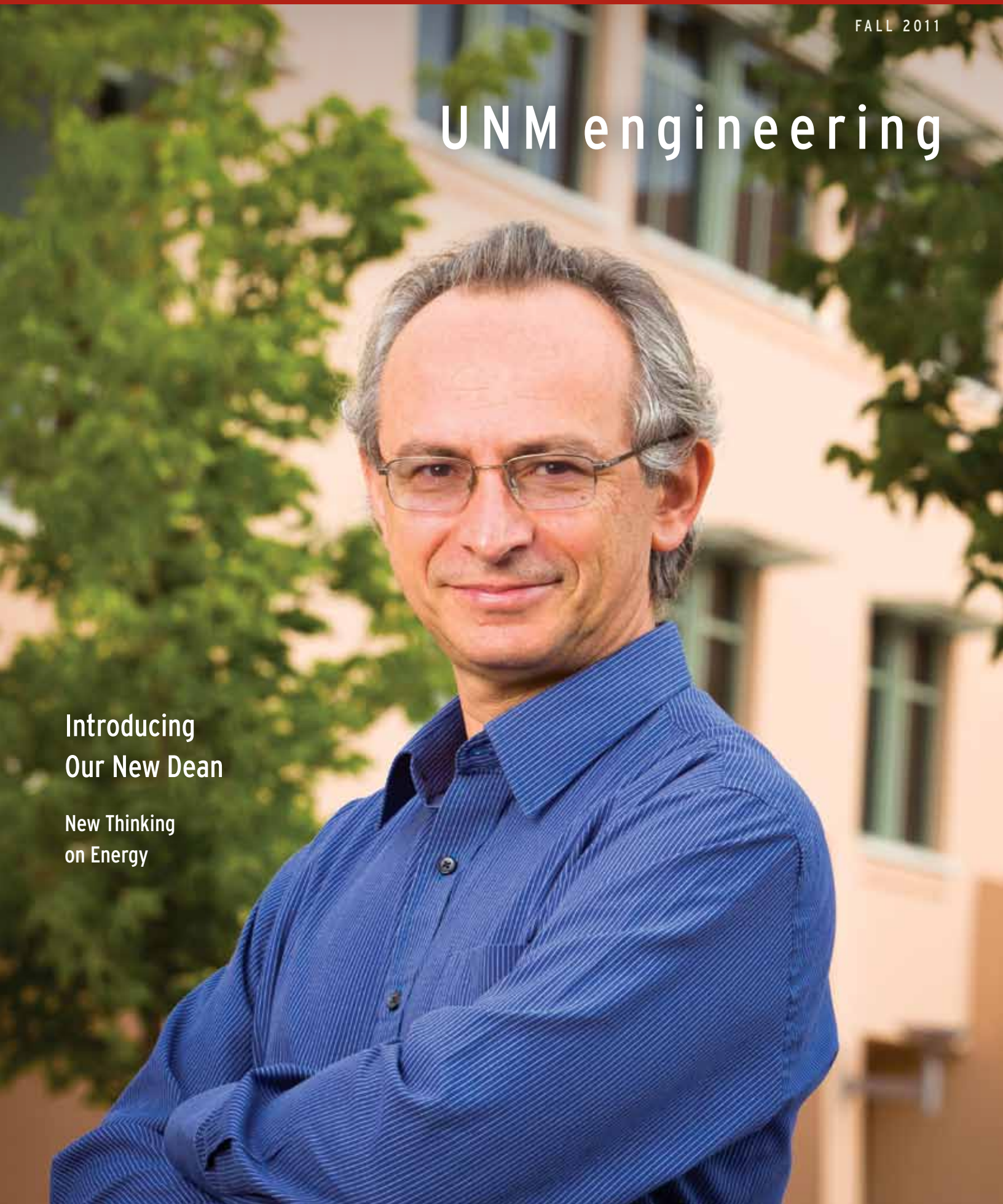
THE UNIVERSITY OF NEW MEXICO SCHOOL OF ENGINEERING

FALL 2011

UNM engineering



Introducing Our New Dean

New Thinking on Energy

From the Dean

In the last century, engineering has been transformed in fundamental ways. As a discipline, it extended its intellectual influence by enabling fields like biology, computing, architecture, and others to build on traditional engineering research and design methods; for example, we are now using nanoscience to design drug delivery mechanisms. At the same time, engineering research has acquired a fundamentally multidisciplinary nature. As a practice, engineering has emerged as an integrative endeavor that engages all other dimensions of our social and physical existence by factoring environmental, business, esthetic, and personal dimensions in the design and manufacturing process.

Within this broader context, the University of New Mexico School of Engineering aspires to make a lasting social contribution through its rich research portfolio and to have a deeply personal impact on its students through progressive and creative educational programs. We pursue research that is both fundamental and applied in areas designed to greatly impact the way our society lives now and in the future. We engage in teaching that both educates and trains our students, giving them valuable skills that are in demand, while encouraging them to follow their passion and expand their horizons across areas of study, within and outside our school.

This issue is dedicated to sustainability as a research and education theme and it is illustrative of our efforts to be faithful to the vision outlined above. Research highlights focus on engineering for energy efficiency in buildings, wastewater treatment, solar cell technology, fuel cells, nuclear safety, and more. Student involvement in research is amply visible throughout and so are efforts to engage both industry and other disciplines in our research endeavors.

With best regards,

Catalin Roman
Dean, UNM School of Engineering

SOE Quick Facts

Research
Total annual expenditures: $31.73 million
Annual expenditures per faculty: $300,000

Number of Faculty
Tenured and tenure-track faculty: 100
Visiting and research faculty: 47

Enrollment
Undergraduate: 1179 (35% Hispanic)
Graduate: 620 (14% Hispanic)

NSF CAREER Awards in the last 3 years: 11

SOE Innovations since 1995
Patents issued: 203
Start-up companies: 23

Contents

Points of Pride

Presidential Award

Yasamin Mostofi, assistant professor of electrical and computer engineering, has been awarded the Presidential Early Career Award for Scientists and Engineers (PECASE). The award, presented by President Obama, is considered the highest honor bestowed on science and engineering professionals in their early independent research careers. Mostofi was honored for her groundbreaking research on mobile sensor networks and dedicated educational activities.

Engineering Faculty Appointed Provost

Chaouki T. Abdallah, previously the chair of the Electrical and Computer Engineering Department, was appointed UNM interim provost and executive vice president of academic affairs beginning July 1, 2011.

CHTM Exceeds 100 Patents

The US Patent office has issued over 100 patents to **Center for High Technology Materials researchers** since the Center was founded in the early 1980s, 45 of which have been licensed by companies wishing to use the technology.

R&D 100 Awards

Two technologies developed by UNM SOE researchers have been recognized by *R&D Magazine* as among the 100 top high technology products this year. Regent's Professor **Jeff Brinker** collaborated on Biomimetic Membranes for Water Desalination, a solution to address the global challenge of clean water. Assistant Professor **Dorian Arnold** collaborated on Stack Trace Analysis Tool (STAT), a highly scalable, lightweight debugger for parallel applications.

