Mechanical & Aerospace Engineering Department

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UCLA Bruin Astronaut and MAE Alumna Megan McArthur

UCLA Engineering

HENRY SAMUELI SCHOOL OF
ENGINEERING AND APPLIED SCIENCE

William Klug's mathematical model gives clearer picture of physics of cells, organelles

Research could shed light on life cycle of membrane-bound viruses like HIV

BY WILEEN WONG KROMHOUT

William Klug

Cells are filled with membrane-bound organelles like the nucleus, mitochondria and endoplasmic reticula. Over the years, scientists have made much progress in understanding the biomolecular details of how these organelles function within cells, but understanding the actual physical forces that maintain the structures of these organelles' membranes continues to be a challenge.

Now, UCLA Mechanical and Aerospace Engineering Department associate professor William Klug and colleagues from the California Institute of Technology and the Whitehead Institute for Biomedical Research have devised a mathematical procedure for accurately predicting the three-dimensional forces involved in creating and maintaining certain organelle membranes.

Their study, which appeared December 8, 2008, in Proceedings of the National Academy of Sciences and is currently available at http://www.pnas.org/content/105/49/19253.full?sid=d9fb446b-aa10-47bd-a360-6871f5af1a63, could potentially shed light on the life cycles of membrane-bound viruses such as HIV.

"The study is exciting because it provides a roadmap for ways we can do predictive computational science," said Klug. "The mathematical model is able to provide us with a quantitative understanding of the physics of cells that is essentially impossible to obtain directly by experiment."

To understand the researchers' mathematical description of how forces can lead to deformations in a membrane, one can consider the simple concept of a bathroom scale.

"When you step on a scale, a small spring in the scale defines how heavy you are or what force is being applied to the scale," said study co-author Paul Wiggins, a fellow at the Whitehead Institute. "Similarly, with membranes, springs or forces cause them to bend. In a sense, we wanted to see if we could play the same game with the organelles of a cell — to take the observed structure and see if we can predict what forces are applied to give rise to the structure and hold it together."

The team used an artificial biomembrane to investigate the dynamic forces that act on a cell's membrane and organelles. With optical tweezers — a scientific instrument that uses a focused laser beam to provide an attractive or repulsive force — they were able to trap and move parts of the cell. This enabled the researchers to exert known forces in different ways, giving them an opportunity to analyze the response of the membranes when their structures were changed dramatically and to validate their mathematical procedure for predicting forces based on the deformed shapes of the membranes.

"We have this geometry, so what are the forces?" said Klug. "It seems straightforward if you write it out mathematically but in practice, actually measuring the forces reliably where you can quantify the error is really tricky."

The researchers believe that understanding the forces and mechanisms that are responsible for maintaining the geometries of the organelles will help them uncover the crucial factors that lead to changes or malfunctions in organelles.

"When cells undergo oxygen damage, that usually leads to a change in the structure of the mitochondria — the specialized organelles often referred to as the powerhouses of cells," Wiggins said. "There is a close link between the ability of the mitochondria to function and its structure. By relating structure to force, we can uncover the crucial factors that lead to the change in the structure of the mitochondria and other organelles."

Membrane-bound viruses like HIV infect cells and then replicate and break from the cells by budding. This budding process eventually uses up the cell membrane and kills it. "The forces that lead to the process of budding are essentially unknown," Klug said. "Researchers have looked at the image data of HIV in different stages of budding to try to understand the forces that lead up to it. If we can eventually understand what those forces are, we might be able to come up with a way to disrupt the viral assembly process. And that's a different strategy than what is being done today to treat retroviruses and HIV in particular."

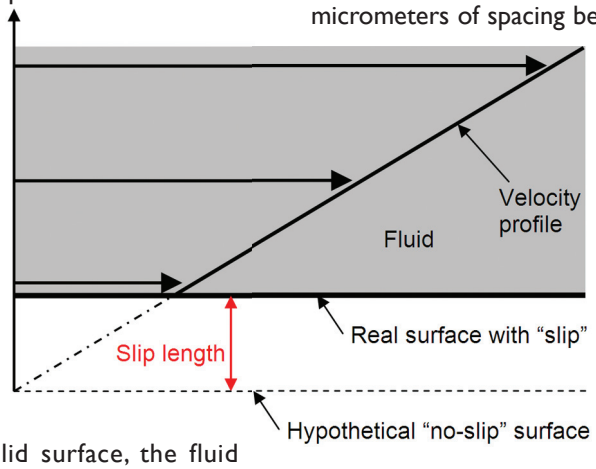
Giant Liquid Slip Achieved Using Structured Surfaces

BY MATTHEW CHIN

Chang-Jin Kim

It started off as an engineering research project in nanotechnology: To create nanoengineered nonwetting surfaces, so fluids could flow past with barely any surface contact, and therefore without much friction. A key was "nano" because the ultra small spacing between the surface structures was needed to fight off liquid from filling in between the structures. Spacing larger than a few micrometers is not a good engineering solution, because the surface will be flooded under many realistic conditions that involve pressure fluctuations and spikes.

But to establish how much of a difference structured surfaces could make, a UCLA engineering group, led by Mechanical and Aerospace Engineering professor C.J. Kim, detoured its research into basic physics. Over several years, the group has successfully pushed liquid slip lengths to theoretical limits.



When a fluid flows past a solid surface, the fluid molecules closest to the surface stick to it as they move past — creating friction that slows down the flow. This "no-slip" condition means that under normal circumstances the fluid velocity is zero at the solid surface. The surfaces created by Kim's group exhibited "slip" – the fluid velocity at the surface was non-zero.

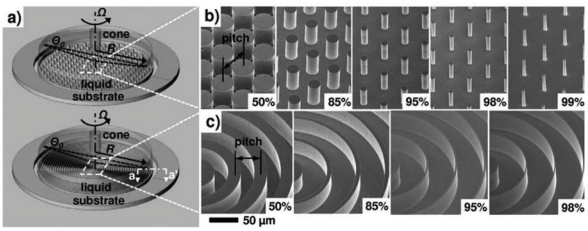
A measure of how slippery a solid surface is for a liquid flowing past it is the "slip length." This is the distance at which the velocity extrapolates to zero (see diagram). To look at it another way, a slip length of 20 microns means that liquid right at the contact surface is flowing as if it were 20 microns away from a normal "no-slip" surface. Slip length is the most objective way to describe how slippery a solid surface is, because unlike drag reduction, it is not affected by non-surface factors such as channel diameter or flow condition.

The research group also included current graduate student Choongyeop Lee, the lead author on two recent papers, and Ph.D. alumnus Chang-Hwan Choi, now an Assistant Professor of Mechanical Engineering at the Stevens Institute of Technology.

For the initial project Choi, who was then at UCLA, and Kim created a surface that was dotted with billions of hydrophobic posts nanometers apart. These needle-like structures supported liquid flowing over them via surface tension, and therefore minimized liquid-surface contact to only the sharp points of the posts.

Using this "NanoTurf" surface, they found slip length of 20 μm. This result was a big leap from the previous records of around 1 μm. The research was published in Physics Review Letters in 2006 (Phys Rev Lett 96, 066001, 2006). However around the same time, another research group achieved similar lengths, but with tens of micrometers of spacing between the structures which would remain viable only at low pressure.

As an engineer, Kim knew such a large spacing would give a large slip length under careful lab conditions but wouldn't lead to real-world solutions. But to prepare a clear message to the scientific community, he took his engineer's hat off and turned the emphasis to pushing just how far liquid slip lengths could be taken. Exercising his expertise in MEMS, his approach was to micromachine an ideal surface structure even though it would work only under careful flow experiments.



(a) Schematic description of a rheometer test. A rotating cone imposes a constant shear rate over a test section with either posts or grates. (b) Scanning electron microscopy (SEM) images of post patterns with 50 μm pitch and different gas fractions. (c) SEM images of grate patterns with 50 μm pitch and different gas fractions. The direction of grates coincides with the direction of liquid flow generated by the cone rotation.

Giant Liquid Slip Achieved *(continued from page 3)*

At Kim's urging, Lee worked to create defect-free microstructures, a step up in scale from the earlier NanoTurf. These hydrophobic surfaces had micrometer-scale grooves and posts, which hold pockets of air allowing liquids to levitate over them for small distances, without drag from surface contact friction. The result is similar to an air hockey table, only in this example, the liquid floats over the structures because of surface tension, rather than streams of air.

The height of the posts and grooves, their shape, and their density combine to keep a layer of air beneath the liquid, and surface tension keeps the liquid from filling the gaps between the grooves and posts. Using this method, the group found slip lengths as large as 185 μm. To succeed at this level, however, no defect was allowed, because if the liquid enters any one gap between the structures, the entire test area gets flooded – the reason Kim considers the success of only scientific value.

These results were published in the August 2008 issue of Physical Review Letters (Phys Rev Lett 101, 064501, 2008). The paper was also summarized in Nature as a Research Highlight (Nature 454, 920, 21 August 2008).

In 2009, Lee and Kim went further, this time making nanoscale pores on sidewalls of the micrometer-scale grooves. This additional element allowed them to maximize the surface tension effect and achieve slip lengths of 400 μm, close to the theoretical limit. (The result is published online in Langmuir at: http://pubs.acs.org | doi: 10.1021/la901824d).

This latest advance suggests that these surfaces could significantly reduce drag in fluid systems at a macroscopic level. And new types of low-friction surfaces could be used in fluidic applications such as underwater vehicles and pipe flows as well as for various microscale devices – alas, only if not-so-perfect surfaces can be kept dry as well.

Now, after several years working on the basic sciences behind maximizing liquid slip, Kim's team has returned to exploring these types of new slippery surfaces for use in potential engineering solutions, dealing with defective surfaces.

This research was funded by the National Science Foundation NIRT Grant No. 0103562 and California NanoSystems Institute. The authors thank MAE associate professor Pirouz Kavehpour for help with the rheometer measurements.

Air Force officials consider applications of Pirouz Kavehpour's 'jamming' model

BY Molly Lachance / Originally published on Air Force Office of Scientific Research website

Pirouz Kavehpour

Granular fluids, like salt or sand, and viscous liquids, like toothpaste or wood glue, can behave like liquids or solids depending on certain conditions. When these fragile materials stop flowing, scientists refer to the transition as "jamming."

With funding from the Air Force Office of Scientific Research, Dr. Pirouz Kavehpour and his team of researchers at the UCLA Henry Samueli School of Engineering and Applied Science have developed a special system called a Tribo-rheometer for testing their new theoretical model to predict jamming behaviors in fragile materials.

Air Force officials are interested in the benefits this model will have on new materials that enhance Department of Defense systems. These materials could range from a new family of lubricants for extreme environment application to a new generation of impact-resistant shields.

Fragile materials share common jamming behaviors, but until now, researchers have been unable to establish a common mechanism among the different types. By using a thermodynamic approach, the researchers at UCLA can now predict jamming behavior of numerous materials using a single model.

The team began by focusing on the behavior of dry sand. Doctor Kavehpour and his team used an existing model, but introduced a non-thermal temperature that measures the fluffiness of the granular material. The temperature variable also made sense when studying viscous liquids, which when cooled become resistant to flow.

Doctor Kavehpour's team plans to use the model for a variety of actual applications in the commercial and defense industries. Currently the team is working with the Air Force Research Laboratory to study the behavior of a new family of durable, strong materials with potential applications of interest to the Air Force.

Richard Wirz to build UCLA turbine lab

BY JOHN ANZELC / The Daily Bruin (edited)

Richard Wirz

UCLA is preparing to build a new wind turbine research facility in downtown Los Angeles as part of an ongoing push toward sustainable energy.

The lab is the only one of its kind in Southern California. It will focus on developing stronger and more aerodynamic turbine blades.

"The building already exists and has been selected," said Richard Wirz, director of the UCLA wind energy lab and assistant professor of mechanical and aerospace engineering.

The project is still in the planning phase and work on converting the facility into a laboratory has not started yet. The Los Angeles Department of Water and Power projects it to open in 2010, Wirz said.

The building will be part of a green research center that anchors the north end of Los Angeles' CleanTech corridor, a four-mile swath of industrial land west of the Los Angeles River and east of downtown.

The Los Angeles Department of Water and Power owns the land that this center will be built on, but under the recently announced CleanTech Los Angeles partnership, researchers from UCLA, USC and Caltech will come together to work on a number of green projects in the center.

The focus for UCLA research will be on wind turbines, which make electricity by capturing wind energy and converting that to electricity. One of the problems with wind power is that it is an intermittent power source, Wirz said. The blades of a wind turbine are optimized for a certain wind speed, and so if it gets too strong or too weak the turbine will not work nearly as well, he added.

If a turbine can operate more efficiently at increased wind speeds, that means getting a better return on the initial investment of building the turbine. This translates into cheaper wind power, which will drive greater adoption of this technology in the energy marketplace.

According to Wirz, there will be three main components to the facility: a wind tunnel for experimental testing, a computational modeling center to complement the wind tunnel by attacking aerodynamic and structural issues, and a site demonstration component where researchers can compare their prototypes to existing wind turbines and actually test their work in a real-world environment.

"We have a bunch of turbines out in the desert and we have a lot of data on them. Other sites might have a wind tunnel and the computational modeling, but we have the ability to actually test these things in an established wind energy type environment," Wirz said.

For Wirz, the creation of this lab is a big accomplishment after years of working on renewable energy. Although he spent several years working on plasma propulsion immediately prior to this project, Wirz has been working on renewable energy since the 1990s. "That's when it wasn't cool to be working in renewable energy," he said.

Wirz plans to combine his experience from working in each of those two fields to make the blades of the turbine stronger and more aerodynamic. The lab will research the application of plasma actuators, tiny devices that create a little plasma discharge on the surface of the blade, which have the potential to greatly improve aerodynamic performance.

