

iNews

MEMS Research Advances Design to Cool Miniature Devices

Also in this issue...

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Dowd Fellowship

The 2011-2012 Dowd-ICES Fellows are Announced

In an NPR story announcing the death of Steve Jobs, he was described as "bold enough to think he could change the world and talented enough that he actually did." Steve Jobs was innovative because he thought outside of the box.

It is this kind of innovative thinking that also drives our ICES faculty to think outside of their departmental boxes and find ways to collaborate with colleagues across and beyond the departments of the College of Engineering, as well as outside the university with industry, government, and other non-profit partners. This issue of *iNews* illustrates how our faculty and students are doing just that in their research endeavors.

Our first feature article looks at the collaborative work electrical and computer engineering and mechanical engineering researchers have been doing to design an energy efficient, miniaturized cooling module, based on the Stirling cycle model, for use in chip- and board-level electronics, sensors, and radio frequency systems. Our other feature story looks at the 13-year Emerson-CMU partnership as a model for the success of industry-academic collaborations.

News on the ICES research centers and clusters reveals more of this "out of the box" collaborative and multidisciplinary thinking. The recent physical move of Carmell Therapeutics Corp., a CMU start-up company developing blood-based biomaterials, to the Institute for Transfusion Medicine has allowed it to partner more closely with the Central Blood Bank.

This fall, the Pennsylvania Smart Infrastructure Incubator (PSII) showcased its new IBM Smart Infrastructure Lab, solidifying even further the collaborative work being done with IBM. An article on the PSII-Gannett Fleming partnership, funded in part by the Pennsylvania Infrastructure Technology Alliance, emphasizes this as well.

The issue includes updates on the latest efforts of the Enterprise-Wide Optimization group; the upcoming spring NSF-funded Center for Multiscale Modeling for Engineering Materials conference; the Steinbrenner Institute of Environmental Education and Research co-host of the 2011 Association for the Advancement of Sustainability in Higher Education Conference in Pittsburgh; and the NSF-funded Serendi-Cyber Discovery and Innovation project, which is developing a web-based community for microsystem and nanosystem design.

Graduate students are also benefitting from and contributing to multidisciplinary research and distinguishing themselves as future innovative leaders. This fall, CMU welcomed the first cohort of students into the Nanotechnology-Environmental Effects and Policy (NEEP) program. NEEP allows student trainees to pursue an interdisciplinary and innovative program of study leading to a Ph.D. in engineering from CMU or Howard University. We also proudly list the recipients of our ICES fellowships and their funded projects in this issue.



We highlight, not only the numerous awards and distinctions our faculty and students are receiving, but the extra efforts they make to volunteer for ICES outreach events, making an impact on the next generation of innovators. It is this level of excellence that brings in grant funding as well for our research projects. Recent funders include the National Science Foundation, the National Institute for Occupational Safety and Health, and industry partner Invivomon.

I hope that you enjoy the latest issue of *iNews*. And, as you read, if you become inspired to create your own innovative and interdisciplinary project, please do not hesitate to contact me. ICES provides a place for interdisciplinary ideas to be realized, to grow, and to thrive. Let the lesson of Steve Jobs' life achievements be our license to pursue and realize our innovative dreams.

Gary K. Fedder, ICES Director

ACKNOWLEDGEMENTS

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To read more about ICES, please visit our website at <http://www.ices.cmu.edu/>.



ICES outreach is fueled by the energy that our faculty, student, and staff volunteers bring to these programs. Featured here are some of our community members who have become involved with ICES outreach in the last year.

ICES Postdoctoral Fellow Peter Gilgunn created a new activity for the Moving 4th into Engineering program. He worked with area 4th-grade students as they built and measured their own accelerometers.

He also spent time teaching students from the Gifted Education Collaborative about MEMS (micro-electro-mechanical systems)



The middle-school girls in the Summer Engineering Experience for Girls (SEE) program have benefited from young faculty Professor of Electrical and Computer Engineering Gabriela Hug created a SEE activity teaching about energy management.

She is also becoming involved with the Pennsylvania Smart Infrastructure Incubator with her work on electric smart grids.



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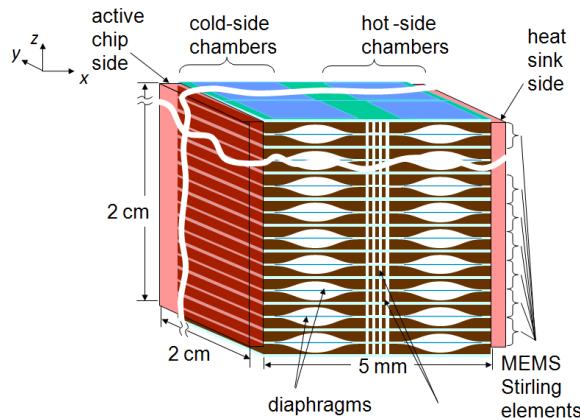
MEMS Research Adv

With the expanded use of chip-and board-level electronics, sensors, and radio frequency systems, the need for cooling mechanisms within these systems has grown. In many cases, it is a specific electronic part within these systems that becomes extremely hot and requires a miniaturized cooling module to reduce the temperature locally. In recent years, thermoelectric coolers – most frequently used as refrigeration devices – have been scaled down to the micro-level for this purpose. However, challenges arise with how to ensure that these devices achieve a high efficiency of energy conversion into cooling.

Gary Fedder, Howard M. Wilkoff professor of electrical and computer engineering (ECE) and professor of The Robotics Institute; Shi-Chune Yao, professor of mechanical engineering (MechE); and Alan McGaughey, assistant professor of MechE; have been designing a micro-scale cooler based on the Stirling cycle as an attractive potential alternative to the thermoelectric cooler. They are conducting this research as a part of the Defense Advanced Research Projects Agency (DARPA)-funded Active Cooling Modules (ACM) program and are collaborating with industry partners Isotherm Technologies, LLC. and Advanced Cooling Technologies, Inc.

The primary goal of the ACM program is to develop and demonstrate ideas based on novel materials and structures that can provide tens of degrees of cooling for a 25 W/cm^2 heat load in miniature cooling modules with a coefficient of performance of 2 or better. The volume of the proposed active cooling module is 1000 times less than a standard "small-scale" (2000 cc) Stirling engine.

The CMU researchers' commitment to the Stirling cycle is based on the fact that macro-scale Stirling machines have been able to realize high efficiencies of energy conversion. With the development of micro-electro-mechanical (MEMS) technologies, Fedder, Yao, and McGaughey envision creating an arrayed split Stirling micro-cooler as an ideal refrigerator for the ACM program.



Arrayed Stirling Microcooler: x-y array formed with planar MEMS Stirling elements, z dimension formed by wafer stacking, entire assembly sealed in hermetic package.

