

Sandia research team is first to measure thermoelectric behavior by 'Tinkertoy' materials

By Patti Koning



Sandia researchers have made the first measurements of thermoelectric behavior by a nanoporous metal-organic framework (MOF), a development that could lead to an entirely new class of materials for such applications as cooling computer chips and cameras and energy harvesting.

"These results introduce MOFs as a new class of thermoelectric materials that can be tailored and optimized," says Sandia physicist François Léonard (8342). "This discovery brings us a step closer to realizing the potential of MOFs in practical applications."

The results were published in "Thin Film Thermoelectric Metal-Organic Framework with High Seebeck Coefficient and Low Thermal Conductivity," which appeared April 28 online in *Advanced Materials*. This work builds on previous research in which the Sandia team realized electrical conductivity in MOFs by infiltrating the pores with a molecule known as tetra-

(Continued on page 3)

THIS PLAYGROUND STRUCTURE represents a larger-than-life nanoporous metal-organic framework (MOF) to this Sandia research team of (clockwise from upper left) Michael Foster, Vitalie Stavila, Catalin Spataru, François Léonard, Mark Allendorf, Alec Talin, and Reese Jones. The team made the first measurements of thermoelectric behavior in a MOF.

(Photo by Dino Vournas)

Robot Rodeo 2015



Story and photos on page 4.

Sandia LabNews

Vol. 67, No. 10

May 29, 2015

Managed by Sandia Corporation for the National Nuclear Security Administration



Got unlisted electrical equipment?

Sandia inspection process aims to ensure electrical equipment meets recognized safety standards

Sandia has embarked on a Labs-wide program to inspect electrical equipment to ensure it is listed and certified by a Nationally Recognized Testing Laboratory (NRTL) such as Underwriter's Laboratories or has been inspected and passed Sandia's internal electrical safety program's inspection process.

Not only is this inspection process required by federal regulation and Sandia's contract with DOE/NNSA, it is an important piece of the Labs' overall efforts to ensure members of the workforce are safe from electrical hazards.

The safety of electrical equipment is a real concern. In the last five years, there have been 25 occurrence reports across the DOE complex related to minor shocks, fires, explosions, or equipment failures from unlisted equipment. In the last three years, seven events at Sandia resulted in minor shock and significant damage from unlisted equipment. That is a lot of near misses, says Susan Pickering, senior manager in Nuclear Energy Safety Technologies Dept. 6230.

To get a handle on the scope of the concern at Sandia, Susan and the Electrical Safety team in Safety Engineering Dept. 4122 conducted a root cause analysis and identified appropriate corrective actions.

"This is a systemic problem, so we are focusing on clearing the backlog of unlisted equipment and upgrading the management system so we don't backslide," Susan says. "The vice presidents and Policy Area owners are fully behind this effort."

The most visible activity is going on right now, Susan notes. Every division is assessing its electrical equipment and identifying equipment to inspect, store, or send to Property Management and Reapplication Dept. 10264.

In this process, proper disposal of failed equipment is essential, not just for the

"This is a systemic problem, so we are focusing on clearing the backlog of unlisted equipment and upgrading the management system so we don't backslide. The vice presidents and Policy Area owners are fully behind this effort."

— Susan Pickering, senior manager, Nuclear Energy Safety Technologies Dept. 6230



safety of Sandians but for the public as well, Susan says.

"Failed or rejected unlisted equipment if not disposed of properly could be given away through the reapplication process and potentially injure members of the public," she says.

Some originations identified as "pockets of excellence" have been working for some time to bring their electrical equipment into compliance with NRTL guidelines; they will have less equipment to manage. Actions in

the Policy Areas have been or will be implemented, too, including in Procurement and

Reapplication. Much more information can be found on the Electrical Safety Homepage. It is the first link if you search on "zap" on TechWeb.



DOE award

Mark Taylor has won DOE's 2014 Secretary's Honor Award, the department's highest non-monetary employee recognition. Read about it on page 2.



Navy honors Jerry McDowell. See page 5.



Remembering Don Gilbert. See page 5.



Top doc

Sandia robotics scientist Aleksandra Faust, who escaped war-torn Serbia in the 1990s, wins prestigious UNM dissertation award. Read about it on page 8.

That's that

Over the past couple of years, there has been a lot of talk in the media about so-called "smart drugs." Purportedly, these drugs can, as the name suggests, give you an edge in cognitive functions over your non-medicated associates.

The \$64,000 question is, do they work? And if so, how? The answer to the first question is not as straightforward as it might sound. The answer to the second question is still a bit fuzzy.

As we know, Sandia is full of smart people. There aren't many places in the world where performing at a super-high cognitive level is more important than here.

So here's another question: For the sake of argument, let's say that certain smart drugs do work. Let's say they're safe, at least as far as we know. Now let's say you're working on a project that demands every shred of smarts you can bring to the table. Would you take a smart pill to help you meet the challenge? A cautionary note here: Sandia policy (backed up by random drug testing) forbids the non-prescribed use of such drugs as Ritalin, Adderall, and other medications that are often associated with cognitive enhancement. And another cautionary note: Some of these drugs can have serious side effects; as such, it is extremely ill-advised bordering on foolhardy to take these medications unless under the supervision of a doctor.

But people will do foolhardy things to give themselves an edge. Think baseball's steroid era. Think DeflateGate. Think the periodic cheating scandals at our military academies (not to single them out) where to be caught means instant career-ending expulsion and public shaming.

Regarding smart drugs, one news article called them "academia's dirty little secret." As far back as 2008 an informal survey conducted by *Nature* found that among some 1,600 respondents one in five said they had used smart drugs (Ritalin, etc.) for non-medical reasons, in particular to enhance focus, concentration, or memory. The authors of the *Nature* story said they expect those numbers to increase as the use of such drugs becomes more widely accepted for cognitive enhancement.

But do these drugs really work? Well, yes and no. There seems to be clear evidence that for some people some drugs do help improve focus, reduce fatigue, and address other factors that may be impairing cognitive abilities. But it seems clear, too, that smart pills aren't making anyone any smarter. As one news article put it: "You aren't going to turn Homer Simpson into Albert Einstein." Or as another explained: "With smart drugs, all you're doing is taking the brain that you have and putting it in its optimal chemical state."

And there's another factor to consider – and I think this has particular relevance for Sandians: It appears that the smarter you are to begin with, the less that smart pills will do for you. That is, smart people may be smart because they're already using their brains at an optimal level.

