

UNLV

HOWARD R. HUGHES
College of
ENGINEERING



*Engineering
Following
Nature*

Kwang J. (Jin) Kim, Ph.D.

Educate, Engage, Inspire, Innovate / **FALL 2016**

Educate, Engage, Inspire, Innovate

BY DEAN VENKAT



DEAN VENKAT IN THE THOMAS BEAM ENGINEERING BUILDING'S GREAT HALL. A REPLICA OF HOWARD R. HUGHES' H-1 RACER, IN WHICH HE SET A WORLD-RECORD FOR SPEED, HANGS IN THE BACKGROUND.

Throughout my career I've had inspirational people encourage me in my endeavors. From my high school teachers, to my college professors, they have inspired me to reach further than I thought I could, discover what seemed indiscernible, and think beyond what is known.

And that hasn't stopped since I became Dean. I continue to be inspired, now by our faculty, staff and students. This year we welcomed our largest class of freshmen yet. As a group of sophomores, juniors, and seniors fielded questions from the incoming freshmen, I couldn't help but be inspired by the dedication, passion, and energy of the "elder" students. These students not only balance the work of an engineering major's coursework, but are also in the Honors College, take on leadership roles in student organizations like IEEE, ASME and SASE, volunteer their time as Engineering College Ambassadors, and are completing minors in multiple fields.

In all, this year Engineering faculty instructors are inspiring 2,400 undergraduates and 300 graduate students every day in the classroom and laboratories with their knowledge, experience, and passion for educating the next generation of engineers, scientists, and entrepreneurs.

This past summer I was also inspired by our college's success in providing STEM learning opportunities to those who otherwise might not be exposed to it. Through the Army Education Outreach Program (AEOP) Unite grant, 40 middle and high school students learned programming, research, and presentation skills. Our participation in Project Lead The Way gave 80 middle and high school teachers from 60 schools valuable training and resources to help them better engage their own students in STEM learning.

Meanwhile, our faculty researchers were busy inspiring not only me, but also their colleagues and the public with their innovations. A collaborative team of faculty from Engineering and Health Sciences has patented their invention for a fitness tracker that makes calorie-counting as easy as taking a picture. One of our mechanical engineering professors and his students are working on the cutting edge of soft robotics and multiple shape memory polymers, laying the groundwork for advanced artificial muscles, new medical devices, and defense underwater vehicles.

It isn't just those working in the college who inspire me. Our donors and supporters whose unwavering commitment to the growth of the college, the hands-on experiences of our students, and resources for our faculty are truly inspirational. Entrepreneurs like the late Fred Cox and his wife Harriet, Robert and Paula Mendenhall, and Selma Bartlett are inspirational not only for their innovative spirit, the successful businesses they started and ran or the numerous patents they have under their belts, but also for the trust they have given us. That trust has come in the form of countless monetary gifts—such as the Gilman and Bartlett Scholarship, the Fred and Harriet Cox Senior Design Competition, the Mendenhall Innovation Program—and in the time and intellect they have shared.

"People inspire us to be bigger than ourselves. To continually improve. To discover. To grow. In the College of Engineering we thank everyone who has inspired us and hope that through our research, work, and passion, we have the opportunity to inspire others."

learn more online: unlv.edu/engineering / unlv.edu/toptier



Engineering Following Nature

To understand where Professor Kwang Kim's passion and inspiration come from for his lifelong academic work, one needs to look no farther than the natural world. The ocean, specifically. In fact, a quick glimpse at a video of a flying fish is a typical introduction to his anything-but-typical and complex research.

As a professor and Director of the Active Materials and Smart Living (AMSL) Laboratory in the Howard R. Hughes College of Engineering, Kim is a leading expert in active materials and energy systems.

SOFT ROBOTICS AND ARTIFICIAL MUSCLES – NATIONAL SCIENCE FOUNDATION RESEARCH

One of Kim's most recent projects includes leading an international research team to create advanced artificial muscles for use in soft robotics. The project is funded by a \$3.8 million grant from the National Science Foundation's "Partnerships for International Research and Education" (PIRE) program, designed to strengthen scientific collaboration between U.S. and international researchers.

