Mechanical Engineering

Spring 2009

The MEssenger

UNIVERSITY OF WASHINGTON
COLLEGE of ENGINEERING
A Community of Innovators

Trinity College gate

Riley Collaborates with Top Researchers at Isaac Newton Institute

James Riley

Jim Riley spent most of Autumn Quarter 2008 as an invited Senior Fellow at the Isaac Newton Institute in Cambridge, U.K. He participated in a three-month program on "the Nature of High Reynolds Number Turbulence." Six different workshops, each attended by more than 100 participants, covered a variety of topics in turbulence. Most of the top researchers in the world working on turbulence attended one or more of the workshops. "The program was stimulating and intense," Riley said. In addition to presenting papers at the workshops, Riley also gave seminars at the University of Cambridge Engineering Department, Imperial College London, and the University of St Andrews.

Reflecting on Cambridge, Riley described it as "a unique, interesting, and intellectually inspiring town." He added, "Cambridge has retained its medieval street pattern and many buildings dating back to the thirteenth and fourteenth centuries."

The Newton Institute is located in the mathematical sciences complex on the west side of the town, occupied jointly with the Department of Applied Mathematics and Theoretical Physics (DAMTP) and the Mathematics Department. DAMPT, founded by the famous fluid dynamicist George Batchelor, has many illustrious faculty, such as Stephen Hawking. Nearby is Microsoft's research facility. The Newton Institute is closely associated with several colleges, including Trinity College and St John's College. Trinity College is the birthplace of the *Journal of Fluid Mechanics*, for which Riley is an associate editor.

Continued on page 3

Bioengineering Pioneer Honored for Life's Work

Wayne Quinton on a treadmill of his design

ME alumnus Wayne Quinton (BS '58) is known around the UW and well beyond as the world's first bioengineer and the "father of biomedical engineering." Quinton's inventions include the lightweight cardiac treadmill, the oxygenator for the first open-heart surgery in the Pacific Northwest, and the cannula system that enabled long-term kidney dialysis. Quinton has always looked for difficult and challenging things to do. An entrepreneur to the core, Quinton believes that "a magnificent failure is better than mediocre success."

This spring both the UW and the College of Engineering are recognizing Quinton's magnificent successes—inventions that have saved countless lives, improved the quality of life for millions of people worldwide, and contributed substantially to the local economy. The UW is according him the highest honor it can bestow upon a graduate—*Alumnus Summa Laude Dignatus*. He will receive the award in early June from President Mark Emmert at a campus-wide recognition ceremony and will be recognized during the University's commencement ceremonies.

The college also selected Quinton as this year's winner of the Diamond Award for Entrepreneurial Excellence. He is among five honorees in various categories to be recognized at the fourth annual

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In this issue

Chair's Corner

ME Chair

Mark Tuttle

Many of you may be wondering how the ME Department is fairing in these dismal financial times. As I write this in early April, we do not have a definitive answer, except that our budget will certainly be strained over the next few years. We absorbed a 1% budget cut during the current academic year, and in January developed contingency plans for an additional 8%, 10%, or 12% cut for the 2009–11 biennium. Unfortunately, the state budget deficit has grown since January, and the latest news out of Olympia implies cuts for higher education that are even deeper than originally suggested. The bad news is that these cuts will lead to an increase in average class size and a reduction in the number and variety of classes we offer. The good news is that I expect that the number of students within ME Department will remain at current levels (about 250 undergraduate and 150 graduate students), at least for the 2009–10 academic year.

Despite this gloomy financial forecast for the next few years, the ME department is well prepared for the long term. We recently welcomed our two newest faculty members, Professors Junlan Wang and Brian Polagye. Please see pg 7 for an introduction to these new colleagues.

ME alums John Roundhill and Wayne Quinton will both receive multiple awards this spring. Roundhill, who will be the featured speaker at the ME graduation ceremony this June, is being honored by Boeing and the Museum of Flight. (See pg 6.) Quinton will be honored by the UW and the College of Engineering. (See pg 1.) Congratulations to John and Wayne on these outstanding recognitions of your extraordinary careers!

Our new External Advisory Board (EAB) was established last fall. The EAB is discussing ways to assist the department in achieving its mission of teaching and research.