The whole area of smart drugs is the subject of serious study and experiment, but researchers need to get a far better handle on what makes us smart before they can come up with a true cognitive enhancer. And then there's the whole question of whether chemically enhanced intelligence is, on balance, a good thing. I think a case can be made either way.

But let's say the ethical issues are resolved as the research moves forward. The current state of understanding suggests that there won't be a one-size-fits-all solution. What works for Homer Simpson probably won't work for you. (On the other hand, it might just work for me, in which case I could try to realize my long-put-off ambition to be a *Jeopardy* champion.)

* * *

With or without smart drugs, it seems we're all getting smarter. Or maybe I should say "smarter." From the early 1900s to today, Americans have gained three IQ points per decade on two commonly used IQ tests and five points per decade on another. Across the developed world, the results are similar. No one disputes these numbers, but there is plenty of debate about the whys and wherefores. Some argue that the rising IQ scores reflect an increase in our ability to reason abstractly, an ability fostered by the fact that we deal much more in abstractions than did our forebears 75 years ago. Some argue that better nutrition, more widespread education, and increased literacy explain the rising scores. No one has an airtight explanation; it's likely all of the factors cited contribute. But do the higher scores actually mean we're smarter? Or just better at taking IQ tests? After years of playing *Trivial Pursuit* with my now-grown kids, I think I know the answer.

See you next time.

– Bill Murphy (MS 1468, 505-845-0845, wtmurph@sandia.gov)

Mark Taylor receives highest award from DOE secretary

Mark Taylor (1446) has received DOE's 2014 Secretary's Honor Award — the department's highest non-monetary employee recognition — for his work as chief computational scientist for DOE's Accelerated Climate Modeling for Energy (ACME) executive council team.

The award recognizes the team's work to unify the DOE's climate modeling research community. Integration of DOE's many efforts to develop atmosphere, land, ocean, and sea-ice models will enable coordination of a fully coupled climate-system computational simulation with ultra-high resolution. This model will better serve the department's energy and science missions.

Expected to be available in 2017, the ACME model will be used to address the most difficult questions that climate scientists face.

Says Mark, "Sandia will play a leading role by contributing our expertise in high-performance computing, uncertainty quantification, and software engineering best practices. I'm honored to be part of this exciting project."

He shared the award with William Collins from Lawrence Berkeley National Laboratory and David Bader from Lawrence Livermore National Laboratory.

Secretary of Energy Ernest Moniz presented a plaque and certificate to Mark on May 7 in Washington, D.C.

— Neal Singer



MARK TAYLOR

Lab News Reader Service

The *Sandia Lab News* is distributed in-house to all Sandia employees and on-site contractors and mailed to all Sandia retirees. It is also mailed to individuals in industry, government, academia, nonprofit organizations, media, and private life who request it.

Retirees (only): To notify of changes in address, contact Benefits Dept. 3332, Customer Service, at 505-844-4237, or Mail Stop 1021, Sandia National Laboratories, Albuquerque, NM 87185-1021.



Sandia National Laboratories

<http://www.sandia.gov/LabNews>

Albuquerque, New Mexico 87185-1468

Livermore, California 94550-0969

Tonopah, Nevada • Nevada National Security Site

Amarillo, Texas • Carlsbad, New Mexico • Washington, D.C.

Sandia National Laboratories is a multiprogram laboratory operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corp., for the US Department of Energy's National Nuclear Security Administration.

Bill Murphy, Editor 505/845-0845

Randy Montoya, Photographer 505/844-5605

Patti Koning, California site contact 925/294-4911

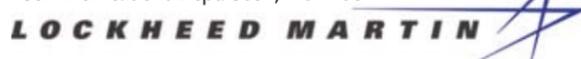
Michael Lanigan, Production 505/844-2297

Contributors: Michelle Fleming (Ads, Milepost photos, 844-4902), Neal Singer (845-7078), Patti Koning (925-294-4911), Stephanie Holinka (284-9227), Darrick Hurst (844-8009), Heather Clark (844-3511), Sue Holmes (844-6362), Nancy Salem (844-2739), Tim Deshler (844-2502), Valerie Larkin (284-7879), Lindsey Kibler (844-7988), Rebecca Brock (844-7772), Valerie Smith, manager (844-6167)

Lab News fax 505/844-0645

Classified ads 505/844-4902

Published on alternate Fridays by Internal & Digital Communications Dept. 3651, MS 1468



Tribal visitors learn about Labs' cyber capabilities



SANDIA'S CYBER PROGRAMS (Bob Hutchinson, 8970) partnered earlier this month with the Tribal Cyber Initiative team (Laurence Brown, 0163; Curtis Keliiaa, 9336; and Ben Mar, 5337) to host representatives from nine Tribal Nations with lands in nine states. The goal was to understand Cyber Critical Infrastructure Protection concerns for interdependent tribal public safety communications, telecom enterprises, IT departments, and economic development. The tribal visitors learned about Sandia capabilities in cyber forensics (Kevin Nauer, 9312), RF systems (Dahlon Chu, 5020), data center design (David Martinez, 9324), and distributed energy technologies (Stan Atcity, 6111). (Photo by Randy Montoya)

Thermoelectric behavior in 'Tinkertoy' materials

(Continued from page 1)

cyanquinodimethane, or TCNQ, as described in a 2014 article in *Science*.

"The fact that a TCNQ-filled MOF conducts electricity quite well made us hopeful that we'd also see thermoelectricity, but it was by no means a given," says Sandia senior scientist Mark Allendorf (8300). "We found that not only is the material thermoelectric but also the efficiency of its temperature conversion approaches that of the best conducting materials like bismuth telluride."

Thermoelectric devices convert heat to electricity and have no moving parts, making them extremely attractive for cooling and energy harvesting applications. Thermoelectric MOFs could take these advantages a step further with improved performance, smaller size, and flexible designs.

The researchers also gained a fundamental understanding of the charge transport properties of these novel materials that furthers the long-range goal of molding MOFs into electronic and optoelectronic devices.

"The great thing about chemistry is you can synthesize a wide variety of molecules to be inserted inside a MOF to change its properties. In optimizing materials, this gives you a lot of knobs to turn."

— Materials scientist Alec Talin

Guest@MOF concept described

Described as "molecular tinker toys," MOFs have a crystalline structure that resembles molecular scaffolding, consisting of rigid organic molecules linked by metal ions. Those organic molecules are the sticks and the metal ions are the balls.

The hybrid of inorganic and organic components produces an unusual combination of properties: nanoporosity, ultralarge surface areas, and remarkable thermal stability, which are attractive to chemists seeking novel materials. The empty space framed by the organic molecules and metal ions is what truly sets apart MOFs — empty space that can be filled with practically any small molecule a chemist chooses.

