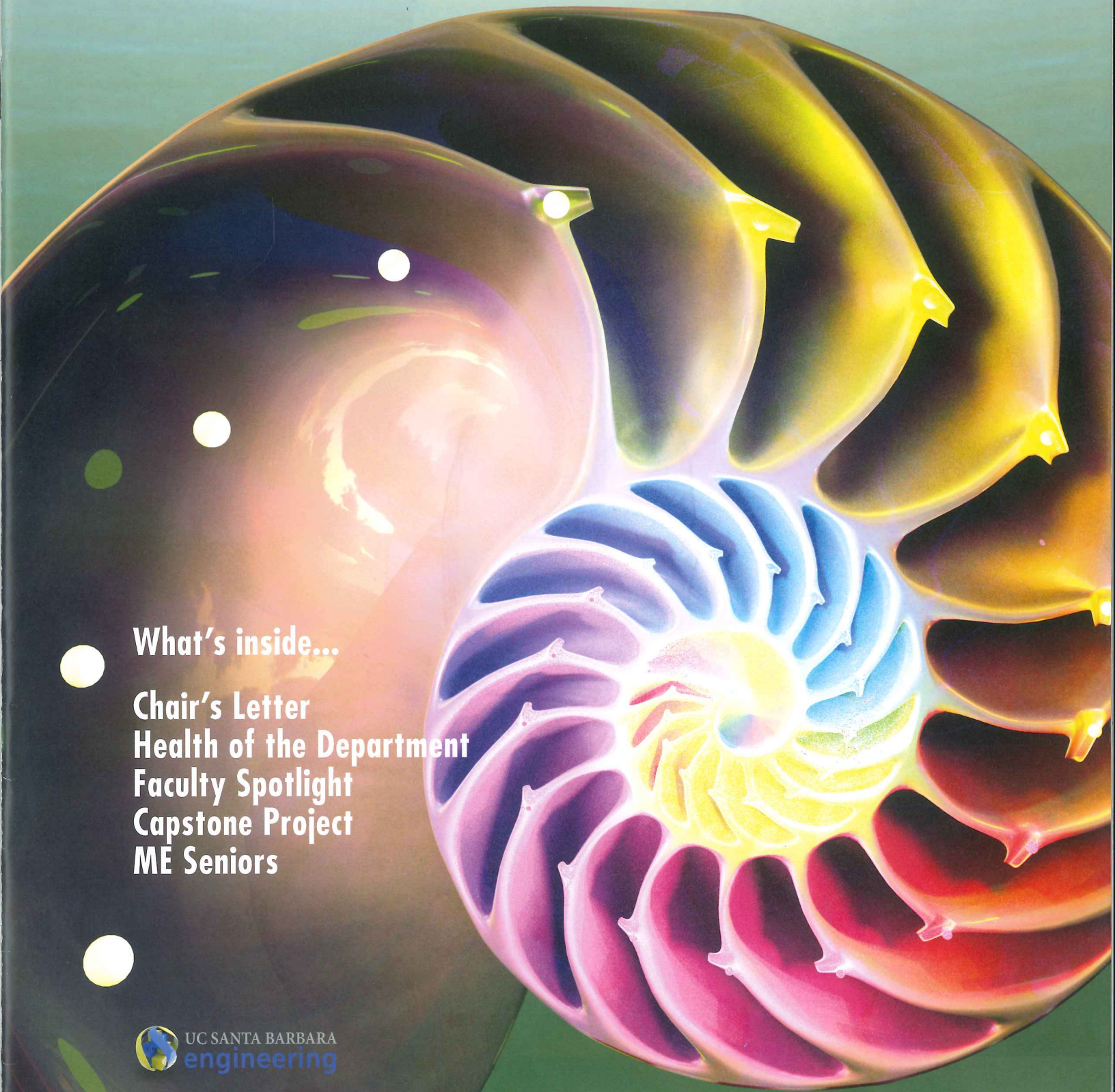
UC Santa Barbara Mechanical Engineering

KINETIC



What's inside...

UC SANTA BARBARA engineering

Chair's message

Salutations! It is my great pleasure to present this snapshot of the Mechanical Engineering Department here at UC Santa Barbara. Since our last newsletter, many wonderful things have happened. First and foremost is our Departmental Ranking. In 2010, the National Research Council ranked us as a top 10 department. Every Engineering department in the College is now ranked in the top 10, a very notable achievement by UCSB. The main reason for this is our excellent faculty. Robert McMeeking (former Chair) was recently elected to the Royal Society, Linda Petzold was named the Faculty Research Lecturer (highest UCSB honor bestowed upon its faculty), and Sumita Pennathur was awarded the Presidential Early Career Award by President Obama. These are just a few of the notable achievements by our faculty. As many of you know, the success of a faculty is related to the success of its graduate program, and ours continues to be strong and vibrant. Our Ph.D. graduates are going on to successful and decorated careers in academia as well as in industry, and are representing UCSB with aplomb.

Our undergraduate program is also notable. Mechanical Engineering is one of the most selective majors at UCSB, and the most selective in the College of Engineering. Our incoming GPA is over 4.0, and our transfer GPA is ~3.8. Our students go on to top graduate programs, as well as careers in industry. In this newsletter you will not only see highlights of our capstone design program, but also a highlight on three of our former students who are now working for a local biomedical startup company. The strong education that our students get, a mixture of theory and application, continues to create competent, creative engineers.

