowered it to the ground. The demonstration has led to three-year funding for the Mobile Adaptive/Reactive Counter Unmanned System (MARCUS) project, which incorporates advanced algorithms developed for the Department of Homeland Security Science and Technology Directorate. Jointly conducted with the University of New Mexico, the MARCUS project is funded by the NATO Science for Peace and Security Programme in partnership with Armasuisse Science and Technology of the Swiss Federal Department of Defense, Civil Protection and Sport. Read more in the full [Sandia Labs News](#) article.

### UNM/Sandia Project Controls, Project Management, and Program Management Program

In January 2018, UNM and Sandia signed a strategic memorandum of understanding (MOU) to advance Project Management as a profession and create a pipeline of project management professionals from UNM who would be qualified to work at the Labs. As agreed, UNM established a Master of Science (MS) program in project management to educate students in project controls, project management, and leadership, all of which will enable them to contribute effectively and quickly to Sandia's national security mission. Over the last two years, Sandia—co-chair of the program's advisory board—not only has partnered with UNM to develop appropriate courses and content, but also has also provided written support for the MS program to further the approval process. The proposed MS Project Management degree program has already passed several critical approval stages.

Sandia relies on its project managers to deliver on national security activities in a timely and cost-effective manner. Sandia currently employs approximately 450 project management professionals and anticipates an increasing need for at least the next 15+ years. Many factors are driving an increased and continued demand for rigorous project management, from several complex nuclear weapon modernization programs in planning and execution stages to large capital construction projects being planned to maintain and advance Sandia's capabilities. In addition, most of Sandia's customers are requiring enhanced project management, and Sandia's overarching prime contract has specific requirements for using and implementing project management practices on the work it executes. All these drivers combined with industry expectations and trends, factor into Sandia's growing need for project management expertise.

### Did you know?

- Staff and faculty: Are you looking for a collaborator at UNM? UNM's School of Engineering has developed a [Faculty Expertise Finder](#) to help you find the right collaborator to complement your research needs. The expertise finder will provide the contact information of faculty within the School of Engineering that matches your search.



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- Are you interested in fostering knowledge about pulsed power or electrical damage research?



*A close-up of the rod*

Would you like to obtain an Output Transmission Line rod that has been used in Sandia's Z-machine? These polycarbonate rods have been damaged by electrical arcs on the order of 5.5 MV and 400 kA. Each rod is about three feet long and three inches in diameter in the middle. Each discharge of the Z-machine is the equivalent to seven times the entire world production of electricity. Rods are available for donation to K-12 science classes, universities, and STEM outreach organizations. Please contact [Scott Beatty](#), if

interested. And take a peek behind the world's largest pulse power machine by watching this [YouTube video](#).

### Spotlight on People

Each quarter we highlight people who were engaged in our NM partnership! This can include a student, faculty member, and/or a Sandia principal investigator (PI). If you have suggestions on who to spotlight, please contact [Diane Peebles](#).

#### *Student Spotlight: Joseph Mohagheghi*



*Joseph Mohagheghi*

Watching an explosives demonstration at Sandia Labs when he was 11 years old, Joseph knew "from that moment," he says, that he "wanted to work in national security." As an undergraduate, he spent a summer as a chemistry intern with Sandia Carlsbad. One internship opportunity led to another, and Joseph transitioned into the realm of additive manufacturing and chemical analysis, this time at Sandia Albuquerque. Never one to let "school get in the way of learning," as he puts it, Joseph has paired academic investigation with hands-on internships at Sandia. As a year-round graduate intern in materials sciences, Joseph is completing his master's thesis on "chemical-mechanical interactions between cement-geomaterial interfaces" at New Mexico Tech. At the same time, he holds a systems engineering position in a weapons program group.



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Driven by the desire to solve technical production issues, Joseph applies scientific knowledge and understanding to dynamic problem solving in a team setting. And that's how Joseph became an integral part of a nine-month team effort to set up a cement fabrication and testing laboratory to give researchers access to cement samples produced in-house. Each learning partnership with Sandia Labs has expanded Joseph's knowledge, provided intellectual and career growth opportunities, and has, one might say, "cemented" his commitment both to national security and the nuclear deterrence mission.