"We describe this concept as Guest@MOF, with the guest being practically any molecule small enough to fit in the MOF pores," says materials scientist Alec Talin (8342). "The great thing about chemistry is you can synthesize a wide variety of molecules to be inserted inside a MOF to change its properties. In optimizing materials, this gives you a lot of knobs to turn."

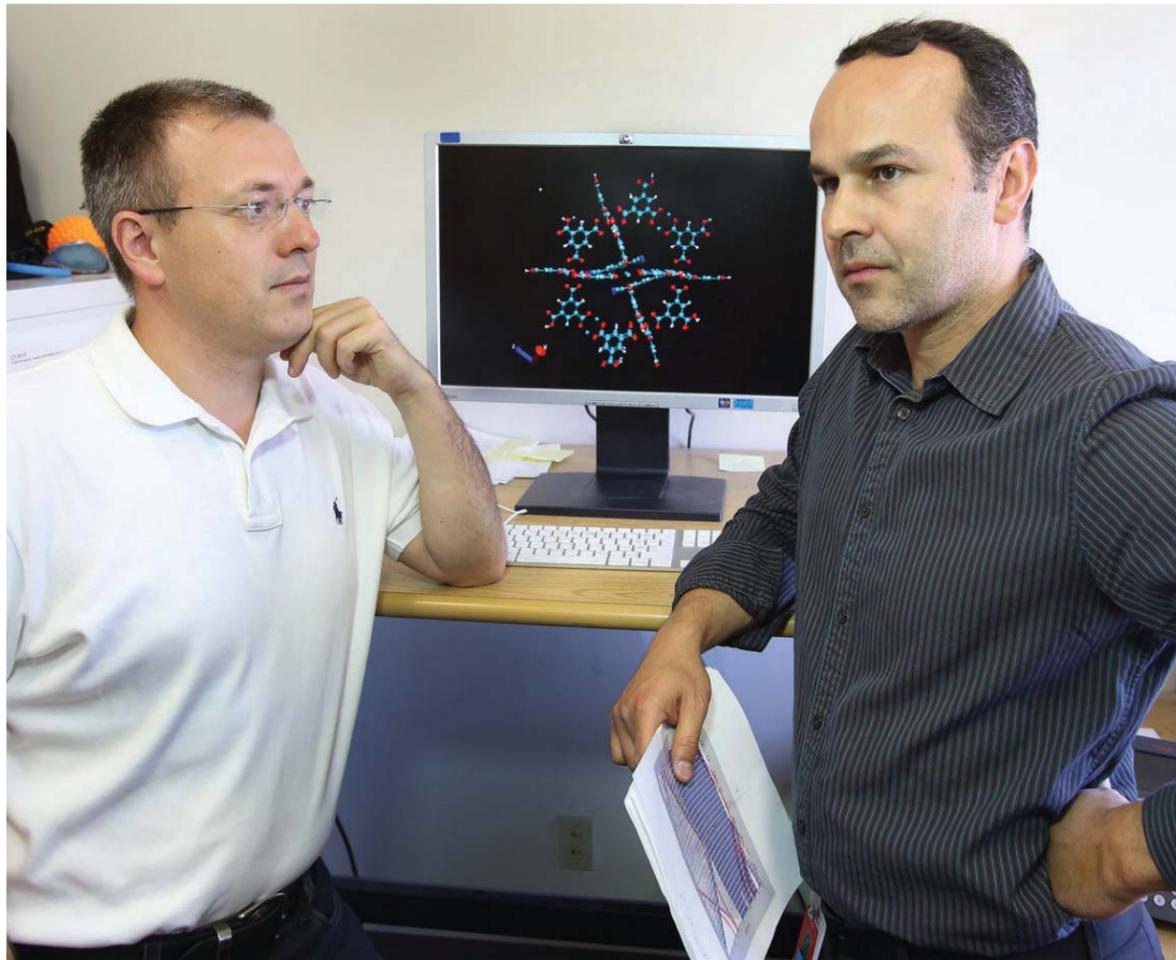
MOF-enabled efficient energy conversion

The researchers had to devise a method to measure the thermoelectric properties of TCNQ@MOF, where TCNQ was the guest molecule. MOFs are so new — they were discovered in 1999 — that researchers often find themselves on the frontier of science with few established tools or even a clear understanding of the material's fundamental properties.

François, Alec, and Kristopher Erickson, a former Sandia postdoctoral fellow, created a thermoelectric device by connecting Peltier heaters and coolers to each end of a thin film of TCNQ@MOF to generate a tiny temperature gradient. They accurately measured the temperature gradient with an infrared camera while simultaneously measuring the generated voltage. From these data they obtained the voltage per unit of temperature change, known as the Seebeck coefficient.

Patrick Hopkins, an assistant professor of mechanical engineering at the University of Virginia, and his graduate student Brian M. Foley used a laser technique to measure the thermal conductivity.

The resulting measurements showed great promise. TCNQ@MOF has a high Seebeck coefficient and low thermal conductivity, two important properties for efficient thermoelectricity. The Seebeck coefficient was in



VITALIE STAVILA, LEFT, AND CATALIN SPATARU discuss modeling approaches to conduct electronic structure calculations. The TCNQ molecule changes the MOF's properties to enable thermoelectric conductivity. (Photo by Dino Vournas)

Sandia California News

the same range as bismuth telluride, one of the top solid state thermoelectric materials.

"The next step is how do we make it better?" says Mark. "The energy conversion is not competitive yet with solid state materials, but we think we can improve that with better electrical conductivity."

Measurements yield fundamental understanding of electronic structure

The measurements also captured data that has advanced the team's fundamental understanding of the TCNQ@MOF electronic structure. Sandia physicist Catalin Spataru (8342) and materials scientist Mike Foster (8223) conducted detailed electronic structure calculations of TCNQ@MOF and Sandia materials scientist Reese Jones (8256) performed thermal conductivity simulations.

"We were trying to understand the role of the guest molecule, TCNQ in this case, when it infiltrates the pore of an MOF. Finding a representative configuration for the combined TCNQ@MOF system via computer simulations was particularly challenging, as we don't expect guest molecules to form an ordered structure," says Catalin.

The simulations allowed the researchers to verify the source of the charge transport and establish that TCNQ@MOFs is a p-type material. Applications such as transistors and diodes require semiconductors of both p-type and n-type.

"We're now looking for a molecule that in combination with a MOF creates an n-type semiconductor with similar properties to TCNQ@MOF," says François. "Once we find that, we'll be at the early stage of creating a full thermoelectric device."