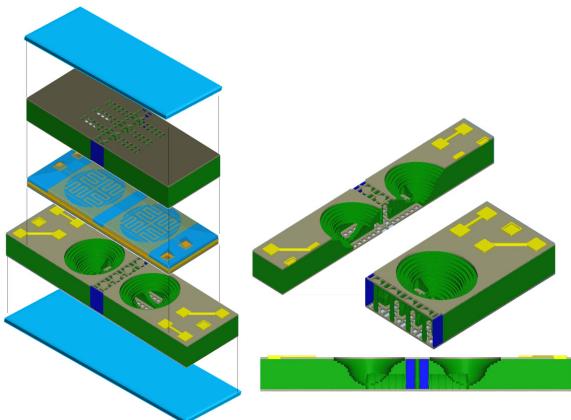
Advances Design to Cool Miniature Devices

The Stirling engine, invented by Robert Stirling in the 19th century as a closed cycle regenerative engine, operates by cyclic compression and expansion of air (or gas) at different temperature levels to create a net conversion of heat energy to mechanical work. The traditional Stirling engine's regenerator increases the thermal efficiency by keeping the system closed so it doesn't exchange the heat with the environment surrounding the engine. The regenerator is an internal heat exchanger and temporary heat store placed between the hot and cold spaces, and the working fluid passes back and forth between these spaces.

Fedder, McGaughey, and Yao – along with ECE process engineer Suresh Santhanam and doctoral students Jinsheng (Jason) Gao (ECE), Dongzhi Guo (MechE) and Ying-Ju (Ivy) Yu (MechE) – recognize that the Stirling cooler design concept is critical to its efficient operation at the micro-scale. They have designed their model so the gas flow direction occurs within the plane of a silicon wafer, from which the system is formed. Pumping the working gas between the hot compression and cold expansion chambers is accomplished with electrostatically actuated diaphragms. This in-plane micro scale implementation offers efficient thermal isolation between the hot and cold chambers by enabling a longer-length regenerator than may be practical in a stacked assembly, which supports gas flow perpendicular to the wafer.

In the ultimate system, the individual in-plane cooling elements are stacked to create a scalable active cooling module. This module assembly is then hermetically sealed in separate packaging to contain the pressurized working fluid, which can be helium or air.

The team has created detailed system models of compressible fluid and heat transfer in COMSOL – a 3D finite-element simulation tool – to evaluate the system's thermal performance. Their results have led to optimal sizing of the regenerator and improved thermal transfer to the chambers.



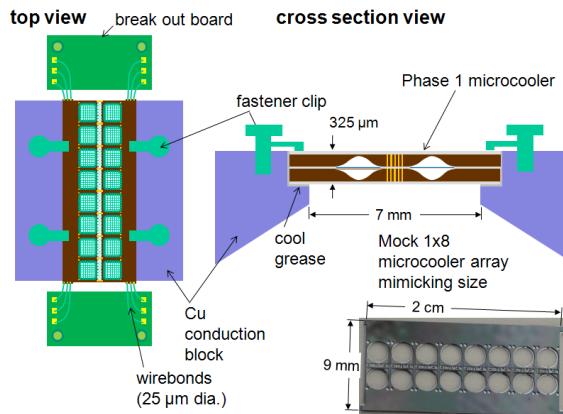
Microcooler Assembly: stacked assembly with activated silicon-silicone bonding, top and bottom chambers can be microfabricated on same wafer.

As well, the team has been testing appropriate materials and micro-fabrication processes to build a full silicon-based process flow to manufacture the system. The pump diaphragms are made from polydimethylsiloxane (PDMS) with embedded thin-film metal electrodes. The regenerator's top and bottom walls are made of silicon dioxide coated with PDMS, which has an effective thermal conductivity about one hundred times less than silicon. The side-walls are made from a structural polymer, also with low thermal conductivity. As a result, the conductive heat leakage from the hot section to the cold section is significantly reduced.

Finally, a series of silicon pillars form the thermal capacitor of the regenerator. These pillars enable efficient heat transfer to and from the gas as it passes through them. They also provide mechanical strength to support the capillary during handling and the stacking assembly. In addition, at the hot compression section and the cold expansion section, a bulk silicon substrate is used, which has a relatively high thermal conductivity, so the isothermal processes of heat transfer between the gas in the chamber and the chamber wall are assured.

Isotherm Technologies is engaged in the project as a consultant on the Stirling system design. Advanced Cooling Technologies (ACT) is collaborating on the packaging and testing of the system, and it will eventually help with the transition of the research from idea to product. ACT is a thermal management solutions company based in Lancaster, PA that designs and manufactures products for diverse applications, including spacecraft thermal control, electronics cooling and temperature calibration.

The research has, so far, resulted in the identification of a realizable design space to meet most of the cooling specifications. Achieving the coefficient of performance goal (i.e., the overall cooling efficiency) is an ongoing challenge currently being studied. The effort on the microfabrication process flow is expected to produce the first full prototype within the next six months.



Test Bed Implementation



EMERSON™

CMU-Emerson Partnership is a Model for Success

For thirteen years, the partnership between Emerson and Carnegie Mellon University (CMU) has been a model for the success of industry-academic collaborations. This is evident with the longstanding success of the CMU-located Software Center of Excellence (SCOE) and the recent creation of the Emerson Innovation Center – Human Centered Design.

Founded in 1890, Emerson is a diversified global manufacturing and technology company that offers a wide range of products and services in the areas of network power, process management, industrial automation, climate technologies, and tools and storage businesses.

In 1998, William Trosky, vice president of Emerson Corporate Technology, came to CMU when Emerson established the SCOE in ICES. The main objective of the Center is to strengthen the overall software engineering culture within Emerson in the areas of technology, process, and people.

Emerson's decision to establish the SCOE on campus was due to CMU's reputation in software and computer engineering, particularly in the areas of embedded computing and software maturity models, as well as due to CMU's multidisciplinary research environment.

By situating itself on campus, the SCOE has been able to draw easily on faculty expertise in support of its external reviews of higher risk areas within Emerson's software development. As well as collaborating with faculty experts in this regard, Emerson and CMU have collaborated on process maturity work, to recruit CMU graduates to Emerson, and on special projects as they arise. "Whatever the need, we are always able to find faculty to support our technology needs – expert firefighting, technical review, and technology transfer," explains Trosky.

In fact, "the SCOE-CMU relationship has been so successful that we decided to adopt the same model for our newly created and CMU-located Emerson Innovation Center – Human Centered Design," continues Trosky.

In 2010, Steven Little was brought to campus to manage the new Center, which focuses on one of Emerson's critical areas for external reviews – Human Centered Design. Little sees the rich discussions that emerge from casual "water cooler conversations" as a benefit to creating productive exchanges between industry and research. These conversations generate opportunities that may pave the way for future collaborations as well. Emerson benefits by being aware of cutting-edge research that could impact their business, while researchers benefit from the practical knowledge of industry in terms of how to commercialize their research.