New Thinking on Energy

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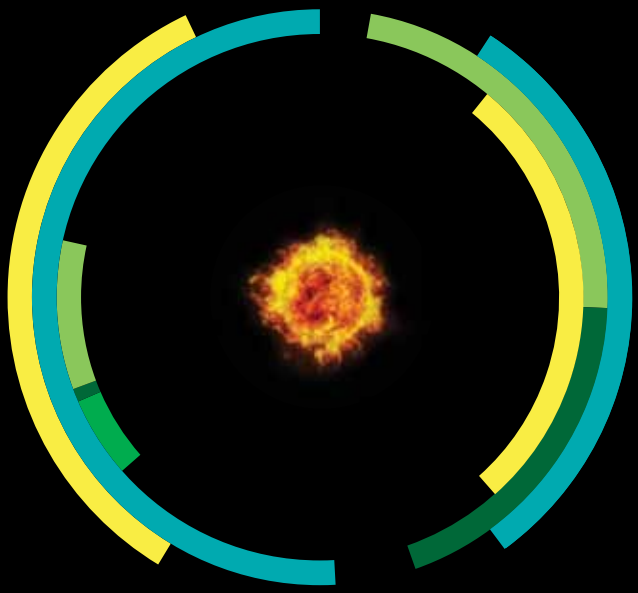
On the Cover
UNM School of Engineering Dean Catalin Roman in front of the Centennial Engineering Center.

Energy Quick Facts

As researchers work to address the world's growing demand for energy, it's helpful to understand who's using it, how much they're using, and where the energy comes from. These charts offer a snapshot of energy consumption around the world.

Renewable Energy Consumption by Energy Source

- Biomass 51%
- Hydroelectric 34%
- Wind 9%
- Geothermal 5%
- Solar 1%



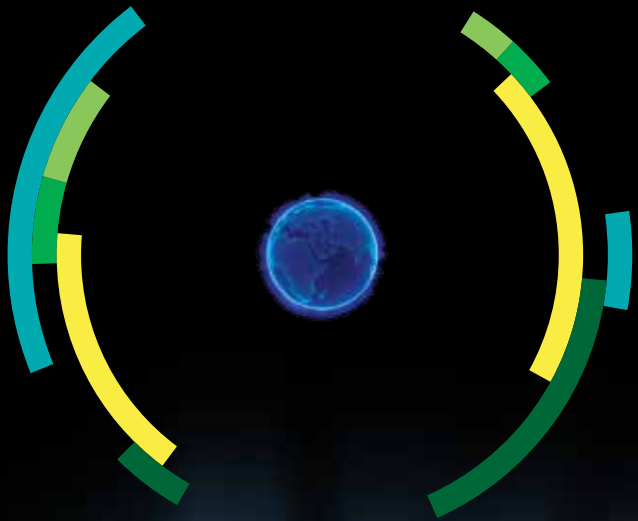
Share of Energy Consumed by Major Sectors of the Economy

- Industrial 31%
- Transportation 28%
- Residential 23%
- Commercial 19%

Source: U.S. Energy Information Administration 2009

World Energy Consumption

- United States 21%
- China 16%
- Russia 6%
- Japan 5%
- India 4%



World Population

- United States 5%
- China 20%
- Russia 3%
- Japan 3%
- India 17%

Source: U.S. Energy Information Administration 2007

BUILDING A BETTER POWER GRID

AN INTERNATIONAL CONSORTIUM STUDIES MICROGRIDS

"Buildings are the largest single consumer of energy—they use 77% of the electric energy in the U.S.," says Andrea Mammoli, associate professor of mechanical engineering and co-director of the Center for Emerging Energy Technologies (CEET). Mammoli and an international consortium are developing ways for buildings to use energy more efficiently and more wisely. Their vision is to seamlessly align production of sustainable energy resources, including wind and solar, with energy needs in residential and commercial buildings.

A Unique Opportunity

The consortium is Japan's New Energy and Industrial Technology Development Organization (NEDO), which is working in partnership with UNM, Sandia National Laboratories, Los Alamos National Laboratory, and PNM, New Mexico's largest electricity provider. With 21 American and Japanese companies involved, the NEDO-led project is the only one of its kind in the U.S.

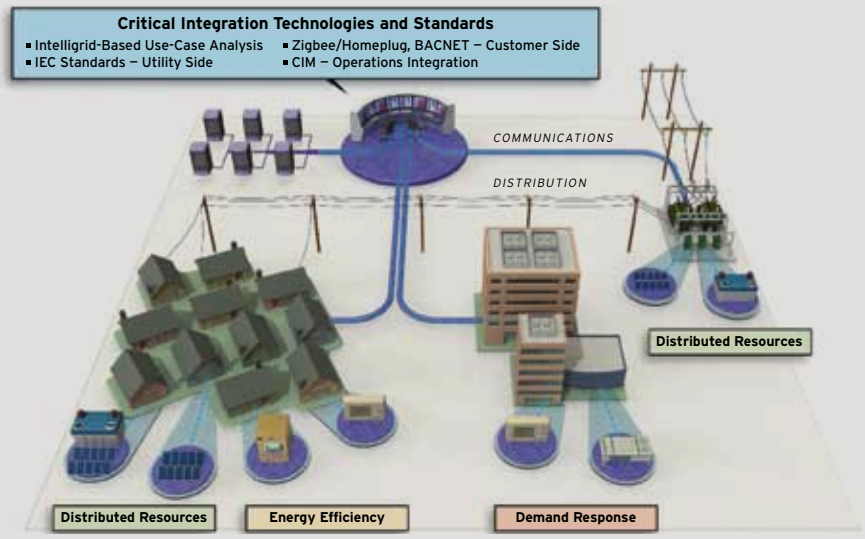
The group is using Mesa del Sol (MDS), a master-planned community in Albuquerque, to research the interface between buildings, distributed power generation, and the power grid. It's also using MDS to test new smart grid technologies. MDS is a greenfield development—undeveloped land without existing technology networks—designed for healthy, simple, sustainable living.

Dr. Olga Lavrova, PhD student Birk Jones, Dr. Andrea Mammoli, and Dr. Svetlana Poroseva, part of an international consortium studying sustainability, in front of the Aperture Center at Mesa del Sol.

Ph.D. student Birk Jones, Dr. Olga Lavrova, Dr. Andrea Mammoli, and Jon Hawkins, Manager of Advanced Technology and Strategy for PNM, stand in front of the PV array that powers PNM's Prosperity Project, a system where utility-scale batteries help to manage solar power to make it more grid-friendly.

PNM Smart Grid Demonstration Project

The distribution grid of the future, where energy resources in homes and commercial buildings interact with utility-side control systems to better align power production with end use.



NEDO is creating a "microgrid," a section of the power grid that can produce and store its own power through a mix of local renewable and fossil energy sources. The microgrid will be able to operate independently of the main power grid. Alongside the NEDO project, the DOE-sponsored PNM Prosperity Energy Storage project will test a battery the size of eight shipping containers that can store power generated by a photovoltaic plant.

Mammoli will study how buildings can absorb intermittent energy produced by solar and wind power. One strategy will be to use novel energy storage solutions and digital controls that manage power use based on demand and the status of local power generation.