### ***Faculty Spotlight: Lorie Liebrock***

Dr. Lorie Liebrock is the Director of the New Mexico Cybersecurity Center of Excellence (CCoE), Director of the New Mexico Tech Cybersecurity Education Center (CEC), and Professor of Computer Science and Engineering at New Mexico Tech. She will lead a new Summer Institute in Cybersecurity, which is a collaboration between Sandia National Laboratories and New Mexico Tech, for students to develop new and/or enhance existing scenarios for Tracer FIRE. For the CEC, Dr. Liebrock is leading a new national effort to enhance participation and performance in the National Security Agency's Codebreaker Challenge. For the CCoE, Dr. Liebrock is working with the New Mexico Economic Development Department to create opportunities for companies in the photonics industry to attain Cybersecurity Maturity Model Certification, which will be so they can contract with the Department of Defense. She is also the Principal Investigator on a proposal for the Department of Energy Minority Serving Institution Partnership Program (MSIPP) that will, if funded, integrate Sandia and Los Alamos Laboratories with NMT, NMSU, UNM, and NNMC to enhance cybersecurity education and research collaboration. The MSIPP project will integrate Transdisciplinary Cybersecurity graduate degree programs across multiple academic discipline areas, which are currently in the middle of the New Mexico's approval process. These initiatives, which are built on a history of collaborative research with Vince Urias and others at Sandia, have recently engaged more than a dozen students in cybersecurity research centered around emulytics. Initiative goals align with the vision and mission for the Cybersecurity Centers, which are focused on increasing cybersecurity awareness, preparing students for high-paying cybersecurity careers, and increasing the number of cybersecurity businesses in New Mexico. With our state working to become preeminent in addressing cybersecurity challenges and opportunities, Liebrock is excited about what New Mexico can accomplish in the coming years.



*Lorie Liebrock*



## *Principal Investigator Spotlight: Matthew Hoffman*



*Matthew Hoffman*

Matthew Hoffman, mathematician in Sandia's Complex Systems for National Security, focuses his research on dynamics and inverse problems for complex hybrid dynamical systems, novel algorithms and applications for data analytics, and a wide variety of applied operations research problems including exact mixed-integer, nonlinear and mixed-integer-nonlinear as well as metaheuristics for many-objective problems. He is currently leading research efforts under the Resilient Energy Systems Mission Campaign, an internal Sandia R&D investment portfolio, in the first year of a seven-year project, focused on improving the resilience of the nation's critical infrastructures, particularly energy. In the electromagnetic pulse (EMP) Grand Challenge, he leads work by (1) characterizing the cascading behavior of the power grid in response to high-altitude electromagnetic pulse, and (2) optimizing the post-cascade stability

and operating state of the grid prior to its restoration following severe emergencies. He is the principle investigator (PI) of a project on stochastic resilience planning optimization for hybrid dynamical systems. In these and other projects he has enjoyed collaborations with New Mexico Tech (his alma mater), University of Illinois, and University of Texas. He is excited to continue expanding his academic partnerships. Hoffman is currently working to foster energy resilience research collaborations that leverage the burgeoning cyber-physical capabilities at the Playas Training & Research Center, owned and operated by New Mexico Tech and being developed under a seven-year contract with the Air Force Research Laboratory.

## **Notable Events**

### *Research Spotlight Forums*

Sandia developed a Research Spotlight Forum series to seed new collaborative relationships with universities by increasing faculty's knowledge of Sandia program areas and providing the opportunity for Sandians to learn more about university capabilities, faculty expertise, and their involvement in related programs. Recent Research Spotlight forums included the topics below. Presentations from previous Research Spotlight Forums can be found on the [Sandia web page](#).

### *March 10 / Advanced Manufacturing*

Caren Wenner, Sandia Senior Manager of Statistics and Human Systems, championed the Spotlight forum on Social Sciences & Decision Making which highlighted the need to understand and design national security applications with the human in mind. Presenters from Sandia, UNM and Georgia Tech Research Institute described research in theory, data analytics, and modeling to



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better understand how the brain works. Topics on how humans make decisions, form teams and problem solve, and how societies are influenced and impacted by technological, ecological, political, and economic systems. Discussion included how knowledge of human dynamics and decision making can impact a myriad of national security domains, including remote sensing, water demand, cybersecurity and intelligence science, in particular. We anticipate that resulting educational partnerships and research will provide new capabilities and enhance the workforce pipeline for national security.

### **NM Capstone challenge culmination and celebration**

“The New Mexico Capstone Challenge was designed to engage undergraduate students across New Mexico to experience interdisciplinary mission-relevant engineering research,” expresses Diane Peebles, the Sandia Capstone Challenge sponsor. “I am very pleased with the students’ engagement, teamwork, and results—job well done!”

Seven months of hard work has ended for 21 students (seven on each school team) from UNM, NMT, and NMSU. Since the initial New Mexico Capstone kickoff meeting in September 2019, the students have made tremendous progress on their integrated sensing devices. In addition to measuring vibration, acceleration, and temperature, and determining signal processing approaches, the students needed to develop a communications app and innovatively incorporate proximity sensors to identify any nearby objects, plus everything had to fit in a box no larger than 600 cm<sup>3</sup> (approximately half the size of a Girl Scout cookie box).

In mid-March, a student from each team tested their preliminary products at the Sandia Environmental Test Facility before returning to their teams and making modifications based on the performance and feedback received. “The testing went amazingly well, and happened just before the stay-at-home orders,” stated a staff member. In the six weeks between the testing and the culmination celebration, the students worked to get their devices and research presentation-ready for the final gathering.