MOFs in space, smartphones, and cars

Once thermoelectric MOFs realize sufficient energy conversion efficiency, they could begin replacing existing cooling methods in devices where compactness and weight are priorities. Cameras mounted on satellites,

which require constant cooling to function properly, are one example. Replacing the fans in computer chips with thermoelectric MOFs could reduce the weight of laptop computers, smartphones, and other portable electronics and the number of moving parts that will eventually wear out.

Energy-harvesting thermoelectric devices capitalize on wasted heat to draw power. A thermoelectric device near a car engine or exhaust system could transfer that wasted heat into a power source for the car's electronics. Thermoelectric devices are also used to provide localized cooling for passenger comfort.

"Another potential application is using temperature gradients in the ground to power sensors in remote areas," says François. "Thermoelectrics could be quite ideal for this application, as you could set up a device and leave it to run for long periods of time."

Future MOF work seeks to improve efficiency

The researchers are now improving the thermoelectric efficiency of TCNQ@MOF. One avenue is to change the MOF films from the polycrystalline structures used in the initial research to single-crystal.

"A unified structure should conduct electricity better," says Sandia chemist Vitalie Stavila (8341), who grew the MOF thin films. "However, we believe the interfaces between the polycrystal grains contribute to the low thermal conductivity. So the best energy conversion efficiency will likely be achieved by balancing these two parameters."

The researchers also are turning their thermoelectric measurement technique to other MOFs and materials, such as carbon nanotube thin films.

"This is a very exciting time to be working on MOFs," says Mark. "Fundamental science is only beginning to catch up with these new applications, which are advancing at a rapid pace. The improved understanding we're beginning to get will help us extend MOFs into many exciting but challenging new areas."

ROBOT RODEO

showcases bomb squad expertise

Story by Rebecca Brock
Photos by Randy Montoya

Bomb squads from across the country saddled up their robots and duked it out at the ninth annual Western National Robot Rodeo and Capability Exercise May 11-15 at Sandia. The five-day event offered a challenging platform for civilian and military bomb squad teams to practice defusing dangerous situations with robots' help.

The rodeo was designed with elaborate props to model the atmosphere of real-life emergencies in a low-risk, competitive environment. Robots are life-saving tools for the nation's hazardous device teams, providing a buffer between danger and first responders.

"Our underlying goal is that we want to make good robot operators into great robot operators," says Jake Deuel (6532), a Robot Rodeo coordinator and Sandia manager. "We design problems and scenarios that take our state and local bomb squad teams way outside their comfort zones, outside the known techniques and procedures to see how they can handle it."

UAVs introduced at Robot Rodeo

This year, Sandia introduced unmanned aerial vehicles (UAVs) into the competition. Sandia's David Novick (6533), a pilot and robotics engineer, flew the UAVs at the event.

"It's exciting to be able to show off a new technology to this group," David says. "This technology is a game changer. It's a stable, highly intelligent vehicle with controls similar to an airplane. Emergency responders can use these small, portable vehicles to get a bird's eye view of a situation to help them get out of a tight spot."

Scenarios at the rodeo change every year and grow in difficulty, which brings competitors back. The event prepares officers for the types of situations they may face on the job.

"The only time we get to simulate the level of complexity that we face in real life is at the Robot Rodeo," says Albuquerque Police Sgt. Carlos Gallegos. "Robots are saving officers' lives and have been critical to our SWAT teams." Challenges have included managing suicide bombers, operating in darkened buildings, responding to roadside bombs, navigating obstacle courses, and rescuing first responders.

Sandia partners with Los Alamos National Laboratory on the annual event, which allows teams to practice emergency scenarios where robots are life-saving tools.

The winning bomb squad team was Doña Ana County Sheriff's Office. Participants included the Albuquerque Police Department, Kirtland Air Force Base Explosive Ordnance Disposal Team, Holloman Air Force Base Explosive Ordnance Disposal Team, Los Alamos Police Department, Riverside County Sheriff's Office from California, two US Army teams from Fort Carson, Colorado, and a team from the British army.



A TEAM MEMBER from the Albuquerque Police Department Bomb Squad controls a robot during the five-day competition.

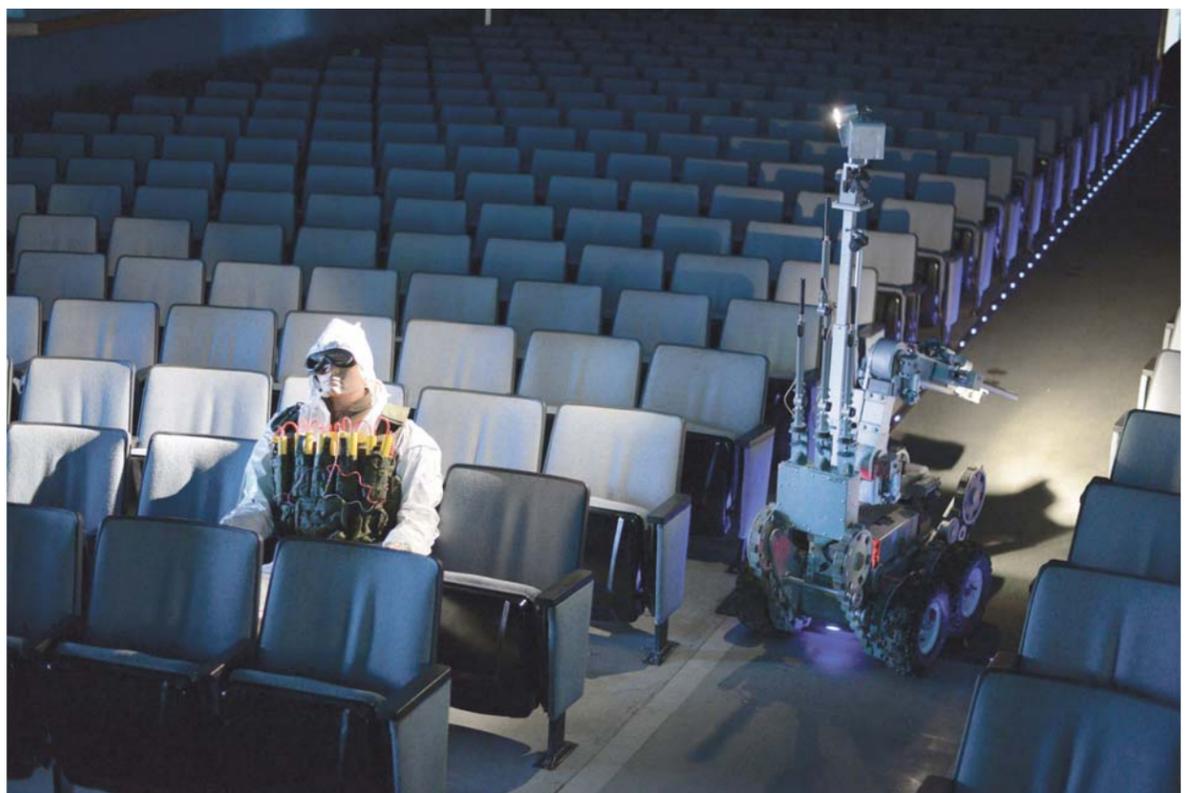
NEW TECHNOLOGY allows members of bomb squads and other public safety organizations to review new products.