The consortium plans to connect MDS's flagship building, the Aperture Center, to the microgrid by the end of the year. At the same time, researchers will create a simulation of the grid to test different scenarios in real time without impacting buildings or residents. Ultimately, the simulation will be connected to actual buildings, allowing researchers to test the collective behavior of many smart buildings and observe the operation of real-life systems in detail. Research will expand as MDS grows.

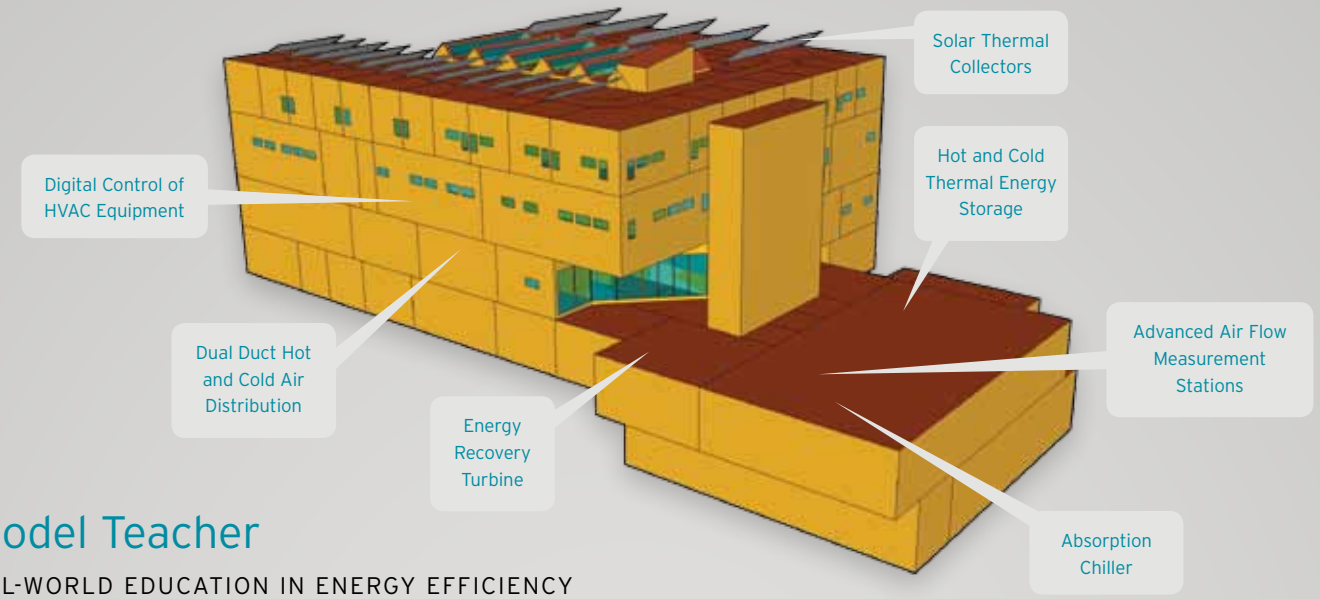
When the two-year research project is complete, UNM will inherit the NEDO hardware (valued at more than $10 million), which will become a substantial component of a unique testbed that will put UNM at the leading edge of smart grid research.

Multifaceted Research Effort

Mammoli has assembled a multidisciplinary team to work on the project. Olga Lavrova, assistant professor of electrical and computer engineering, is modeling multi-agent behavior and analyzing the best way to configure an automatic system that includes many different nodes and controls. She is also modeling battery storage techniques to determine the best use of PNM's giant battery.

As the research progresses, other faculty will get involved. Svetlana Poroseva, assistant professor of mechanical engineering, will use an approach she developed to find an optimal way for connecting buildings and power sources with one another so the microgrid will be more resilient against multiple failures. Melanie Moses, assistant professor of computer science, will apply her expertise in biological systems to help design system architectures that are more resilient. And Tom Caudell, professor of electrical and computer engineering, will use his expertise in neural networks to develop ways of effectively monitoring these increasingly complex systems.

"The Smart Grid is a prototypical example of a complex problem that can only be solved with a multidisciplinary approach," explains Mammoli. "At UNM, we have a team of faculty and students from many disciplines who interact to develop innovative solutions." ✦



A Model Teacher

A REAL-WORLD EDUCATION IN ENERGY EFFICIENCY

Engineering students and faculty learn quite a bit from BERT. The exclusively hands-on lessons include new ways to control power usage in buildings, the mechanics of thermal storage, smart grid technology, and much more. This popular teacher doesn't take attendance, require tests, or have a class schedule.

That's because BERT is actually the Building Energy Retrofit Testbed, a living laboratory at the UNM Mechanical Engineering building. SOE researchers and students use BERT to see how existing structures can become more energy efficient—and stay that way—by intelligently monitoring their own operation and comparing it with an accurate model running in parallel with the real system.

When the ME building opened in 1980, it was a showcase of energy conservation. Since then, new systems and equipment have been added, resulting in approximately $35,000 of energy savings annually, according to Hans Barsun, physical plant engineer. Barsun is also pursuing a Ph.D., researching how to integrate BERT with other energy systems on the electric grid.

Now, thanks to generous support from Yearout Mechanical Inc., BERT's energy systems will be augmented by new digital controls in all 70 air mixing boxes that deliver heating and cooling to the building's rooms and by a series of sensors that measure and monitor airflow and quality throughout the building. The added control and feedback make it possible to effectively compare building heating and cooling scenarios against the energy simulation models.

Ph.D. student Birk Jones, who is leading the implementation of the new equipment, hopes that his research will increase their abilities to accurately predict energy use and reliably operate energy systems within existing buildings.

BERT is also an excellent research complement to the new NEDO consortium studying microgrid technology at Mesa del Sol *(see previous article)*. The experience gained through BERT will help the team operate the sophisticated microgrid equipment installed by NEDO. For example, some of the control strategies developed and fine-tuned using BERT will be used in the more demanding commercial building environment.

Improvements and research progress can be followed on the website http://iseslab.unm.edu

What is our greatest energy challenge?

"It's a combination of things. Resources are being depleted pretty quickly, especially because emerging nations are going to want to consume energy at the rate we do. There's the climate to consider. And water issues because energy is very intimately connected with water. Everything is tied together — so we have to find a way to use less energy."