PSII Researchers Receive HP Labs Innovation Award

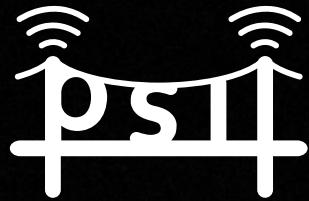
The Pennsylvania Smart Infrastructure Incubator (PSII) members Bruce Krogh and Mario Berges have received a 2011 HP Labs Innovation Research Award for their work on using smart devices for system-level management and control in the smart grid. Dr. Krogh – professor of electrical and computer engineering – and Dr. Berges – assistant professor of civil and environmental engineering – were granted one of 62 awards given to 51 institutions in 11 countries. The Innovation Research Program is designed to create opportunities for researchers around the world to engage in ground-breaking collaborative research with HP.

Also in recent PSII news, Mario Berges and Anthony Rowe, assistant research professor of electrical and computer engineering, have been named as faculty co-directors for the Smarter Infrastructure Analytics Lab for the PSII. They will be overseeing a variety of analytic approaches associated with the construction, operation, and maintenance of facilities and infrastructure assets. The lab is housed within the newly opened IBM facility in Porter Hall.



(L to R) Bruce Krogh, Anthony Rowe, Mario Berges

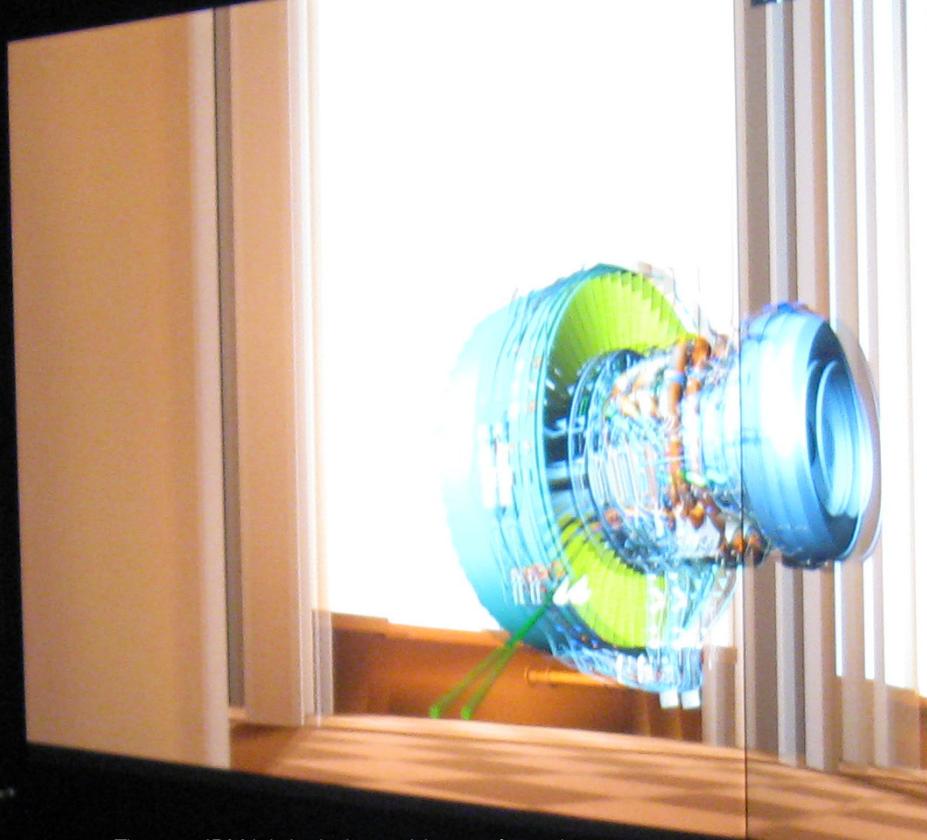




Pennsylvania Smart Infrastructure Incubator

PSII Presents New IBM Smarter Infrastructure Lab at CMU

On September 14, the Pennsylvania Smart Infrastructure Incubator (PSII) showcased its new IBM Smart Infrastructure Lab at the quarterly PSII/IBM Local Interest Group meeting. James Garrett, Thomas Lord professor and department head of civil and environmental engineering, and CEE postdoctoral student Xuesong "Pine" Liu led IBM and faculty collaborators through the renovated space in Porter Hall.



The new IBM lab includes a video conferencing meeting room (bottom left), a highly sensed HVAC system (bottom middle), IBM servers (bottom right) and a 3D Visualization CAVE (above). The CAVE allows researchers to navigate collected data visualized in 3-D and overlaid on building information models.



Erika Ninos: Environmental Program Coordinator

ICES welcomes Erika Ninos as the new environmental program coordinator for the Steinbrenner Institute for Environmental Education and Research (SEER) and the new Nanotechnology-Environmental Effects and Policy (NEEP) Integrative Graduate Education and Research Traineeship (IGERT) program. Her position will involve working with SEER Executive Director Deborah Lange and SEER Faculty Director David Dzombak on publications, special events, and outreach and campus sustainability efforts. She will also be providing administrative support to NEEP and the program's director Jeanne Van Briesen.

Before coming to CMU, Erika held education and program coordinator positions with the Pennsylvania Resources Council, Phipps Conservatory, and most recently, with Chatham University. However, by choosing to come to CMU, Erika has the opportunity to

reconnect with her interest in the environment. Holding a master of science in sustainable systems, with a specialization in environmental education from Slippery Rock University, she is excited to be involved with "the myriad of environmental education and campus activities that are happening at CMU."

Erika's first impressions of both ICES and SEER are that they are "filled with fascinating and passionate faculty and staff who are on a quest to uncover as much as possible about their specific areas of research and somehow make sure this translates in a practical way." What she loves about the IGERT program is that "it is an amazing way for students who have an interest in interdisciplinary and 'out of the box' academics to gain real world experience in their field while getting a top-notch education."