BOMB SQUAD COMPETITORS from the Los Alamos Police Department prepare a robot before a scenario with an active shooter.



KIRTLAND AFB Explosive Ordnance Disposal Team debriefs with evaluators after one of the training exercises.



A ROBOT ENTERS a movie theater, in this case the old KAFB theater, to defuse a dangerous situation during one of the 12 challenging scenarios at the annual Robot Rodeo.

Employee death

A great and caring mentor, Don Gilbert passes away

For Don Gilbert, who passed away on May 10 in Albuquerque at age 60, it was “family first and mission always.” Oh, and there was the motorcycle, too. According to an obituary published in the *Albuquerque Journal*, nothing made Don happier than riding a rough trail on his motorcycle — nothing, that is, except time with friends and family.

The Fort Worth native, who moved with his family to Albuquerque in 1958, was an engineering support technologist in Energetic Systems Research Dept. 5437. He was hired on as a Sandia employee in 2013, but his association with Sandia goes back to 1997, when he started as a contract associate.

Don’s manager, Russ Maines, started working with him just a few months ago. But Russ says he was already familiar with Don’s work and was very happy to have him on his team.

“Don’s technical reputation always preceded him,” Russ says. “Folks in the nuclear business would call him and ask him to set up their experiments because they had confidence in his work.

They knew he’d never oversell the data that he generated, the diagnostics he ran, or tests he conducted. He was an honest man, who held scientific integrity and engineered reliability as the highest forms of serving our country.”

‘If it was broken, he could fix it . . .’

Don’s technical prowess and love for technology wasn’t limited to the workplace. According to the *Albuquerque Journal* obituary, “Don loved anything with an engine. If it was broken, he could fix it; if it moved fast, he could make it move faster. . . . He was always researching, studying, or working on a new project. Don’s talents with both mechanical and electronic objects meant that he was the ‘go to’ guy for repairs.”

Colleague Karmen Lappo (5436) also attests to Don’s technical contributions to the Labs.

“Don was an extremely resourceful colleague and a pleasure to work with,” Karmen says. “I most often



DON GILBERT

served in a role of coordinating projects and interfacing with a customer, being the face of the project. . . . It gave me comfort to know that when I would stand in front of a critical audience, I had Don Gilbert’s data on my slides.”

Don was humble about his abundant skills and his demeanor was “thoughtful and calming,” Karmen says. He was a steady hand when schedules got compressed or a crisis arose.

“He will be missed in our work execution and as a friend,” she says.

Another colleague, Allen Gorby (5437), says Don embodied the role of mentor. “I sincerely think that his greatest joy in life was seeing others succeed.” Like all great mentors, Allen says, Don wouldn’t just give you an answer, “he gave you an understanding of the problem, so that when something similar arose, you could think your way through it on your own.”

Allen says he feels fortunate to have been taken under Don’s wing. “I use things he’s taught me every day of my life. As a friend, his sense of humor, upbeat attitude toward life, and his philosophy of family first, was something all of us could learn from and strive to emulate. It is as a friend that I will miss Don the most.”

In his brief time as Don’s manager, Russ says he was very aware of Don’s role as a mentor, knew he was always responsive to those who sought out hands-on knowledge and wisdom.

“Don was always willing to share what he could, and took it upon himself to become an arbitrator for those



DON GILBERT measures the distance from ground zero to a blast gauge down at EMRTC — the Energetic Materials Research & Testing Center — at New Mexico Tech in Socorro. “He was doing what he always did, triple checking everything so that we could get everything right the first time,” says colleague Allen Gorby.

who could not seem to come to a meeting of the minds,” Russ says. “Don’s service to the national mission was not only meritorious, but exemplary. I only wish I had the chance to know him better. He will be sorely missed.”

The *Albuquerque Journal* obituary said, “Don’s true legacy lies with his family, friends, and colleagues. He believed his life’s most important work was being the best husband, father, uncle, friend, and mentor he could be. Don’s love and compassion improved countless lives and he has left the world a better place.”

He is survived by his wife, Cynthia; his sons, Travis and Brett; his sister, Linda Sexton; his step-brother, Maka Toloa; several brothers- and sisters-in-law; and many nieces and nephews. — Bill Murphy

Navy honors Jerry McDowell with achievement award



JERRY McDOWELL and his wife Tara pose with Vice Adm. Terry Benedict upon Jerry’s receipt of the Fleet Ballistic Missile Achievement Award. Tara received a certificate and personal letter from Adm. Benedict thanking her for her family’s sacrifice to the national security mission.

(Photo courtesy US Navy)

By Jennifer Awe

Jerry McDowell, who retires from his position as Sandia’s Deputy Labs Director and Executive VP for National Security Programs on July 4, has been presented the Fleet Ballistic Missile (FBM) Achievement Award, which recognizes significant personal contributions by FBM contractor personnel deemed pivotal to the success of the US Navy’s FBM Strategic Systems Program.

Jerry was honored for his significant contributions to national defense over the course of his 35-year career at Sandia. Major contributions by Jerry to the FBM program cited in the nomination package include his advocacy to the national security community, his contributions to technology development programs, and his management of projects and capabilities supporting Sandia’s nuclear and

conventional weapon responsibilities.

US Navy Vice Adm. Terry Benedict, who hosted the awards ceremony held in Washington, D.C., on May 7, recollected times he and Jerry had worked together over the years in their various positions within the Navy and Sandia, first on conventional weapons and, later, on the nuclear weapons side.

“I was humbled to receive this award from Adm. Benedict and to be recognized by someone I respect and admire as a great leader,” Jerry says.

Special recognition to families

Benedict also paid special recognition to the families of awardees, noting that he deeply appreciated the team commitment to serving the nation. He invited Jerry’s wife, Tara, to join them on stage, where he presented her with a certificate and a personal note of thanks.