Soft robotics is an emerging field where the components of a robot are made of pliable materials. Traditional robots have rigid underlying structures, restricting their movement and ability to function in unpredictable environments. Inspired by biology—animals and plants with soft structures—researchers have been working with flexible materials that would allow robots to adapt their shape and locomotion strategy, and move in more complex ways.

In this case, Kim and partner researchers from four other U.S. universities, and institutions in Korea and Japan, are working with electroactive polymers which are not only flexible and soft, but also electrically shape-controllable to improve the function and lower the cost of artificial muscles. If successful, the artificial muscles developed will help advance the robotics industry and could also be used in medical diagnostics and tools, or for invasive surgical systems.

UNDERWATER SENSORS – ONR RESEARCH

Another interesting aspect of electroactive polymers is that they can also be used to sense motion, a desirable quality for soft robotics, as well as other applications Kim is working on.

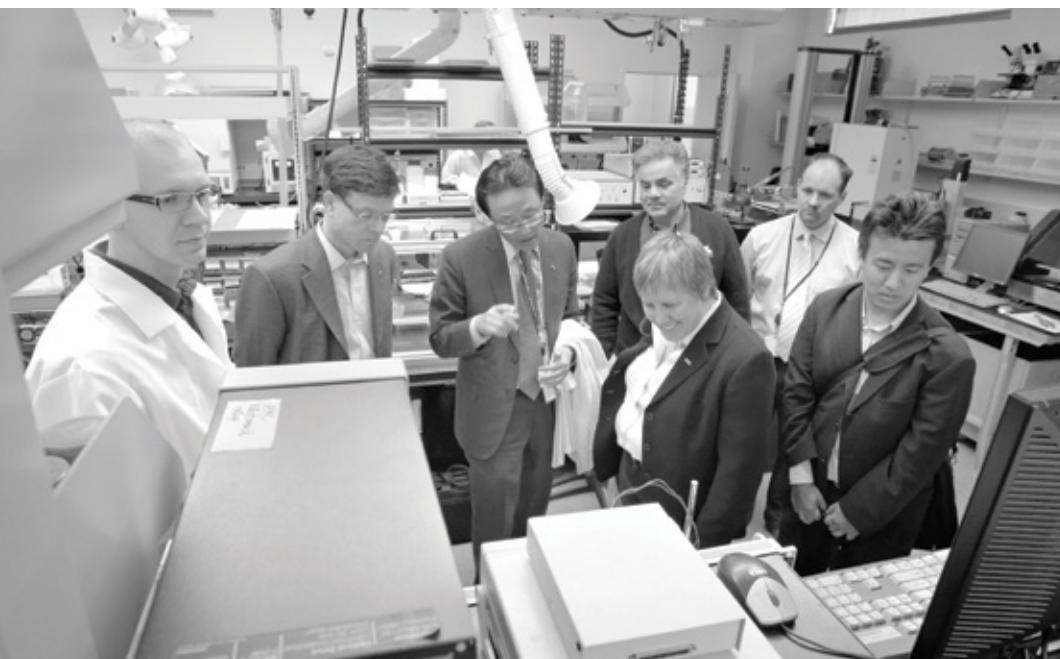
In spring, Kim was awarded a \$454,529 multi-year grant from the Office of Naval Research (ONR) to design an effective fluid flow sensor system using micro-sensor/artificial muscle arrays for underwater operations. Kim's approach is to create an array of artificial cilia micro-sensors using electroactive polymers. When in operation, the electroactive polymer materials are very quiet since they have no vibration-causing components, such as gears, motors, etc. Nonlinear acoustic sensing of fluid flows is important to naval operations as it can provide real-time visualization of the environment around a mobile, underwater object.





"The development of artificial muscles will benefit understanding of methods that mimic biology and could be applied in many fields of future engineering and science."

KWANG J. KIM, PH.D.



“While we’re still quite far from seeing the results of our research being realized in industry, one of the main things we’re trying to accomplish is to advance technology so it can meet a future industrial application and make some significant influence in the field.”

**TYLER STALBAUM, PH.D.
STUDENT AND CO-RESEARCHER
ON THE PROJECT**

For the Navy, the advantages are attractive, particularly for small autonomous underwater vehicles. Kim’s group at UNLV has already successfully fabricated and designed an early prototype of the micro-sensor array with electroactive polymer-based cylindrical fibers.