"They function like small physical actuators, which improve the performance of a blade. It adds momentum to the boundary layer of the flow to prevent flow separation," Wirz said.

Additionally, Wirz said that his work with new wind turbine blade designs "will apply directly to the ocean" and that "it's definitely something we want to look at in the lab." He added, "After solar, offshore wind is one of the biggest resources we have in California."

Wirz also wants the lab to be open to use by UCLA professors and even undergraduate students doing research. High school students will be able to tour the facility, which Wirz hopes will encourage their interest in engineering.

Scientists Develop Sensitive Salivary Sensor

(Edited from a news release orginally published at the NIDCR news site. http://www.nidcr.nih.gov/Research/ResearchResults/NewsReleases/CurrentNewsReleases/Salivary%2BSensor.htm)

Chih-Ming Ho

For people who dislike needles, medical tests that require a drop of saliva instead of a vial of blood will one day make a trip to a doctor or dentist much easier. But as scientists now construct the first of these saliva tests for early signs of cancer and other diseases, they continue to push the technological envelope in interesting ways.

As published in the August issue of the journal Biosensors and Bioelectronics, a team of researchers supported by the National Institute of Dental and Craniofacial Research (NIDCR), part of the National Institutes of Health, report they have developed an ultra-sensitive optical protein sensor, a first for a salivary diagnostic test. The sensor can be integrated into a specially designed lab-on-a-chip, or microchip assay, and preprogrammed to bind a specific protein of interest, generating a sustained fluorescent signal as the molecules attach. A microscope then reads the intensity of the fluorescent light – a measure of the protein's cumulative concentration in the saliva sample – and scientists gauge whether it corresponds with levels linked to developing disease.

In their initial experiments, the scientists primed the optical protein sensor to detect the IL-8 protein, which at higher than normal concentration in saliva is linked to oral cancer. Using saliva samples from 20 people – half healthy, the others diagnosed with oral cancer – the sensor correctly distinguished in all cases between health and disease.

Importantly, the sensor achieved a limit of detection for IL-8 that is roughly 100 times more sensitive than today's blood-based Enzyme-Linked ImmunoSorbent Assay (ELISA) tests, the standard technique to measure protein in bodily fluid. The limit of detection, or LOD, refers to a sensor's ability to distinguish the lowest concentration of a protein or other target molecule apart from competing background signals.

According to UCLA Mechanical and Aerospace Engineering Department professor Chih-Ming Ho, senior author on the above-mentioned paper in Biosensors and Bioelectronics, his group's first step in widening the LOD window was to restructure the initiation of the fluorescent signal. They directly labeled the sensor-bound IL-8 with fluorescent probes, thereby cutting out the common intermediate step of using enzymes to amplify the signal. This streamlining improved the LOD of their saliva test to a level comparable with a standard ELISA blood test.

But Ho and colleagues decided to push the limit of detection even harder. Saliva naturally contains much lower concentrations of protein than blood, and they wanted their sensor to attain the extremely high sensitivity that some future salivary diagnostic tests will likely require. Sensitivity refers to the smallest amount of a substance, such as a protein, that a diagnostic test can detect, which Ho said he hoped to extend down to the femtomolar range, or six orders of magnitude less than one atom per cell.

To increase the sensitivity – and thus extend the lower limit of the LOD – Ho and colleagues sought novel ways to turn down the noise. Noise refers to the various ambient molecules in the saliva sample that typically stray to the sensor and bind. This creates the visual equivalent of static that heightens the intensity of the fluorescence and can lead to false positive diagnoses.

"When we talk about pushing a test's limit of detection, or LOD, we're referring to the signal to noise ratio," said Ho. "It's really a matter of figuring out how to reduce the background noise and make the signal stand above the noise."

Leyla Sabet, a member of Dr. Ho's lab and a lead author on the paper, explained that the group already filtered out other wavelengths of light that might pollute the signal. That left them to parse the fundamental – and often overlooked – subject of where to collect the light. Does the signal-to-noise ratio vary within or above the fluorescent pathway of light? If so, is there a precise spot that offers the highest signal and the least noise?

But to answer the where question, the group first needed a better optical tool to collect the light and see what's there. They utilized a confocal microscope, which gathers all of the fluorescence and has the added advantage of locking onto a single slice, or horizontal plane, of light and then viewing it from multiple points.

Sabet and colleagues began by locking the focus of their confocal microscope on the surface of the sample, where signal and noise typically coalesce. From there, they moved up from the surface one micron at a time,

collecting the light and calculating the signal to noise ratio at each point.

"We identified a location that has the maximal signal-to-noise ratio," said Sabet. "By focusing on this signal-rich point of light, we extended the LOD by two orders of magnitude."

Winny Tan, Ph.D., also a lead author and a lab member, said the proof-of-principle tests of the sensor currently take between 30 minutes to an hour to complete. But she noted that this figure is a bit misleading. "About 90 percent of our time was spent in sample preparation, not actually performing the assay," she said. "With further integration and automation of the test, the time could be reduced significantly."

The laboratory already has developed a saliva-based electrochemical sensor, which binds the protein of interest using an electrical sensor system. Dr. Fang Wei in Ho's group has demonstrated the record of detecting 25 RNA molecules in 4 micro liters of saliva. For protein detection, the LOD can be as low as 1 pg/ml. Dr. Ho said the optical and electrochemical sensors, like all technologies, have their pros and cons.

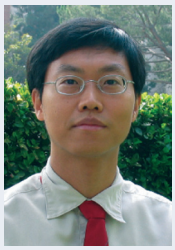
"The optical sensor requires a more expensive set up because of the confocal microscope," said Ho. "So, in a small dental or doctor's office, the electrochemical sensor generally would be easier and cheaper to use. But to really push down the signal to noise ratio, the optical sensor has the advantage."

Ho said the optical sensor might be better suited for use in a more specialized central laboratory. "But the technology is advancing so rapidly, it's difficult to predict how the optical sensor might be used in the years to come," said Ho. "At this point, it has certainly pushed the envelope for the limit of detection and this will be an important capability in advancing salivary diagnostics."

Ho's optical sensor has already been recognized in the Popular Mechanics article, "20 New Biotech Breakthroughs that Will Change Medicine." It was ranked fourth and was described as follows: "Forget biopsies — a device designed by researchers at the University of California, Los Angeles detects oral cancer from a single drop of saliva. Proteins that are associated with cancer cells react with dyes on the sensor, emitting fluorescent light that can be detected with a microscope. Engineer Chih-Ming Ho notes that the same principle could be applied to make saliva-based diagnostic tests for many diseases."

MAE Profs. Ju, Karagozian, and Speyer use technology to assist the military

Based on an article in the Daily Bruin by Ben Thaler



Y. Sungtaek Ju

Ann Karagozian

Jason Speyer

The Mechanical and Aerospace Engineering Department at UCLA has been conducting research applied to military technology use, with funding from organizations such as the Defense Advanced Research Projects Agency. DARPA's mission as an arm of the U.S. Department of Defense is to maintain the technological superiority of the U.S. military.

A team of UCLA researchers led by Professor Sungtaek Ju recently received a multimillion dollar award from DARPA to conduct innovative research and development in the area of electronics cooling, which is now an ongoing project within the department.

Ann Karagozian, a professor in the MAE Department, said her research has been funded by many government and military organizations, and the technology they develop can have both commercial and military applications.

"We have several projects, all of which have applications to energy-efficient propulsion systems, which is a huge issue for the military of course, especially the Air Force, because fuel costs to the Air Force have tripled over the past few years," Karagozian said.

She said her research team has also looked at ways to incorporate alternative fuels for jets. "We're looking at fuels that have not been derived from crude, such as ethanol, methanol and synthetic fuel derived from natural gas or coal," she said.

Additionally, MAE professor Jason Speyer has worked on a DARPA-funded project that would potentially use a computer program to provide military leaders with fast, easy-to-understand information to assist them in managing various military operations, from humanitarian missions to large-scale border defense. Speyer noted that this project used economic theories and games to assess different situations in war, such as being in the middle of a jungle and needing to know how many enemies you may be facing.

Dr. Tetsuya Iwasaki joins UCLA's MAE Department

Tetsuya Iwasaki

Dr. Tetsuya Iwasaki joined the UCLA faculty in the summer of 2009 as Professor of Mechanical and Aerospace Engineering. He came to UCLA from the University of Virginia (UVa), where he was a faculty member since 2000. Dr. Iwasaki specializes in dynamical systems and control, and has contributed to developments of systematic methods for control systems analysis and synthesis, with a recent focus on biological mechanisms underlying rhythmic body movements during animal locomotion.

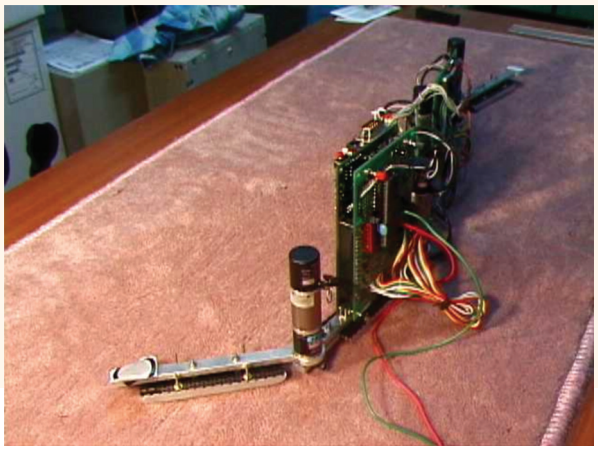
His initial exposure to systems theory was at Tokyo Tech through power electronics research. He was quickly attracted by the beauty of systematic optimization when he investigated during his Master's study whether extended Kalman filtering was a viable tool for estimation of induction motor parameters. His Ph.D study at Purdue focused on development of feedback control theory to achieve stability and regulation performance for dynamical systems. The early 1990s was the time when the control community began to recognize linear matrix inequalities (LMIs) as a powerful computational tool for optimization. His Ph.D research showed how LMIs enable unification of robust and optimal control theories with a variety of specifications, and contributed to introduction of LMI-based design methods to the control community. His dissertation work appeared in a book publication, "A Unified Algebraic Approach to Linear Control Design," coauthored by his advisor R.E. Skelton and his colleague K.M. Grigoriadis.

In the late 1990s, Dr. Iwasaki joined the faculty of Tokyo Tech and collaborated with leading experts in robotics and automation as a member of a government funded Center-of-Excellence (COE) project on "super-mechano systems." The aim of the project was to establish a design theory for achieving highly robust and adaptive motion of robotic systems via feedback control. A direction of his research was aligned with a collective effort of the COE team toward development of biologically-inspired robotic systems, attempting to realize undulatory snake locomotion that is more suitable for rugged environments than wheeled vehicles. He successfully applied a robust control scheme to achieve crawling locomotion of a robotic snake, but then realized the necessity of a new control theory that enabled adaptation of the undulation pattern, or the gait, to the changing environment so that high efficiency of locomotion was maintained.

Soon after moving to UVa in 2000, he found a clue for such a control paradigm, oscillator in a feedback loop, by talking to Prof. W.O. Friesen, a biologist whose lifelong research aim was to discover neuronal control principles underlying undulatory swimming of leeches. They immediately started collaborative research through NIH funding on modeling of leech swimming mechanisms, involving the neuronal control circuits called the central pattern generator (CPG), muscle biomechanics and physiology with motoneuron activation, body-fluid interactions to generate thrust via undulation, and sensory feedback to adjust the CPG command for body oscillation. His research in this direction has recently been expanded to include the development of underwater vehicles inspired by ray swimming with flapping wings, and he collaborates with fluid mechanicians, a structural dynamicist, and a biologist on an ONR-funded MURI project.

Dr. Iwasaki's current research interests include neuronal control mechanism of animal locomotion, nonlinear oscillators, and robust/nonlinear control theory and its applications to mechanical, aerospace, and electrical systems.

Dr. Iwasaki received his B.S. and M.S. degrees in Electrical and Electronic Engineering from the Tokyo Institute of Technology (Tokyo Tech) in 1987 and 1990, respectively, and his Ph.D. degree in Aeronautics and Astronautics from Purdue University in 1993. He was a Post-Doctoral Research Associate at Purdue University (1994-1995), Research Associate (1995-1996), Lecturer (1996-1997) and Associate Professor (1997-2000) at Tokyo Tech, and Assistant Professor (2000-2002), Associate Professor (2002-2004), and Professor (2004-2009) at the University of Virginia. He is a Fellow of IEEE and a member of ASME, and has served as associate editor of IEEE Transactions on Automatic Control, Systems and Control Letters, IFAC Automatica, and International Journal of Robust and Nonlinear Control. He received the CAREER Award from NSF, Pioneer Prize from SICE, George S. Axelby Outstanding Paper Award from IEEE, and Rudolf Kalman Best Paper Award from ASME.



Iwasaki's robotic snake

John Kim elected to National Academy of Engineering

BY MATTHEW CHIN AND WILEEN WONG KROMHOUT

John Kim

UCLA Mechanical and Aerospace Engineering professor John Kim has been elected to the National Academy of Engineering, one of the highest professional distinctions awarded to engineers.

Kim, who holds UCLA's Rockwell International Chair in Engineering, revolutionized the way turbulent flows are studied and modeled. He has made outstanding contributions to the development of direct numerical simulations and large eddy simulations as reliable and respected tools for understanding the physics and control of turbulence.

Kim was among the first to use modern computers for the study of the fundamental physics of turbulence, and his pioneering work has helped make direct numerical simulation an invaluable tool in turbulence research. In addition, Kim has made several important contributions to understanding the physics and control of turbulent flows.

Kim's work has been recognized with the NASA Medal for Exceptional Scientific Achievement, the H. Julien Allen Award from the NASA Ames Research Center, the Otto Laporte Award from the American Physical Society and the Ho-Am Prize in Engineering from the Ho-Am Foundation. He is a fellow of the American Physical Society and has served since 1998 as editor of the journal Physics of Fluids. Kim joined UCLA Engineering in 1993, following more than 10 years as a research scientist, section head and, ultimately, branch chief at the NASA Ames Research Center at Moffett Field, Calif.