ME External Advisory Board

Seated (L to R): Tina Toburen, Dianne Chong, Jill McCallum
Standing (L to R): Donald Sandoval, Hamid Mortazavi, James Reichman, Robert Schneider, Jeremy Rife, A. Stanley Gent, K. Michael Sekins, Martin Dunn, Tim Stearns, David Barr
Not pictured: Peter Janicki, Michael Kintner-Meyer, and Fred Silverstein.

Bioengineering Pioneer

Continued from page 1

Diamond Awards Dinner on May 8. (For more information, visit http://www.engr.washington.edu/alumni/diamond).

Quinton earned his ME degree while working as head of the UW Medical Instruments Department. His engineering studies inspired many discussions with physicians seeking to solve clinical problems. He pioneered and built 44 medical devices, including gastrointestinal biopsy devices, shunts, oxygenators, and catheters and devices for gastrointestinal biopsy.

In 1961 he founded Quinton Instrument Company, which grew into one of the most respected and recognized cardiac brands for cardiac stress testing and rehabilitation management systems, employing more than 700 people. Quinton treadmills, used in many physical therapy and sports medicine clinics, are widely acknowledged as the "gold standard" for performance and reliability.

ME Leadership Seminar Series 2009

ME thanks the following alumni, friends, and faculty for participating in our leadership seminar series.

Tim O'Neill (BSME '81, MSME '85)
Founder and President
Engineered Compost Systems and Measurement Technologies NW

Edwin Heacox (BSME '64)
Senior Vice President
Tessera Technologies

Anders Brown (BSME '92, MSME '94)
Senior Vice President
iSoftStone

Robert "Bob" Schneider
(BS Physics '71, MS Nuc. Eng. '73, MBA '76)
Senior Principal Engineer/Manager
D. Hittle & Associates, Inc.

Tina Toburen (BSME '92, MSME '94)
Founder and President
T2E3 – Energy Efficiency Enterprises

Brian Soderberg (BSME '79)
Founder and Partner
Zipper Interactive, Inc.

Don Isaacson (BSME '68)
CEO, ICOM Mechanical, Inc.

David Bluhm (BSME '84)
CEO, Zero260
Co-founder and Director, Medio

Robert Scheibe (ME PhD '96)
ME Affiliate Associate Professor
Principal Mechanical Engineer
GT Engineering

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Many of the speakers were recorded and made their slides available on ME's website. They can be viewed at http://www.me.washington.edu/about/videos/.

Contact April Johnson to learn more about the ME Leadership Seminar Series by phone at 206-543-8779 or e-mail aprijohn@u.washington.edu.

Sample parts printed using UWME ceramic powders, including fully glazed pots

ME RESEARCH GROUP DEVELOPS INEXPENSIVE 3D PRINTING MATERIALS FOR CERAMICS

Three-dimensional printers have become common in the industrial world, churning out fast 3D prototypes of everything from airplane parts to running shoes. The machines also are becoming popular among artists, hobbyists, and in high schools. The materials used in 3D printing, however, can be very expensive.

Three-dimensional printers are based on inkjet technology and look like photocopying machines that spit out solid objects. The inkjets are filled with an adhesive, or binder, that prints onto thin layers of powder. Any surface with binder will be included in the finished object. Users generally create their designs on a computer and send the completed design file to the printer. Over a period of 10 to 60 minutes, the object is built up layer by layer, each about the thickness of a piece of paper. Users then dust or blow away the excess powder to reveal the prototype.

About five years ago, Professor Mark Ganter became frustrated with the high cost of commercial materials used in 3D printing and began experimenting with his own formulas. He and his students gradually developed a home-brew approach, replacing a proprietary mix with artists' ceramic powder blended with sugar and maltodextrin, a nutritional supplement. The results are printed in an article in the February 2009 issue of *Ceramics Monthly,* authored by Ganter, Professor Duane Storti, and Ben Utela (PhD '08).

"Normally these supplies cost $30 to $50 a pound. The lab can go through $4,000 of materials per quarter," Ganter said. Lab fees were already at the maximum, so the group went looking for cheaper materials.