Andrea Mammoli
Associate Professor of Mechanical Engineering and Co-director of the Center for Emerging Energy Technologies

Catching the Waves

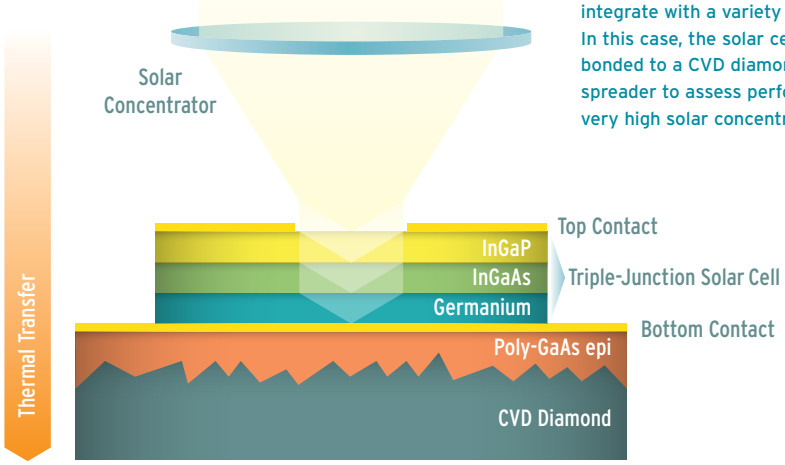
RESEARCHERS BLEND NOVEL MATERIALS TO CAPTURE MORE ENERGY FROM THE SUN

The nanoscale crystals and quantum dots Ganesh Balakrishnan creates are mere nanometers in diameter, but they could help next generation solar cells harness more power from the sun by collecting light of different colors or wavelengths.

Balakrishnan, assistant professor of electrical and computer engineering, leads a materials research group at the Center for High Technology Materials (CHTM). The team is combining dissimilar materials to create high efficiency, low cost solar cells. "We're trying something fundamentally new as we work on next generation solar cell technology," says Balakrishnan.

Their goal is to integrate semiconductors that absorb different wavelengths of light into a single material by developing new techniques to manipulate crystal growth. Standard solar cell technology made from silicon uses a single crystal that catches only part of the spectrum.

"Solar energy is very broad spectrum light, which means it has lots of different wavelengths or colors," explains Balakrishnan. "If you can stack different materials on top of each other, the first layer could capture the first part of the spectrum and the second layer could capture the second." The wafers of novel materials Balakrishnan develops could be used as solar cells in compact but powerful solar arrays on rooftops or other small spaces.



A traditional triple junction solar cell design is one of the structures that Balakrishnan's lab is trying to integrate with a variety of substrates. In this case, the solar cell is being bonded to a CVD diamond heat-spreader to assess performance at very high solar concentrations.

In one research project, Balakrishnan is collaborating with scientists from the National Renewable Energy Laboratory to grow crystals of gallium antimonide, a family of relatively expensive compounds, on a substrate of inexpensive gallium arsenide or silicon. The substrate absorbs the visible and ultraviolet part of the spectrum while the gallium antimonide absorbs the invisible infrared spectrum.

He's applying the same idea but using different structures in a second project where he's anchoring quantum dots of a gallium antimonide on a substrate, then surrounding the dots with gallium arsenide.

What is our greatest energy challenge?

"It's getting enough people to work on the problem because it's not going to solve itself overnight. The problem requires a sustained effort and we're going to need the next generation of researchers to work on it."

Ganesh Balakrishnan
Assistant Professor, Electrical and Computer Engineering

Ganesh Balakrishnan uses the molecular beam epitaxy machine to create novel wafers that could be used as solar cells.

> *"We're trying something fundamentally new as we work on next generation solar cell technology."*
>
> GANESH BALAKRISHNAN

Decades of Expertise

Balakrishnan uses CHTM's molecular beam epitaxy (MBE) machines to create these novel materials. The MBE allows researchers to build precise layers of semiconductors by growing one atomic layer at a time.

"CHTM has one of the best MBE labs in the world for quantum dots and antimonide semiconductors," says Balakrishnan. "Such dominance in these two research fields can be traced to several decades of cutting-edge epitaxial research by faculty members such as Steve Brueck, Ralph Dawson, Luke Lester, Sanjay Krishna, and Kevin Malloy."

Balakrishnan's novel materials find their way into a collaborative network of faculty members working in the area of photovoltaics. The team led by Luke Lester, interim chair and professor of electrical and computer engineering, fabricates the semiconductors into working solar cells and also tests them in his solar cell laboratory. Olga Lavrova, assistant professor of electrical and computer engineering, works very closely with the two teams to implement the solar cells into systems.

In the future, these low cost, high efficiency solar cells could be on rooftops near you, pulling more power out of every ray of the sun and helping fuel a clean energy future. ✦

Gaining The Competitive Edge

Special programs give undergraduates valuable training

In a secure lab at the Center for High Technology Materials (CHTM), researchers move carefully around a hulking, million-dollar molecular beam epitaxy machine (MBE). One small mistake on the machine can result in a repair bill that could easily run into the thousands—or hundreds of thousands—of dollars. Which is why it might be surprising to know that several of the researchers are undergraduates.

Those students have special training with the MBE, thanks to UNM's Minority University Research Affiliate (MURA) program. The prestigious Department of Energy-funded program trains undergraduate students for careers in the solar industry. The program is open to all students but puts special focus on Native American and Hispanic undergraduates.

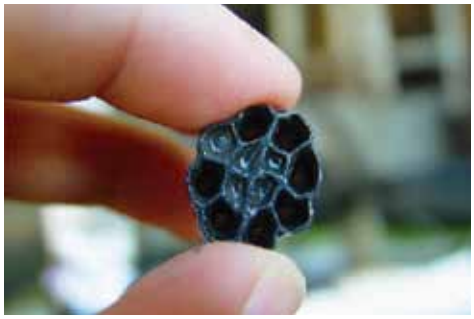
MURA participants learn safety and lab procedures and receive training on lab equipment, including the MBE. The MURA also acts as a pipeline between SOE undergraduate programs and the CHTM graduate program. "The goal is to make UNM grads more competitive in the energy area, whether they join our program or another program elsewhere in the country," says Ganesh Balakrishnan, who runs the MURA with Olga Lavrova, both of whom are assistant professors in the Electrical and Computer Engineering Department.

Victor Patel (B.S., E.E.'11) is proof positive of the MURA's efficacy. Patel joined the program his senior year to conduct optoelectronic and crystal growth research with Balakrishnan's group. "This program gave me great hands-on research experience and helped me decide what specialty I want to go in to," says Patel. Now he's in graduate school at the University of Notre Dame and credits his MURA experience with helping him stand out in a competitive pool of graduate school applicants. "Notre Dame was really impressed with my experience. They acknowledged that most undergraduates don't do this type of research."

The MURA is one of several special training programs at CHTM. An NSF Research Experience for Undergraduates (REU) trains undergraduates on nanosolar technologies, and a Department of Defense Micro Autonomous Systems and Technology (MAST) program gives students experience in renewable energy technologies. In addition, Balakrishnan helps manage an NSF scholarship program that awarded annual $5,000 scholarships to five students studying high technology materials last year.

The New Possibilities of Plastic

Developing energy efficient materials that clean waterways



Reel in a smallmouth bass from some locations along the Mississippi River, dissect it, and chances are good it will be an "intersex" fish with both male and female characteristics. According to a recent U.S. Geological Survey study, up to 70% of the smallmouth bass at sites in the Mississippi, Colorado, and Columbia River basins are intersex; usually male fish with egg cells in their testes.

These intersex fish are likely the result of pollutants such as hormones and pharmaceuticals that pass through wastewater treatment systems and into waterways at trace concentrations.

A subsequent U.S. Geological Survey study showed that exposure to estrogen puts these intersex fish at greater risk of disease and premature death. The presence of intersex fish is a red flag for ecologists, as these changes can signal widespread ecosystem disruption.