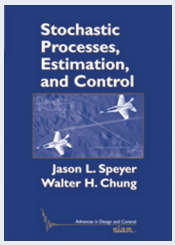
"I am humbled and honored to be recognized for my contributions to the fundamental physics of turbulent flows," Kim said. "This is particularly meaningful and encouraging, considering the current academic environment, where basic research does not get much attention. I am grateful to my current and former students and postdocs at UCLA and former colleagues at the NASA Ames Research Center for their contributions, and to UCLA for providing the environment in which I could carry out such basic research."

The National Academy of Engineering's mission is to promote the technological welfare of the nation by gathering the knowledge and insights of eminent members of the engineering profession. The NAE is the portal for all engineering activities at the National Academies, which along with the NAE include the National Academy of Sciences, the Institute of Medicine and the National Research Council.

MAE Professor Jason Speyer and Walter H. Chung author new control book

(Excerpted from siam.org, http://www.ec-securehost.com/SIAM/DC17.html)

Jason Speyer



Stochastic Processes, Estimation, and Control

By Jason L. Speyer and Walter H. Chung

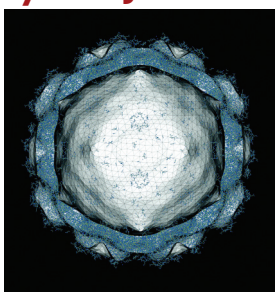
Uncertainty and risk are integral to engineering because real systems have inherent ambiguities that arise naturally or due to our inability to model complex physics. The authors discuss probability theory, stochastic processes, estimation, and stochastic control strategies and show how probability can be used to model uncertainty in control and estimation problems. The material is practical and rich in research opportunities.

The authors provide a comprehensive treatment of stochastic systems from the foundations of probability to stochastic optimal control. The book covers discrete- and continuous-time stochastic dynamic systems leading to the derivation of the Kalman filter, its properties, and its relation to the frequency domain Wiener filter as well as the dynamic programming derivation of the linear quadratic Gaussian (LQG) and the linear exponential Gaussian (LEG) controllers and their relation to H2 and H∞ controllers and system robustness.

Ajit Mal gives plenary and keynote presentations at the 2008 AES-ATEMA Conference

MAE Professor Ajit Mal gave the Plenary and Keynote Presentations at the 2008 AES-ATEMA Second International Conference on Advances and Trends in Engineering Materials and their Applications, as part of their Distinguished Lecture Series. Prof. Mal's Plenary Presentation was "Health Monitoring of Advanced Structures." Mal also gave the Keynote Presentation, "A Semi-Autonomous Damage Monitoring Method for Composite Structures."

William Klug and Melissa Gibbons have featured cover article in the Biophysical Journal



An article by MAE professor William Klug and graduate student Melissa Gibbons, "Influence of Nonuniform Geometry on Nanoindentation of Viral Capsids," was featured on the cover of Biophysical Journal. The article is available at http://www.cell.com/biophysj/fulltext/S0006-3495(08)78508-4 .

Pei-Yu Chiou's research highlighted in Nature Photonics

Pei-Yu Chiou

UCLA Mechanical and Aerospace Engineering Assistant Professor Pei-Yu Chiou recently had his reseach highlighted in Nature Photonics: Microfluidics: Drop by drop, Appl. Phys. Lett. 93, 221110 (2008)

Pei-Yu Chiou and co-workers from University of California at Los Angeles and Berkeley have come up with a new way of manipulating liquid droplets — a single, continuous optoelectrowetting (COEW) electrode. Electrowetting uses a voltage to modify the wetting properties of a solid material. Optoelectrowetting refers to the control of electrowetting using patterned optical images — typically, it involves using a patterned electrode serially connected to a photoconductor.

Rajit Gadh quoted in magazines, gives keynotes

UCLA Mechanical and Aerospace Engineering Professor Rajit Gadh was recently quoted in For The Record Magazine, in the article "Is RFID Technology Too Nosy?" Gadh says his lab has been developing PediaTrak, a technology that would track newborns in a hospital's nursery. "If there were any unauthorized movement, like the baby heading toward a door when it should not be, then the hospital could quickly locate the situation and deal with it," he says.

Gadh says a randomized ID number placed on the RFID tag should alleviate privacy concerns. Under this premise, the randomly assigned number is meaningless to anyone who doesn't have access to the hospital's database. "Privacy issues are alleviated because the person reading the tag would have to get past a firewall to log on to the database and interpret the information," he says. "And only with proper authorization and HIPAA compliance would that information be released to anyone else."

An article in RFID Journal discusses Gadh's SpecimenTrak RFID system, which is being tested for use in UC's Anatomical Donation Program. Gadh, who is also director of UCLA's Wireless Internet for Mobile Enterprise Consortium (WINMEC), says SpecimenTrak was designed so that an end user can select any type of passive RFID tag and reader to use with the SpecimenTrak software. The end user will also be able to decide whether to reuse the tags (assuming they are packaged in a long-lasting, waterproof housing that can be sterilized for multiple uses).

Prof Gadh gave the keynote address at Raytheon's Innovation Café. The title of Prof. Gadh's talk was "Mobile Internet of Artifacts 2.0 – On the future of a Wireless Smart Grid for control, communication, computing, content and commerce." Gadh also gave the keynote address at DCOSS-2009 - International Conference on Distributed Computing in Sensors Systems - http://www.dcoss.org/program.php. The topic was "Smart Grid - Convergence for a Future Energy Transmission and Distribution System with Wireless communications, Sensors/Monitors, RFID and I.T."

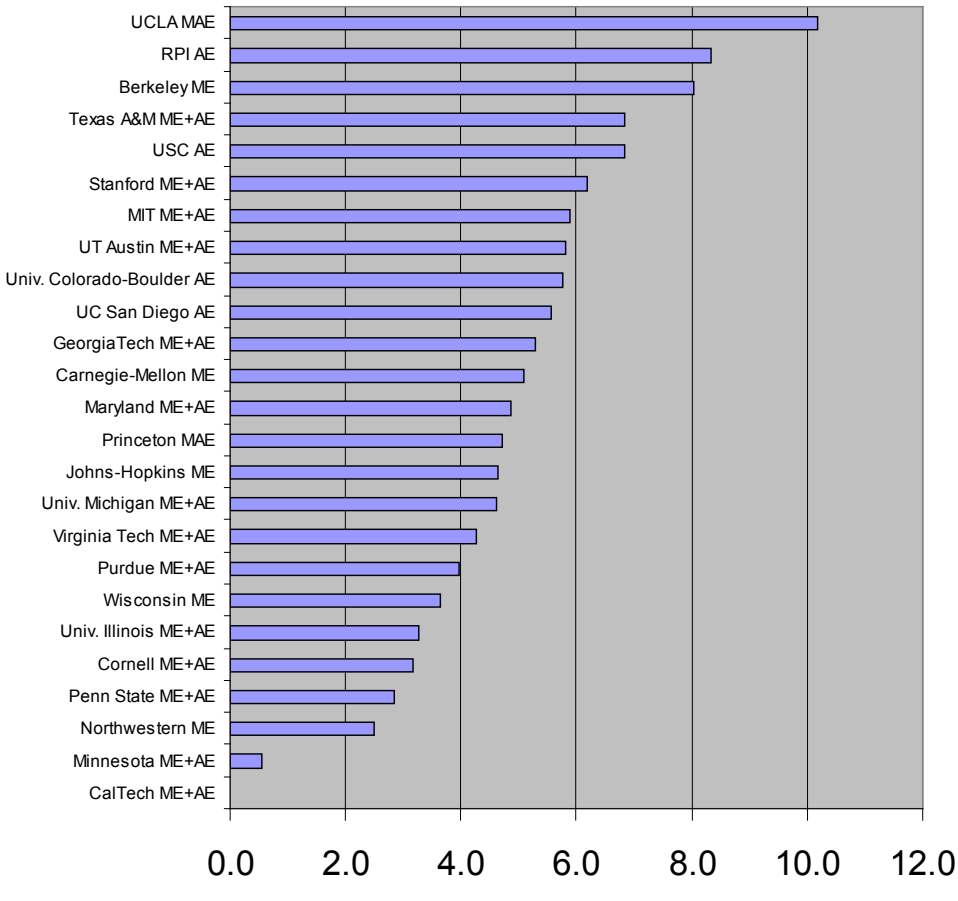
Christopher Lynch completes term as SMASIS Inaugural Conference General Chair

UCLA Mechanical and Aerospace Engineering Professor Christopher Lynch completed his term as General Chair of the Smart Materials, Adaptive Structures and Intelligent Systems (SMASIS) Inaugural Conference. The conference was held from October 28-30, 2008 in Ellicott City, MD. There were 230 presentations and 300 participants for six symposia.

UCLA Tops the Charts in Minority Graduate Enrollment

By a large margin, UCLA's MAE Department has the highest percentage of underrepresented minority graduate students compared to all universities ranked in the top 20 by US News & World Report in either mechanical or aerospace engineering. We are proud to provide a welcoming environment for students from a variety of backgrounds. The chart shows the rankings.

For universities that have separate mechanical and aerospace engineering departments that are both in the top 20, the enrollments of both were combined. The category of underrepresented minority includes Hispanic, African American, and Native American. The minority enrollment data were taken from the American Society of Engineering Education College Profiles, 2008, http://profiles.asee.org/. The top 20 list was taken from the U.S. News & World Report 2010 Graduate Schools rankings (released in 2009).



Aviation Week's 2008 Workforce Study lists UCLA's MAE UG program in top 5, and grad program in top 3

Aviation Week's 2008 Workforce Study, which ranks schools that aerospace and defense companies prefer to recruit from, listed UCLA's Mechanical and Aerospace Engineering undergraduate program in the top five, and its graduate program in the top three.

The annual survey asks companies to list the top five institutions that they recruit from. The criteria that a company uses to determine schools it recruits from can include courses and innovative methodologies offered, research projects, and diversity. Also, the success of a school's graduates, existing corporate relationships, and the ability to "feed" its graduates to the company can also be factors in recruiting.

Purdue University topped the list in 2008. UCLA was tied for fifth with Arizona State, Ohio State, UC San Diego, and the University of Washington.

Georgia Tech was first in graduate institutions, followed by Purdue and UCLA.

The annual study appeared in the August 18-25 issue of Aviation Week Space and Technology.

Pei-Yu Chiou and Chang-Jin Kim's Lab on a Chip paper reported on in Analytical Chemistry

UCLA Mechanical and Aerospace Engineering Professors Pei-Yu Chiou and Chang-Jin Kim's Lab on a Chip paper was reported on in an Analytical Chemistry article:

Incompatibility often leads to divorce. But a group led by Chang-Jin "CJ" Kim at the University of California Los Angeles (UCLA) has managed to marry two seemingly incompatible technologies by giving each its own space. The group's device moves droplets around by electrowetting-on-dielectric (EWOD) and sorts particles inside the droplets with optoelectronic tweezers (OETs) (Lab Chip 2009, DOI 10.1039/b821508a). "We would like to manipulate individual cells inside a single droplet that can be moved around," says UCLA coauthor Pei-Yu Chiou.

10 questions for Bruin Astronaut and MAE Alumna Megan McArthur

BY MATTHEW CHIN AND JUDY LIN
Reprinted from UCLA Today

Megan McArthur
All photos courtesy NASA

When Space Shuttle Atlantis mission STS-125 lifts off on Monday, May 11, for NASA's final mission to service the Hubble Space Telescope, a proud Bruin will be among the seven crew members on her first space flight. Mission Specialist K. Megan McArthur earned her B.S. in aerospace engineering at UCLA in 1993. She went on to obtain a Ph.D. from the Scripps Institution of Oceanography at UC San Diego. In 2000, she joined NASA, where she worked in the Shuttle Avionics Integration Laboratory and the Space Station and Space Shuttle Mission Control centers. In 2004, she served as the crew support astronaut, stationed at the Johnson Space Station in Houston, for the Expedition 9 crew during their six-month mission aboard the International Space Station. The planned repairs to the Hubble should allow the telescope to function until at least 2013, when its successor, the James Webb Space Telescope, is due to be launched.

How did your interest in becoming an astronaut start?

My dad was a career naval aviator, so I was always around airplanes growing up. As a teenager, we lived at Moffett Field Naval Air Station, which is on the same base as NASA's Ames Research Center [in Sunnyvale, Calif.]. I used to see astronauts flying in to do their training in one of the simulators there, and I thought, well, that looks like a pretty neat job. But mostly it made me interested in the space program in general, because it seemed like a long shot to ever get selected to be an astronaut. But I liked the idea and tucked it away in my head. What appeals to me about being an astronaut is that it's a challenging job. You have to be a generalist as well as a specialist in some areas — and, of course, it's a lot of fun.

The crew of Atlantis STS-125.

19 May 2009— Astronaut Megan McArthur, STS-125 mission specialist, works with lithium hydroxide (LiOH) canisters from beneath Space Shuttle Atlantis' middeck during flight day nine activities.

Did you have an experience at UCLA Engineering that helped you find your career?

One of my good friends in school, Derek Leek, was going to be a Navy submarine officer after graduation. He read about a competition called the Human Powered Submarine Races, and put together a small team of aero engineers to compete. With the support of the engineering school, we designed, built and raced a two-person flooded submersible at the International Submarine Races in Fort Lauderdale, Fla. The experience of designing, building and operating real hardware was a crucial part of my education.

What's it like to anticipate actually launching in a space shuttle?