“It meant a lot to me that Adm. Benedict recognized the sacrifices Tara and my children made while I was away from home on Navy business,” Jerry says.

Over the years, Jerry’s program responsibilities have spanned the breadth and depth of national defense, including nuclear deterrence; conventional strike; missile defense; information operations; intelligence, surveillance, and reconnaissance; counterproliferation of weapons of mass destruction; nonproliferation technologies; and intelligence matters. In 2003, he served as a member of DoD’s Science Board summer study related to Strategic Strike. According to FBM nominators, this advocacy role — supporting senior DoD officials, such as US Strategic Command — produced significant positive impacts on the Navy’s Strategic Systems Program.

“A person in my position at Sandia can only be honored with an award like this because of the support and sacrifice of the hundreds of Sandians who work every day to meet the Navy’s mission,” Jerry said during his acceptance speech. “I accept this award on their behalf.”

The nomination states Jerry was critical to “shaping current and future national security missions and capabilities at Sandia, enabling important and unique deliverables for the Navy’s advanced conventional weapon development program, and supporting Sandia’s engineering and systems integration responsibilities.”

Jerry is the seventh Sandian to receive the Fleet Ballistic Missile Achievement Award. Other recipients include Mark Rosenthal (2600), Ron Hartwig (2200), Rick Knudson (5353), Rich Heintzleman (5353), Charles Williams (ret.), and Dan Hardin (ret.).

Mileposts

New Mexico photos by
Michelle Fleming



Jaye Bullington
40 6925



Michi Wada
40 1751



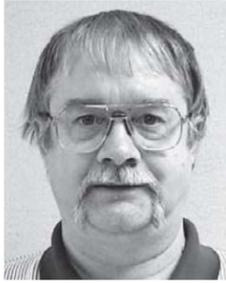
Gary Ashcraft
35 2662



Juan Espinosa
35 2245



Mark Geerts
35 2982



Mark Greenslete
35 2913



Ralph Keyser
35 5532



James Klarkowski
35 2624



Larry Miller
35 6832



Roxanna Salazar
35 5425



Diana Perea
35 5562



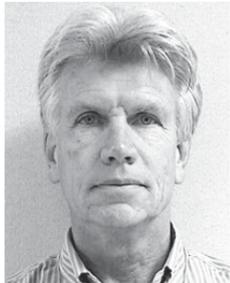
Tim Spears
35 5547



Timothy Wheeler
35 6231



Amalia Black
30 1544



Bill Chambers
30 157



Bob Chambers
30 1526



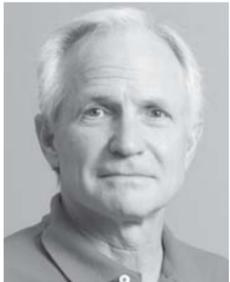
Randall Cygan
30 6910



Barbara Funkhouser
30 5500



Sabina Erteza Jordan
30 158



Tom Laub
30 1341



Barbara Mills
30 5531



Fred Oppel III
30 6522



Kent Pfeifer
30 1714



Roger Smith
30 2915

Recent Retirees



Larry Yellowhorse
41 6913



Tamara Orth
37 9515



RoseMary Baca
35 10623



Jennifer Nelson
31 6520



Sam Cancilla
27 9328



Jim Green
22 10222



Carol Ferguson
15 10672



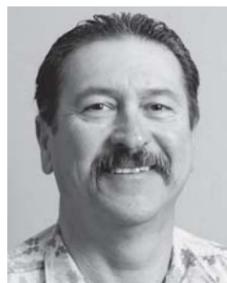
Jeffrey Anastasio
25 9324



Wallace Bow
25 5448



Brian Geery
25 2242



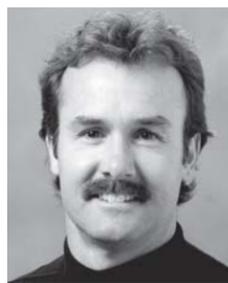
Orlando Griego Jr.
25 4237



Mike Hagengruber
25 9538



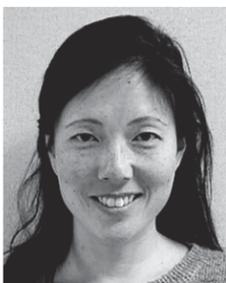
Paul Helmick
25 1385



Marc Kniskern
25 5422



John Mounho
25 9548



Hae-Jung Murphy
25 5418



Beverly Ortiz
25 9517



Patsy Rowland
25 4825



Tim Scofield
25 2622



Vincent Tidwell
25 6926



Jose Vigil
25 2731

Sandia Classified Ads Sandia Classified Ads Sandia Classified Ads Sandia Classified Ads

MISCELLANEOUS

STEPPING STONES, 24, Flex stone, \$70; black Champ golf travel bag, \$25; Masterflow gable vent, \$30. Weagley, 385-4059.

ELLIPTICAL MACHINE, Nordic-Track Audiostrider 990 Pro, has iFit, great condition, sturdy, \$350 OBO. Griego, 505-980-2755.

STEEL CABINET, large, \$60; maple woodworking bench, \$450; maple workbench, \$75; Iron Man spin bike, \$350. Olbin, 275-2681.

DJ EQUIPMENT, pair QSC12 (1-kW) powered speakers, strands, Yamaha mixer MG124CX, mic stand, pair DJ lights, Fascinator. Loubriel, 268-1341.

BOX FRAME, queen, good condition, \$50. Naber, 918-637-6663.

HITCH, heavy-duty, w/stabilizer bars, \$150 OBO. Moreno, 238-0494.

LEATHER COUCH, burgundy/maroon, top-grain leather, nail head, 90" x 40", \$500 OBO. Hennessey, 505-269-6243.

CRYPT, in mausoleum, Sunset Memorial Park, 924 Menaul Blvd. NE, \$10,000 OBO. McBride, 505-715-7982.

FIREWOOD, dry logs cut, ready for easy splitting, on private Jemez land, need 4x4 pickup, free. Menicucci, 505-235-8501.

CYCLING COOL BAG, Crivit Sports of Germany, never used, black, ~6L capacity, straps into handlebar, \$20. Wagner, 505-504-8783.

QUIZ FOR A CAUSE, benefits non-profit Fabulous Felines, June 4, 8 p.m., at the Cube. Mundt, 505-412-3812.

SPEAKERS, 4, Bose 301, Klipsch subwoofer, Bose center speaker, Sony receiver, will sell separately, \$450 OBO. Jellison, 573-0281, ask for Maria.