I hope you enjoy this snapshot of our Department. Additionally, I would love to hear from our friends and alumni. Please email me at: turner@engineering.ucsb.edu with updates and information! If you're ever in town, and would like a tour of the department, do let me know. Have a wonderful 2013!

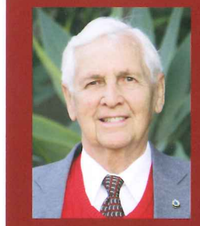
Mechanical Engineering news flash

NSF CAREER Award Honors UCSB's Promising Academic Leaders

Professors Megan Valentine has been honored with the National Science Foundation CAREER Award, given to promising faculty who are most likely to become the academic leaders of the 21st century. The program grants at least $400,000 over a five year period for winning proposals that integrate research and education.

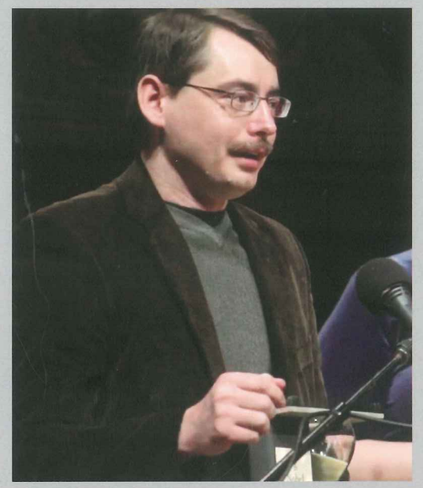
Valentine's proposal explores the mechanical interactions between neural cell microtubules and actin.

Professor Honored with Starnes Award for Contributions to Structural Mechanics



Mechanical engineering professor Keith Kedward has been honored with the 2013 James H. Starnes, Jr. Award, presented by the American Institute of Aeronautics and Astronautics (AIAA) and the American Society for Composites (ASC). The award recognizes Kedward's significant lifelong contributions in the field of composite structural mechanics, and his devotion to the mentoring of students and colleagues.

Science Behind the Coffee Spill



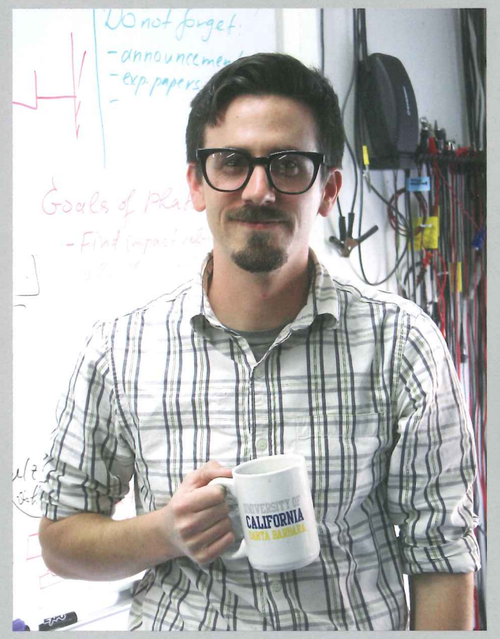
At an annual ceremony held at Harvard University, publishers of the Annals of Improbable Research hand out Ig Nobel Prizes for research that "makes people laugh and then think." Mechanical engineering professor Rouslan Krechetnikov and graduate student Hans Mayer received a 2012 Ig Nobel Prize in Fluid Dynamics "for studying the dynamics of liquid-sloshing to learn what happens when a person walks while carrying a cup of coffee."

"I am quite proud of the prize," commented Krechetnikov about being among the 2012 Ig Nobel winners. "The Igs"—awards that are highly coveted and hilariously tongue-in-cheek—are intended to spur public curiosity and interest in science and other fields of endeavor.

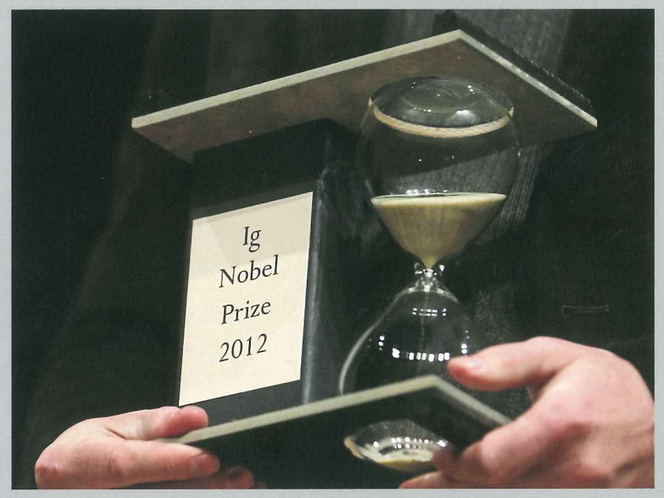
"We just wanted to satisfy our curiosity and, given the results, to share what we learned with the scientific community through peer-reviewed literature," Krechetnikov said. "It is one of those cases where we were interested in explaining the phenomena, but not changing it."

Earlier this year, Krechetnikov and Mayer made major headlines when they published "Walking with coffee: Why does it spill? " in Physical Review E. The Ig Nobel award thrust the UCSB researchers into the international spotlight.

In his acceptance speech at the Ig Nobel Prize award ceremony, Krechetnikov said,"To paraphrase the Nobel Prize laureate in Physics, Pyotr Kapitsa (1978): In the same way that fairy tales help children learn about the world of adults, simple science problems help students and researchers to learn about the physics picture of the universe. Some problems become part of the folklore."