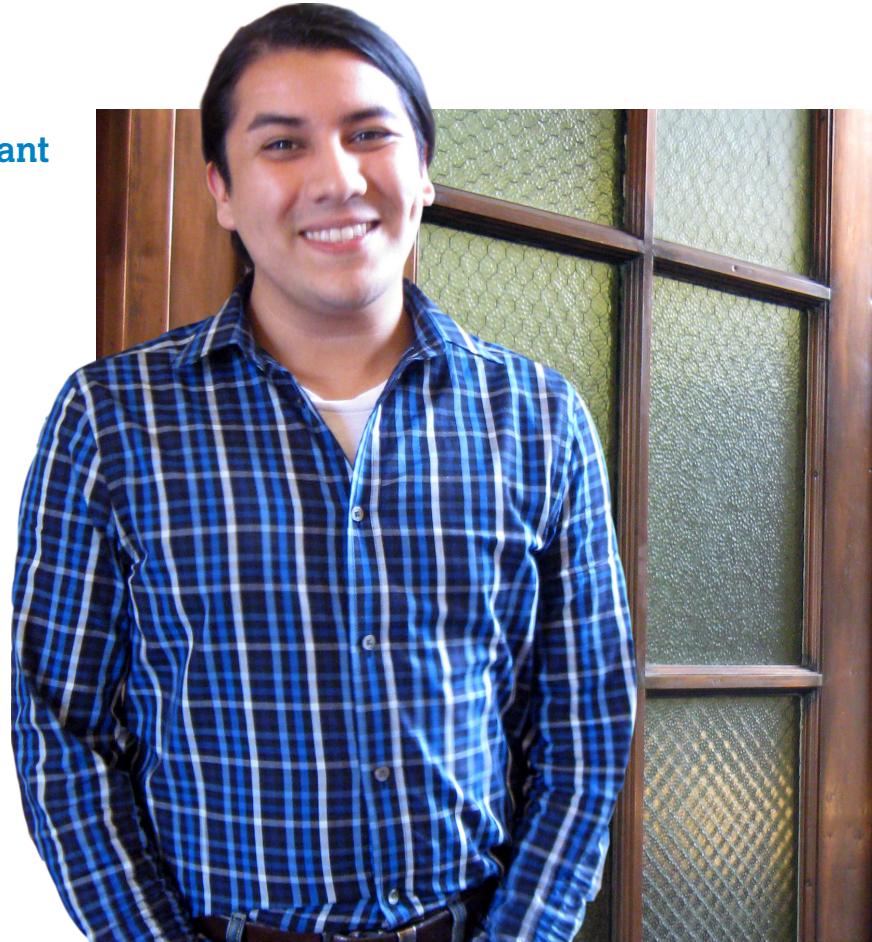


ICES Welcomes New Staff Members

Gilbert Huerta: Administrative Assistant

Gilbert Huerta has recently joined the ICES community as the new administrative assistant. Originally from Springfield, MO, he worked previously as a staff writer for Drury University, a recruiter for the Grand Crown call center, and most recently as a commercial assistant at UMB Bank. He is looking forward to the continuation of his education at CMU as a sociology and education major. "Thanks to ICES," says Gilbert, "I'll have the opportunity to be involved with the Institute's daily activities while easing myself into coursework."

Gilbert feels that ICES offers a wonderful support system for the goals toward which the staff and faculty are continually working. "Everyone is supportive of and invested in one another's personal and professional growth."



New Postdoctoral Fellows at ICES

ICES welcomes **Qinglong Zheng** who started working in the Fall 2011 semester as a postdoctoral fellow with David Greve, professor of electrical and computer engineering, in collaboration with Gary Fedder, Howard M. Wilkoff professor of electrical and computer engineering, Lee Weiss, research professor of The Robotics Institute; and Dr. Antonia Chen, resident-MD in orthopaedic surgery at UPMC. A joint effort of ICES's Center for Implantable Medical Microsystems and the Advanced Biosensor Consortium at UPMC, the research project aims to use a surface acoustic wave (SAW) sensor to measure the extent of strain in an intermedullary nail inserted into a leg bone to help the healing process of a fracture.

The nail helps to share and thus, alleviate a load that is placed on a healing bone. As the fracture heals and the stiffness of the bone increases, the force shared by the nail reduces. The research team believes that the strain experienced in the nail is an ideal index to see the progress of fracture healing or as an early warning in case of non-union. Qinglong is working with them to design, fabricate, and test a SAW sensor model as the first step toward this goal.

Qinglong received his B.S. degree in mechanical engineering from Tsinghua University, in Beijing, China and his Ph.D. in electrical and computer engineering from Wayne State University. He has been settling into CMU, enjoying the local surroundings, including the area restaurants, and finding the faculty, students, and staff to be very friendly and pleasant colleagues.

ICES is also pleased to welcome **William (Bill) Clafshenkel** and **Siddhesh (Sid) Angle** as new postdoctoral fellows. They are working with ICES Research Professor Phil Campbell and Robotics Institute Research Professor Lee Weiss on tissue engineering research that uses innovative bioprinting and bio-patterning technologies to study growth factors. Their work has specific craniomaxillofacial and orthopaedic applications in regenerative medicine for musculoskeletal disease and trauma.

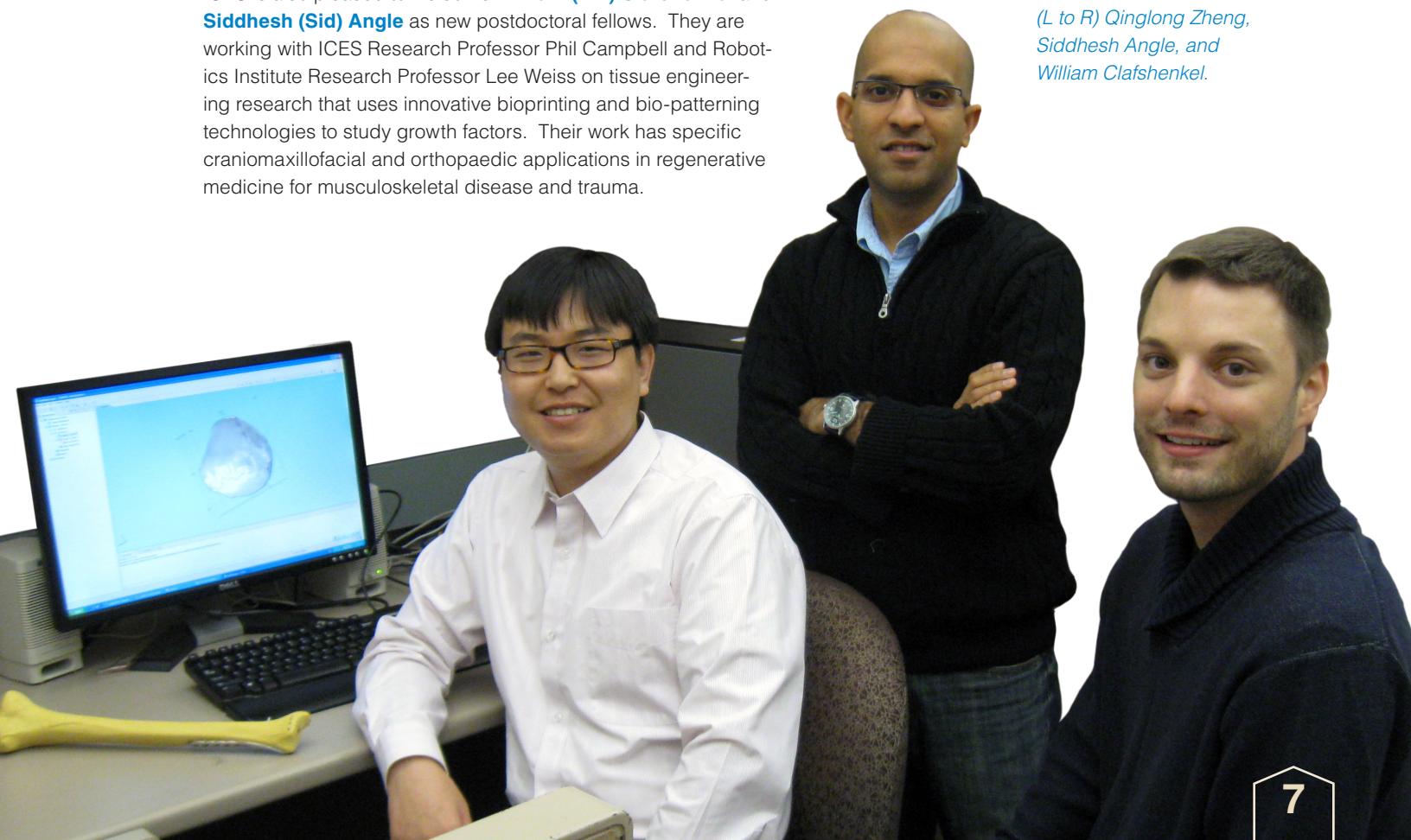
Bill's work involves using bioprinting to study which patterns and combinations of growth factors are the most important for generating tissue such as bone, muscle, and tendon. He is also studying how this novel strategy can be applied to better control inflammation. Bill has spent most of his life in Pittsburgh.