"Our materials cost less than a dollar a pound," said Ganter. He wants to distribute the free recipes to democratize 3D printing and expand the range of printable objects. Recipes are available on the *Ceramics Monthly* website at http://tinyurl.com/d5lcpa. "When powders are $30 a pound, I can't let students try something new or experimental," Ganter said. "But when it's $1 a pound, I don't care. I encourage them to try new things."

The low-cost ceramics experiment began when the group landed a National Science Foundation grant to print custom dental implants. Utela did much of the initial experimenting with different materials and processes. From Utela's work, materials were developed allowing 3D printers to use artist-grade ceramics. Creating the formulas required experimentation. "Graduate student Ian Blanch spent six months perfecting the procedures and formula for a single powder-and-binder combination," Ganter said. Much progress has been made since then. Grant Marchelli, MSE candidate, is currently adapting porcelain and stoneware to this process.

"Now that the ceramics formulas are working, it should make the technology more accessible to anyone who is used to working with traditional art ceramics," Ganter said. Artists and museum curators are already investigating possible collaborations.

For more information, contact Ganter by e-mail at ganter@u.washington.edu.

Riley at Isaac Newton Institute

Continued from page 1

"The intellectual history of Cambridge is overwhelming," said Riley. "Although it's a rather small town, intellectual output probably exceeds that of any other Western city." This year Cambridge is celebrating the 200th anniversary of the birth of one of its more illustrious citizens, Charles Darwin. At Trinity College were the likes of Isaac Newton, Roger Bacon, and Alfred Tennyson, plus 31 Nobel laureates, an incredible number for such a small college. Trinity was founded in 1546 by Henry VIII, whose statue is still above the entrance to the college grounds. Intellectual history is everywhere in Cambridge. For example, a popular establishment that Riley enjoyed is the Eagle Pub, where James Watson and Francis Crick used to argue about the "secrets of life," and where they first presented to the public their conclusions on the structure of DNA.

Eagle Pub

CAREER Awards

Nathan J. Sniadecki
CAREER Award
2009

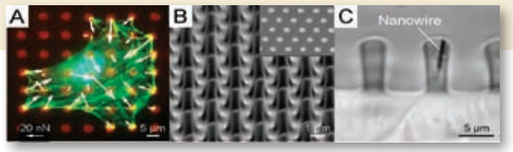


Fig.(A) Microposts and (B) nanoposts for measuring smooth muscle contraction forces with spatio-temporal resolution (vector arrows in A). (C) Magnetic microposts can apply external forces to cells through magnetic torque for isotonic loading of muscle at the nanoscale.

Nathan Sniadecki received his CAREER Award in 2009. The award was made for research in the mechanics of vascular smooth muscle contraction using nano-mechanical testing and computational modeling. He is also pursuing research in the cellular mechanics of the cardiovascular system as it relates to biomedical devices, miniaturized diagnostic systems, tissue engineering, and the mechanical aspects of disease. Visit his website:

http://faculty.washington.edu/nsniadec/research.html

Beginning in 1983, the National Science Foundation established a series of funding programs specifically intended to launch the careers of young faculty just beginning their academic careers. These programs were named the Presidential Young Investigator Program (PYI; 1983–92), NSF Young Investigator Program (NYI; 1992–96), Presidential Faculty Fellows Program (PFF; 1992–2000), Faculty Early Career Development Program (CAREER; 1995–present), and the Presidential Early Career Awards for Scientists and Engineering Program (PECASE, 1997–present).

This section highlights Mechanical Engineering faculty who have received one of these national awards. Visit their websites to learn more about the exciting research studies that have been made possible, at least in part, by the NSF awards received early in their careers.