LEADING THE WAY

An intriguing outcome of these and other research projects was the discovery by Kim and his team of colleagues and graduate assistants of the first single actuator with multiple-shape memory effect, able to perform complex motion by two external inputs, electrical and thermal.

Shape memory polymers (SMP) are materials that can memorize a permanent shape, and then later return to their original shape under specific conditions such as external thermal, electrical, or other stimulation. But they have limitations, including memory of only one shape, response to only one external stimulus—such as thermal—and a long recovery time. To achieve multiple or instantaneous movements, additional electronics or motors are needed which increase the size and noise of the object.

Which brings us back to the flying fish. Using an electroactive polymer, Nafion™, the team was able to program multiple shapes at individual temperature ranges, and using both electrical and thermal inputs. The actuator can perform high-frequency bending motions under external electrical input, and stable, complex

motion under external thermal inputs. This allows for the complex twisting, bending, and oscillation motions that are frequently observed in the natural world, such as fish fins, underwater turtles, and other nature-built machines.

Until now, no single actuator has been capable of dynamic control of complex twisting and bending deformations, either simultaneously or separately.

In spring of this year, their research* was published in **Scientific Reports**. The full copy can be viewed online at <http://www.nature.com/articles/srep24462>.



**KWANG J. (JIN) KIM, PH.D.
DEPT. OF MECHANICAL
ENGINEERING UNLV,
ASME FELLOW**

*A Multiple-Shape Memory Polymer-Metal Composite Actuator Capable of Programmable Control, Creating Complex 3-D Motion of Bending, Twisting and Oscillation Researchers/authors: Professor Kwang Kim, Qi Shen, Sarah Trabia and Tyler Stalbaum, Active Materials and Smart Living Laboratory, Department of Mechanical Engineering, University of Nevada, Las Vegas; Viljar Palmre, Department of Neurosurgery, The University of Texas Health Science Center at Houston, Medical School; Il-Kwon Oh, Creative Research Initiative Center for Functionally Antagonistic Nano-Engineering, Department of Mechanical Engineering, Korea Advanced Institute of Science and Technology (KAIST).

learn more online: <http://tinyurl.com/softrobotics>

Kim graduated from Yonsei University, Korea, in 1987 and received his MS and Ph.D. from Arizona State University in 1989 and 1992. He has authored/co-authored more than 360 technical publications including three books and has been awarded three U.S. patents.

Two Alumnae Awarded Young Engineer of the Year

Kathryn Leonardo & Kamakshi Sistla, UNLV Engineering's proud alumnae, were recently awarded Young Engineer of the Year.

Both Leonardo and Sistla won the award from two separate local branches of national engineering organizations—American Society of Civil Engineers (ASCE) and National Society of Professional Engineers (NSPE), respectively.

These two amazing engineers were recognized for their accomplishments ranging from assisting in the redesign of the Airport Connector to helping design storm drains. In addition, their contributions to the community of young, aspiring engineers helped place them ahead of the rest of the competitors.

For more of Kathryn & Kamakshi's inspirational journeys please visit: <http://tinyurl.com/COEAlumna>

Startup Bringing Innovative UNLV Product to Market

MEALCHECK TECHNOLOGIES, INC. WILL PRODUCE AN ADVANCED WEARABLE HEALTH TRACKER INVENTED BY AN INTERDISCIPLINARY TEAM OF UNLV RESEARCHERS

Smartwatches that help you track daily steps and heart rate? That's old hat, according to UNLV researchers who have recently licensed their latest patent for a fitness tracker that makes calorie-counting as easy as taking a picture.

Professors in Engineering and Nursing set out to up the ante in the wearable technology industry by creating a device that combines and exceeds the best of existing activity-tracking devices such as Fitbit. UNLV's version will merge current fitness assessment functions with camera and scanning technology that allows users to photograph their food and find out its nutritional content, including the caloric value, based on the type of food, portion sizes, and fat content.

The invention—set to enter the commercial development stage soon—represents the next step in making health management effortless, quick, and non-intrusive for everyone from diabetic patients to athletes or anyone interested in monitoring their fitness regimen, researchers said.