DINING TABLE, cherry wood, 42" x 42" x 37"H, 4 chairs w/cushions, photos available, \$50. Wagner, 858-922-9471.

ENGINE, V6 225CI, from older Jeep, \$75; automatic transmission TH350, fits V6, \$35. Bentz, 857-0728.

BED FRAME, loft, full size; cast iron wood-burning stove; Craftsman table saw & band saw; copper & glass wood-burning stove. Cronin, 299-6747, ask for Maxine.

BICYCLE RACK, Thule, trunk-mounted, holds 2 bikes, \$75. Kelly, 270-4485.

SPINET PIANO, free. Dodge, 379-9971.

RIMS, Dropstar Luxury DS20, for Mustang, black, size 20 x 8.5, brand new, \$600. Gutierrez, 917-0763.

LATHES, 2, JET mini lathe model 1014, \$300; Delta, full-size lathe, \$425. Montoya, 850-8829.

GEOTRAX, child friendly train, 8 engines, many cars, structures, bridges, track, etc., \$200 or offer. Hibray, 505-821-3455.

HARLEY-DAVIDSON MAG WHEELS, 16-in., slotted/solid-style, perfect condition, call for photos, \$150/set. Cocain, 281-2282.

HUGE ESTATE SALE, furniture, appliances, clothing, tools, much more, May 29-31, 8 a.m.-5 p.m., 2716 Utah NE, 87110. Allen, 615-0595.

How to submit classified ads
DEADLINE: Friday noon before week of publication unless changed by holiday. Submit by one of these methods:
 • EMAIL: Michelle Fleming (classads@sandia.gov)
 • FAX: 844-0645
 • MAIL: MS 1468 (Dept. 3651)
 • INTERNAL WEB: On internal web homepage, click on News Center, then on Lab News link, and then on the very top of Lab News homepage "Submit a Classified Ad." If you have questions, call Michelle at 844-4902. Because of space constraints, ads will be printed on a first-come basis.

- Ad rules
1. Limit 18 words, including last name and home phone (If you include a web or e-mail address, it will count as two or three words, depending on length of the address.)
 2. Include organization and full name with the ad submission.
 3. Submit ad in writing. No phone-ins.
 4. Type or print ad legibly; use accepted abbreviations.
 5. One ad per issue.
 6. We will not run the same ad more than twice.
 7. No "for rent" ads except for employees on temporary assignment.
 8. No commercial ads.
 9. For active Sandia members of the workforce, retired Sandians, and DOE employees.
 10. Housing listed for sale is available without regard to race, creed, color, or national origin.
 11. Work Wanted ads limited to student-aged children of employees.
 12. We reserve the right not to publish any ad that may be considered offensive or in bad taste.

TRANSPORTATION

'07 HYUNDAI TUCSON, 4x4, V6, new brakes & timing belt, only 62K miles, excellent condition. Evans, 265-5229.

'00 FORD RANGER PICKUP, 1/2-ton, V6, 2-dr. supercab, towing/camper pkg., blue, 200K miles, runs excellent. Crosby, 260-1070 or 453-2880.

'05 MERCEDES-BENZ E55 AMG, rare, 469-hp supercharged, AT, white/black, loaded, 94K miles, excellent condition, luxury & performance, \$20,500. Sedillo, 505-890-2698.

'12 MAZDA 3, iGrand Touring, fully loaded, 23.5K miles, priced to sell, \$12,000. Sabo, 510-542-7490.

'10 CHRYSLER TOWN & COUNTRY MINI VAN, w/automatic wheelchair ramp, 28K miles, \$38,000 OBO. Jojola, 505-977-4574.

'11 BMW 328xi, AWD, white, all books & records, 33K miles, new condition, \$24,000. Lucero, 471-1389.

'99 CADILLAC DEVILLE, leather, 12-disc CD changer, always garaged, 92K miles, completed 100K tune-up, outstanding, \$4,800. Bauck, 994-0999.

RECREATION

BICYCLES, 2, 28-in. men's; 26-in. women's, 21-spd., helmets, \$125 ea.; car carrier, like new, \$50. Boenig, 836-6977.

'86 HARLEY-DAVIDSON FXSTC, burgundy leather, after-market bags, 42K miles, runs well, \$5,500 OBO. Romero, 307-9389.

'10 KZ-COYOTE HYBRID TRAVEL TRAILER, sleeps 8-10, lightweight, slide out, easy setup, excellent condition, \$13,000. Sedillo, 238-6079, call or text.

'04 HONDA SILVER WING SCOOTER, CB, intercom, air horn, iPod connect, manuals, battery/tires 1 yr. old, Edgewood, 22K miles, \$3,200. Madole, 286-2368.

'10 TRAVEL TRAILER, like new, new tires, queen bed, many extras, tow pkg., on KAFB. Kappelman, 407-2226.

REAL ESTATE

3-BDR. HOME, 1 bath, 1-car garage, 1,700-sq. ft., currently a rental, 3-yr. tenants in home, worth ~\$150,000, will sell w/tenant in place for \$135,000. Boyer, 974-8195.

3-BDR. HOME, 2 baths, 1,664-sq. ft., NW Albuquerque, 20 mins. from Sandia, MLS#836598, \$184,500. Ruiz, 505-934-2667.

3-BDR. HOME, 2-1/2 baths, 1,600-sq. ft., 1 mile from Labs, 11023 Vistazo Place SE, built in '07, \$220,000. Keller, 505-238-9461.

WANTED

JEEP CHEROKEE, mid '90s-'01, 4x4, 6-cyl., AT, decent condition. Owen, 408-905-7463.

LOVING HOME, for older, small, pretty, tabby cat, due to arrival of new baby. Kelly, 306-4365.

YARD WORKERS, involves shoveling & wheeling dirt & rocks, will pay \$10/hr. Goodner, 505-379-4023.

ROOMMATE, share 3-bdr. home, NE Heights, 15 mins. to KAFB, \$450/mo. for room & own bath, includes utilities. Gilliland, 505-306-1711.

WORK WANTED

AVAILABLE TO PET SIT, reasonable rates. Rogers, 379-2032.

