Dear Alumni, Friends, and Colleagues:

In July 2012, I had the honor of becoming the department chair of mechanical engineering with the responsibility of making this already good department with a rich history to a great department with a strong future. Time flew by with so many different activities and achievements in one year, much more than I expected. Some of the key events are captured in this newsletter to keep you all informed of the highlights of the year. Our undergraduate and graduate program counted more than 650 undergraduates and 130 graduate students last year and climbing to nearly 800 undergraduates and 160 graduate students this fall. In anticipation of this explosive growth we did several things. First, we ran an international search for additional faculty members and interviewed 18 faculty candidates from institutions throughout the nation and the world and were fortunate enough to attract three faculty members, Dr. Hongseok Choi, Dr. Rodrigo Martinez-Duarte, and Dr. Phanindra Talapragada to come to Clemson. Next time you are on campus, please stop by and welcome our newest faculty members and share your experience if you were an alumni here. We are in the process of renovating Cook Laboratory and the Dillard Hall teaching room to accommodate modern teaching tools and larger and additional classes in the future. The construction and outfitting are nearly complete. Faculty research has accelerated with annual research expenditures jumping 23% to nearly $2.7M, and proposal activities to federal agencies exceeding over $11M. Two of our faculty members, Drs. Summers and Vahidi were on a full year sabbatical in France and UC Berkeley and came back with rich experiences. Dr. Harry Law retired after 40 years of service to Clemson. The department went through a successful review by the Southern Association of Colleges and Schools (SACS) accreditation board. Dr. Figliola and his research work was used by Clemson University to advertise in Chronicle of Higher Education and other media in- cluding the University website exemplifying excellence and impactful research. Three faculty members received highly competitive National Science Foundation awards for their proposals for cutting edge research. Groups of faculty received funding to pursue collaborative research work with leading industrial partners on their difficult problems utilizing their expertise. Our students have had very productive co-op experiences and have benefitted from dedicated faculty members mentoring the students in creative inquiry and honors projects. Our senior capstone design course has had successful student-invented solutions to industrial problems to a maturity level second to none and the sponsors often have looked at commercializing the solution, which speaks very highly of the quality of education students receive in Mechanical Engineering at Clemson. Although this high quality has become an expectation of Clemson Mechanical Engineering, it is an honor to be given the chance to lead the department to a level of greatness with a full understanding of its heritage. If you have any experiences and ideas that you would like to share, please drop me a note.

Regards,
Ram
The Paris-based Leducq Foundation has awarded researchers at Medical University of South Carolina (MUSC) and Clemson University, and a collaboration of other institutions in the US and Europe, $6M to establish a Transatlantic Network of Excellence focused on developing improved support decisions for treating children born with only one functioning heart ventricle. These patients require radical and complex heart surgeries to alter blood flow in order to live. This Network will use computational fluid flow models of a patient's own anatomy to allow physicians to perform virtual surgeries, and to observe the effects of different decisions based on the individual patient's data. Additional US Network members include researchers at University of California-San Diego and University of Michigan Medical Center in the United States. European researchers are based in University College of London's Institute of Child Health, Politecnico di Milano, and Institut National de Recherche en Informatique et en Automatique - Paris.

The grant will be headed by pioneering pediatric heart surgeon, Dr. Marc de Leval, and by MUSC heart surgeon Dr. Tain-Yen Hsia. Clemson engineering Professor Richard Figliola will coordinate the engineering efforts across the Network. He and his students will develop experimental validation methods for the computer models, including life-like replicas of specific patient blood vessels, and will lead new research to advance the understanding of the mechanics of ventricle-artery couplings.

The work of the Network encompasses research intended to develop new transformative knowledge about the interaction of blood vessels and the heart muscle, as well as translational research intended to apply state-of-the-art engineering tools to improve patient-specific clinical decisions by physicians.