Ph.D. student Hans Mayer, whose work with Professor Rouslan Kretchetnikov was awarded a 2012 Ig Nobel prize.



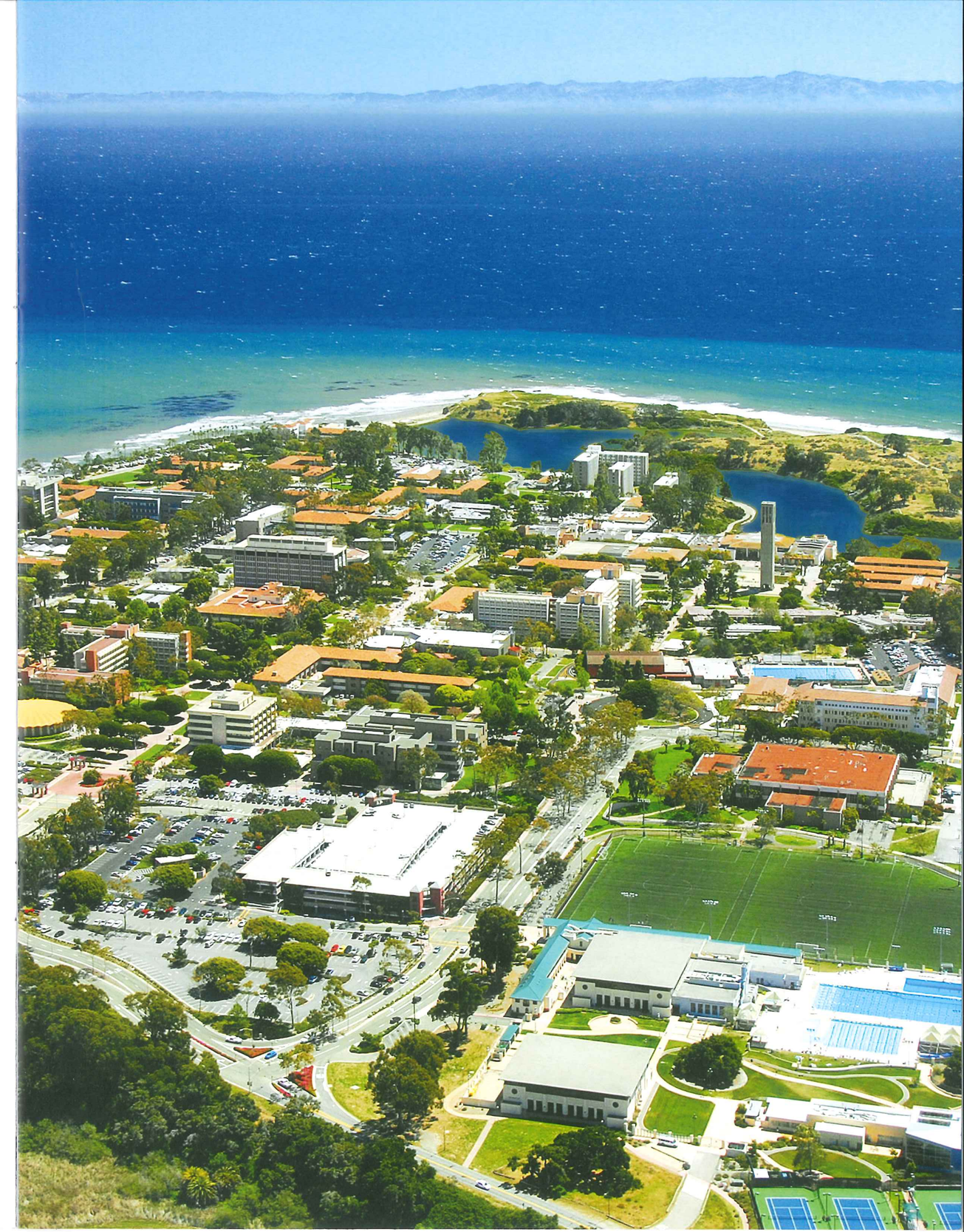
Health of the Department:

Over the last 15 years, the prestige of the Department of Mechanical Engineering at UCSB has skyrocketed. According to the National Research Council, a branch of the National Academy of Engineering that ranks academic institutions, UCSB's mechanical engineering department rose from #41 in 1994 to #7 in 2009, and this upward trend is continuing.

The health of the department is unmistakable during the admission process. Each year, we compete with the best engineering schools- such as MIT and Stanford- for candidates for our PhD program. More and more, we are winning this competition. This past year, more than half of the students we invited for our recruitment day are joining our program.

The number of students winning fellowships is also increasing. Such fellowships are awarded by our campus or by national agencies like the National Science Foundation or the Department of Energy. They recognize both past accomplishments and future potential.

In the Department of Mechanical Engineering, we offer a vibrant research atmosphere where our students learn to become leaders in their fields, and our graduates are sought after by academic institutions, national laboratories, and corporations. We both value and enjoy helping them grow from students to colleagues.