"The missing piece within the fitness tracking space is nutrition monitoring," said Jason Pottinger, director of business strategy at MealCheck Technologies, Inc., the startup that, per a recently signed licensing agreement, will commercially develop, manufacture, and sell UNLV's device. "What can't be accomplished through self-reporting and apps will be possible through this technology we're producing."

MealCheck—an offshoot of Academic Technology Ventures, Inc., which specializes in sponsoring and commercializing academic research—was founded specifically to bring this invention to market.



FROM LEFT TO RIGHT: MOHAMED B. TRABIA, MECHANICAL ENGINEERING PROFESSOR AND ASSOCIATE DEAN FOR RESEARCH, GRADUATE STUDIES AND COMPUTING IN THE HOWARD R. HUGHES COLLEGE OF ENGINEERING; JILLIAN INOUYE, PROFESSOR AND ASSOCIATE DEAN FOR RESEARCH IN THE SCHOOLS OF NURSING AND ALLIED HEALTH SCIENCES; AND VENKATESAN MUTHUKUMAR, ASSOCIATE PROFESSOR OF ELECTRICAL AND COMPUTER ENGINEERING.

"MealCheck Technologies, Inc., offers commercialization expertise and a genuine enthusiasm for our technology," said Zach Miles, UNLV's associate vice president for economic development, "so we're really excited to partner with them."

The device is the brainchild of UNLV's Jillian Inouye, professor and associate dean for research in the Schools of Nursing and Allied Health Sciences; Mohamed B. Trabia, Mechanical Engineering professor and associate dean for research, graduate studies and computing in the Howard R. Hughes College of Engineering; and Venkatesan Muthukumar, associate professor of Electrical and Computer Engineering.

(Reprinted courtesy of UNLV News Center)

Building for the Future – Advanced Engineering Studies Building

The Howard R. Hughes College of Engineering has embarked on an exciting plan for the expansion of the college with the addition of a new 50,000 square foot engineering building. Since 2010, the College has experienced steady growth in student enrollment, grants awarded, and the number of patents and licenses received. All of these activities are vital to creating and maintaining not only a successful, productive, and vibrant engineering college, but in supporting UNLV's commitment to becoming a Top Tier institution.

With increased enrollment, research, and grant activities comes a need for an increase in faculty, staff, and infrastructure to support the teaching and research efforts of the College. The new, state-of-the-art engineering building will help the College to continue to attract highly qualified students, researchers, and corporate partners.

INSPIRING INNOVATION AND CREATIVITY

A key focus of the new building will be on spaces that inspire innovation and creativity. This includes additional teaching and research laboratory space to support the activities of faculty working on externally

funded research programs. In addition, a college-wide "MakerSpace" will be included, inviting collaboration between students, not only from engineering, but also a variety of disciplines. The "MakerSpace" will provide the opportunity for hands-on activities including building working prototypes and test-flying unmanned aerial vehicles (UAVs), as well as creating flex space for students to work on Senior Design and student engineering association competition projects.

Added space will also enable the College to better meet the demands of increased student enrollment by providing room for faculty and graduate student offices, and increased advising and tutoring center areas.

HELP EDUCATE, ENGAGE, AND INSPIRE THE ENGINEERS OF TOMORROW

If you or your company is interested in supporting the Howard R. Hughes College of Engineering's new building project, please contact Jack Aylor at jack.aylor@unlv.edu or (702) 895-2913, make a donation in the enclosed envelope, or make a secure online donation at www.unlv.edu/engineering/support.

learn more online: www.unlv.edu/toptier / www.unlv.edu/engineering/support

(L) INTERIOR VIEW OF THE MAKERSPACE.
(R) EXTERIOR VIEW LOOKING NORTH FROM
THE SOUTHWEST.