He received a B.S. degree in biology and a minor in chemistry from Westminster College. He has worked as a medical laboratory technician for UPMC Presbyterian Hospital and completed his M.S. and Ph.D. in pharmacology at Duquesne University.

Sid's research involves using bio-patterning technology to spatially control the delivery of endogenous growth factors – those originating from within a tissue or cell – and signaling molecules to control stem cell fates in multi-tissue entities. Sid received his bachelor's degree from Mumbai University. He then received his master's and doctor's degrees in bioengineering, from the University of Illinois at Chicago, in association with Rush University Medical Center.

They both feel that everyone they have met at ICES and on CMU's campus have been very welcoming and supportive. In their work, they also have the opportunity to collaborate with clinicians and scientists from the University of Pittsburgh, Children's Hospital of Pittsburgh, and Allegheny General Hospital.

*(L to R) Qinglong Zheng,
Siddhesh Angle, and
William Clafshenkel.*



Carmell Therapeutics Benefits from New Space and Financing

Carmell Therapeutics Corp., a CMU start-up company developing blood-based biomaterials, is benefitting from the recent move of its offices and some of its lab space to the Institute for Transfusion Medicine (ITxM). The ITxM, an umbrella organization that provides transfusion medicine and related services, includes several subsidiary groups, like the Central Blood Bank. Carmell CEO Alan West calls the move "ideal."

"Because of this move, we are able to partner more closely with the Central Blood Bank," explains West. "The Blood Bank is not only our source for blood plasma, but it can also help us navigate through FDA regulations related to blood-based products. As well, the medical director of the Blood Bank is an advisor to Carmell."

Carmell will also continue to maintain a small laboratory space at Allegheny General Hospital, another company partner, for conducting some of its product testing.

Carmell has been developing biologically-active materials made from blood plasma since ICES Research Professor Phil Campbell, Robotics Institute Research Professor Lee Weiss, and Allegheny General Hospital neurosurgeon James Burgess founded the company in 2007. Carmell's products contain a concentra-

tion of growth and regenerative factors which are "designed by nature" in the right proportion to heal tissue. Their physical properties can be tailored to the application, and their degradation time can be designed to optimize healing, with controlled release of natural growth factors.

The company also recently announced that it received its first round of A financing for its REPAIR™ Bone Putty, a pliable putty manufactured from platelet-rich plasma for augmenting and accelerating the healing of bone injuries. This will enable Carmell to complete a pilot manufacturing facility and conduct a clinical study in the coming year. This is part of Carmell's development of products designed to treat injuries to connective tissues (tendons, ligaments, cartilage and bone), offering rapid healing and better clinical outcomes.



REPAIR Bone Putty and Gun Prototype.

Serendi: Creating a Cyber Community for Micro- and Nano- System Design

How often during the day do you turn to your computer for answers to those nagging questions like "What does sesquipedalian mean?" After pausing briefly to scan your memory, you turn to the closest connected device and enter the question in the search field. Such searches often lead to unexpected information that opens your mind to fields of knowledge whose existence you never imagined.

Serendi-CDI provides this experience for people interested in the design of microsystems and nanosystems and helps answer questions like: "What is the best way to model a parametric non-linear resonator?" or "What is the second mode shape of a fixed-fixed beam?"

Serendi-CDI (www.serendi-cdi.org) is a web-based design community and off-shoot of the National Science Foundation's Cyber Discovery and Innovation Type-II (CDI) project. Tamal Mukherjee, professor of electrical and computer engineering and co-director of the MEMS (micro-electro-mechanical) Lab at CMU, is the principal investigator for the project. Mukherjee

is collaborating with ICES Director Gary Fedder, Jason Vaughn Clark of the University of Purdue, and Narayan Aluru of the University of Illinois at Urbana-Champaign. ICES postdoctoral fellow Peter Gilgunn and ECE graduate student Congzhong Guo are working on the project.

The goal of the CDI project is to bring about transformative change in the way microsystems and nanosystems are designed, by leveraging the power of web-based communities to share information and stimulate collaboration among people spread across the globe. Serendi-CDI provides in-depth information on hierarchical microsystem and nanosystem design topics and allows its members to download the source code for all the microsystem and nanosystem models in its pages. Serendi-CDI also encourages its members to share their models by uploading them to the site. Informational content is collaboratively generated by the community members through its wiki-driven site Serendipedia. In the future, discussion boards will be added to the site to provide a more dynamic forum for sharing and collaboration.



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LOGIN FORM

Username	<input type="text"/>
Password	<input type="password"/>
Remember Me	<input type="checkbox"/>
<input type="button" value="Login"/>	

*Forgot your password
*Forgot your user ID
*Create an account

LATEST NEWS

- [Microsystem and Document](#)
- [Open Source](#)
- [The Community](#)
- [Serendi-CDI Links](#)

CM²EM Hosts NSF Workshop on Multiscale Modeling in April

During April 2-4, 2012, the Center for Multiscale Modeling for Engineering Materials (CM²EM) will host a National Science Foundation (NSF)-funded workshop to discuss multiscale modeling for engineering applications. The workshop will be held on Carnegie Mellon University's campus, in the Singleton Room, Roberts Hall.

The purpose of the NSF workshop is to bring together international experts in engineering, mathematics, and physics to have an open discussion on the potential and shortcomings of existing mathematical and physical approaches for solving these multi-scale modeling problems.

The workshop is expected to produce a basis for understanding and evaluating multiscale modeling methodology that can serve as a common interdisciplinary standard for the future and lead to strong collaborations between engineers, mathematicians, and physicists.

For more information on the workshop, please contact Professor of Civil and Environmental Engineering Amit Acharya at acharyaamit@cmu.edu.

Enterprise-Wide Optimization Project Creates Collaboration Opportunities

In the past year, the Enterprise-wide Optimization (EWO) project has been furthering the flow of information and collaboration among its members through presentations, seminars, course material, and the creation of online information. A major focus of the EWO project at ICES, headed by Dean University Professor of Chemical Engineering Ignacio Grossmann, is the optimal planning and operation of supply chains, including their manufacturing facilities, which often require the use of nonlinear process models.

The last two general meetings held in 2011 included presentations on game theory by Dr. Tatsushi Nishi from Osaka University and presentations by graduate students and researchers who are working in collaboration with industrial members from companies that include ABB, Air Liquide, Air Products, Cognizant, Dow Chemical, Ecopetrol, ExxonMobil, PPG, Praxair, Total and Unilever, and EWO's most recent member, Braskem.