*Sandians Abby Carnali and Ralph Lied-Lopez, show student team representatives Mark Thomas (UNM), Isaac Martinez (NMSU), and Dyllian Powell (NMT, hidden) how their devices are responding to extreme vibrations in the Environmental Test Facility on March 13.*



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In the final event held via Skype on April 24, 2020, each team presented their design approach, device integration, hurdles, modifications made after the March tests, and their own test results. The teams also fielded questions about their projects. At the conclusion of the event, each student received a custom-made dog-tag to commemorate their participation.

Sandia staff members are evaluating this inaugural capstone challenge to set the tone for future events. Students and faculty mentors have encouraged Sandia to host another Capstone Challenge, which served as an opportunity to work on a real-life project and cultivate students' project management skills. If Sandia chooses to continue with the event, staff hope to complete the final competitive test.

The NM Capstone Challenge is designed to support undergraduate engineering design course objectives by providing a multidisciplinary challenge that increases awareness of Sandia as a national laboratory and potential employer for engineering graduates, and our national security mission.

If you are interested in sponsoring or participating in a NM Capstone Challenge, please contact [Diane Peebles](#).

### Recent Joint Publications

Entries were pulled on April 14 using data from the [Clarivate Web of Science](#). Titles below link to DOI references for full information.

#### UNM

- [Robust Molmer-Sorensen gate for neutral atoms using rapid adiabatic Rydberg dressing](#)
- [Antibacterial activity of iron oxide, iron nitride, and tobramycin conjugated nanoparticles against Pseudomonas aeruginosa biofilms](#)
- [Multichannel, triaxial, neutron time-of-flight diagnostic for experiments at the Z facility](#)
- [Tail queues: A multi-threaded matching architecture](#)
- [Following Spatial Distribution of Photosynthetic Pigments Across the Development of a Leaf using Hyperspectral Fluorescence Microscopy](#)
- [Seismic Characterization of the Nevada National Security Site Using Joint Body Wave, Surface Wave, and Gravity Inversion](#)
- [Building and using dynamic risk-informed diagnosis procedures for complex system accidents](#)



- [GaN/InGaN Blue Light-Emitting Diodes on Polycrystalline Molybdenum Metal Foils by Ion Beam-Assisted Deposition](#)
- [Porphyrin-based photocatalysts for hydrogen production](#)

### NMSU

- [Ab Initio Studies of Discharge Mechanism of MnO<sub>2</sub> in Deep-Cycled Rechargeable Zn/MnO<sub>2</sub> Batteries](#)

### NM team contacts

Who	Title	Email	Phone
Diane Peebles	NM Partnerships Manager	<a href="mailto:depeeb@sandia.gov">depeeb@sandia.gov</a>	(505) 845-8087
Linnea Sands	NM Partnership Development	<a href="mailto:lsands@sandia.gov">lsands@sandia.gov</a>	(505) 844-1333
Stephanie Gallegos	NM Administrative Support	<a href="mailto:srgall@sandia.gov">srgall@sandia.gov</a>	(505) 844-9636
Sheri Martinez	NM Capstone Challenge Faculty Loan Program	<a href="mailto:slmarti@sandia.gov">slmarti@sandia.gov</a>	(505) 844-8145
Carol Adkins	UNM Campus Executive	<a href="mailto:cladkin@sandia.gov">cladkin@sandia.gov</a>	(505) 845-9119
Isaac Romero	UNM Deputy Campus Executive	<a href="mailto:icromer@sandia.gov">icromer@sandia.gov</a>	(505) 844-4813
Nicole Streu	UNM Recruiting Specialist – Technical	<a href="mailto:nstreu@sandia.gov">nstreu@sandia.gov</a>	(505) 845-0931
Theresa Cordova	UNM Recruiting Lead - Technical	<a href="mailto:tecordo@sandia.gov">tecordo@sandia.gov</a>	(505) 844-7396
Antoinette Cummings	UNM Recruiting Specialist – Business	<a href="mailto:acummi@sandia.gov">acummi@sandia.gov</a>	(505) 284-8475
Cody Steele	UNM Recruiting Lead - Business	<a href="mailto:csteele@sandia.gov">csteele@sandia.gov</a>	(505) 844-0345
Ron Baker	NMT Campus Executive	<a href="mailto:rmbaker@sandia.gov">rmbaker@sandia.gov</a>	(505) 284-0218
Gaby Gutierrez	NMT Recruiting Specialist	<a href="mailto:grgutie@sandia.gov">grgutie@sandia.gov</a>	(505) 844-7669
Kim Haulenbeek	NMT Recruiting Lead	<a href="mailto:kkhaule@sandia.gov">kkhaule@sandia.gov</a>	(505) 845-3191
Jaime Moya	NMSU Campus Executive	<a href="mailto:jlmoya@sandia.gov">jlmoya@sandia.gov</a>	(505) 844-7955
Antoinette Cummings	NMSU Recruiting Specialist	<a href="mailto:acummi@sandia.gov">acummi@sandia.gov</a>	(505) 284-8475
Joe Sorroche	NMSU Recruiting Lead	<a href="mailto:jjisorro@sandia.gov">jjisorro@sandia.gov</a>	(505) 284-6769