Brian C. Fabien
Presidential Faculty Fellow Award
1993

Brian Fabien was granted the Presidential Faculty Fellow Award to support research in the following areas: multi-disciplinary dynamic systems modeling, nonlinear optimal control, and the control of electromagnetic suspensions. His current research interests continue in these areas. Information is available at:

http://abs-5.me.washington.edu

Mamidala Ramulu
Presidential Young Investigator Award
1989

Ramulu was awarded a Presidential Young Investigator Award to study the mechanics of waterjet cutting and manufacture. His current research includes abrasive waterjet machining, friction-stir welding and super plastic forming, machining and surface integrity studies of advanced composites, and surface modification effects on fatigue and fracture behavior. For additional information, visit his website at:

http://mstl.me.washington.edu

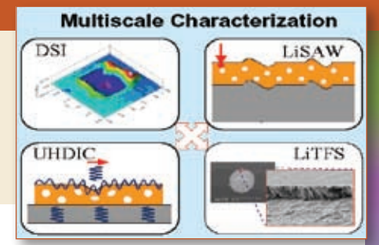
Amy Q. Shen
CAREER Award
2007

Amy Shen received a CAREER Award for research on confinement and flow effects on synthesis of sol-gel materials. Her current research concerns complex fluids and their processing to create morphologies and structures that can find application in nanotechnology, biotechnology, microelectronics, and energy-related materials. Her research takes advantage of the coupling of complex fluid microstructures with the spatial confinement that is possible by using microfluidic control methods, thereby offering morphological control of soft materials. Professor Shen's research involves both experiments and computations. Visit her website at:

http://faculty.washington.edu/amyshen

CAREER Awards

Junlan Wang
CAREER Award
2008



Junlan Wang's CAREER Award supports a project to develop an integrated research and education program to investigate the microstructural and mechanical properties of nanoporous thin films. She developed a multiscale experimental approach, including depth-sensing indentation (DSI), laser-induced surface acoustic waves (LiSAW), laser-induced thin-film spallation (LiTFS), and ultrasonic holography based on digital image correlation (UHDIC). The goal is a set of experimental tools that can be used to study varieties of nanoporous materials. For additional information on this and other research projects, visit her website at:

http://nanomech.me.washington.edu/

Alberto Aliseda
CAREER Award
2008

The subject of Alberto Aliseda's CAREER project is the dynamics of microbubbles in the human circulation system and the effects of flow pulsatility and ultrasound radiation. His research focuses on fundamental problems in fluid mechanics, involving multiphase flows and turbulence. Most of his research finds application in biomedical and environmental flows, including the cardiovascular system, and in energy conversion. More information is on his website at:

http://www.me.washington.edu/people/faculty/aaliseda

Ann M. Mescher
CAREER Award
1998

In 1998 Ann Mescher was awarded an NSF CAREER Award for research in the area of thermal-fluids sciences and materials processing, with emphasis on the relation between the material properties of a manufactured product and its processing conditions. Her present research is in the areas of stochastic behavior in polymer optical-fiber drawing and microalgal oil extraction and analysis for renewable biofuel. Visit her research website at:

http://depts.washington.edu/polylab

Wei (Wayne) Li
CAREER/PECASE Award
2004

Photo by Bill Ingals

Wei Li (center) receives his award at the U.S. Treasury Building from Dr. Arden L. Bement Jr. (L), Director of the National Science Foundation, and Dr. John H. Marburger III (right), director, Office of Science and Technology Policy, Executive Office of the President.

Wei Li received his CAREER Award for research in the fabrication of hierarchically structured open-cell porous polymers for biomedical applications. The PECASE is a special award made to no more than 20 CAREER award recipients to recognize engineers and scientists who show exceptional promise for pioneering research. Li's current research interests are in the areas of nano- and bio-materials processing, with a focus on multi-functional nanofoamed nanocomposites and 3D micro-scale tissue model systems. For further information, visit his website at:

http://faculty.washington.edu/weiwli/

Take-off for 2009 Graduates

John Roundhill Will Impart Lessons from High-Flying Career

The big day — June 14 graduation — is in sight for ME seniors, masters, and doctoral graduates. Caps and gowns, diplomas, congratulations, farewells, and anticipation for what's next in life infuse this momentous right of passage.

The class of 2009 and their families are especially fortunate that alumnus John Roundhill (BSME '67, MSME '73) will deliver the words of insight that send these new graduates off to their futures. They will hear from a consummate engineer whose career touched every Boeing commercial jet liner from the 737 to the 747, 757, 767, 777, and 787.

It is a career that many aspiring engineers might dream about. During 37 years at Boeing, Roundhill traversed from research specialist in acoustics and propulsion technology on the 747-100 to chief of product development technology on the 737 and 757, and chief engineer for 777 preliminary design and configuration. He also had a key role on the marketing team for the 777, working with customer airlines on configuration and product development.