Existing technologies for removal of trace pollutants, such as reverse osmosis, can be power-intensive and expensive. As energy costs rise, municipalities are looking for more energy efficient technologies. Andrew Schuler, associate professor of civil engineering, may have the answer.

Schuler is focusing on using the natural process of biodegradation using integrated fixed film activated sludge (IFAS) systems *(pictured above),* which include thousands of faceted plastic pieces that float in bioreactors and create surfaces where pollutant-removing bacterial biofilms can grow. Because the plastic pieces simply float in the water, they don't use any additional power at all.

Most IFAS pieces are made of cheap, extrudable plastic. Schuler is studying alternative materials with different surface properties to attract specialized populations of bacteria that are better at removing hormones and pharmaceuticals.

For example, researchers in Schuler's laboratory recently inserted sheets of alternative materials into Albuquerque's wastewater treatment plant. After four months of biofilm growth, his lab extracted them and measured their performance. "We found several inexpensive materials that produced biofilms providing much better estrogen removal," says Schuler. "The idea that we can control bacterial populations through manipulation of attachment surfaces is really exciting."

Now Schuler is studying how to adhere specialized ammonia and hormone removing bacteria to these surfaces. By combining novel materials with new 3-D shapes of attachment media, Schuler aims to engineer biofilms that remove a range of hormones and pharmaceuticals. The result will provide new technologies that use minimal energy to protect our waterways.

The foundation for this research garnered Schuler the prestigious 2008 Paul L. Busch Award, presented by the Water Environment Research Foundation to a researcher who is conducting innovative environmental research, and included a $100,000 cash prize.

What is our greatest energy challenge?

"One critical challenge is addressing mobile energy uses. We will be able to meet many of our needs by developing renewable sources such as solar and wind, but it's doubtful we'll be able to run an airplane on a battery. Efficiently producing renewable liquid fuels, such as algal biodiesel, is going to be an important piece of the puzzle."

Andrew Schuler
Associate Professor
Civil Engineering

A New Frontier in Fuel Cell Technology

Non-platinum fuel cell to debut in electric vehicles

Fuel cell technology promises clean power for electric cars, efficient domestic combined heat-and-power generation, and many useful gadgets, but it has significant drawbacks. One of the biggest is that current fuel cell technology requires platinum catalysts. Not only is platinum extremely expensive, but consistent access to it is uncertain because the metal is heavily concentrated in foreign-owned mines in South Africa.

That's why researchers have worked for years to develop fuel cell catalysts that approximate the performance of platinum without using any of the precious metal. Earlier this year, a consortium of researchers, including **Plamen Atanassov**, professor of chemical and nuclear engineering and director of the Center for Emerging Energy Technologies, made important steps towards achieving that goal. Atanassov is collaborating with scientists from the Daihastu Motor Corporation, a subsidiary of Toyota, to create the world's first platinum-free fuel cell for an electric vehicle. Several Japanese universities as well as private and government organizations are partnering in the effort as part of the informal Creating Alkaline Fuel-cell for Earth (CAFÉ) consortium.

This breakthrough fuel cell uses a new type of polymer electrolyte membrane that conducts electricity by exchanging anions (hydroxyls), as opposed to the proton-exchange membranes that are popular today. The membrane allows the use of non-platinum catalysts for both oxidation of fuel on the anode and oxygen reduction on the cathode. The catalyst is stable in an alkaline media rather than a platinum catalyst, which dominates in an acidic media.

Until now, alkaline membrane fuel cells were inferior in their performance and not as well developed as acidic models.

"For the first time, an alkaline membrane fuel cell has been engineered for an electric vehicle."

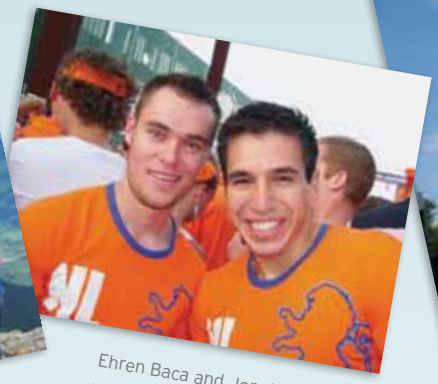
PLAMEN ATANASSOV

"This is an ambitious project. We are replacing the paradigm with a new one," says Atanassov. "For the first time, an alkaline membrane fuel cell has been engineered for an electric vehicle." If this new technology takes off, it may open the opportunity to introduce automotive technology that is not materials limited and constrained by the scarcity of platinum. ✦

Exploring New Horizons in Education and Research

Study abroad experience shapes students' futures

Dr. Abhaya Datye (lower left), Jonathan Paiz (right), and participants of the PIRE summer school



Ehren Baca and Jonathan Paiz watch Holland play in the finals for the World Cup

Eindhoven University of Technology

Jonathan Paiz was finishing his first year as a doctoral student in chemical engineering at UNM and wasn't sure which direction his research should take. That's when Abhaya Datye, director of the Center for Microengineered Materials (CMEM), suggested Paiz pack his bags and head to Eindhoven University of Technology in the Netherlands, one of the newest members of UNM's NSF-funded Partnerships for International Research and Education (PIRE) grant.

Paiz was one of 15 students from the U.S. who traveled to Europe as part of the PIRE program. What the students learned during their experience will hopefully contribute to new frontiers in the development of clean burning liquid fuels and more efficient chemical production from biomass.

Paiz says his ten-week experience studying abroad was just the "kick start" he needed. While in the Netherlands, he worked with Dr. Peter Thüne, a German professor visiting Eindhoven University (www.tue.nl/en/) who studies iron oxide catalysts. The research was a departure from the research Paiz had conducted at UNM. "My experience in the Netherlands gave me real motivation and new ideas," he says. "It inspired me to do more research and to really get into my subject."

In the university's advanced labs, Paiz collaborated with students from other European universities and found value in that experience, too. "They're pioneers in catalysis. I learned that their culture and work ethic is very similar to ours," he says.

Datye says cultural exchange is a key benefit of the PIRE. "We see the value of our students studying abroad because they get a sense of what other students at other universities are learning and what type of research they do," he comments.

With support from the PIRE, Paiz continued a long-distance collaboration with Thüne during the school year. Paiz returned to Eindhoven University, host of the 2011 workshop for PIRE students, this past summer to continue his research and hopes to publish his first paper based on the experience soon. ✦

What is our greatest energy challenge?

"Our greatest challenge is to capture and convert the energy we get from the sun into more useful forms, such as liquid fuels and electricity. We're addressing a global problem and the solutions are not going to come from just one place. That's why we are partnering with the leading institutions around the world."

Abhaya Datye
Distinguished Professor, Chemical and Nuclear Engineering and Director of the Center for Microengineered Materials

Critical Connections

UNM program links nuclear criticality experts worldwide

When a nuclear criticality safety expert in France has a question about the best way to recycle nuclear materials, she can turn to colleagues in the U.S. for answers. And when engineers in Russia need input on the safe processing of uranium solutions, they have a worldwide network of professionals to turn to for advice. These essential connections are fostered by the **Nuclear Criticality Safety Group** (NCSG), an organization that offers courses, workshops, and networking to approximately 1,200 nuclear criticality safety professionals worldwide.