It is hard sometimes to get my head around the fact that we're leaving the surface of the Earth. It's not really going to sink in for me until I am out there and have a minute to look out the window, take a deep breath and go "Wow!" Our orbit will be about 300 miles above the surface of the Earth. I tease my family, "Well, I'm only going to be 300 miles away." But, of course, that's only when I'm on the same side of the planet as they are. And even just to talk about that — like that's a normal thing to do — is pretty amazing.

The Hubble is renowned for its awe-inspiring images of the universe. Are you glad to be on a mission to service it?

It's a tremendous feeling for me, very meaningful to realize that I'm going to contribute to the body of knowledge that we have about our universe. Everyone who sees images from the Hubble are fascinated by what they see, not only because the images are beautiful to the eye, but also because of the questions that are asked. There are other planets out there that are similar to planets we have in our own solar system. That really captures the imagination. I think human beings are just very curious about what else is out there.

You have a couple of different jobs throughout the mission. What's your job as you take off?

During the ascent portion of the flight, we have about eight minutes when we're under the power of the main engines, leaving the surface of the Earth to get into orbit. Inside the shuttle on the flight deck, I'll work with the commander, the pilot and another mission specialist — it takes four people to fly the spacecraft. We'll work together to keep everything on track and make sure we're going where we're supposed to. I'm trained to run procedures in the event of malfunctions, but we expect things to go really smoothly.

What will you be doing when it comes time to service the Hubble?

Once we're in orbit, we rendezvous with the telescope. Participating again with the commander and the pilot and the other mission specialist, we'll do a sequence of burns to match our rate of speed in space with the telescope — to fly in formation. When we get very close to the telescope — within a couple hundred feet — the commander and I will look out windows that face into the payload bay and determine if we've succeeded in matching rates. We'll all be going 17,500 miles per hour around the Earth, but relative to one another, we'll look very stable. When we're matched up, I'll use the ship's robotic arm to grab the telescope and place it in the payload bay — like putting something in the bed of your pickup truck. We have to be very controlled in the way we do everything, something we've trained over and over again in the simulator.

How will the Hubble be serviced?

We'll send out four crew members trained to do spacewalks, who will go out in teams of two to work over a period of five days. Once two crew members are outside the airlock, the two others that remain inside basically choreograph that spacewalk, telling the spacewalkers exactly every step they need to take and what tools they need to have. I'll be driving the robotic arm throughout each one of those spacewalks. There's always one of the crew members on the end of the arm, and I'll help put them into position to do their work so they can be hands-free, not having to hold on to stabilize themselves. I can put them in a stable position so they can do their work. When we're finished, I'll use the robotic arm to grab the telescope, take it out over the side of the payload bay and let go of it. Then we'll do a series of burns to get away from it, pretty much wrap it up and go home.

Flying in space can be dangerous. Why are you willing to take the risk?

Exploration is important to me. I think it's important to the human spirit. It's something that we have always done, pushed beyond the boundaries of what we know, what we can do, what we can build. We're always pushing ourselves; we're always looking to find out what's out there and what we can learn. We can't accomplish this without flying in space. We don't have robots and machines to perform the tasks we're going to perform.

We understand you'll be taking along a couple of items from UCLA?

We are allowed to fly some small personal items for our families as well as for organizations that are important to us. I contacted the School of Engineering and told them, "I'd really like to fly something that represents UCLA with me on my flight because UCLA was a big part of my life." I'm going to take along a miniature IMP, the computer switch that served as the first node of the Internet at UCLA in 1969. I'll also be bringing along a UCLA T-shirt because, as you know, go Bruins! I had a lot of life-changing events when I went to school there, so I'm happy to fly with a little piece of UCLA.

What advice could you give people about pursuing their dream?

You have to trust your instincts. You have to find something you love to do and then do it really well, enjoy it. And you have to persevere. It's been almost nine years since I was hired by NASA to be an astronaut. If you set really large goals for yourself, you have to take the long view … the stair-step approach to reach them. You also have to tell people what it is that you want. Don't hide your dream because you think, "Oh, it's crazy for me to want to do that." Let people know that's what you want to do, that that's what you're working to do and that you're serious about it. People will help you.

18 May 2009 — Astronaut Megan McArthur works the controls of the remote manipulator system (RMS) on the aft flight deck of the Earth-orbiting Space Shuttle Atlantis during flight day eight activities.

Mohamed Abdou was elected as the first president of the Council of Energy Research and Education Leaders (CEREL). CEREL is the first multidisciplinary membership organization made up of heads of academic energy research and education centers. CEREL provides the means for leaders in energy research, education, and communication to collaboratively advance the role of higher education in the energy field to improve education, decision-making, and societal well-being.

Additionally, he delivered: the Invited Keynote Opening Lecture, Presqu´île de Giens - France; the Invited Keynote Speaker - American Nuclear Society 18th Technology of Fusion Energy Meeting (TOFE-18), San Francisco, CA; the Opening Keynote Plenary Lecture, Krakow, Poland; the Plenary Lecture, Xi'an Jaintong University, Xi'an, China; and the Keynote Plenary Lecture, Dalian, China.

Greg Carman was part of the Boeing Team that won the American Helicopter Society Howard Hughes Smart Rotor Team Award. The Howard Hughes award is given for an outstanding improvement in fundamental helicopter technology brought to fruition during the preceding year.

Nasr Ghoniem was selected as the recipient of the Outstanding Achievement Award by the Materials Science and Technology Division of the American Nuclear Society for "significant and sustained contributions to the modeling of materials behavior, especially for applications in advanced nuclear systems."

Chih-Ming Ho received an honorary research chair professor and was also elected as a Distinguished Alumnus from National Taiwan University, his alma mater.

Additionally, he delivered plenary or keynote talks in the following national and international conferences: the 3rd International Symposium on Bio-inspired Engineering; the Academia Sinica Conference in memory of Leroy Chang; the ASME Micro and Nanosystems Conference; Gordon Research Conference; the University Forum, National Cheng-kung University; and the Annual Conference of Institute of Biological Engineering.

Ann Karagozian was elected Vice-Chair of the American Physical Society's Division of Fluid Dynamics. In subsequent years, Karagozian will serve as Chair Elect, then Chair of the Division. She also recently completed her fourth year as Vice Chair of the Air Force Scientific Advisory Board.

Additionally, Professor Karagozian received the 2008-2009 UCLA Mechanical and Aerospace Engineering Teaching Award. This award recognizes contributions to the educational mission of the department, and is based on student evaluations of teaching, contributions to student welfare, and curriculum development.

John Kim was elected to the U.S. National Academy of Engineering.

Additionally, he won the Distinguished Alumni Award, College of Engineering, Seoul National University.

Webb Marner was appointed Secretary and Treasurer of the American Society of Mechanical Engineers (ASME) by the Board of Governors of the Society. The Secretary and Treasurer is an Officer of the Society and a volunteer member of ASME.

Laurent Pilon won the Young Scientist Award in Radiative Transfer, of the Journal of Quantitative Spectroscopy and Radiation Transfer. This award acknowledges the contributions from talented young researchers, under the age of 36, to the field of radiation transfer.

Richard Wirz won the NASA/JPL Research and Technology Development Award. This award supports the development of an in-situ lubrication device for use on spacecraft and planetary rovers. Prof. Wirz is working on this project in conjunction with colleagues at NASA's Jet Propulsion Laboratory, California Institute of Technology. Prof. Wirz was also part of a team that received a Strategic Initiative Research and Technology Development Award to investigate modeling and experimental methods for predicting and improving the life of plasma thrusters for near-term NASA missions.

NAE

National Academy of Engineering Members

Vijay Dhir

Vijay K. Dhir, Dean of the UCLA Henry Samueli School of Engineering and Applied Science and professor of mechanical and aerospace engineering, was elected into the National Academy of Engineering (NAE) in 2006. Honored for his work on boiling heat transfer and nuclear reactor thermal hydraulics and safety, Dhir joins five other UCLA mechanical and aerospace engineering faculty who are NAE members. Dhir has been a faculty member at UCLA since 1974, and leads the Boiling Heat Transfer Lab, which conducts pioneering work in fundamental and applied research in phase change heat transfer.

Chih-Ming Ho

Professor Chih-Ming Ho, director of the Center for Cell Control and director of the Institute for Cell Mimetic Space Exploration, was elected in 1997 for his contributions to the understanding and control of turbulent flows. He joined UCLA to lead research in microelectromechanical system (MEMS) in 1991, and served as the founding director of the Center for Micro Systems. UCLA's MEMS program has been recognized as one of the top three programs worldwide.

John Kim

Professor John Kim was elected into the National Academy of Engineering in 2009 for development of direct numerical simulation and seminal contributions to the understanding of the physics and control of turbulent flows. Kim, who also holds the Rockwell International Chair in Engineering, revolutionized the way turbulent flows are studied and modeled. He has made outstanding contributions to the development of direct numerical simulations and large eddy simulations as reliable and respected tools for understanding the physics and control of turbulence.

Jason Speyer

Professor Speyer was elected to the National Academy of Engineering in 2005 for "the development and application of advanced techniques for optimal navigation and control of a wide range of aerospace vehicles." He has pioneered new optimal deterministic and stochastic control, team and differential game strategies, estimation, and model-based fault detection.

Affiliated Professor

Kuo-Nan Liou

Professor Kuo-Nan Liou, who holds a joint appointment in mechanical and aerospace engineering, was elected in 1999 for contributions in the theories of radiation transfer and light scattering, with applications to remote sensing technology and climate modeling.

Endowed Chairs

H. Thomas Hahn - Raytheon Company Manufacturing Engineering Chair

Professor H. Thomas Hahn holds the Raytheon Company Chair in Manufacturing Engineering, established to support a renewed focus on manufacturing engineering at UCLA, and to recognize excellence in research and education in this field. Hahn joined the UCLA faculty in 1992, coming from Pennsylvania State University where he was the Harry and Arlene Schell Professor. He also held a professorship at Washington University in St. Louis and research positions at the Lawrence Livermore National Laboratory and the Air Force Materials Laboratory. Hahn's research interests cover a wide spectrum of composites technology ranging from design and analysis to processing and manufacturing. Hahn served as chair of the UCLA Mechanical and Aerospace Engineering Department from 2002 to 2006.

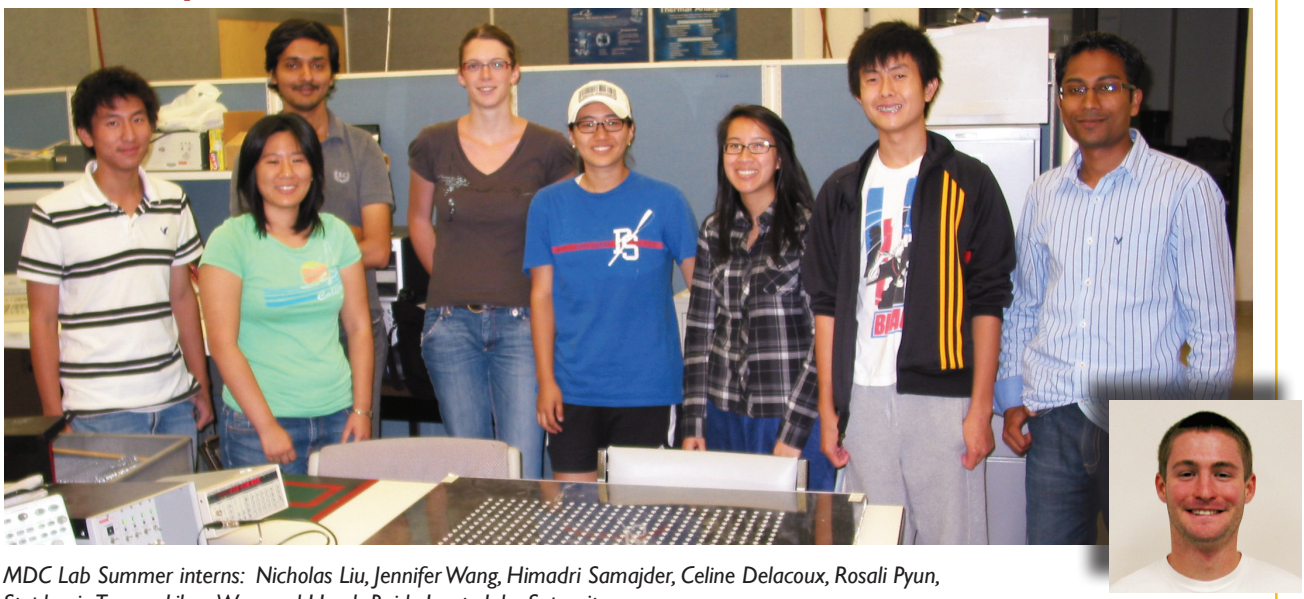
Chih-Ming Ho - Ben Rich Lockheed Martin Chair

Professor Chih-Ming Ho holds the Ben Rich-Lockheed Martin Chair, which honors the late Ben R. Rich (MS '50), one of the world's leading aircraft engineering pioneers. The chair was established to recognize a faculty member conducting advanced research in aeronautics, including microelectromechanical systems. Ho is the Director of the NASA-funded Institute for Cell Mimetic Space Exploration at UCLA, an interdisciplinary center focused on identifying, developing, and commercializing nano-, bio-, and information technologies for space exploration. He is an internationally renowned researcher in bio-nano technology, micro/nano fluidics, and turbulence. Ho was elected a member of the National Academy of Engineering and an Academician of Academia Sinica which honors scholars of Chinese origin with exceptional achievements in liberal arts and sciences.