CURRENT RENDERINGS COURTESY OF PGAL
AND SMITHGROUP JJR



College of Engineering Major Research Areas & Capabilities

BATTERY

- Life prediction for battery design
- Modeling electrochemistry of electrodes
- Fuel cell catalysts/batteries
- Nanostructured Si-based anode materials for Li-ion Batteries
- Ionic-liquid-based energy storage technology



BIOMEDICAL ENGINEERING

- Biosensors and actuators design
- Modeling of cardiovascular blood flow
- Lab-on-a-chip technologies for medical diagnostics
- Medical imaging
- Technologies for people with visual impairment

ENVIRONMENTAL ENGINEERING AND WATER RESOURCES

- Remote sensing
- Hydrologic and hydraulic modeling
- Urban thermodynamic and hydrodynamic modeling
- Transport of toxic constituents
- Environmental microbiology



NATIONAL SECURITY ENGINEERING

- High-speed, high-frequency microelectronics
- Nuclear applications of accelerators
- Radiation detectors
- Structural dynamics, explosives, and impact analysis

RENEWABLE ENERGY

- Electric power systems and power equality
- Solar power generation
- Design of photovoltaic (PV) systems
- Power plant dry cooling

TRANSPORTATION

- Intelligent Transportation Systems
- Highway monitoring
- Transportation emergency management
- Transportation Safety Systems
- Traffic and vehicle control systems and sensors

UNMANNED AERIAL SYSTEMS (UAS)

- Airport ground operations
- Cybersecurity of UAS and ground systems
- UAS data acquisition and management
- Privacy and blurring

learn more online: www.unlv.edu/engineering/research

Recent Grants

COLLEGE OF ENGINEERING

Rama Venkat, Dean, College of Engineering

PROJECT: NASA TELEDYNE MENTOR-PROTÉGÉ PROGRAM

CO-PRINCIPAL INVESTIGATORS: FATMA NASOV, ASSISTANT PROFESSOR, COMPUTER SCIENCE

MATTHEW BERNACKI, ASSISTANT PROFESSOR, COLLEGE OF EDUCATION

HELGA WATKINS, DEAN, COLLEGE OF FINE ARTS

AGENCY: TELEDYNE BROWN ENGINEERING, INC

Robert Boehm, Professor, Mechanical Engineering

PROJECT: REGIONAL TEST CENTER PHASE III

AGENCY: SANDIA NATIONAL LABORATORIES

Ke-Xun Sun, Professor, Electrical & Computer Engineering

PROJECT: PRECISION FIBER OPTICS ACOUSTIC SENSORS (FOAS) – TASK 5

AGENCY: NATIONAL SECURITY TECHNOLOGIES

William Culbreth, Professor, Mechanical Engineering

PROJECT: BASELINE STUDIES OF MOLTEN SALT TECHNOLOGY

FOR THERMAL ENERGY STORAGE – PHASE II

AGENCY: OFFICE OF NAVAL RESEARCH

Alexander Barzilov, Associate Professor, Mechanical Engineering | CO-PRINCIPAL INVESTIGATOR

PROJECT: UNLV NUCLEAR SCIENCE & ENGINEERING FELLOWSHIP PROGRAM

PRINCIPAL INVESTIGATOR: GARY CEREFICE, ASSOCIATE PROFESSOR, SCHOOL OF ALLIED SCIENCES

AGENCY: NUCLEAR REGULATORY COMMISSION

Brendan O'Toole, Chair, Mechanical Engineering Department | CO-PRINCIPAL INVESTIGATOR

Pushkin Kachroo, Professor, Electrical & Computer Engineering | CO-PRINCIPAL INVESTIGATOR

PROJECT: I-CORPS SITES UNLV LEAN ENTREPRENEURSHIP ADVANCEMENT PROGRAM

PRINCIPAL INVESTIGATOR: ANDREW HARDIN, ASSOCIATE DEAN, LEE BUSINESS SCHOOL

AGENCY: NATIONAL SCIENCE FOUNDATION

Engaging STEM Teachers From Across the Nation

COLLEGE OF ENGINEERING HOSTS PROJECT LEAD THE WAY (PLTW)

Over summer, middle and high school teachers from across the United States convened at UNLV to take part in the annual PLTW STEM (science, technology, engineering, mathematics) training event. PLTW is a nonprofit organization providing transformational learning experiences for K-12 teachers and students. This is the fifth consecutive year that UNLV's Howard R. Hughes College of Engineering has organized and hosted the event, joining more than 8,000 other schools in all 50 states which also offer PLTW programs.

"Hosting PLTW is one of the many ways our College works with K-12 educators to accomplish that," said Rama Venkat, dean of the Howard R. Hughes College of Engineering.