UNM has offered short courses and workshops on nuclear criticality safety for decades, but the process was formalized in 1991 when the NCSG was established. NCSG is directed by Bob Busch, Ph.D., facility supervisor of the UNM Nuclear Engineering Laboratory, and with administrative assistance from Cheryl Brozena.

Busch also teaches a large portion of the undergraduate curriculum of the Nuclear Engineering program, including nuclear criticality safety courses. UNM is one of only two universities in the nation to offer such classes. "For the nuclear industry to remain viable, we need engineers trained in the methods of safe materials processing," he explains. "Without these courses, there would not be enough trained individuals to oversee the safe handling of fissile materials."

Nuclear criticality safety focuses on everything done to fissile material outside nuclear reactors. Engineers in the field research safe long-term nuclear waste storage, study how to reprocess and recycle spent nuclear materials,

"Without these courses, there would not be enough trained individuals to oversee the safe handling of fissile materials."

BOB BUSCH

and develop ways to avoid accidents related to handling nuclear materials.

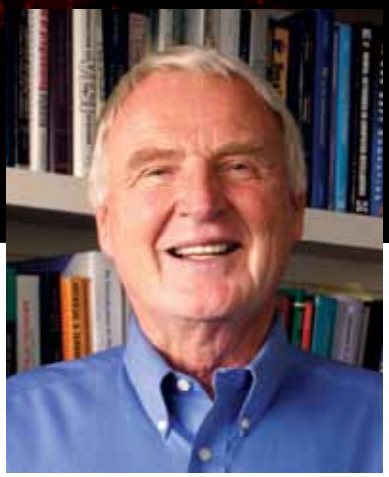
A criticality event is distinctly different from the accidents that happened at the Fukashima Nuclear Power Plant in Japan because a criticality event is very localized and involves nuclear material that isn't within the reactor.

NCSG short courses and workshops are offered annually in Albuquerque and every other year at an international location. The NCSG organizes courses at three different levels: practitioner, manager, and advanced. International experts from various nuclear installations are invited to teach the courses and interact with students. "People from different companies generously donate their time to teach a class," says Busch. "That's what makes our courses unique from any other. The opportunity for students to interact with mentors from around the world and other students is one they won't have anywhere else." ✚

Participants write about the course: "Exceptionally organized, excellent staff insight, experience, and knowledge." "Valuable curriculum." "Excellent for my job."

"It's about understanding a complex situation and being able to put together rules that can save energy."

GEORGE LUGER



Harnessing the Power of Data

Luger's research converts data into answers

As technology advances, researchers are producing immense amounts of data on everything from astronomy to zoology. Ironically, much of that raw data is just long, complex strings of numbers or words that must be analyzed and organized into meaningful information. For that job, researchers turn to computer scientists like **George Luger** who has a talent for creating tools that turn data into possible answers that can improve our world.

"Computation has become like Galileo's lens," explains Luger, interim chair of the Computer Science Department. "Without that lens, Galileo would not have seen the relationships between the planets. Today, computer scientists offer tools like that to help scientists and researchers in many areas."

Luger uses his interdisciplinary background in computation, linguistics, and psychology to understand and augment human performance in a range of industries from energy and medicine to language and the weather.

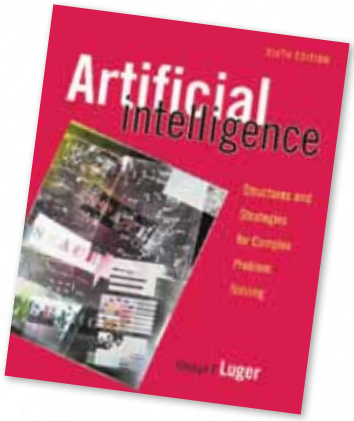
Currently, Luger is using his expertise to help a Seattle-based company improve the efficacy of the controls it develops for optimizing energy use in large buildings. Using artificial intelligence techniques such as rule-based systems and case-based reasoning, Luger creates control systems that can think like a human in real time. The controls are housed in decision-making modules that plug in to the various switches on the building's heating and cooling components. "It's about understanding a complex situation and being able to put together rules that can save energy," explains Luger. "The AI system can make suggestions and implement them. Then it can take feedback from the implemented rules to make adjustments."

Outside of the energy field, Luger has joined with Vince Clark, associate professor of translational neuroscience at the MIND Research Network, and Sandia National Laboratories to employ probabilistic modeling for creating computer models of how problem-solving information is stored and retrieved by human subjects.

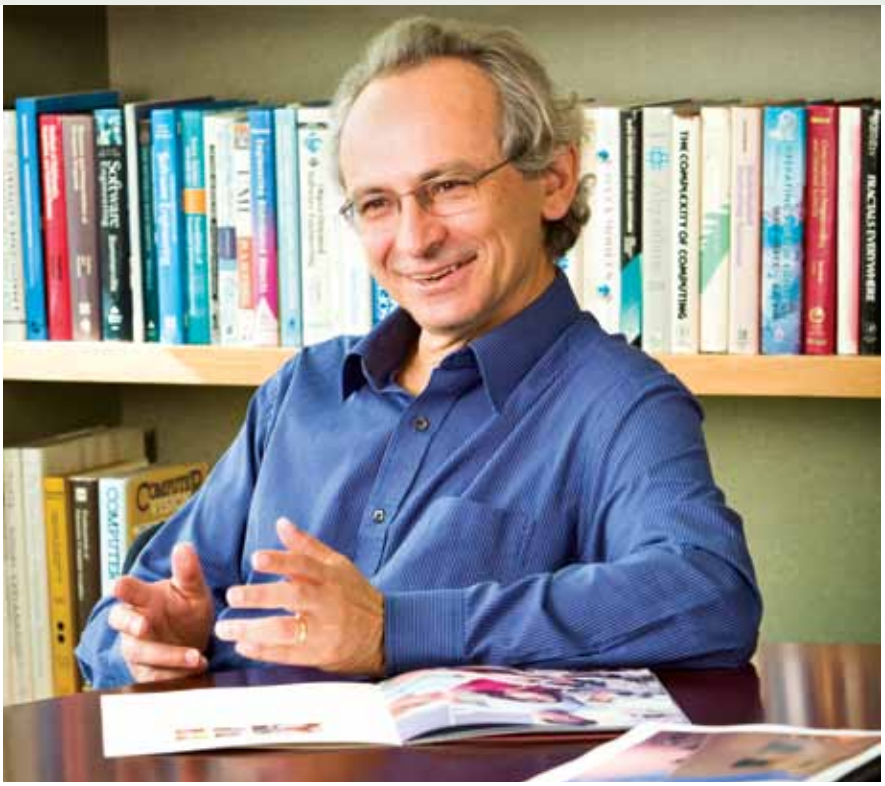
Clark, Luger, and other colleagues studied the functionality of components of the cortex and created computer models of how problem-solving information is stored and retrieved by subjects. They sampled data points from fMRI images to induce a model that would explain the subjects' behaviors.