John Kim - Rockwell International Engineering Chair

Professor J. John Kim holds the Rockwell International Chair in Engineering, which was established to support exceptional research and educational accomplishments in aerospace and aeronautical engineering. Kim's primary research interest is numerical simulation of transitional and turbulent flows, physics and control of turbulent flows, and numerical algorithms for computational science. He has been a pioneer in developing direct numerical simulations and large eddy simulations as a reliable and respected tool for studying physics of turbulence. Kim has been at the forefront of the application of a new cutting-edge approach to flow control. Kim is a Fellow of the American Physical Society, and received a NASA Medal for Exceptional Scientific Achievement in 1985, the H. Julien Allen Award from NASA Ames Research Center in 1994, the Otto Laporte Award from the American Physical Society in 2001, and the Ho-Am Prize in Engineering from the Ho-Am Foundation in 2002.

Summer Interns in Material Degradation and Characterization Laboratory



MDC Lab Summer interns: Nicholas Liu, Jennifer Wang, Himadri Samajder, Celine Delacoux, Rosali Pyun, Stephanie Truong, Lihan Woo, and Harsh Baid. Inset: Jake Supowit.

Seven students – three from high school and four undergraduates – did summer internships in UCLA's Material Degradation and Characterization Laboratory, or MDC Lab. Each of the students had a different route to the program and had interesting stories to tell.

The MDC Lab was founded by UCLA Mechanical and Aerospace Engineering Professor Ajit Mal, and is currenly managed by Ph.D. students Harsh Baid and Himadri Samajder. The lab focuses on improving materials, mostly those used for airplane and aerospace structures. The lab figures out ways to find cracks and other damaging flaws in aircraft and aerospace structures to insure their safety in a cost-effective manner. The lab's most recent work is called structural health monitoring (SHM). This involves monitoring the structures for internal damage using an ultrasound based method. The general idea behind SHM is akin to the way we humans monitor our injury and seek help when needed. Modern commercial and military jetliners and space structures are expected to use this approach in the not too distant future.

Celine Delacoux, one of the four undergraduate students, found out about the program from the mechanical engineering department at her school ENSMA (Ecole Nationale Supérieure de Mécanique et d'Aérotechnique), in France. She discussed her experience in the lab. "I had already done destructive tests in France, but I wanted to compare the records from these tests with a nondestructive test. We studied isotropic materials, like aluminum and steel and composite, which is an anisotropic material. I find this to be very interesting because in the future aircraft and aerospace structures will use more and more composites."

UCLA undergraduate student Jennifer Wang took the internship to gain real world experience. "In class, we usually learn about theoretical concepts and do calculations. But in the lab, we test the properties and we can see how our experimental data matches the theoretical data."

UCLA undergraduate student Rosalie Pyun expressed appreciation for the the training provided by Harsh Baid in using testing machines to measure material properties.

Lihan Woo, one of the three high school students, found out about the program at a talk at his school, and is now considering engineering as a career. "Engineering seems like a good career to go into. If it was only computational and entering data into the computer, I probably wouldn't, but there's experimental stuff and it's pretty fun."

High school student Nicholas Liu found the Instron machine fascinating. "The Instron machine basically pulls out materials to see what they do. We were looking to see with what force the material will break and when the material broke, it was so quick - it was an exciting moment."

One idea in particular stood out to high school student Stephanie Truong. "I remember when Harsh made a comment about how an engineer can save more lives than a doctor because say a structure collapses, you can kill many more lives. He made me realize that if I majored in engineering, I could save more lives than a doctor."

They Did It. UCLA Supermileage: 1030+ miles per gallon!

BY JORDAN CHASE
2009 UCLA SUPERMILEAGE VEHICLE TEAM PRESIDENT & PROJECT LEADER

2009 Shell Eco-marathon Americas. Photo courtesy Shell.

The UCLA Supermileage team camped out from April 15-18 at the Autoclub Speedway in Fontana, CA while competing at the third annual Shell Eco-marathon Americas. Highlights of the event were finishing safety and technical inspections by 11:00 AM on the first day that teams were allowed on the course. Team driver, Danya Linsteadt, was also able to get in 10 practice laps, with Jordan Chase beside her on his bicycle, with only minor mishaps: driving off-course and breaking a wheel-well, but after a quick fix with a few rivets and some engineering (aka duct) tape the car was back out on the track.

The team posted a mileage of 570 mpg on the second day of competition, but were 30 seconds too slow for the run to be valid. The 7 lap course had to be completed within 39 minutes in order to post an official fuel mileage. The team continued to be unable to post a run for the day due to two tires blowing out and Danya rolling the car over. Fortunately, Danya was unharmed during the roll. Footage of her right afterwards can be seen at shell.com/us/ecomarathon under UCLA's team profile. Go to YouTube.com, "UCLA Supermileage Vehicle," to find several team member interviews.

As the team members discussed that day's events, there was a bittersweet feeling among them. On the bright side there were no major mechanical issues with the car, but the four year goal to reach 1000 mpg seemed like it might not happen. Even their personal record of 834 mpg from two years before seemed out of reach.

That night the majority of the team, consisting of Jordan Chase, Jon Ho, Vito Mazzarino, Albert Wu, Karina Hernandez, Ambika Luthra, Jon Chu, Keegan Leary, and Brett Rosenthal stayed up until 3:00 AM addressing everything they could to mitigate the failures of the day. Members Adam Kellada, Philippe Garretsen, and Josh Green took the quick road trip back to LA to grab spare parts from the lab on campus. Back in the team's pit area nearly an hour was invested in perfecting the toe-angle of the front wheels, while they also increased the size of the rear gear to improve acceleration, pressed a bearing into a completely new crank case cover, changed the oil in the engine to one of lighter weight, and tuned the clutch to engage at a lower rpm.

The next morning UCLA Supermileage was one of the first teams on the track, and something seemed to be different about how this day would unfold. Danya was able to finish all seven laps and posted a valid run on her first attempt. As they pulled off the top fairing after she crossed the finish, the 200 mL fuel tank looked reassuringly full. They knew that they had to have burned less than 44 mL to beat the 834 mpg car from '07, and after the official fuel reading back in the garage, the technician read 37.5 mL off the refill burette. Anxiously awaiting the official score, the UCLA crew got Danya back in the car and headed out for another run. Several minutes later it was posted:

UCLA Supermileage: 1030+ miles per gallon!

"We had done it!"

SMV at Shell start line. Photo by Jon Ho.

SMV with hood off. Photo by Josh Green.

Communicating with the driver via radio. Photo by Jon Ho.

Finally, they actually reached the long-awaited four-digit regime. After the second run a posting of 1239.5 mpg put us comfortably in 5th or 6th place. This would be our highest score, however. The car returned to the garage after its third valid run of the day to try some different tires, and to give Danya a well deserved rest. Late in the afternoon on that final day of competition, the car once again rolled with Danya inside, and on her 7th and final lap of the day's fourth run. Once more, completely intact, healthy and now unfazed by rollovers, Danya returned in the rescue truck with a slightly more beaten up UCLA Supermileage Vehicle. With only 7 minutes until the last car would be allowed on the track, we rushed to inspect the chassis, run the engine, and apply some much needed duct-tape to the most injured areas of the car.

UCLA Supermileage did manage to get her back out on the track in the nick of time, but the car had suffered too many battle wounds to complete another perfect run. Danya sensed that something on the car was off, and as Project Manager, Jordan Chase gave her the OK to pull off early and call it a weekend.

At the awards ceremony that followed, the UCLA team was honored with the off-track award of "Most Eco Design" and was handed a check for $500.00, a little icing on the cake. Also, Danya was honored with a bearing key-chain from SKF for having completed 720 degrees of rollover on the track, and for being the only driver to roll at all, much less twice.

Overall the weekend was an amazing success, only made possible by the outstanding members of the biggest team we have ever gathered together. The team would like to say thanks to everyone out there who sponsored them this year, and that they are truly amazed by the efforts of everyone who contributed to this year's car.

Group shot with driver kneeling on the left. Photo courtesy Shell.

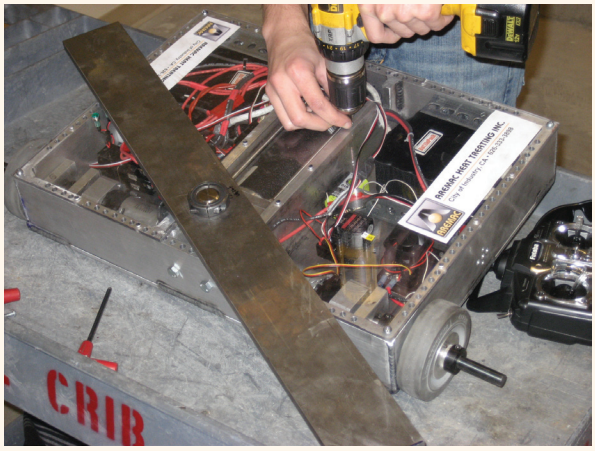
Mechanical engineers design BattleBots for robotic combat

BY SANDY BUI

Ediited from a longer version in the Daily Bruin

With its 12-pound steel bar spinning rapidly, the UBRuined robot can shred other robots apart ruthlessly. With a steel cylinder edged with teeth in front, the UCLASH robot spins while storing enough energy to attack its next enemy.

BattleBots, UCLA's American Society of Mechanical Engineers' student project, has about 45 student members designing and building robots to compete in robotic fighting competitions.



UBRuined

These elaborate machines are the creations of committed robot enthusiasts who are simultaneously gaining hands-on experience with engineering and with battling in competitions.

Members of the BattleBots club "come up with an idea, put it on paper, create a 3-D model, and go in and build it and compete," said Alexander Jozefov, a second-year mechanical engineering student who serves as co-project leader of BattleBots and as UCLA's ASME president.

Jeff O'Donohue, a fifth-year mechanical engineering student and co-creator of the BattleBots club, started it during his second year at UCLA with other engineering students.

Before becoming affiliated with ASME, the club built its first robot called DracUCLA and competed in the RoboGames competition about three years ago.

The club attracts students from not only mechanical engineering, but also computer science and non-technical as well. For the first half of the school year, the students plan and design their robots. In the second half, they construct their robots. The students blend creativity, craft and school spirit into their inventions.

According to the Robot Fighting League's national rankings, UBRuined is currently ranked 10th and Bruiner of Worlds is ranked 11th, Jozefov said. The Robot Fighting League ranks robots according to their weight class and performance at events from the last 18 months.

Though competing is fun, it is not the most important part of BattleBots, O'Donohue said.

"You've got to be the kind of person who likes not only the three-minute match in the arena, but also the six months of designing and building because, if you're completely focused on the end result, you might not build as good of a robot to really enjoy the design and the build process just about as much as the competition," O'Donohue said.

The weeks before competition are more intense as the students go to the student shop and put the finishing touches on their robots. "The competition is like the culmination, and you get to see everyone else's robot and what everyone else designed," O'Donohue said.

Whether or not battling robots will have a practical use in the future is not certain, but robots in general are expected to have an influential effect on society. "(Robots are) just going to become more important in society – not as robots fighting robots, obviously, but whether they're integrated into cars, (or) other hospital machinery," O'Donohue said.

Regardless of the robots' practicality, students are more importantly engaging and learning from hands-on projects in a student-run club.

"I don't think (BattleBots) was some really elaborate scheme to build something great for humanity," O'Donohue said. "You're just doing it to show that you can do it. More importantly, you're learning how to do it. So for a student organization like ours, (members) are learning because they really want to know how to design and build stuff," O'Donohue said.

Jozefov said the competitions are especially entertaining and exciting. "You go to competition, you'll be repairing your 'bot, and you hear a loud clash from across the room. And you go running over to the arena to watch these two robots duking it out, and in some cases, parts go flying everywhere," he said.

Matches end when one robot stops functioning, also

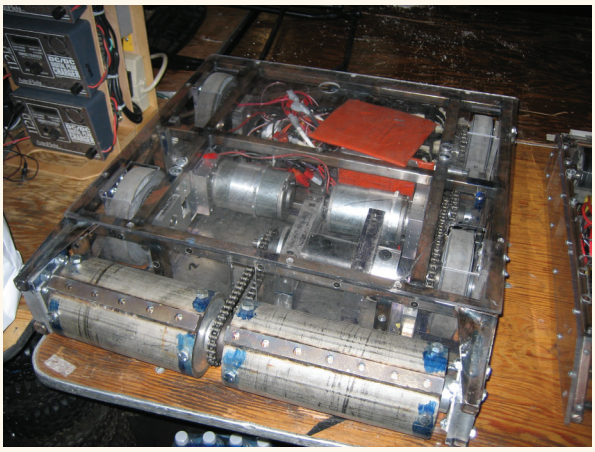
known as a "knock out." If neither robot crashes, then a panel of judges determines the victorious robot.

Winners not only receive a cash prize, but also "a lot of bragging rights," Qian said.

Students involved with BattleBots are gaining knowledge that cannot be offered in academic courses until much later. "It's a really fun way to learn about engineering," O'Donohue said.

Nonetheless, the educational aspect of the club is not the best part of BattleBots. "Nobody's going to say they don't like seeing robots be destroyed," Jozefov said.

Students who are interested should visit the club's Web site at asme.seas.ucla.edu.



DracUCLA

2009 UCLA Baja SAE Project Report

BY MICHAEL RAULS AND ANTHONY GAMBARDELLA

The 2009 vehicle represented a radical change in design philosophy from previous years. The largest focus was on weight savings while maintaining overall reliability. This resulted in the lightest vehicle to date, 412 pounds at technical inspection. We were able to achieve this through a new chassis design, which allowed us to eliminate redundant tubing and simplify mounting points for suspension and drivetrain.