This summer's training welcomed more than 80 teachers from 60 schools. Teachers took part in two-week, one-week and three-day courses, covering such topics as

"It is vitally important the University assists in not only getting more youth interested in engineering and science-related fields, but that we help in making sure they're prepared for those disciplines once they get to college"

DEAN RAMA VENKAT

Automation and Robotics, Energy and the Environment, Green Architecture, and Magic of Electrons. In addition, this year two new courses were added specifically for high school teachers: Principles of Engineering and Computer Science Principles. The College was able to offer the latter due to a generous grant from Splunk, Inc.

"PLTW training is focused on how teachers can better engage students in STEM learning," said



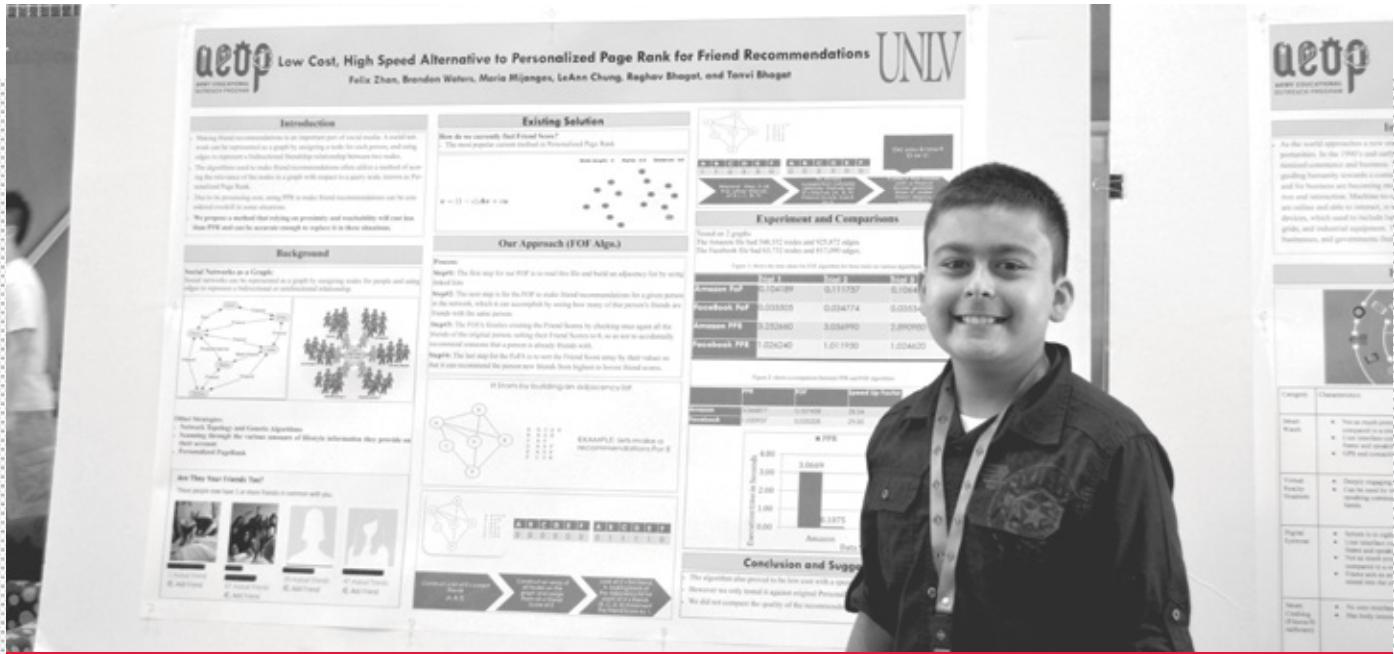
**TEACHERS FROM ACROSS THE NATION
PARTICIPATED IN THE COLLEGE-HOSTED PLTW
STEM PROGRAM THIS SUMMER AT UNLV'S
HOWARD R. HUGHES COLLEGE OF ENGINEERING**

Molly Marks, College of Engineering director of special events and PLTW affiliate director. "The program is unique in giving teachers practical experience incorporating hands-on projects and problem-based activities into their teaching."