They discovered that one group of subjects answered questions using the memory component of the cortex; the other group used the prefrontal cortex. This data reflected the two types of answers the subjects produced when solving the problems. "It was really interesting that people were using different parts of their cortex," says Luger. Findings may be applied to future studies on cortex functionality. ✣

Luger's book, *Artificial Intelligence: Structures and Strategies for Complex Problem Solving,* is printed in five languages and is now in its sixth edition.



Five for Catalin Roman



Born in Bucharest, **Catalin Roman** decided to pursue computer science and an academic career at the age of 14. He was able to fulfill his dream when he became the recipient of a Fulbright Scholarship."It was literally a one in a million chance, and I got the opportunity," says Roman.

After earning his doctorate in computer science and engineering from the University of Pennsylvania, he joined the faculty of Washington University in St. Louis. As the head of the Department of Computer Science and Engineering, Roman had a significant impact on its research expansion, faculty growth, and standing in the University and the country. As a researcher, Roman and his collaborators have made seminal contributions to the emerging area of mobile computing.

1. In your career, what are you most proud of?

I've always felt that shaping students' lives and helping my colleagues do the same has been the most important thing that I've done as a faculty and as an administrator.

2. What is one of the UNM School of Engineering's greatest strengths?

People are the SOE's greatest strength. We have a very diverse, intelligent, creative group of people here.

3. What is one of the SOE's challenges?

Most of the challenges will come from the gap between resources and our high aspirations. For a public institution in this economic climate, private and corporate support is crucial. In addition, we need to maximize how we use our intellectual and organizational resources and our creative energy.

4. What is the SOE's greatest potential?

It's simple – impact. The school has incredible potential and we have to leverage it to help students embark on exciting careers, contribute to economic development, and solve global challenges.

5. What are some changes you'd like to make at the School?

I hope to increase the visibility of the school locally, nationally, and internationally. I plan to have the school more deeply involved with governmental, public, and private institutions across New Mexico and have it emerge as a major contributor to economic and social developments. Our faculty is already involved in many initiatives that cut across school and departmental boundaries in areas such as materials, renewable energy, biomedical engineering, and high performance computing. My vision is to make collaborative education and research the norm in our university.

New Faculty

Seven new faculty have recently joined the ranks of the UNM School of Engineering with two more to follow in January 2012. In July, Dr. Gruia-Catalin Roman became the 18th dean of the School of Engineering ***(see page 13 for an interview with Roman).*** **Also in July, Olga Lavrova was promoted to Assistant Professor in Electrical and Computer Engineering after serving as Research Faculty and Lecturer since 2008. Please join us in welcoming our new faculty!**

Chemical and Nuclear Engineering

Andrew Shreve, ***Professor and Director of the Center for Biomedical Engineering***

Shreve will join the School of Engineering in January 2012. Currently he is at Los Alamos National Laboratory, where he leads the Biomolecular Materials, Spectroscopy and Imaging Team and is co-leader of the Soft, Biological and Composite Nanomaterials Scientific Thrust area in the Center for Integrated Nanotechnologies. His diverse research interests range from bio-inspired materials to energy transfer processes in biology and materials.

Civil Engineering

Mark Russell, ***Lecturer II***

Russell's research focuses on sustainable construction and building rating systems.

His emphasis includes analysis based on life cycle assessments with particular interest in carbon footprinting. Russell obtained his Ph.D. in Design, Construction, and Planning from the University of Florida. He comes to academia with over 15 years of experience in the construction industry.

Vanessa Valentin, ***Assistant Professor***

Valentin's research interests are in sustainable infrastructure developments

with an emphasis on management, public policy, project network dynamics, and public attitudes. Other topics of interest include disaster mitigation and management, resilient infrastructure systems, and construction safety. She received her Ph.D. from Purdue University, where she studied inter-organizational dynamics in nuclear power plant projects.

Guohui Zhang, ***Assistant Professor***

Zhang's research focuses on intelligent transportation systems, large-scale transportation systems modeling and simulation, traffic safety and

accident modeling, congestion pricing, traffic detection and sensor data analysis, and sustainable transportation infrastructure design and maintenance. He received his Ph.D. from the University of Washington and was a Research Associate at the Center for Transportation Research at the University of Texas-Austin prior to UNM.

Electrical and Computer Engineering

Meeko Oishi, ***Assistant Professor***

Oishi came to UNM from the University of British Columbia at Vancouver, where she was an assistant professor. Her research interests include nonlinear dynamical systems, hybrid control theory, verification of human automation

interaction, and control based modeling of Parkinson's disease. She received her Ph.D. from Stanford University and held a Truman Postdoctoral Fellowship in National Security Science and Engineering at Sandia National Laboratories.

Mechanical Engineering

Christopher Hall, ***Chair and Professor***

Previously, Hall served as Head of the Department of Aerospace and Ocean

Engineering at Virginia Polytechnic Institute and State University, where he built a strong space-related research program. His Ph.D. is in Theoretical and Applied Mechanics from Cornell University. He was elected a Fellow of the American Astronautical Society in 2005.

Francesco Sorrentino, ***Assistant Professor***

Sorrentino's research interests include complex dynamical networks, the role of adaptation in complex systems, and strategies for the identification of

nonlinear chaotic systems. The main applications of his research are in the areas of sensor networks, control of groups of unmanned autonomous vehicles, and modeling and control of efficient power grids. He received his Ph.D. from the University Federico II of Napoli and will join UNM in January, 2012.

UNM Interim Provost Chaouki Abdallah; SOE Dean Catalin Roman; UNM VP for Research and Economic Development Julia Fulghum; UNM Cancer Research and Treatment Center CEO Cheryl Willman; UNM Distinguished Professor and Lab Director Jeff Brinker; and NM State Representatives Larry Larranaga, Gail Chasey, and Rick Miera at the Nanomaterials and Nanomedicine Lab grand opening.

New School of Engineering Research Facility

In 2009, the New Mexico State Legislature appropriated $2M to help fund an interdisciplinary nanoscience laboratory dedicated to developing and testing nanoscale materials for a variety of applications, including targeted drug delivery to cancer. On August 23, 2011, legislators joined UNM leaders and researchers from UNM and Sandia National Laboratories for the grand opening of the **Nanomaterials and Nanomedicine Laboratory** and to congratulate lab director **C. Jeffery Brinker** *(center)*.

CE Senior Design Course Wins National Award

The **Civil Engineering Department** was recently named the $25,000 Grand Prize winner in a competition sponsored by the National Council of Examiners for Engineering and Surveying (NCEES). The award recognizes engineering programs that encourage collaboration between students and licensed professional engineers. CE's award was for a senior design project that teamed UNM undergraduates with professional engineer mentors to design real-world facilities for a New Mexico Boy Scout ranch, ranging from a wastewater treatment lagoon to an 80' pedestrian bridge.

NCEES President Joseph Timms, P.E., presents the Grand Prize to Andy Schuler, associate professor of civil engineering and teacher for the capstone course.