The EWO project has been conducting a successful series of seminars this academic year. Speakers so far have included Dr. Antonio Flores from the Universidad Iberoamericana speaking on "Integration of Control and Scheduling" and Peter Bongers from Unilever speaking on "Factory Operations Modelling/Scheduling/Implementation: An Industrial Case Study."

The project has also been developing new concepts, methods, and tools that will be taught as part of the Chemical Engineering Department's Center for Advanced Process Decision-making short course "Optimization Modeling and Integrated Process Operations" from May 10-16, 2012.

Another way that some of the findings of the EWO are being disseminated is through the CMU-IBM Cyberinfrastructure Collaborative site for mixed-integer nonlinear programming (MINLP), <http://www.minlp.org>. The major goal of this site is to create a library of MINLP and generalized disjunctive programming (GDP) problems (linear and nonlinear) in different application areas in which one or several alternative models are presented with their derivation.

Finally, the EWO group is benefitting from a new special interest group on energy systems (ESI), which is inspired by the EWO project. Some of the current ESI topics include solar cell research, technologies for CO₂ capture and sequestration, and advances in energy efficient systems, such as power systems and biofuels.

Welcome to Serendi-CDI

The Community

Open Source and Sharing Philosophy

MEMBER POLL

Which US metropolitan area has the most MEMS companies?

- boston
- san diego
- san francisco
- portland
- pittsburgh
- washington, d.c.
- raleigh/durham

VOTE RESULTS

WHO'S ONLINE

We have 1 guest online

Featured Links

The Institute for Complex Engineered Systems at Carnegie Mellon University
SugarCube facilitates the parameterization of ready-made MEMS.
The Beckman Institute at the University of Illinois at Urbana-Champaign
Ads tv Serendi-CDI

POPULAR

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NEWSFLASH

AcuMEMS announces a new glaucoma product for cataract surgery.

CMU Welcomes First Cohort in Nanotechnology-Environmental Program

This fall, Carnegie Mellon University (CMU) welcomed the first cohort of students into the Integrative Graduate Education and Research Traineeship program in Nanotechnology-Environmental Effects and Policy (NEEP). The NEEP student trainees will be pursuing an interdisciplinary and innovative program of study leading to a Ph.D. in engineering from CMU or Howard University. This year's cohort – all first year doctoral students – includes Amy Dale in Engineering and Public Policy (EPP) at CMU; John Stegemeier in Civil and Environmental Engineering (CEE) at CMU; Rachel Ferebee in Materials Science and Engineering at CMU; and Alix Martin in Electrical and Computer Engineering at Howard.

Directed by CEE Professor Jeanne VanBriesen, NEEP is a part of the Center for the Environmental Implications of Nanotechnology at CMU (CEINT@CMU). CEINT@CMU, directed by CEE Professor Greg Lowry, participates in CEINT, a National Science Foundation-funded collaboration among several U.S. universities which seeks to elucidate the relationship between nanomaterials and their potential environmental exposure, biological effects, and ecological consequences.



(Left to Right) Amy Dale, Rachel Ferebee, Alix Martin, and John Stegemeier.

This semester, Dale, Stegemeier, Ferebee, and Martin are all taking a joint-institution affiliated class based in EPP at CMU, in which one class session per week is devoted to nano-policy issues. As well, lectures are held for both the NEEP trainees and NEEP affiliates, who include other Ph.D. students and faculty research groups affiliated with CEINT from both CMU and Howard. The seminar series also includes professional development topics presented by VanBriesen and other NEEP faculty. These seminars provide an opportunity for the co-mingling of departments and topic areas and encourage NEEP trainees to experience a truly interdisciplinary graduate school experience.

SEER and CMU Host Conference on Sustainability in Higher Education

The Steinbrenner Institute of Environmental Education and Research (SEER) and Carnegie Mellon University served as one of the Campus Host Sponsors for the AASHE 2011 Conference and Expo in Pittsburgh, PA, this past October. This annual three-day conference presented by the Association for the Advancement of Sustainability in Higher Education (AASHE), the largest North American conference focused on sustainability in higher education, drew over 2,500 participants to Pittsburgh, from more than 10 countries. The focus of the 2011 conference was on creating sustainable campuses and communities and included community service projects for both conference attendees and Student Summit participants.

Kicking off the conference was Dr. Wangari Maathai, Nobel Peace laureate and founder of the Green Belt Movement. Additional keynote speakers included Sandra Steingraber, author and ecologist, and Tim White, chancellor of the University of California, Riverside. Bill McKibben, founder of 350.org, was the AASHE Student Summit Keynote presenter. Dr. Mitchell Thomashow, former president of Unity College; Leith Sharp, executive director of Illinois Green Economy Network; and well-known environmentalist David Orr from Oberlin College spoke to intimate audiences during the three-day event.



ICES Announces 2011-12 Northrop Grumman Fellows

ICES is pleased to announce **Jason Larkin** and **Jason Marshall** as the 2011-12 Northrop Grumman Fellowship recipients. Larkin, a doctoral student in mechanical engineering, is working on atomistic modeling of large unit cell crystals for thermoelectric energy generation, with his advisor Alan McGaughey, associate professor of mechanical engineering. Marshall, a doctoral student in civil and environmental engineering, is researching a multiscale method for electronic, multifunctional, and energy materials, with his advisor Kaushik Dayal, assistant professor of civil and environmental engineering.

The Northrop Grumman Fellowship was established through an endowment gift given to ICES (then the Engineering Design Research Center) in 1988 by Litton Industries, now part of the Northrop Grumman Corporation. The Northrop Grumman Fellowship provides merit-based awards to doctoral students in the College of Engineering who are conducting multidisciplinary research that is associated with strategic directions within ICES.

Originally from Pittsburgh, Jason Larkin received his bachelor's and master's degrees from the University of Pittsburgh. The objective of his research is to build a robust, accurate, and efficient computational framework for predicting the thermal conductivity of large unit cell crystalline solids in order to improve the efficiency of thermoelectric energy generation.

Jason Marshall, a native of Scappoose, Oregon, completed his bachelor's degree at California Polytechnic State University – San Luis Obispo and his master's degree at Carnegie Mellon University. His research involves the multiscale atomistic modeling of electromechanical materials in real space, specifically focused on properly handling the long-range electrostatic interactions.