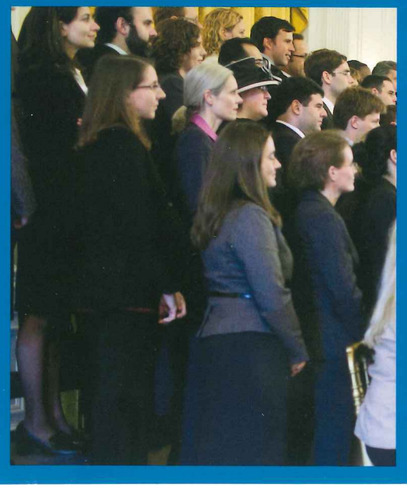
PECASE AWARD- SUMITA PENNATHUR

President Obama named Sumita Pennathur a recipient of the Presidential Early Career Award for Scientists and Engineers (PECASE). The award is the highest honor the nation can bestow on a scientist or engineer at the beginning of his or her career. The award was presented at a ceremony in Washington, D.C. on October 14, 2011. Sumita Pennathur was recognized for outstanding research achievements in the fields of nanotechnology and mechanical engineering. Pennathur's research has provided new insights in the areas of nanofluidics and interfacial science, and have resulted in the development of novel theoretical and experimental platforms that enable breakthrough discoveries relating to protein transport, adsorption, and kinetics.

Professor Pennathur is among 94 individuals across the country to receive the early career awards, which recognize recipients' exceptional potential for leadership at the frontiers of scientific knowledge, and their commitment to community service, as demonstrated through scientific leadership, education, or community outreach.

Pennathur said: "I am honored to be awarded a PECASE to further my research in the development of a nanofluidic tool for protein transport and kinetic measurements. I would like to sincerely thank the combined support of the U.S. Army Research Office, and UCSB's Institute of Collaborative Biotechnologies, Department of Mechanical Engineering, and California NanoSystems Institute to make this dream possible."

Pennathur's research is focused on using fundamental fluidics knowledge at both microscale and nanoscale to create novel devices for practical applications. Major efforts include creating and developing enabling tools to identify and characterize biological substances, improving current bioanalytical devices, and designing entire systems for point-of-care usage. Pennathur received both her B.S. and M.S. in aerospace and aeronautical engineering from M.I.T., where she studied microscale cavitation in microelectromechanical systems. She received her Ph.D. in mechanical engineering at Stanford University in 2006, where she investigated electrokinetic transport of fluids at the nanoscale.



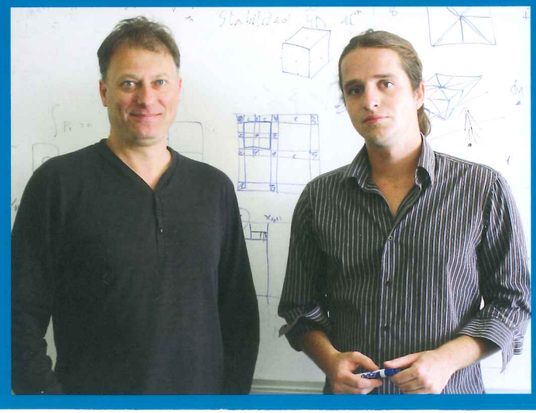
SPOTLIGHT ON GRADUATE STUDENT:

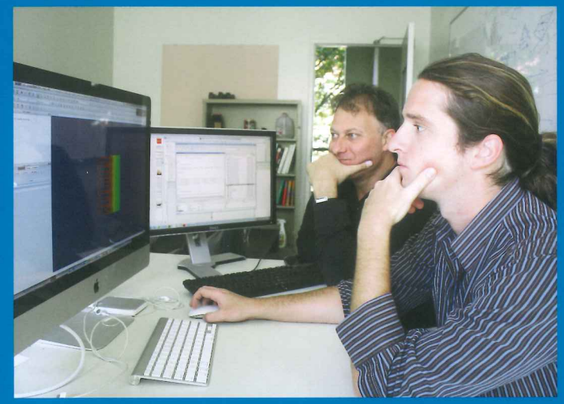
MAXIME THEILLARD

Maxime Theillard, working in Prof. Gibou's research group, is the recipient of the 2012-2013 Dean's fellowship, a prestigious award given to the best graduate students at UCSB. Maxime was also the recipient of the "Premier Grand Prix de Mathematiques Appliquees" at Ecole Polytechnique for the work he did while an intern at UCSB.

"I came to UCSB as part of an internship from my engineering school in France (Ecole Polytechnique) and worked in the Computational Applied Science Laboratory, led by Prof. Gibou. This experience was so engaging that I decided to continue and earn a PhD in Mechanical Engineering, with an emphasis on computational science and engineering. My research is geared towards the design and implementation of novel numerical methods that allow for the simulation of solidification processes.

Directional solidification of a superalloy melt utilizing a temperature cooling profile is the method of choice for growing single crystals, which are vital to the aerospace and energy industries. For example, the critical hot section components of advanced turbine engines such as blades, vanes and disks are composed of nickel-base superalloys. The life and performance of superalloy materials is typically limited by defects, characterized by pores or regions between dendrites. Understanding the formation of these features during solidification is critical to the development of new materials. Accelerating this process could significantly impact US competitiveness and ensure that it remains at the forefront of advanced materials. The need for novel computational methods is illustrated by the White House Initiative on New Integrated Computational Materials Engineering (ICME).





ICME approaches hold great promise for accelerating development and predicting performance, but are challenged when multi-component materials must be analyzed. In particular, despite significant advances in computational science, solute driven convective instabilities during solidification of superalloys are too complex for current numerical approaches, as one must consider a multiscale problem involving heat flow, mass transfer, fluid motion and fluid/solid coupling in complex geometries. We are using a new framework to approximate partial differential equations on octree grids that allows us to resolve the fine dendritic structures and impose the correct physical conditions at the free boundary, the first time this has ever been done for solidification processes of superalloys.