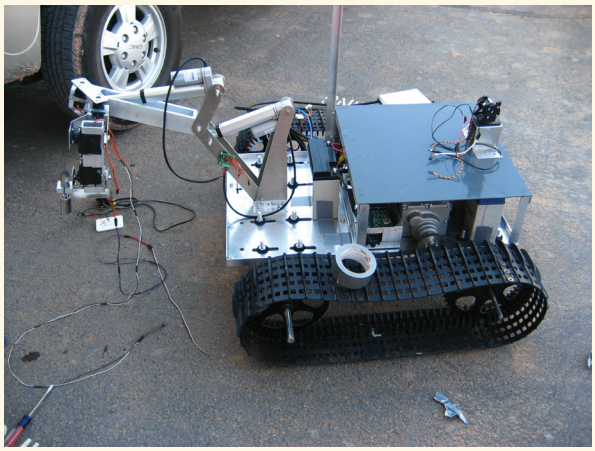
This year we also developed a new drivetrain system which greatly reduced rotating mass, improving the acceleration and climbing abilities of the vehicle. A single speed reduction replaced a chain reduction, resulting in greater reliability and tuning through simplification of tensioning of the final drive chain. We were able to test different drivetrain ratios by changing sprockets. Many components were made in-house, reducing lead times.

The 2009 competition team recorded the best overall finish for UCLA Racing to date. We had exceptional finishes during the Static events day, with 2nd Place in the Sales Presentation and 19th Place in the Design Presentation. As a result of additional driver training, we placed 20th in the Dynamic events, with a 13th Place in Maneuverability, 31st in Rock Crawl, 35th in Acceleration, and 35th in Hill Climb. These scores gave us a great starting position for the Endurance race the following day. We faced many challenges during the Endurance race, such as a broken chain and deformed roll cage. The chain swap took 20 minutes, and we were back out on the track turning in laps. Immediately after our first driver change, we suffered our second roll over, and the judges required us to add front bracing to the vehicle, taking us out for a further 1 hour and 45 minutes. We returned to the track with a vengeance, passing every vehicle left out on the course. Even with our comeback, we finished 39th in the Endurance race, giving us an overall finish of 31st for the weekend.

We would like to thank the UCLA R&D Shops for their tremendous support. They offered advice, scrap metal, and volunteered their time to help us. Miguel Lozano also allowed us to use the MAE Department's CNC Waterjet machine.

Robotics Club

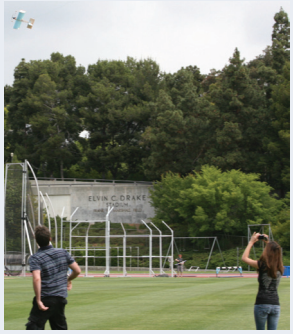
BY ANDREW BOGGERI



Last year, our primary focus was the University Rover Challenge, a competition only three years old in which teams from different colleges across the globe design, build, and test a Mars rover. The event itself takes place in the isolated Utah desert, where conditions are quite similar to those on Mars.

Specifically, all teams must demonstrate their robot through four different tasks: finding and screwing pre-affixed bolts to a board, identifying the coordinates of various targets, locating a "downed astronaut" using only a last known location, and searching for areas with a greater-than-average chance of life. Such tasks are quite complicated, requiring not only pulling from mechanical, electrical, and computer engineering (in building a chassis as well as power, computer, and radio systems) but also other fields including geology and astrobiology.

Outside of this competition, our club also worked hard to educate our members. In the first quarter, we held an Educational Research Project, a simplified task designed specifically to acclimate new members to the world of robotics. As a part of this project, we also held several tutorials to teach members about embedded programming and CAD. Unfortunately, last year's project of building an autonomous robot capable of locating and picking up green objects was overambitious; learning from that mistake, we plan on creating a vastly easier task for this coming year. Combined with more structured tutorials and office hours, I am confident that our members will become more capable this year, ensuring greater success at the coming University Rover Challenge and other competitions.



Photos by James Wang

Model Airplane Challenge

BY ALBERT MEDINA AND ANN KARAGOZIAN

This year the Fluid Mechanics and Aerodynamics Laboratory (MAE 157A) project was to design and build a radio controlled single propeller aircraft.

Both sections of this course were taught by MAE Prof. Owen Smith, an experienced pilot who has built and flown his own plane, a 70% scale P-51 Mustang.

Each 157A group, consisting of 4 to 5 members, was given a single motor, two servos, speed controller, receiver, and battery. The objective was to design an aircraft with a takeoff distance of 100' and capable of carrying the maximum amount of payload possible. The primary difficulty in this year's project was the limitation on wingspan; design specifications called for a wingspan of no more than 11". Lifting surfaces with such wingspans still capable of carrying the required equipment and additional payloads called for lower end aspect ratios. As a result, multiple lifting surfaces were employed such as bi- and tri-wing designs. With only one propeller per aircraft, it was up to the groups to decide whether a push or pull propeller design was more beneficial.

Extensive wind tunnel testing was conducted throughout the design process. Propeller blades of various diameter and angle of attack were tested at varying wind speeds to determine efficiency and speeds of operation. Lifting surfaces constructed by groups with a selected airfoil profile were tested for lift and drag and entire aircrafts were tested for stability of flight at cruising speeds. Finally, the aircrafts were tested from landed configuration with increasing wind speeds to determine necessary takeoff speed. Come flight day, each aircraft was flown individually with UCLA's Drake Stadium providing a runway. Although many aircraft were capable of takeoff, maintaining a controlled flight proved difficult.

AIAA Rocket Project

BY VICTOR REZNIKOV

For the AIAA Rocket Project, 2008/2009 was a rebuilding year. After the club was restarted in 2007 by Bret Keller (Project Lead for 2007/2008) and Faculty Advisor Professor Richard Wirz, most of the members graduated the following spring. With the success of last year's team, we had decided to focus our efforts on our own design of a hybrid motor (rather than using a commercial motor as had been previously done). Because much of last year was dedicated to researching the theory and design behind hybrid systems, most of the progress made was on paper. Fall quarter of 2008 was spent trying to figure out just how to approach such a problem. Much of our research was based on Stanford's work with N20-Paraffin hybrids and this was a natural starting point for our design. Once preliminary research was complete, we dedicated a large amount of time to developing a parameter optimization program. This program was designed to provide us with important parameters including dry mass, wet mass, and maximum expected altitude as a function of the inner diameter of our paraffin fuel grain. Many nights were spent in our lab working out all the details of the program. However, all of this work has been worthwhile as we now have an efficient means of checking the performance of our rocket as a function of various input parameters which should help subsequent groups in the years to come.

During the Spring Quarter, we focused on constructing our hybrid system and running cold flow tests. This was when we began to finalize many of the small details of hybrid design such as piping configuration. Currently, we are waiting for one of our sponsors, Lorents, to machine out our test oxidizer tank and injector head for the cold flow tests. The cold flow tests will be used to determine the performance of injector plates of various orifice configurations as well as to determine mass flow rates and pressure losses across our piping. Once cold flow tests are complete, we will progress to the hot fire tests where we will test the full hybrid system and gather additional data.

Last year wasn't just spent working out equations. We also had several fun and engaging activities for our members, as described in the photos and captions below.

During winter quarter of 2009, our team took a trip to AFRL along with Professor Wirz. There, we were given a tour of various research facilities and presented our preliminary design to members of the AFRL staff. The trip was very rewarding. From left to right: Nathan Reynolds (Structures lead), Chris Quinonez, Loren Prendergast (Propulsion Lead), Daniel Chen, Kurt Zimmerman, Anthony Gambardella, Hannah Jorgensen, Peter Chang, Victor Reznikov (Project Lead).

During spring quarter of 2009, we participated in the Engineering Open House. Here, we're speaking to prospective freshmen about our project and the many benefits of UCLA engineering. Note, the rocket shown in the photograph is the first-place rocket from the 2007/2008 team. At this point, we did not have our frame constructed as we were still developing our motor (the components of which are partially shown on the table). On the right hand side is Victor Reznikov (Project Lead).

Alumni and Student News

Neal Hutchinson

Neal Hutchinson received the 2009 Harry M. Showman Prize at the undergraduate level.

"The prize is awarded to those who most effectively communicate the achievements, research, results or social significance of any aspect of Engineering to a student audience, the engineering professions, or the general public. Primary consideration will be given to written articles or editorial services for an engineering student publication, but the award may also be conferred for meritorious contributions in other areas of communication."

Neal worked in Mechanical and Aerospace Engineering Professor Laurent Pilon's Research Group for the last two years and graduated with a BSAE in March 2009. His work resulted in three archival journal papers (two as first author and one as co-author) recently accepted in Thin Solid Films and Journal of Applied Physics. Neal worked closely with Thomas Coquil and Ashcon Navid who should be acknowledged for contributing to his success.

Mr. Neal Hutchinson is a participant in the Center for Excellence in Engineering and Diversity (CEED) programs. CEED, through its NSF funded RISE-UP program (NSF grant # 04316970), encourages and prepares CEED students to compete for Faculty REU research positions. Neal was one of sixteen recipients of RISE-UP funding to conduct research in Summer 2007. Neal was assigned to Professor Pilon's laboratory, and due to his deepening interest and performance, Neal was selected to continue his research in Fall 2007. In the RISE-UP Poster session, Neal won one of the top honors and received a RISE-UP award from Dean Vijay Dhir. Subsequently, Neal was supported by the National Science Foundation through Prof. Pilon's CAREER Award and the Research Experience for Undegraduates program (CTS 0449429).

Juliett Davitian

Juliett Davitian gave a highlighted talk at the American Physical Society/ Division of Fluid Dynamics conference, held Nov. 23-25, 2008 in San Antonio, TX. A press release from the American Institute of Physics highlighed 8 talks (out of 1500 total) at the APS/DFD conference and among those talks was the one given by Dr. Davitian, who recently completed her Ph.D. in the MAE department. The title of Davitian's APS presentation was "Open Loop Control of Self-Excited Transverse Jets," which described research conducted in the UCLA Energy and Propulsion Research Laboratory under the supervision of Prof. Ann Karagozian.

Please view the full press release at http://www.mae.ucla.edu/mae_news/2008_11/aps.txt.

Young Jae Chun

Young Jae Chun, a student of MAE Professor Greg Carman, won the ASME/AIAA Conference on Smart Materials Adaptive Structures and Integrated Systems (SMASIS) Best Student Paper Competition. Chun's paper is "Thin Film Nitinol Microstent for Aneurysm Occlusion," and it was written with Greg Carman and K.P. Mohanchandra from UCLA's MAE Dept., and Daniel S. Levi from the Pediatric Cardiology Dept. of UCLA's Mattel Children's Hospital.

The text from the abstract can be found at http://www.asmeconferences.org/SMASIS08/TechnicalProgramOverview.cfm#63 in context with the other conference papers.

Please visit http://www.asmeconferences.org/SMASIS08/ to read more about the conference.

Ibrahim Ghanem, a senior in the Mechanical and Aerospace Engineering Department in the Samueli School of Engineering and Applied Science at UCLA, received an Outstanding Engineering Student Award from the Orange County Engineering Council at the OCEC's annual Engineering Week Awards Banquet on February 20, 2009, at the Center at Sycamore Plaza.

Ibrahim Ghanem

Dmitry Yudovsky

Dmitry Yudovsky, PhD student in the MAE Department, has won first place in the Biophysics track at the 10th Annual Systemwide Bioengineering Institute of California Symposium. The goal of this symposium is to increase the synergistic interaction of UC's vast biomedical engineering research expertise with the practical medical and healthcare engineering undertaken by biomedical firms and a number of agencies in the government including Lawrence Livermore National Labs. The symposium was held at UC Merced on June 19-21, 2009 and hosted 175 participants. Dmitry Yudovsky's talk was entitled "Optical Model of Human Skin for Biomedical Reflectance Spectroscopy: Application to Diabetes Care." The project was supported by HyperMed, Inc. from Burlington, MA, under the supervision of Prof. Laurent Pilon (UCLA MAE Dept. and Biomedical IDP) and Prof. Aksone Nouvong (UCLA Surgery). Symposium Website: https://eng.ucmerced.edu/bioe2009

MAE HSSEAS Commencement Awards winners

The recipients of the MAE following Outstanding Student Awards were announced at the June, 2009 Commencement Ceremony. All students are commended for their accomplishments!

2009 HARRY M. SHOWMAN PRIZE
Neal Jacob Hutchinson, B.S., ME, W09

2009 ENGINEERING ACHIEVEMENT AWARD FOR STUDENT WELFARE
Rodrigo Flores, B.S., ME, W09
Sabrina Lorena Marquina, B.S., AE, Sp09
Brett Alexander Rosenthal, B.S., ME, Sp09
Ian Alexander Schultz, B.S., AE, Sp09
James A. Umali, B.S., AE, Sp09

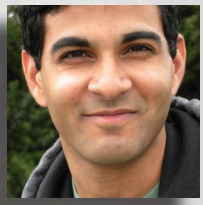
OUTSTANDING AE AND ME DEGREE RECIPIENTS
Vishal Sanjay Parikh, B.S., AE, Sp09
David McIntyre Pisani, B.S., ME, W09
Hann-Shin Mao, M.S., AE, Sp09
Aleksandra Sasha Lukyanets, M.S., ME, Sp09
Juliett Davitian, Ph.D., AE, F08
Gaurav Jitendra Shah, Ph.D., ME, F08

2009 OUTSTANDING GRADUATING SENIOR IN THE MAE DEPARTMENT
James A. Umali, B.S., AE, Sp09

OASA SPECIAL CONGRATULATIONS
Brian Ethan Shedd, Ph.D., ME, F08

OASA RECOGNITION
David Lui, M.S., ME, W10

In Memoriam



Vishal Parikh

(April 21, 1987 - April 24, 2009)

It is with profound sadness that the UCLA MAE Department announces the passing of Vishal Parikh, an exceptional undergraduate student in Aerospace Engineering and a member of the UCLA Energy and Propulsion Research Laboratory. Vishal had been struggling valiantly with cancer since the summer of 2008, and after enduring many months of treatment, succumbed at his family's home in Cypress on Friday, April 24, 2009. Vishal was a remarkable student at UCLA, with a near-perfect GPA attained while serving as a member of the AIAA Rocket Group, Tau Beta Pi, and EPRL. He had also worked as a summer intern at Northrop-Grumman and as a UCLA homework grader and SAT/PSAT tutor. He was a UCLA National Merit Scholar and Valedictorian of his Pacifica High School class of 2005. Vishal will be greatly missed by all who knew him.