Later management positions included director of engineering for the 737 and 757 programs and 747 derivatives. From 1997 until retiring in 2002, he was vice president of product strategy and development for the commercial airplane group. The revolutionary design concept for the 787 emerged from the work of his team.

The Museum of Flight is recognizing Roundhill's contribution to the aerospace industry with its 2009 Pathfinder Award. His name will go on the Wall of Fame, joining Frederick Kirston, T.A. Wilson, Scott Crossfield, and other luminaries.

Roundhill and his wife, Arlene, now live in northwest Montana, where he's enjoyed restoring antique Ford Model A cars such as a 1931 deluxe coupe and a 1928 roadster pickup.

"They are simple to work on, even for an ME like me without much mechanical ability, and fun to drive. Everyone honks at you," Roundhill said.

Retirement didn't completely take, however, and Roundhill continues to consult for Boeing on product development and the 787 program, making regular visits to Everett to meet with the teams working on future 787 derivatives.

"It's useful for the team to hear from someone who has more than 30 years of perspective on the kinds of challenges that arise when developing a new plane," Roundhill explained.

An important piece of advice will be to remain engaged with ME and the UW, even though most graduating students can hardly wait to leave. Roundhill practices what he advises. For many years he served as Boeing's liaison to the UW and then on the board of the Center for the Advancement of Engineering Education.

"We are so privileged to receive a great education," he said, "and we have so many ways to stay engaged, be it keeping in touch with classmates, attending events, offering monetary support, mentoring students, or getting involved with a professor's project."

John Roundhill with a model of the 787 – his current favorite Boeing plane. He plans to be back in Everett later this spring to observe the first flight.

Three Million Parts Equal Teamwork

What insights might Roundhill offer the departing class of 2009?

"When I left the UW I had no clue how applicable my skills would be or how much knowledge I had gained," he said. "Students might be surprised they can put their skills in fluid mechanics, thermodynamics, computer programming, and applied math to very good use."

In thinking back on his student days, he realized how much he had learned about working with people in a technical context in the labs and during his senior capstone project.

"At Boeing I ran headlong into the realization that people working together can accomplish so much more than one person working independently," he said. "It takes an incredible amount of teamwork to build an airplane with three million parts."

Boeing, the UW, and the college have honored Roundhill with a named professorship, the Boeing-Roundhill Professor of Engineering, which will rotate among the departments. His legacy will be remembered along with those of Jack Steiner, Joe Sutter, and three other esteemed Boeing engineers and alumni honored with named professorships.

"The letter from President Emmert," came out of the blue," Roundhill said. "As a young engineer I worked for Steiner and Sutter. It's humbling and amazing to be recognized with them. I take it not as an individual award, but as one for the team. It is so gratifying to be part of the Boeing–UW relationship and the mission to enhance education."

Brian Polagye

Brian Polagye Joins ME Faculty

Research Assistant Professor Brian L. Polagye joined the faculty on April 1. He earned both his MSME '05 and PhD '09 in mechanical engineering at the University of Washington. He graduated from the Department of Mechanical and Aerospace Engineering at Princeton University in 2000 with a BSE. From 2000 to 2002 he worked at a consulting firm in the Washington, DC area.

Polagye's doctoral research investigated the far-field environmental effects of in-stream energy extraction, including an understanding of Puget Sound's resources. His research will concentrate on tidal in-stream energy, which involves harnessing the kinetic energy available in strong tidal currents. He will also focus on numerical modeling of arrays of in-stream turbines and the development of cost-effective instrumentation packages for site and device characterization. These activities will help to advance in-stream energy in a responsible and sustainable manner.

His efforts are part of a broader program within the Northwest National Marine Renewable Energy Center, a DOE-funded partnership between Oregon State University and the University of Washington. At the UW, this interdisciplinary program combines the expertise of the Department of Mechanical Engineering, School of Oceanography, and Applied Physics Lab.