UCSB is a first-rate university with researchers that are leaders in their respective fields of research. What truly sets it apart, however, is the collaborative atmosphere among researchers, which is extremely important to modern science. For example, my work is only possible because of our tight collaboration with Prof. Pollock in the Materials Department, a member of the National Academy of Engineering and a leading experimentalist in the field of superalloy crystal growth.

The Department of Mechanical Engineering at UCSB is a top-ranked department, the students and faculty are friendly and talented, and the collaborative, interdisciplinary environment fosters innovation. Being located a few yards from the beach is not bad either."

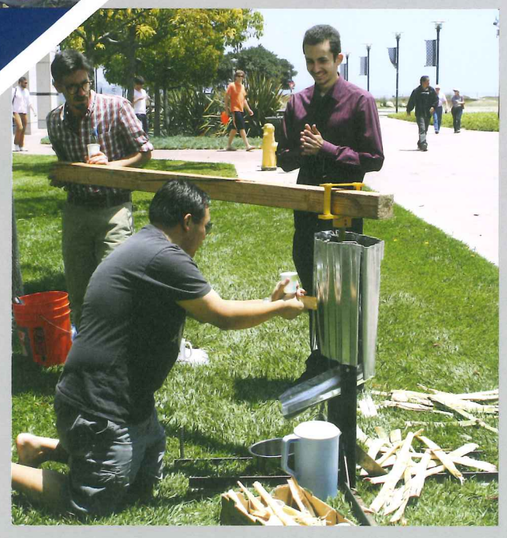
Frederic Gibou (left) and Maxime Theillard (right)

UCSB ME Design - A Snapshot

Engineers Without Borders

Mechanical Engineering 189

Team members from left to right:
Kelly Lin
David Cordeiro-Buell
Adam Scott
Marcela Areyano
Erika Eskenazi



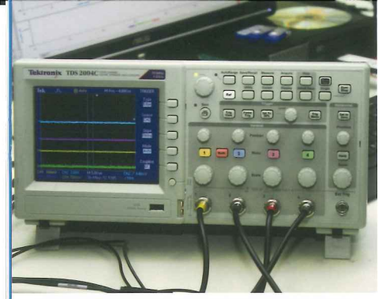
Capstone 2012

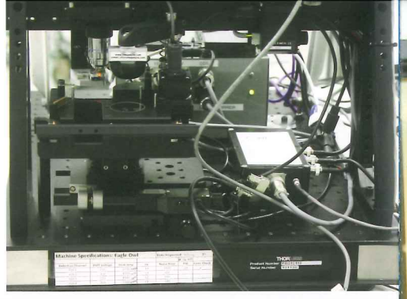
The EWB ME189 project this year is a continuation of a previous project from 2008 in conjunction with African Sky. Together we are exploring the potential to increase the economic and agricultural viability of the sweet sorghum crop in Mali, Africa. The ME189 team in 2008 produced a small, hand-powered sorghum press that was eventually sent to Mali and used in a sorghum harvest. The feedback from the villagers was that the sorghum farming project was exciting, however a more capable press was needed in order to reduce the labor burden of a large sorghum harvest. This year's ME189 team set out to create a human-powered sorghum press that was capable of increased throughput compared with the 2008 version, while keeping in mind the economic and manufacturing restrictions of producing a robust, efficient, and cost-effective machine in a rural, third-world setting.

I chose this project because not only did it have the potential to have a direct impact on people's well-being; but also I immediately recognized that this was a purely mechanical problem that would require many hours spent in the machine shop building, testing, and refining our machine design. Because this is not an industry-sponsored project that will be reviewed and approved by a technical audience, it was very important for us to prototype our design and put it through rigorous testing and refining to ensure that our final deliverable was user-friendly, robust, and safe. Because of the importance of prototyping, our team got to work in the machine shop early winter quarter. Our first prototype sorghum press was completed by early March. As a team we gained invaluable experience in machining, welding, and mechanical design for manufacturing. The insight we gained over winter quarter inspired us to create an improved design for spring quarter that was simpler to make, easier to use, cheaper, and it is capable of efficiently processing sorghum at about 5X the rate of the 2008 design .

At the end of spring quarter we were given the opportunity to show off our current design to Scott Lacy, the founder of African Sky and the mind behind the creation of this project. He was so excited about what we had accomplished that he literally jumped for joy. I can't wait to hear how the press performs during next year's sorghum harvest in Mali. Our achievements would not have been possible without the opportunity that the school provides for us to work independently in a fully equipped and very capable machine shop. I would also like to thank the machine shop supervisors, Andy Weinberg and Nicole Holstrom for providing both machine shop instruction as well as valuable design input. Overall I think that this project was a huge success not only for EWB and African Sky, but for myself and my teammates, Kelly Lin, Erica Eskenazi, Adam Scott, and Marcela Areyano. Together we learned so much about group dynamics, teamwork, and practical hands-on engineering skills. As a group we achieved far more than we proposed or imagined at the beginning of the year.