(Left) Jason Marshall (Right) Jason Larkin



SEER Fellowship Recipients

JARED AND MAUREEN COHON GRADUATE FELLOWSHIP IN CIVIL AND ENVIRONMENTAL ENGINEERING

Stacey Louie, Civil and Environmental Engineering
Research project: Macromolecular Coatings on Nanoparticles: Characterization and Impact on Environmental Transport
Advisor: Greg Lowry

STEINBRENNER INSTITUTE GRADUATE FELLOWSHIPS

Wayne Chuang, Chemical Engineering
Research project: Characterization and Aging of Black Carbon Particles
Advisor: Neil Donahue

Arvind Murali Mohan, Civil and Environmental Engineering
Research project: Determining the Microbial Impacts on the Fate of Radionuclides in Flowback Water from Hydraulic Fracturing of the Marcellus Shale
Advisor: Kelvin Gregory

Wee-Liat Ong, Mechanical Engineering
Research project: Enabling Greener Solar Cells, Automobiles, and Devices through Hybrid Organic-Inorganic Thermoelectric Materials
Advisor: Jonathan Malen

RECIPIENT OF THE STEINBRENNER INSTITUTE ROBERT W. DUNLAP GRADUATE FELLOWSHIP:

Ahmed Abdulla, Engineering and Public Policy
Research project: Investigating the Economic Viability of Small, Modular Nuclear Reactors
Advisor: Ines Azevedo

CEE Professor **Burcu Akinci**, Robotics Institute Systems Scientist Daniel Huber, and co-authors Antonio Adan and Xuehan Xiong received the Best Paper Award at the 28th International Symposium on Automation and Robotics in Construction for their paper entitled "Automatic Creation of Semantically Rich 3D Building Models from Laser Scanner Data."

Christopher Bettinger, who is developing new materials to advance the medical device industry, has been selected by *Technology Review* magazine as one of the world's 35 top innovators under the age of 35.

Bayer Professor of Chemical Engineering **Lorenz (Larry) T. Biegler** was recently awarded the elite distinction of University Professor.

ICES Director **Gary K. Fedder** was asked to serve as the technical lead from CMU on a committee of university faculty who will be working with the Advanced Manufacturing Partnership (AMP). The AMP was announced by President Barack Obama to bring together industry, universities, and the federal government to invest in emerging technologies that will create high quality manufacturing jobs and enhance our global competitiveness.

In August, **Andrew Gellman**, head of CMU's Chemical Engineering Department, was honored as an American Chemical Society Fellow.

Ignacio Grossmann, the Rudolph R. and Florence Dean university professor, was selected by the American Institute of Chemical Engineers as a winner of the 2011 Research Excellence in Sustainable Engineering Award.

CEE Professor **Craig Maloney** recently received two awards from the National Science Foundation (NSF): an NSF Faculty Early Career Development (CAREER) grant and NSF funding for his proposal entitled "Homogeneous Dislocation Nucleation," which he co-authored with CEE Professor **Amit Acharya**.

Priya Narasimhan will head one of two new Intel Science and Technology Centers (ISTC) based at CMU that will focus on cloud and embedded computing. Each center involves multiple universities and will receive \$15 million over the next five years. Narasimhan, associate professor of electrical and computer engineering and director of Carnegie Mellon's Mobility Research Center, is also a co-PI of the ISTC for Embedded Computing along with Mei Chen, senior research scientist at Intel.

Anthony Rollett, professor of materials science and engineering, was named a fellow of The Minerals, Metals & Materials Society (TMS).

This past spring, Associate Professor of Mechanical Engineering **Metin Sitti** received the 2011 Nano-engineering Award from SPIE - the international society for optics and photonics — for his work on devices that can manipulate objects on a molecular level.

Robert Tilton, professor of chemical engineering and biomedical engineering, has been named a Fellow of the American Chemical Society.

Jay Whitacre's company Aquion Energy has been named start-up company of the year by Pittsburgh Technology Council. Aquion Energy, Lawrenceville, is developing a new type of battery using sodium-ion technology. Whitacre is an assistant professor in the departments of Materials Science and Engineering and Engineering and Public Policy

PhD student **Yujie Ying** received Best Data Sensing and Analysis Paper Honors with the paper "Applications of Machine Learning in Pipeline Monitoring", co-authored by **Joel Harley, James H. Garrett, Jr., Yuanwei Jin, Irving J. Oppenheim, Jun Shi**, and **Lucio Soibelman**. The award was given at the 2011 American Society of Civil Engineers International Workshop on Computing in Civil Engineering.

Recent ICES Awards

BIOENGINEERING TECHNOLOGIES CLUSTER

ICES Research Scientist **Alan Rosenbloom** received funding from Invivomon, Inc. for his work on optimizing intravenous glucose microdialysis with an embedded system controller.

CENTER FOR MULTISCALE MODELING FOR ENGINEERING MATERIALS (CM²EM)

Amit Acharya, professor of civil and environmental engineering and director of CM²EM, is being funded by the National Science Foundation for the creation of workshop on research in averaging methods for multiscale phenomena in engineering materials.

Craig Maloney, professor of civil and environmental engineering, has received a National Science Foundation (NSF) Faculty Early Career Development (CAREER) grant for his research on plasticity and jamming. Dr. Maloney has also received an NSF grant for his proposal entitled "Homogeneous Dislocation Nucleation," which he co-authored with **Amit Acharya**, professor of civil and environmental engineering and director of CM²EM.

LABORATORY FOR INTERACTIVE REAL-TIME COMPUTING SYSTEMS (LINCS)

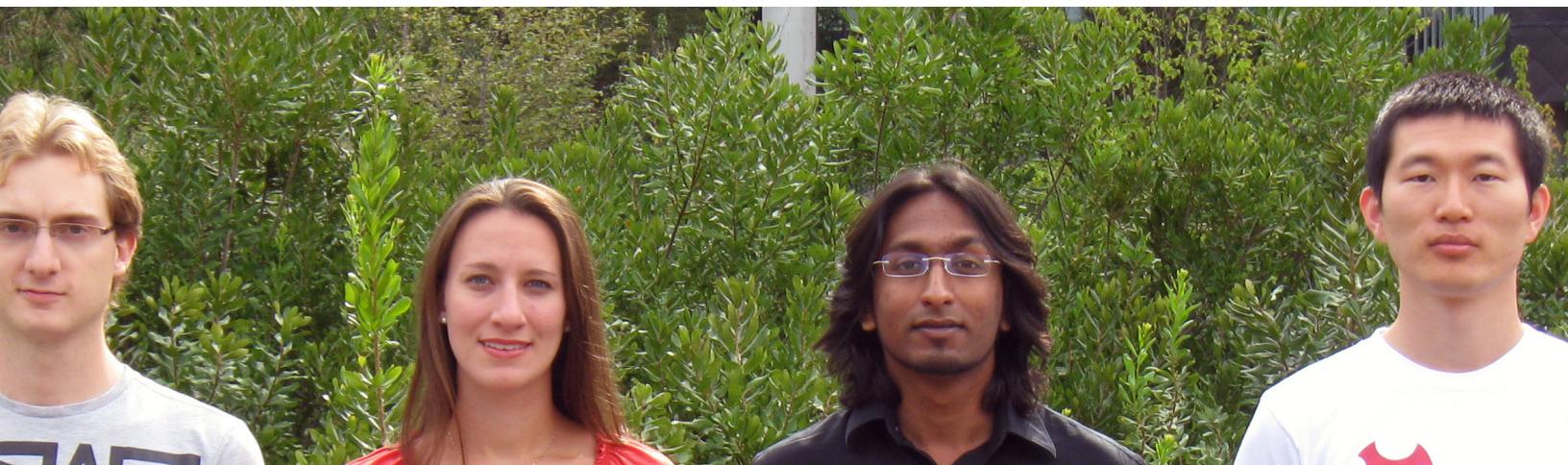
ICES Research Professor **Asim Smailagic** has received funding from the University of Pittsburgh for his work on advancing real-time data collection by using adaptive sampling and innovative technologies.