Junlan Wang

Welcome to Junlan Wang

Associate Professor Junlan Wang joined the Department of Mechanical Engineering in December 2008 after serving as an assistant/associate professor at the University of California, Riverside from 2003 to 2008. Prior to that, she held a postdoctoral position in the Division of Engineering at Brown University. She received her PhD in theoretical and applied mechanics from the University of Illinois at Urbana-Champaign in 2002, and MS and BS degrees in mechanics and mechanical engineering from the University of Science and Technology of China in 1997 and 1994, respectively.

Professor Wang's research is in the area of nanomechanics of complex material systems such as thin films/multi-layer structures and devices, nanoporous materials, cells, and bio-inspired materials. She is particularly interested in developing novel experimental techniques to study the mechanical, interfacial, and surface properties under various temporal and length scales. Her research aims to reveal the fundamental structure-property relationship and the deformation mechanisms of these advanced materials for applications in aerospace, semiconductor, biomedical, energy, environmental, and defense applications. Professor Wang's research has been sponsored by various funding agencies including the National Science Foundation, Army Research Office, Semiconductor Research Corporation, and Naval Surface Warfare Centers.

Honors & Awards

NATHAN J. SNIADECKI has received an NSF CAREER Award for research on smooth muscle mechanics.

JIANGYU LI received the first Nemat-Nasser Early Career Award Medal of the ASME Materials Division at the IMECE in November 2008.

VIPIN KUMAR was an invited panelist on the Innovative Materials & Manufacturing session at the Washington Innovation Summit 2009 in Bellevue on April 9. The session explored new "miracle" materials from forest products to potential packaging materials made from components still being developed.

JULIO L. DAVIS has received a NASA Space Grant Graduate Fellowship for Spring Quarter 2009. The grant consists of a $5000 award plus tuition for the quarter. Davis is an MSE student with M. RAMULU.

During the last week of March, JAMES J. RILEY presented a series of lectures on geophysical turbulence at the Polytechnical University in Madrid, Spain. This series was funded by the NATO Research and Technology Agency, as part of a research exchange program among NATO member nations.

CHAO MA was selected to participate in Nanyang Technological University's Technopreneurship and Innovation Program. Nanyang and UW students prepared business plans from patents approved by the UW Technology Transfer Office. Ma is working on his MSME with CHUNYE XU.

ME senior BEN SHUMAN'S paper, "Development of a Microfluidic Shear Flow Test Fixture," won a $250 first prize at the ASME Western Washington Student Section paper competition. NATE SNIADECKI guided Shuman's work.

ME junior Tim Campbell participated in a student team that won the $10,000 grand prize at the UW Environmental Innovation Competition. Their innovative faucet attachment gauges water flow.

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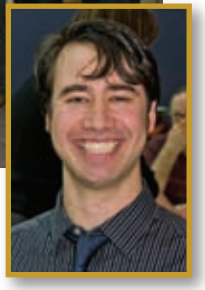
Scholarship and Fellowship Recipients

A February 19 luncheon honored 55 undergraduates who received scholarships and four graduate students who received fellowship awards for the 2008–09 academic year. Nate McGowan (BSME ’09) represented the recipients by delivering a moving speech thanking the donors. Scholarship donors or representatives attending were: Clyde Crawford (BSME ’70); Joanne Jeppesen; Albert Kobayashi (MSME ’52); Marilyn Martin and Greg Anton; Kelly McGee (BSME ’68); James Morrison (MSME ’54) and Virginia Morrison; John Purvis (BSME ’59); Henry Schatz (BSME ’64); and Peichi, Susie, and Pedro Tsai.



Morrison scholars with Prof. James B. Morrison (foreground) and ME alum Henry Schatz (standing behind Prof. Morrison). Nate McCowan (R) spoke on behalf of the students.

SAE 2009 Formula Car Rollout

UW President Mark Emmert tries out the 2009 Formula SAE car.

UW Formula SAE Team unveiled its 2009 car on April 8 at Kane Hall to a group of about 300 sponsors, alumni, faculty, staff, students, and family. This car will compete at the Formula SAE series in Michigan May 13-16 and in California June 17–20. This year marks the 20th anniversary of the team. The 2009 car features a full aerodynamics package, aluminum cast rearbox, and centerlocking wheels. For more information, or to show your support for the team, please visit the website at http://students.washington.edu/auto or email auto@u.washington.edu.