- David Hunter Cordeiro-Buell



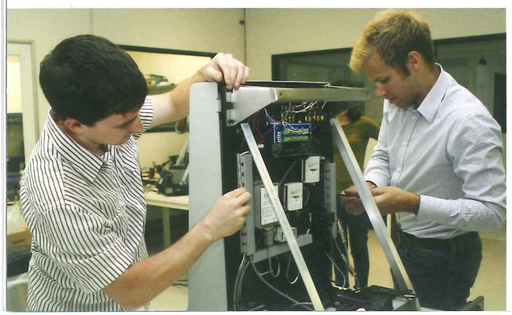


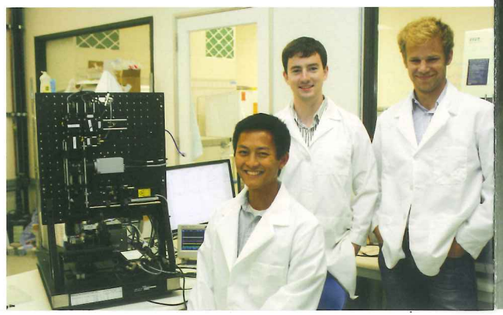
Mechnical Engineering Graduates Working Locally at Owl Biomedical

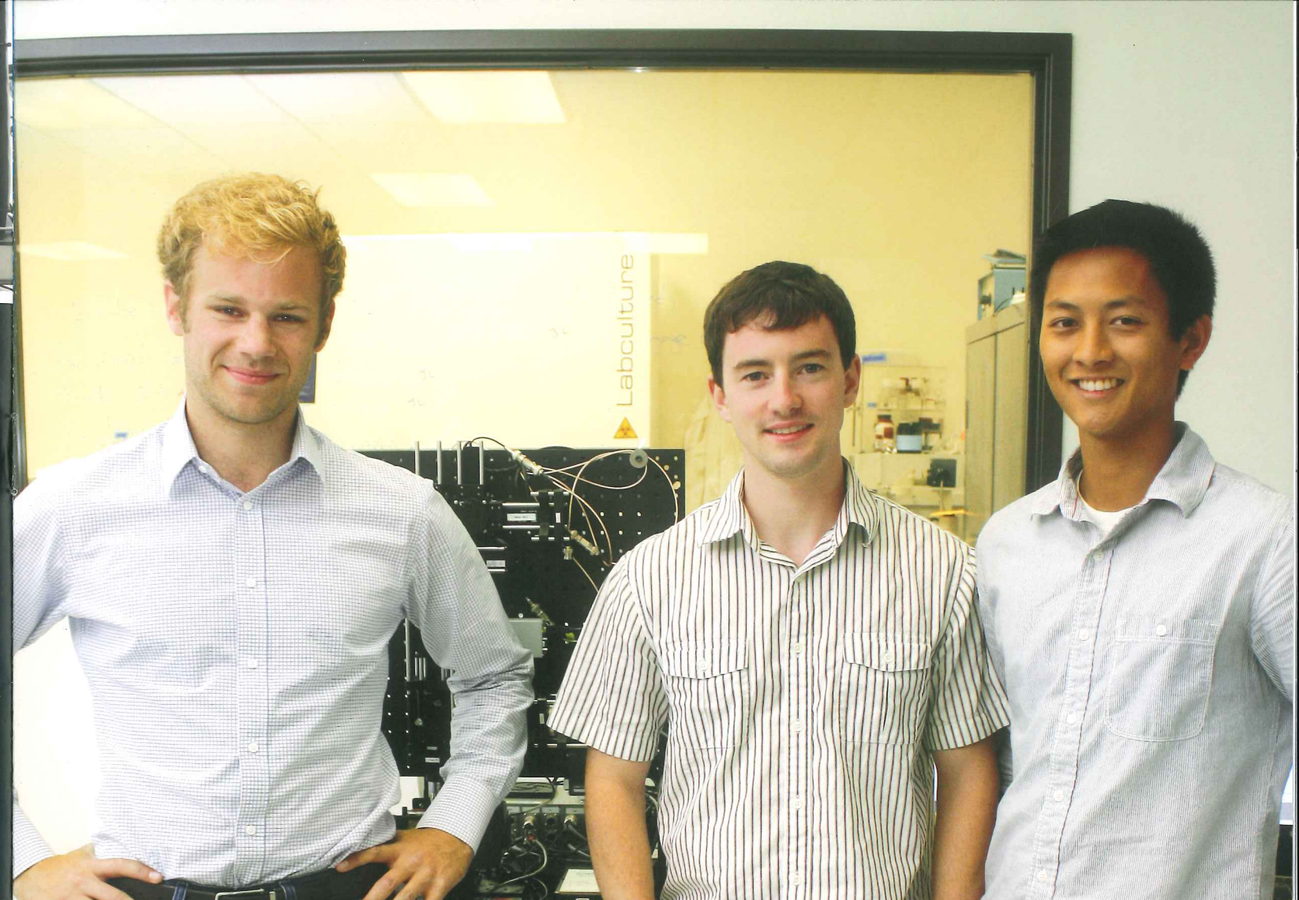
Owl biomedical is a new and emerging company based in Santa Barbara, CA developing the Nanosorter, a MEMS based cell sorting platform. Applications for cell sorting include adoptive immunotherapy for treatment of cancer, stem cell therapies for regenerative medicine, and cell-based cancer diagnostics. Three of the current employees at Owl are UCSB mechanical engineering alumni, Josh Lee and Kevin Shields (class '11), and Nick Martinez class ('09). Their day to day tasks span everything from designing and building mechanical assemblies to programming the system interface and even running biological experiments on the Nanosorter.