MICROSYSTEMS FACULTY

ICES Director **Gary Fedder** is being funded for his work on low-cost chemical monitoring using nanostructured gold micromechanical sensors by the National Institute for Occupational Safety and Health (NIOSH).

PENNSYLVANIA SMART INFRASTRUCTURE INCUBATOR (PSII)

James Garrett, Thomas Lord professor & head of the Civil and Environmental Engineering Department, received funding from the National Science Foundation for his work on monitoring indirectly the health of bridges by using moving vehicles.



The 2011–2012 Dowd-ICES Fellows (Left to Right): Quentin Jallerat, Katherine Hess, Prahlad Menon, and Zonghui Su.



Dowd Fellows Announced

This fall, ICES announced its 2011-12 Dowd-ICES Fellowship recipients: **Katherine Hess**, **Quentin Jallerat**, **Prahlad Menon**, and **Zonghui Su**. On Monday, November 21, they will present their research to the College of Engineering community at the annual Dowd-ICES Fellowship Seminar, along with last year's fellows and the 2010 Dowd Teaching Fellow **Jelena Kovacevic**.

Katherine Hess, a doctoral student from Mechanical Engineering (ME), hails from Wellesley, MA. She is researching, with her advisor Shawn Litster (ME), through-plane measurements in order to advance aqueous hybrid batteries for grid-scale energy storage.

A doctoral student from Biomedical Engineering (BME) and originally from Ville d'Avray, France, Quentin Jallerat is working with advisor Adam Feinberg from Materials Science and Engineering and BME. They are working on regenerating a vascularized myocardium using biomimetic ECM scaffolds.

Prahlad Menon (BME), a native of Bangalore, India, is working with advisor Kerem Pekkan (BME and ME). Their research is on the hemodynamic control of neonatal aortic outflow cannula jet flow regimes for improved cardiopulmonary bypass using computational fluid dynamics.

Zonghui Su (ME) and advisor Jonathan Malen (ME) are researching thermal transport in solid-state lighting. Su originally hails from Weihai, China.

Established in 2001 through a generous grant from Philip (B.S. Materials Science and Engineering, 1963) and Marsha Dowd, the Philip and Marsha Dowd Engineering Seed Fund provides support for graduate students working on cutting edge research projects that do not have other sources of funding.

Dowd Alumni News

In 2004, Mechanical Engineering doctoral student **Bahareh Behkam** received a seed Dowd Fellowship to support her work with Mechanical Engineering Professor Metin Sitti on novel bacteria propelled micro-robotic systems for future medical applications. Dr. Sitti recently received a \$1.2M NSF grant for research that has evolved from this original project.

Catherine Izard (2010-11 fellow) has received an Environmental Protection Agency STAR fellowship based on the work she conducted using Dowd Fellowship seed money.

Jacob Melby (2009-10 fellow) has co-founded a company this year with his research advisers, Materials Science and Engineering professors Lisa Melby and Robert Davis, along with Electrical and Computer Engineering Project Scientist Jason Gu, and Peter Foller, former Electrical and Computer Engineering post-doctoral fellow. The company, SenSevere LLC, is aimed towards the com-

mercialization of hydrogen and hydrocarbon sensors for severe environments. Melby is currently a doctoral student in Materials Science and Engineering.

Warren Ruder (2007-08 fellow) has co-authored an article appearing in the September 2, 2011, issue of *Science*. Ruder and his co-authors highlight advances in the biomedical application of synthetic biology, specifically the field's clinical potential for such areas as therapies for the treatment of infectious diseases and cancer, as well as approaches in vaccine development, microbiome engineering, cell therapy, and regenerative medicine.

Phil LeDuc received news that he received a Gates Foundation Grand Challenges grant, based on **Mary Beth Wilson's** (2010-11 fellow) work and ideas on "Cell mechanics to increase nutrition of vegetable-based fare in third-world countries".

PITA

Pennsylvania Infrastructure Technology Alliance

PSII and Gannett Fleming Streamline Building Facilities Information

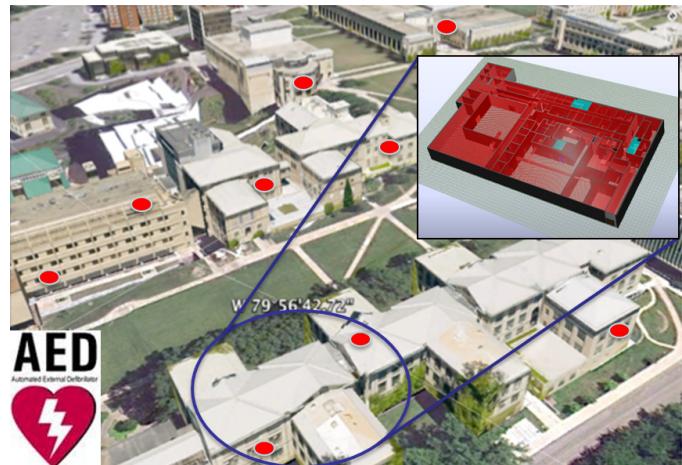
Industry analysts report that a lack of information integration about facilities is costing U.S. facility owners and operators more than \$11 billion a year in lost manpower time and equipment shortages.

Pennsylvania Smart Infrastructure Incubator (PSII) researchers are responding to this problem by collaborating with new industry partner Gannett Fleming on a project that will give building managers the information they need to make better decisions about facilities operations and maintenance.

Led by Burcu Akinci, professor of civil and environmental engineering, and James Garrett, Thomas Lord professor and department head of civil and environmental engineering, the research team is developing a unique approach to integrate three different facilities-related information sources to address inter-operability and information needs of facility operators and managers. These information sources include: building information models (BIM), geographic information system (GIS), and computerized maintenance management systems (CMMS) databases.

Funded in part by the Pennsylvania Infrastructure Technology Alliance (PITA), the collaboration between CMU researchers and Gannett Fleming – a broad-based engineering and environment services company – brings distinct expertise in GIS, BIM, and facility management and operation domains. This has allowed the research team to formalize, develop, and test ways to integrate different data sources and visualize the data in 3D to support stakeholders making facility management decisions.

"We think this is an excellent team that brings facility management experience and information modeling and visualization expertise to the table," comments Akinci. "Our team has been evaluating different 3D visualization environments as well as working closely with several facility operators and managers to identify their information and visualization needs."



Asset management in 3D world. The figure illustrates the envisioned system displaying the assets (AED units) distributed over the campus. Researchers can get more detailed information in a particular building, if needed.

Our collaboration with Gannett Fleming enables us to explore the important need to integrate different sources of facility information within a model and then develop approaches to query and visualize that data to support critical facility management tasks.

— Burcu Akinci