Throughout the courses, teachers learned how to guide their students to identify a problem, find unique solutions, and lead their own learning, rather than just having them be passive recipients of information in a question-and-answer-based environment.

learn more online: Project Lead The Way – www.pltw.org

Providing Engineering Experiences to Underserved Students



AEOP UNITE GRANT PROGRAM PARTICIPANT AND INCOMING 7TH GRADER, RAGHAV, STANDS IN FRONT OF HIS TEAM'S RESEARCH POSTER

This summer the College of Engineering invited 40 middle and high school students to participate in an intensive six-week computer programming and research session.

The program was put on through an Army Education Outreach Program (AEOP) UNITE grant, awarded to provide pre-collegiate summer experiences for talented high school students from groups historically underrepresented and underserved in STEM. The \$40,000 two-year grant was secured by Computer Science professor Justin Zhan and chair of Computer Science Laxmi Gewali.

The students were selected from a pool of 165 applicants. Classes covered C/C++ programming

and big data research, and included a group research project guided by a research mentor, and a final presentation in front of fellow participants, engineering faculty, friends, and family.

The program was such a success that the students scored an average of 77 on computer programming tests typically administered to college undergraduates.

Photos of the event are located on the college's Facebook page, "AEOP UNITE 2016" album.

UNLV Academy of Engineering Recognition Society Announced

The UNLV Howard R. Hughes College of Engineering has announced the formation of the Academy of Engineering to begin a formal recognition program for alumni, faculty, and friends who by example demonstrate our values of education, engagement, inspiration, and innovation according to Dr. Rama Venkat, dean of the College.

"This marks another milestone for the Howard R. Hughes College of Engineering. We want to honor the achievements of our many alumni, educators, and industry friends," said Dean Venkat. The Academy of Engineering Awards will be given annually during Engineering Week, the last week of February. The inaugural event is tentatively scheduled for the afternoon of Friday, February 24, 2017. Nominations may be made on-line at: <http://tinyurl.com/engnomination>.

Three categories of awards will be given: Engineering Alumni Award, Engineering Educator Award, and Engineering Industry Partner Award.

The Engineering Alumni Award will be in recognition of outstanding career achievement, community service, and/or loyalty to the UNLV College of Engineering. Carrie Porterfield, '90 BS Computer Science, president of the Engineering Alumni Association Chapter, will serve as chair.

The Engineering Educator Award will recognize individuals who have made outstanding contributions to the field of engineering education with demonstrated achievement in teaching or research, or service to the UNLV College of Engineering. Dr. George Mauer, associate dean of engineering, will serve as chair.

The Engineering Industry Partner Award will recognize individuals or organizations recognized as having made outstanding contributions to the engineering profession and have demonstrated loyalty to the UNLV College of Engineering. The committee chair will be from the College of Engineering Advisory Board.



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DR. RAMA VENKAT, DEAN OF THE COLLEGE



Your Donation Makes a Difference

In the last academic year, the College gave out more than \$500,000 in scholarships to assist students in their engineering academic pursuits. Scholarship and student research awards begin at \$1,000, and Named Scholars can be established with commitments or gifts of \$5,000 or more. Endowments of \$30,000 or more provide a permanent award and named recognition.



PICTURED: DWAYNE THOMAS AND IAIN DREWS, IMPACT SOLUTIONS TEAM, FRED & HARRIET COX SENIOR DESIGN COMPETITION

"My engineering classes at UNLV have given me the knowledge and resources to take an idea, make it something physical, and actually get it to a point where we can bring it to market."

In addition to scholarships, contributions can be designated to specific departments or programs to support a variety of student and faculty research projects. Opportunities include:

- Advanced Engineering Studies new building campaign
- Solar Decathlon U.S. Department of Energy contest
- Fred and Harriet Cox Senior Design Competition
- Dennis Waibel Memorial Golf Tournament supporting scholarships for Civil and Environmental Engineering and Construction
- TechConnect supporting John S. Werth Scholarships for Computer Engineering

If you or your company is interested in supporting the Howard R. Hughes College of Engineering, you can contact Jack Aylor at jack.aylor@unlv.edu or (702) 895-2913, make a donation in the enclosed envelope, or make a secure online donation at www.unlv.edu/engineering/support.

learn more online: www.unlv.edu/engineering/support



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Aerial view of the proposed new Advanced Engineering Studies Building featuring a university-wide MakerSpace.

Current renderings courtesy of PGAL and Smithgroup JJR