"Working at Owl has given us the opportunity to explore the many facets of mechanical engineering. Due to the small engineering team of a start-up, we've become versatile in our skill sets, allowing us to work on all aspects of the Nanosorter. We're assigned projects that require a comprehensive understanding of mechanical design, testing, and analysis. We feel a large part of our success in industry comes from the courses and projects we took on at UCSB. We gained a thorough understanding of mechanical engineering fundamentals and were given a chance to apply those skills in our junior and senior CAPSTONE projects. The faculty and staff do an excellent job at exposing students to cutting edge technology by bringing topics from their own research and industry experience into the classroom. We want to thank UCSB and the Department of Mechanical Engineering for an undergraduate experience filled with memories of the CAD lab, countless office hours, and of course tortillas."

Josh, Kevin, Nick







Best TA:

2010-11: Chris Burgner

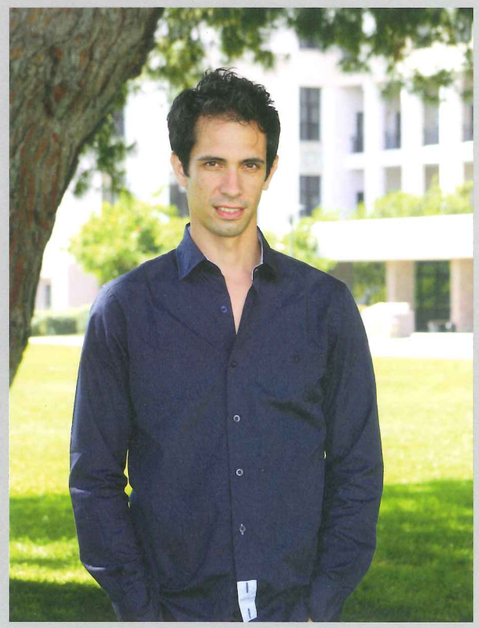
2009-10: Hans Mayer and Joseph Durham
2008-09: Trevor Marks

Best PhD Thesis:

2010-11: Brian Scott Ferguson (Soh)

2009-10: Per Danzl (Moehlis)
2008-09: Brian Piorek (Meinhart)

New Faculty: Otger Campas

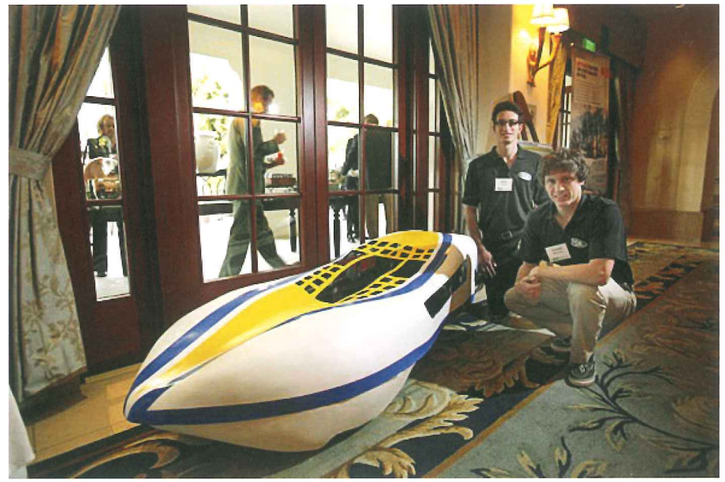


Our newest faculty member, Otger Campas, was originally trained as a theoretical physicist, but his interests in complex systems soon brought him closer to biological systems. After working on several aspects of cellular biophysics during a Ph.D. at the Curie Institute (Paris), he moved to Harvard to study the physical and genetic processes that shape living organisms into the remarkable morphologies observed in the natural world. At UCSB, Prof. Campas plans to work toward identifying general principles of self-organization in living matter, with the goal of eventually understanding the fundamental differences of self-organization in inert versus living systems. Although the interests of his research group remain broad, they specifically work on morphogenesis in embryonic development, mechanics of tissue growth and cell shape, both theoretically and experimentally. These problems combine aspects of soft-matter physics, non-linear and non-equilibrium physics, materials science, developmental biology, cell biology and genetics, dynamical systems, network theory, multi-agent systems, pattern formation, etc. The highly interdisciplinary approach required to answer many of the questions that Dr. Campas is interested in makes them as challenging as they are exciting.

Design Competitions - SuperMileage 2012

In 1939, researchers at Shell made a bet to see who could design a vehicle with the highest gas mileage. Today, the Shell Eco-marathon is an annual student competition in the U.S., Europe, and Asia. The UCSB Supermileage Team, led by captain Daniel Samarin and fellow Mechanical Engineering students as part of their Senior Capstone Project, represented UCSB Engineering for the fourth year against hundreds of competitors from other top universities and high schools across the nation.

Giving their car "Eleanor" a supercharged overhaul, the UCSB Supermileage Team competed in the Futuristic Prototype category--designing for the most streamlined vehicle possible to reduce drag. They replaced the 500cc, 2-stroke Aprilia scooter motor with a clean, lighter, and more efficient 4-stroke Honda weedwacker engine. They also added a CVT--Continuously Variable Transmission--which enabled the team to get a wide range of gear ratios, and adjusted the drivetrain to fit the new motor accordingly. Eleanor delivered at well over 1,000mpg in the competition.