DYNAMICS

Oddvar O. Bendiksen

Classical and computational aeroelasticity, structural dynamics and unsteady aerodynamics.
Associate Fellow, AIAA, 1995

Daniel C. H. Yang

Robotics and mechanisms; CAD/CAM systems, computer controlled machines.
Fellow, ASME, 2007

James S. Gibson

Control and identification of dynamical systems. Optimal and adaptive control of distributed systems, including flexible structures and fluid flows. Adaptive filtering, identification, and noise cancellation.

FLUID MECHANICS

Jeff D. Eldredge

Bio-inspired locomotion in fluids; Numerical studies of high-speed flows; Development and application of computational tools for unsteady flow physics and flow-structure interaction; Generation and control and aerodynamic sound; Biomedical flows.

Ann R. Karagozian

Fluid mechanics and combustion, with applications to improved engine efficiency, reduced emissions, alternative fuels, and advanced high speed air breathing and rocket propulsion systems.
Fellow, AIAA, 2004
Fellow, American Physical Society, 2004

H. Pirouz Kavehpour

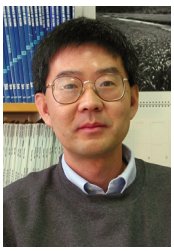
Microfluidics and biofluidics, biofuel cells, cardiovascular flow, complex fluids, interfacial physics, micro-tribology, non-isothermal flows, drug delivery systems, and artificial organs.

John Kim

Numerical simulation of transitional and turbulent flows, turbulence and heat-transfer control, numerical algorithms for computational physics.
Member, National Academy of Engineering, 2009
Fellow, American Physical Society, 1989

Owen I. Smith

Combustion and combustion-generated air pollutants, hydrodynamics and chemical kinetics of combustion systems, semi-conductor chemical vapor deposition.



Xiaolin Zhong

Computational fluid dynamics, hypersonic flow, hypersonic boundary layer stability and transition, numerical simulation of transient hypersonic flow with nonequilibrium real gas effects, numerical simulation of micro two-phase flow, MHD control of hypersonic boundary layers, high-order numerical methods for flow simulation.
Associate Fellow, AIAA, 2004

Richard Wirz

Electric and micro propulsion, low temperature plasma and plasma discharges, spacecraft and space mission design, alternative energy generation and storage.

HEAT AND MASS TRANSFER

Mohamed A. Abdou

Fusion, nuclear, and mechanical engineering design, testing, and system analysis; thermomechanics; thermal hydraulics; neutronics, plasma-material interactions; blankets and high heat flux components; experiments, modeling and analysis.

Fellow, American Nuclear Society, 1990
Associate Fellow, TWAS, 1989

Ivan Catton

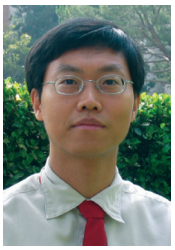
Heat transfer and fluid mechanics, transport phenomena in porous media, nucleonics heat transfer and thermal hydraulics, natural and forced convection, thermal/hydrodynamic stability, turbulence.

Fellow, ASME, 1989
Fellow, American Nuclear Society, 1999

Vijay K Dhir

Two-phase heat transfer, boiling and condensation, thermal and hydrodynamic stability, thermal hydraulics of nuclear reactors, microgravity heat transfer, soil remediation.

Member, National Academy of Engineering, 2006
Fellow, ASME, 1989
Fellow, American Nuclear Society, 1997



Y. Sungtaek Ju

Micro- and nanoscale thermosciences, energy, bioMEMS/NEMS, nanofabrication.

H. Pirouz Kavehpour

Microfluidics and biofluidics, biofuel cells, cardiovascular flow, complex fluids, interfacial physics, micro-tribology, non-isothermal flows, drug delivery systems, and artificial organs.

Adrienne Lavine

Thermal energy harvesting, thermal control of nanoscale manufacturing, thermomechanical behavior of shape memory alloys, thermal aspects of manufacturing processes including machining and plasma thermal spray.

Fellow, ASME, 1999

Anthony F. Mills

Convective heat and mass transfer, condensation heat transfer, turbulent flows, ablation and transpiration cooling, perforated plate heat exchangers.

Laurent G. Pilon

Radiation transfer, biomedical optics, photobiological hydrogen production, sustainable energy, nanoscale thermoscience, foams.

MANUFACTURING AND DESIGN

Mohamed A. Abdou

Fusion, nuclear, and mechanical engineering design, testing, and system analysis; thermomechanics; thermal hydraulics; neutronics, plasma-material interactions; blankets and high heat flux components; experiments, modeling and analysis.

Fellow, American Nuclear Society, 1990
Associate Fellow, TWAS, 1989

Gregory P. Carman

Electromagnetoelasticity models, piezoelectric ceramics, magnetostrictive composites, characterizing thin film shape memory alloys, fiber optic sensors, design of damage detection systems for structures.

Fellow, ASME, 2003

Rajit Gadh

Radio frequency identification (RFID), middleware for RFID networks, wireless internet of artifacts, RFID in supply chain/logistics/manufacturing, reconfigurable wireless network sensors, wireless internet architectures for enterprise, wireless multimedia - video/imaging/graphics, digital rights management for multimedia content, CAD/visualization.

Nasr M. Ghoniem

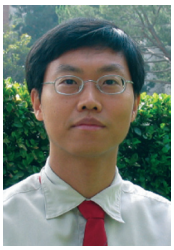
Damage and failure of materials in mechanical design; mechanics and physics of material defects (point defects, dislocations, voids and cracks); material degradation in severe environments (e.g. nuclear, fusion, rocket engines, etc.); plasma and laser processing; materials non-equilibrium, pattern formation and instability phenomena; radiation interaction with materials (neutrons, electrons, particles, laser & photons).

Fellow, American Nuclear Society, 1994
Fellow, ASME, 2006

H. Thomas Hahn

Multifunctional composites, nanocomposites, nanomanufacturing, energy harvest/storage systems, autonomic composites for self healing and thermal management.

Fellow, ASME, 1993
Fellow, American Society for Composites 1996



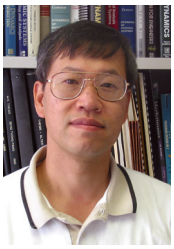
Y. Sungtaek Ju

Micro- and nanoscale thermosciences, energy, bioMEMS/NEMS, nanofabrication.

Daniel C. H. Yang

Robotics and mechanisms; CAD/CAM systems, computer controlled machines.

Fellow, ASME, 2007



Tsu-Chin Tsao

Modeling and control of dynamic systems with applications in mechanical systems, manufacturing processes, automotive systems, and energy systems, digital control; repetitive and learning control, adaptive and optimal control, mechatronics.

MEMS AND NANOTECHNOLOGY

Gregory P. Carman

Electromagnetoelasticity models, piezoelectric ceramics, magnetostrictive composites, characterizing thin film shape memory alloys, fiber optic sensors, design of damage detection systems for structures.

Fellow, ASME, 2003

Yong Chen

Nanofabrication, nanoscale electronic materials and devices, micro-nano electronic/optical/bio/mechanical systems, ultra-scale spatial and temporal characterization.

Pei-Yu Chiou

Biophotonics, nanophotonics, BioMEMS/NEMS, electrokinetics, microfluidics and biofluidics, guided self-assembly, high throughput single cell analysis.

Vijay Gupta

Experimental mechanics, fracture of engineering solids, mechanics of thin films and interfaces, failure mechanisms and characterization of composite materials, ice mechanics.

Fellow, ASME, 2005

Chih-Ming Ho

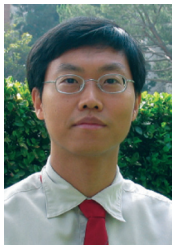
Molecular fluidic phenomena, nano/micro-elector-mechanical-systems, bio-molecular sensors, control of complex systems.

Member, US National Academy of Engineering 1997

Academician, Academia Sinica, 1998

Fellow, American Physical Society, 1989

Fellow AIAA, 1994



Y. Sungtaek Ju

Micro- and nanoscale thermosciences, energy, bioMEMS/NEMS, nanofabrication.

H. Pirouz Kavehpour

Microfluidics and biofluidics, biofuel cells, cardiovascular flow, complex fluids, interfacial physics, micro-tribology, non-isothermal flows, drug delivery systems, and artificial organs.

Chang-Jin Kim

Microelectromechanical systems (MEMS), surface-tension-based microactuation, nanotechnology for surface control, microdevices including microfluidic applications, full spectrum of micromachining technologies.

Laurent G. Pilon

Radiation transfer, biomedical optics, photobiological hydrogen production, sustainable energy, nanoscale thermoscience, foams.

STRUCTURAL AND SOLID MECHANICS

Oddvar O. Bendiksen

Classical and computational aeroelasticity, structural dynamics and unsteady aerodynamics.
Associate Fellow, AIAA, 1995

Gregory P. Carman

Electromagnetoelasticity models, piezoelectric ceramics, magnetostrictive composites, characterizing thin film shape memory alloys, fiber optic sensors, design of damage detection systems for structures.
Fellow, ASME, 2003

Nasr M. Ghoniem

Damage and failure of naterials in mechanical design; mechanics and physics of material defects (point defects, dislocations, voids and cracks); material degradation in severe environments (e.g. nuclear, fusion, rocket engines, etc.); plasma and laser processing; materials non-equilibrium, pattern formation and instability phenomena; radiation interaction with materials (neutrons, electrons, particles, laser & photons).
Fellow, American Nuclear Society, 1994
Fellow, ASME, 2006

Vijay Gupta

Experimental mechanics, fracture of engineering solids, mechanics of thin films and interfaces, failure mechanisms and characterization of composite materials, ice mechanics.
Fellow, ASME, 2005

H. Thomas Hahn

Multifunctional composites, nanocomposites, nanomanufacturing, energy harvest/storage systems, autonomic composites for self healing and thermal management.
Fellow, ASME, 1993
Fellow, American Society for Composites 1996

William Klug

Computational structural and solid mechanics, computational biomechanics, and micro/nanomechanics of biological systems.

Christopher Lynch

Ferroelectric materials including experimental characterization of constitutive behavior under multiaxial loading.

Ajit K. Mal

Mechanics of solids, fractures and failure, wave propagation, nondestructive evaluation, composite materials, structural health monitoring, biomechanics.
Fellow, ASME, 1994
Fellow, American Academy of Mechanics, 1994
Fellow, International Society for Optical Engineering, 2005

SYSTEMS AND CONTROL

James S. Gibson

Control and identification of dynamical systems. Optimal and adaptive control of distributed systems, including flexible structures and fluid flows. Adaptive filtering, identification, and noise cancellation.

Tetsuya Iwasaki

Neuronal control mechanism of animal locomotion, nonlinear oscillators, and robust/nonlinear control theory and its applications to mechanical, aerospace, and electrical systems.

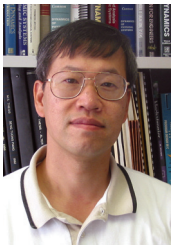
Robert T. M'Closkey

Nonlinear control theory and design with application to mechanical and aerospace systems, real-time implementation.

Jason Speyer

Stochastic and deterministic optimal control and estimation with application to aerospace systems; guidance, flight control, and flight mechanics.

Member, National Academy of Engineering, 2005
Life Fellow, IEEE, 2004
Fellow, AIAA, 1985



Tsu-Chin Tsao

Modeling and control of dynamic systems with applications in mechanical systems, manufacturing processes, automotive systems, and energy systems, digital control; repetitive and learning control, adaptive and optimal control, mechatronics.

PROFESSORS EMERITI

Andrew F. Charwat
Peretz P. Friedmann
Robert E. Kelly
Michel A. Melkanoff
D. Lewis Mingori
Peter A. Monkewitz
Philip F. O'Brien
David Okrent
Alex Samson
Lucien A. Schmit, Jr.
Richard Stern
Russell A. Westmann

STAFF

Janice Bedig	Management Services Officer
Lili Bulhoes	Staff Personnel/Payroll
Angie Castillo	Student Affairs Officer
Coral Castro	Purchasing
Cynthia Rueda	Administrative Assistant
Duy Dang	Business Office Manager
Alexander Duffy	Web and Publications Manager
Lance Kono	Facilities Manager
Abel Lebon	Student Affairs Officer
Miguel Lozano	Senior Laboratory Mechanician
Mary Ann Macaso	Fund Manager
Martin Olekszyk	Fund Manager
David Shatto	Administrative Assistant
Benjamin Tan	Senior Development Engineer
Marcia Terranova	Academic Personnel/Payroll

The MAE Department thanks its Industrial Partners:

CURRENT PARTNERSHIPS

- Aerospace Corporation
- BEI Technologies
- Boeing
- Conoco Philips
- Honeywell Engines
- Intel
- Lockheed Martin
- NASA/Dryden
- NASA/JPL
- Northrop-Grumman
- Pratt & Whitney
- RAND Corporation
- Raytheon
- USAF

JOINT APPOINTMENTS

Albert Carnesale
J.S. Chen
Kuo-Nan Liou

ADJUNCT PROFESSORS

Leslie Lackman
Webb Marner
Neil Morley
Robert S. Shaefer
Xiang Zhang

Graduates 2008-2009 DOCTOR OF PHILOSOPHY

Commencement, June 2009.