Mileposts

New Mexico photos by Michelle Fleming



Ben Aragon 20 5425



Shawn Burns 20 263



Dwight Coles 20 9543



Michelle Griffith 20 5791



Gerald Hendrickson 20



Dominic Martinez 20 6835



Dave Schoch 20 9538



Lorraine Sena-Rondeau 20 2719



James Taglianetti 20 9511



Tricia Toya 20 5942



Shannon Delgato 15 2626



Laura Fielder 15 6831



Rebecca Ivey 15 10502



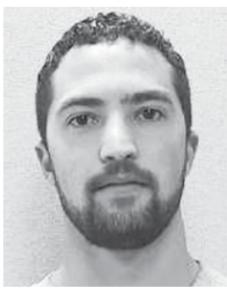
Leann Marie Jenkins 15 10223



Vincent McRoberts 15 6012



Roger Pawlowski 15 1446



Dominic Pohl 15 5436



Bryan Sanchez 15 2547



Jeri Timlin 15 8631



Tim Vanderburg 15 2523

Top doc

By Nancy Salem

Aleksandra Faust's family got lucky as civil war raged in their native Serbia. They were tapped in 1995 for US permanent residency in what is known as the green card lottery, which makes thousands of resident visas available each year to natives of countries with low rates of immigration to the United States.

Sandra's father, mother, and brother quickly fled the fighting but she stayed behind to finish a bachelor's degree in mathematics at the University of Belgrade. "Education is important to me," Sandra (5563) says. "The war situation was really bad. I knew that a degree was critical to getting a job and succeeding in the United States. It was a risk to stay behind but it was a bigger risk to quit and start over."

Two years later, degree in hand, Sandra rejoined her family in Michigan where she worked in industry a few years. Education called again, and she enrolled in the University of Illinois at Urbana-Champaign, earning a master's degree in computer science in 2004.

Sandia hired Sandra in 2006 and in the fall of 2012 she entered the Labs' Doctoral Studies Program to pursue a PhD in computer science at the University of New Mexico. She graduated last summer.

Sandra left UNM on a high note. The university announced recently that she won the 2015 Tom L. Popejoy Dissertation Prize recognizing the highest level of academic excellence among doctoral students.

"This is a prestigious award, extremely competitive, juried by tenured faculty members and the dean of Graduate Studies," says Margaret Gonzales of the UNM Graduate Studies Department. "It's the only dissertation award provided by UNM that is university-wide."

How to program a robot

Sandra's dissertation, "Reinforcement Learning and Planning for Preference Balancing Tasks," centered on robotics and started with the problem of how to control an unmanned aerial vehicle that carries a suspended load (see abstract at right). "Robots are becoming ubiquitous in our daily lives, from cleaning homes to building cars. Advances are being made, but there are challenges," says Sandra's UNM adviser Lydia Tapia. "It is often a difficult and manual process to program a robot to perform a task."

Sandra's thesis put forth new learning-based algorithms to program complex, high-dimensional robotic systems. She also provided mathematically rigorous stability guarantees of robots' behavior, and application to several complex robotic tasks.

She developed a framework, called PEARL, that addresses three major challenges of robots learning motion-based tasks: efficiency, safety, and adaptability. Her thesis led to a provisional patent and publication of numerous technical papers.

Sandra recently began a Laboratory Directed Research and Development project in geosciences using methods developed in her thesis to adaptively change seismic data processing parameters on the fly for more accurate seismic event characterization and detection. And she is working on the Hardware Acceleration of



SANDRA FAUST received her doctorate in computer science from the University of New Mexico. She was later named this year's top doctoral student.

Sandia robotics scientist wins prestigious UNM dissertation award



GIVING BACK — Computer scientist Sandra Faust, a mother of two, reaches out to Albuquerque young people through a weekly math club. "Getting the younger generation involved in STEM, in particular girls, minorities, and the disadvantaged, is very important to me," she says. "As a professional, I offer another point of view without the grades, tests, and other pressures. I am free to expose children to aspects of math not covered in the classroom, like hands-on activities and games."

Adaptive Neural Algorithms, or HAANA, Grand Challenge. HAANA is developing a data analysis platform that uses neural-inspired algorithms and hardware to rapidly identify, learn, and track the evolution of threats.

Dissertation with technical, logical, and social impacts

Gonzales says the Popejoy Award jury was extremely impressed with Sandra's dissertation. "They said it was well written and exhibited a balance between theory and application," she says. "They concluded the research has deep technical, logical, and societal impacts."

Sandra says she chose UNM for her doctorate so she could work closely with both the university and Sandia. "My goal was to bridge the collaboration between the Labs and UNM," she says. "UNM maintains a high level of research and is in the top 100 computer science graduate programs in the country. And I received tremendous help and support from within Sandia all along the way."

She says UNM provided more than just a technical education. "I didn't expect to get such a great mentoring experience in terms of career, writing, and presenting myself," she says. "It was really great to work one-on-one with a mentor."

Sandra, who received the Popejoy Award at UNM's spring commencement, says she was overwhelmed at the honor. "It is an endorsement of the research I developed," she says. "I am excited to apply what I learned to challenges facing the Labs."

And she says the award took her back to the commitment to education she made in war-torn Serbia. "It is a confirmation that years of hard work do pay off, and that in this country one does not need to be privileged to succeed," she says. "I immigrated to the United States to escape wars in the Balkans. I arrived with a diploma in math, two suitcases, and a desire to live a dignified life, working hard. I worked three jobs during my first year in the States. Over the years, I invested in furthering my education. I worked on what I am passionate about and expanded my personal and professional network. This award is the crowning achievement of that effort."

Winning dissertation

Reinforcement Learning and Planning for Preference Balancing Tasks

by
Aleksandra Faust

Abstract

Robots are often highly non-linear dynamical systems with many degrees of freedom, making solving motion problems computationally challenging. One solution has been reinforcement learning (RL), which learns through experimentation to automatically perform the near-optimal motions that complete a task. However, high-dimensional problems and task formulation often prove challenging for RL. We address these problems with Preference Appraisal Reinforcement Learning (PEARL), which solves Preference Balancing Tasks (PBTs). PBTs define a problem as a set of preferences that the system must balance to achieve a goal. The method is appropriate for acceleration-controlled systems with continuous state-space and either discrete or continuous action spaces with unknown system dynamics. We show that PEARL learns a sub-optimal policy on a subset of states and actions, and transfers the policy to the expanded domain to produce a more refined plan on a class of robotic problems. We establish convergence to task goal conditions, and even when pre-conditions are not verifiable, show that this is a valuable method to use before other more expensive approaches. Evaluation is done on several robotic problems, such as Aerial Cargo Delivery, Multi-Agent Pursuit, Rendezvous, and Inverted Flying Pendulum both in simulation and experimentally. Additionally, PEARL is leveraged outside of robotics as an array sorting agent. The results demonstrate high accuracy and fast learning times on a large set of practical applications.