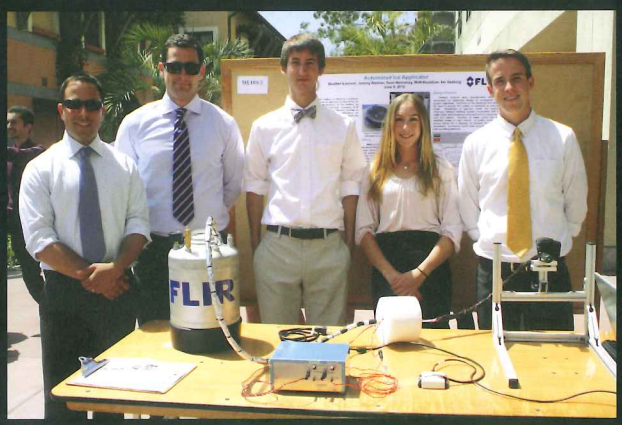


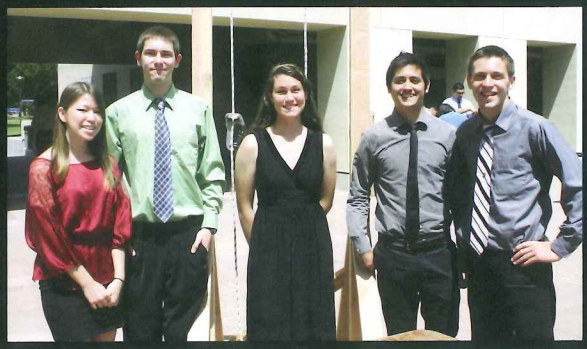
The UCSB Supermileage Team was invited by Shell to present their vehicle at the Wall Street Journal ECO:nomics Conference, held this past March at the nearby Bacara resort in Goleta, California. The team was invited to talk to conference attendees--business and technology leaders the likes of Bill Gates and Elon Musk, CEO of Tesla Motors--about their project. They were also featured as guest contributors for *The Road to Eco-marathon* series on National Geographic's The Great Energy Challenge blog.

Recent Ph.D. graduates

Hall, Brendon	Submarine channel and sediment wave formation by turbidity currents: Navier-Stokes based linear stability analysis	Meiburg	Winter 2009
Gonzalez, Esteban	Gravity Current - Submarine Structure Interaction: Hazard Analysis via High-Resolution Simulations	Meiburg	Winter 2009
Kim, Unyoung	Development of Novel Microfluidic Cell Sorters Using Dielectrophoresis and Magnetophoresis	Soh	Spring 2009
Eisenhower, Bryan	Targeted Escape in Large Oscillator Networks	Mezic	Spring 2009
Smith, Stephen	Task Allocation and Vehicle Routing in Dynamic Environments	Bullo	Summer 2009
Kim, Lina	Characterizing the Edge of Chaos for Shear Flows	Moehlis	Summer 2009
Feldman, Hope	Electrothermal and Buoyancy Driven Microstirring to Enhance Scalar Transport	Meinhart	Summer 2009
Ferri, Enrico	Blast Resistance of Prismatic Sandwich Structures	Evans	Fall 2009
Zielke, Mark	Nanostructured coatings for MEMS chemical senors	Turner	Winter 2010
Bopardikar, S.	Pursuit Strategies for Autonomous Vehicles	Bullo	Winter 2010
Danzl, Per	Dynamical Characterization and Feedback Control of Oscillatory Neural Systems	Moehlis	Spring 2010
Obermeyer, Karl	Visibility Problems for Sensor Networks and Unmanned Air Vehicles	Bullo	Spring 2010
Bozorgi, Payam	Application of Pulsed Laser Welding in MEMS Packaging	MacDonald	Fall 2010
Helgadottir, Asdis	Simulation Tools for Three Dimensional Fluid Flow with Electrostatic Forcing Term on Arbitrary Geometry Using Octree Grids	Gibou	Fall 2010
Kakuda, Tyler	Phase of Photothermal Emission Analysis as a Diagnostic Tool for Serviceable Engine Components Applied with Thermal Barrier Coatings	Bennett	Fall 2010
Papac, Joe	A Level Set Approach for Epitaxial Growth of Quantum Dots with a Step Edge Barrier	Gibou	Fall 2010
Ferguson, Scott	Development of Novel Integrated Microfluidic Electrochemical Point-of-Care Sensors for Pathogen Detection and Continuous Drug Monitoring	Soh	Winter 2011
Lin, Chun-Hung	Bio-Inspired Structural Control and Health Monitoring due to Earthquakes	Yang	Winter 2011
Durham, Joseph	Distributed Coordination Algorithms for Teams of Robots	Bullo	Spring 2011
Dandach, Sandra	Distributed Decision Making	Bullo	Spring 2011
Kimura, Margot	Group Decision-Making Models for Cybernetic Systems	Moehlis	Summer 2011
Thakur, Gunjan	Encoding Informaton in Coarse Grain Models for Self-Assembling Systems	Mezic	Fall 2011
Hsieh, Kuangwen	Development of Advanced Electrochemical Sensors for DNA Detection at the Point-of-Care	Soh	Winter 2012
Menezes de Oliveira, Rafael	Three-dimensional Navier-Stokes simulations of miscible displacements in Hele-Shaw Cells	Meiburg	Spring 2012
Marks, Trevor	Fabrication, Micro-structural Analysis, and Mechanical Testing of High Density Polymeric Foam	Milstein	Spring 2012
Burgner, Christopher	Noise in Nonlinear MEMS as it Applies to Sensing	Turner	Spring 2012
Yie, Zi	Exploiting Parametric Resonance and Amplification in Microcantilever-based Mass Sensing	Turner	Spring 2012

Mechanical Engineering
Seniors 2012





http://me.ucsb.edu/

Department of Mechanical Engineering,
UC Santa Barbara, Santa Barbara, CA 93106