Anderson, Michael Louis: Roughening of Surfaces under Intense and Rapid Heating (Prof. N. Ghoniem)

Berberoglu, Halil: Photobiological Hydrogen Production and Carbon Dioxide Sequestration (Prof. L. Pilon)

Bhatia, Amit: Sampling-Based Algorithms for Analysis and Design of Hybrid and Embedded Systems (Prof. E. Frazzoli)

Chen, Xu: Probing the Effects of Nanoscale Architecture on the Mechanical Properties of Periodic Surfactant-Templated Silica Polymer Composite Thin Film (Prof. V. Gupta)

Chun, Young Jae: Thin Film NiTi Endovascular Stent Grafts for Cerebral and Aortic Aneurysms (Prof. G. Carman)

Chung, Tien-Kan: Magnetoelectric Coupling in Layered Thin Film and Nanostructure (Prof. G. Carman)

Davitian, Juliett: Exploration and Controlled Excitation of Transverse Jet Shear Layer Instabilities (Prof. A. Karagozian)

El-Awady, Jaafar Abbas: Size Effects on Plasticity and Fatigue Microstructure Evolution in FCC Single Crystals (Prof. N. Ghoniem)

Gibbons, Melissa Marie: Computational Mechanics of Nanoindentation of Viral Capsids (Prof. W. Klug)

Huang, Suxian: Biomolecular Nanopatterning and Single Molecule Detection (Prof. Y. Chen)

Johnson, William Leigh: A Musculoskeletal Model of the Rat Hindlimb: Application to Neuroprosthesis Development and Quantitative Gait Evaluation (Prof. T. Tsao)

Kim, Hyoung Il: In-Situ Measurement of Intrinsic Interface Strength and Moisture-Effected Interfacial Fracture Energy (Prof. V. Gupta)

Kwong, Charlotte Ching-Han: A Micro-Deionizer for Dielectrophoretic Manipulation of Cells (Prof. C. Ho)

Lai, Qianxi: Electrically Configurable Materials and Devices for Intelligent Neuromorphic Applications (Prof. Y. Chen)

Li, Na: A Therapeutic Nano Device Based on Molecular Recognition-Triggered Conformational Change (Prof. C. Ho)

Li, Nan: Lab-On-A-Chip Systems for Blood Cell Separation, Counting, and Characterization (Prof. C. Ho)

Lu, Paul Chihpeng: Passive Cancellation of Low Frequency Sound Waves Using Optimized Embedded Mechanisms (Prof. O. Bendiksen)

Lu, Shih Yu: The Thermodynamics of Dense Granular Flow and Jamming (Prof. H.P. Kavehpour)

Ma, Lin: Finite Element Modeling of Shell Structures in Cell Biology Applications for Cell Membranes and Viral Capsids (Prof. W. Klug)

Manickam, Sathish Kumar: Holographic Interferometric Study of Heat Transfer to a Vapor Bubble Sliding Along a Downward Facing Heater Surface (Prof. V. Dhir)

Narula, Manmeet Singh: Experiments and Numerical Modeling of Fast Flowing Liquid Metal Thin Films under Spatially Varying Magnetic Field Conditions (Prof. M. Abdou)

Rajamani, Bharanidharan: Hybrid RANS-LES Modeling of High-Re Turbulent Flows (Prof. J. Kim)

Rodriguez, Juan Ignacio: Acoustic Excitation of Liquid Fuel Droplets and Coaxial Jets (Profs. A. Karagozian and O. Smith)

Seo, Hyoungseock: Damage Tolerance and Durability of Glare Laminates (Prof. H.T. Hahn)

Shah, Gaurav Jitendra: Electrowetting-On-Dielectric (EWOD) for Biochemical Applications: Particle Manipulation for Separation in Droplet Microfluidics (Prof. C.J. Kim)

Shedd, Brian Ethan: Multifunctional Composites for Data Storage, Artificial Muscles, and Microstructures (Prof. H.T. Hahn)

Takeuchi, Junichi: Experimental Investigation of Magnetohydrodynamic Turbulent Pipe Flow of Aqueous Electrolyte Solution (Prof. M. Abdou)

Toomey, Jonathan Edward: Numerical and Experimental Studies of Flexibility in Flapping Wing Aerodynamics (Prof. J. Eldredge)

Wong, Tak Sing: Nanoscale Wetting and Its Implications to Macroscopic Surface Phenomena (Prof. C. Ho)

Yoo, Jang Lawrence Hyun: Passive Biomechanical Characterization and Modeling of Bovine Extraocular Tissues (Prof. V. Gupta)

Zhang, Li: Numerical Studies of Hydrodynamics of Fish Locomotion and Schooling by a Vortex Particle Method (Prof. J. Eldredge)

Commencement, June 2009. All commencement photos by Angie Castillo.

Commencement, June 2009.

M.S. Thesis Plan

Chen, Zhiyu: Dynamic Contact Line Motion on Micro-Structured Surfaces (Prof. C.J. Kim)

Huang, Christopher Lawrence: RFID Based Automated Entry System (Prof. R. Gadh)

Hunt, Ryan Matthew: An Assessment of the Qualification Test of the First Wall Qualification Mockup (Prof. M. Abdou)

Lukyanets, Aleksandra Sasha: A Parametric Study of Fluid Drop Coalescence at Planar Fluid Interfaces (Prof. H.P. Kavehpour)

Norton, Dwight Daniel: Automated Alignment in Two-Dimensions Using Moiré Fringe Techniques (Prof. T. Tsao)

Ou Yang, Chih-Cheng: Read/Write Performance for Low Memory Passive Hf RFID Tag-Reader System (Prof. R. Gadh)

Wu, Tao: Characterization of Dielectric Charging and Reliability of Liquid-Metal Switches Using EWOD Actuation (Prof. G. Carman)

M.S. Comprehensive Exam Plan

Attiyeh, Brian Jeffrey (Prof. C. Ho)

Baloian, Lewis Christopher (Prof. L. Pilon)

Beaman, David Larson, Jr. (Prof. J. Eldredge)

Bray, Jonathan David (Prof. C. Kim)

Bulgrin, Katherine Elizabeth (Prof. A. Lavine)

Burstein, Eileen Patricia Reed (Prof. D. Yang)

Chang, Herrick Lin (Prof. T. Tsao)

Chatterjee, Ovinandan (Prof. V. Dhir)

Chauhan, Savith Reeta (Prof. J.S. Gibson)

Chen, Song (Prof. Y. Chen)

Chu, Kevin Christopher (Prof. T. Tsao)

Citron, Jason Keith (Prof. V. Gupta)

Cole, Lord Kahil (Prof. A. Karagozian)

Dakessian, Nora (Prof. H.P. Kavehpour)

Davis, Scott Benjamin (Prof. H.P. Kavehpour)

Decker, Dakota Blue (Prof. D. Yang)

Douglass, John Sebastiano (Prof. H.P. Kavehpour)

Duong, Nhattrieu Chan (Prof. J. Speyer)

Faghihi, Azin (Prof. J.S. Gibson)

Gariffo, James Michael (Prof. O. Bendiksen)

Getsinger, Daniel Robinson (Prof. A. Karagozian)

Ghanim, Samir (Prof. O. Smith)

Glidden, Robert Mason, Iv (Prof. Y.S. Ju)

Gu, Zhen (Prof. Y. Chen)

Gutierrez, Adrian Alejandro (Prof. P. Chiou)

Hemati, Maziar Sam (Prof. H.P. Kavehpour)

Hendrickson, Cory Scott (Prof. R. M'Closkey)

Hwang, Michael (Prof. D. Yang)

Kroll, Alex (Prof. J. Eldredge)

Lee, Tim David (Prof. R. Gadh)

Lei, Jia (Prof. X. Zhong)

Long, Alexander Sanjay (Prof. W. Klug)

Lu, Chia-Hsien Andy (Prof. V. Gupta)

Luong, David (Prof. J.S. Gibson)

Mao, Hann-Shin (Prof. R. Wirz)

Medina, Albert (Prof. J. Eldredge)

Metchik, Asher Loren (Prof. N. Ghoniem)

Miller, David Harold (Prof. T. Tsao)

Mochizuki, Kotoji (Prof. J. Eldredge)

Muhleman, Jacob Matthew (Prof. D. Yang)

Polidan, Joe T (Prof. A. Karagozian)

Prakash, Akshay (Prof. X. Zhong)

Sharratt, Stephen Andrew (Prof. A. Mills)

Sovero, Sebastian Emilio (Prof. J.S. Gibson)

Sun, Allen Shih-Yuan (Prof. J. Eldredge)

Superfin, Emil (Prof. J.S. Gibson)

Teshome, Sophonias (Prof. A. Karagozian)

Tong, Davy (Prof. Y. Chen)

Truong, Minh (Prof. W. Klug)

Vang, Yeeleng Scott (Prof. J.S. Gibson)

Wang, Yigang (Prof. T. Tsao)

Witham, Cassie Teresa (Prof. A. Mal)

Yang, Seung Ji (Prof. X. Zhong)

Yerkes, Nicholas Todd (Prof. J. Speyer)

Yick, Lee Chun (Prof. N. Ghoniem)

Youssef, George H (Prof. V. Gupta)

Zhang, Wei (Prof. M. Abdou)

Commencement, June 2009.

Publications: Academic Year 2008-2009

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Patents

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Overview

Faculty and Staff

Ladder Faculty:	32
Joint Faculty:	3
Emeritus Faculty:	14
Adjunct Faculty:	6
Lecturers:	40
Administrative Staff:	22
Staff Researchers:	8
Development Engineers:	5
Postdoctoral Scholars:	23
Visiting Ph. D. Scholars:	7
Visiting Intl. Students:	15

Recognitions

Society Fellows:	23
CAREER or Young Investigator Awards:	11
NAE members:	8
Regular Faculty:	4
Affiliated Faculty:	1
Emeriti:	3

Publications

Journal Articles:	102
Conference Papers:	57
Books & Book Chapters:	4
Patents:	13

Research Facilities

The department contributes to three Research Centers:

Center for Cell Control (CCC)
California NanoSystems Institute (CNSI)
Center for Scalable and Integrated NanoManufacturing (SINAM)

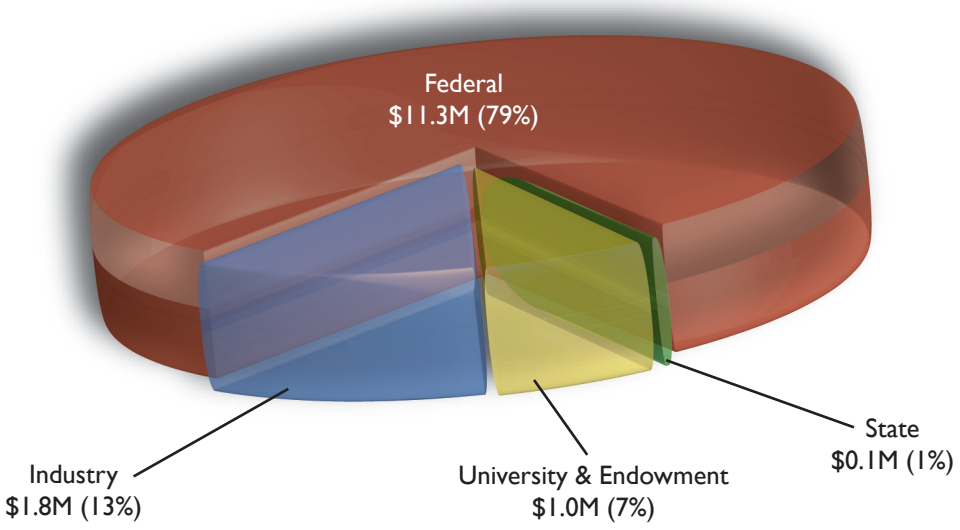
Laboratories and Research Groups: 32

Facilities square footage: 32,743 sq. ft.

Department square footage: 76,918 sq. ft.

Fiscal Year 2008-2009 Sponsored Research Expenditures - Total $14.2M

(Fiscal Year 2008-2009 Sponsored Research Budget - Total $26.2M)



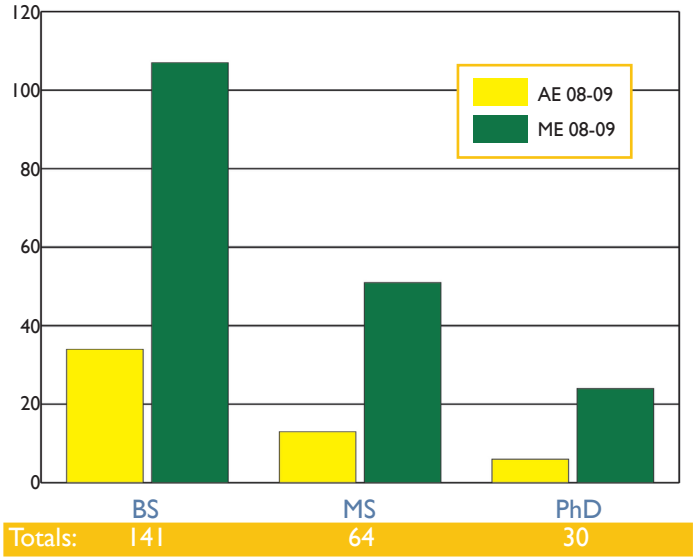
Undergraduate Students

Students Enrolled:	734
Applicants (Freshmen and Transfers):	2451
Admitted:	566 (23%)
New Students Enrolled:	189 (33%)
Average Unweighted High School GPA:	3.90/4.0

Graduate Students

Students Enrolled:	255
Applicants (MS and PhD):	401
Admitted:	196 (49%)
New Students Enrolled:	91 (46%)
Average Undergraduate GPA:	3.66/4.0

AE & ME Degrees Conferred 2008-2009



Department Fellowships and Teaching Assistantships

TA Funding	$ 614,120.50
Graduate Division	$ 590,755.00
HSSEAS Graduate Fellowships	$ 175,000.00
HSSEAS Non-Resident Tuition	$ 117,552.00
Research Mentorship Program	$ 27,670.50
GOFP Fellowship	$ 22,169.50
Chancellor's Prize Fellowship	$ 5,000.00
Total	**$1,552,267.50**

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UCLA Engineering

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