ECE Faculty Team Up on a New NSF ERC

UNM Electrical and Computer Engineering faculty **Luke Lester, Olga Lavrova**, and **Ganesh Balakrishnan** are members of a new NSF Engineering Research Center (ERC) led by Arizona State University titled "Quantum Energy and Sustainable Solar Technology." The 5-year research venture is supported jointly by the NSF and the Department of Energy with a goal of harnessing solar power in economically viable and sustainable ways.

New National Science Foundation CAREER Award

Zayd Leseman, associate professor of mechanical engineering, recently received NSF's prestigious CAREER award for junior faculty who exemplify the role of teacher-scholars. Leseman's award is to develop methods for modeling and characterizing Phononic Crystals (PnCs). Leseman anticipates that this research will lead to a wide range of technological advances in the areas of signal processing and thermo-electric devices.

Zayd Leseman

UNM Team Places in Top 10 for Two Events in International Racing Competition

UNM LOBOMotorSports placed 8th in design, 9th in autocross, and 12th in marketing at the Formula SAE®, an international competition for open wheel, open cockpit formula-style race cars held June 15–18, 2011 in Fontana, CA. The SOE is one of a handful of universities that offer the FSAE program as a credited course; other teams are clubs. The three-semester class tests students' depth of knowledge, leadership and teamwork skills, and the hands-on engineering experience makes them highly sought after by employers. http://fsae.unm.edu/home.php

In Memoriam

Dr. Richard C. Dove (1924–2011) began his career at UNM in 1949. He served as chair of the Mechanical Engineering Department from 1963–1968 and Dean of the School of Engineering from 1968–1974. Dove authored and co-authored numerous technical papers and reports, as well as a book on experimental stress analysis. In addition to directing numerous research projects, he was director of the USAF Civil Engineering Research Laboratory and a consultant at national and international laboratories.

Dr. Victor Bolie (1924–2011) was emeritus professor and chair of the Electrical and Computer Engineering Department from 1971 – 1976. He was an inventor of 38 patents and author of over 90 research and engineering publications. Bolie won the 1988 School of Engineering Award for Distinguished Research Service.

Endowed Fund Honors Longest-Serving Dean

School of Engineering alum **John Farris** (1954 BS ME) is the son of **Marshall E. Farris,** the SOE's longest-serving dean (1931-1960), and has fond memories of when his dad was dean. He also remembers his father's frustration when opportunities arose for the School and hearing the words, "There's just no money for this." Farris recalls the time his father had to turn down a gift from the Army Air Corps – a P-38 fighter aircraft – because he didn't have the funds to create a secure place to display it.

Jo Margaret and John Farris

Farris and his wife **Jo Margaret** have created an endowed fund that can be used by the dean for just such opportunities. The fund will be at the dean's discretion to use to support students, faculty, and staff for scholarships, travel, special projects, and other activities. "This fund is something my dad would have loved to have had to maximize opportunities for the School," says Farris. "It's dedicated in his honor."

Tony Asefi, GAITS Chairman and Thomas Asefi, GAITS CEO, with School of Engineering Dean Catalin Roman.

GAITS Sponsors Scholarship Fund for UNM School of Engineering Students

Headquartered in Fairfax, VA, **Global Analytic Information Technology Services (GAITS)** provides IT and networking solutions and has about 300 employees in New Mexico. Recently the company created a scholarship to support UNM students studying computer science.

"The UNM School of Engineering is honored to receive GAITS' generous support to create scholarships for students majoring in computer science," says **Dean Catalin Roman.** "These much needed scholarships will help ensure that our best and brightest students can concentrate on completing their undergraduate education without juggling outside employment. We look forward to a long and productive partnership with GAITS."

Gifts Invest in Faculty and Students

"Strong academic credentials, demonstrated experience and dedication to mentoring with distinguished records in both teaching and interdisciplinary research," describes some of the criteria for a newly-established endowed professorship in biomedical engineering.

The description also fits **David Whitten**, research professor in the Department of Chemical and Nuclear Engineering and the Interim Director of the Center for Biomedical Engineering (CBME). An internationally known researcher and author, Whitten has been a thesis advisor and mentor to more than 38 Ph.D. students and has co-authored scientific papers with more than 275 colleagues. Since 1997, he has served as Editor-in-Chief of *Langmuir,* a peer-reviewed interdisciplinary journal published by the American Chemical Society.

David and Jo Whitten

Whitten and his wife **Jo**, coordinating editor of *Langmuir,* recently made a legacy gift commitment to fund an endowed biomedical engineering professorship as well a current gift in the form of a fellowship to support students who are pursuing a graduate degree in biomedical engineering.

"David and Jo Whitten's generous gifts will help the School of Engineering attract and retain the brightest, most diverse students as well as add faculty to our biomedical engineering program," says Dean Catalin Roman. "The Whittens' decision to support UNM is a true compliment to the School of Engineering."

Frank Evans (center) signs the endowment agreement with Professor Ju (seated, right) and UNM School of Engineering staff and faculty.

Former Student Thanks Professor For Changing His World

In 1962, when **Frank Evans** was in graduate school in Electrical Engineering, he was excited by the idea of space exploration and wanted to take courses outside of his major to make his education more attractive to potential employers. Professor of Mechanical Engineering **Fred Ju** taught those courses. "Frank's final paper on Orbital Mechanics was so good, that I kept it until I retired from UNM," says Professor Ju.

During a long career with TRW Systems, Evans worked on many space exploration projects. "Professor Ju's courses helped me get a great job in the Apollo program," says Evans. "I am profoundly grateful to Professor Ju and the University for providing me with this opportunity."

Evans and his wife **Janet,** a retired member of the Marquette University Political Science faculty, recently created the Fred Ju Fund to recognize Professor Ju's role and provide need-based scholarships to potential engineering students.

Matching Corporate Interest With SOE Needs: Yearout Mechanical Supports Retrofit Research

Yearout Mechanical Inc. is working with UNM's Mechanical Engineering Department on a special project involving intelligent building energy systems controls. The project, Building Energy Retrofit Testbed (BERT), will use the 31 year old Mechanical Engineering building on UNM's main campus to test new ways to retrofit old buildings to be energy efficient *(see page 5).*

"We believe that the information and advances that will come out of the BERT program will be a foundation to build on in the future, not only for our company but for the industry as a whole," says **Kevin Yearout,** CEO of Yearout Mechanical, Inc.

Honoring the Work of a Loved One

Marvin Duphorne, a longtime resident of Albuquerque, died on December 6, 2010. A UNM Mechanical Engineering alum, Duphorne worked for global companies such as Boeing, Pantex, Singer, Intel, and Allied Signal, and concluded his career at Honeywell on Kirtland Air Force Base.

Marvin Duphorne

His wife **Patsy,** a UNM College of Nursing alum and an assistant professor of nursing, and her only son, **Dante,** a UNM Architecture and Planning alum, wanted to honor him by creating an endowed scholarship. The scholarship will be targeted to non-traditional engineering students. A unique twist to this gift is that Dante's employer, **Electronic Arts Inc,** a major American developer and distributor of video games, has a matching gift program that allows him to maximize his donations. Patsy says, "We created this scholarship as a living legacy to honor Marv's contributions as a mechanical engineer and to assist undergraduate students in pursuing their goals in engineering."

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