Dr. Xiangchun Xuan has been awarded National Science Foundation CAREER grants. The Faculty Early Career Development (CAREER) Program offers the National Science Foundation's most prestigious awards in support of the early career-development activities of teacher-scholars who most effectively integrate research and education within the context of the mission of their organizations. The award description states the activities should build a firm foundation for a lifetime of integrated contributions to research and education. He join Drs. Tong, Miller, Thompson, Li, Mears and Daqaq as Mechanical Engineering CAREER Awardees at Clemson.

Dr. Richard Figliola Award for Collaboration

Geometry of patient specific pulmonary shunt and aorta with aortic coarctation

Faculty News

External Advisory Board

The Industrial Advisory Board met with several of the faculty members in Spring 2013. This advisory board is comprised of nine members. The members are from a wide spectrum of industry, government, and universities, and their purpose is to advise and collaborate with the department on issues relating to academic and research objectives, students, curriculum, and interaction with industry.

Current members:
- Dr. Dianne Chong, VP Manufacturing, The Boeing Corporation
- Gary Foster, President, Automation Engineering Corporation
- Bryan Dods, Manufacturing Technology Lead, GE Energy
- Dr. David Gorsich, Chief Scientist, US Army TARDEC
- Topper Hartness, VP Research and Development, Hartness Corporation
- Mike Lackey, VP Operations, Nuclear Power-Fluor Corporation
- Dr. Judy Vance, Professor, Iowa State University, Former Department Chair and NSF Program Manager
- Ben Leppard, Principal, Leppard Johnson and Associates
- Michael S. Connor, Co-Chair Intellectual Property Practice Area, Alston & Bird LLP
The Department of Mechanical Engineering conducted a large faculty recruiting effort in Spring 2013. The Faculty Search Committee was chaired by Dr. Lonny Thompson. The other members of this committee included Dr. Mohammad Daqaq, Dr. Georges Fadel, Dr. John Wagner, Dr. Yue Wang, Dr. Rui Qiao. There were 306 applicants. Phone interviews were conducted for 24 candidates, of which 16 candidates were selected for an on-campus interview process.

The two day interview process included the candidates meeting with not only the members of the Faculty Search Committee, but also several other faculty members. The candidates also made a one hour presentation of their research. Graduate students were in attendance of this research presentation.

As a result of this recruiting effort, Dr. Phanindra Tallapragada, Dr. Hongseok Choi and Dr. Rodrigo Martinez-Duarte were offered tenure track faculty positions. We are delighted that all three accepted the offer made and welcome them to the Department of Mechanical Engineering at Clemson University.

Mechanical Engineering students Matthew Welch and Eric Roper where selected to attend the Citizens for Space Exploration delegation May 20-23 in Washington DC. Our ME students were 2 out of the 29 engineering student chosen from across the country to attend the delegation.

The delegation attended congressional office meetings to give their perspective on America's Space Program (NASA) and why America needs to continue having a robust Space Program with manned space flights. Over a two day period the 2 students attended over 30 meetings. The organization as a whole did 350 visits.

Matthew is quoted in a newspaper article in the Galveston Daily News about the delegation: “Before 1492 many people in Europe may have argued that it was a waste of money to send Columbus on a wild-goose chase through uncharted waters;”

To learn more about the Citizens for Space Exploration visit their website at http://www.citizensforspaceexploration.org/.

ATTENTION: CLEMSON ME ALUMNI

We would love to share your story, please send info/photos to cbolehm@clemson.edu.

Dr. Phanindra Tallapragada
Dr. Hongseok Choi
Dr. Rodrigo Martinez-Duarte

Welcome

The Department of Mechanical Engineering at Clemson University is delighted to welcome Corbin Kolehmainen.

He joined the department at the end of Summer 2013 as an Administrative Assistant. Corbin is responsible for maintaining the department website, creating the department’s publications, creating/updating faculty and lab webpages, digital signage, and ME administrative roles.

He is a recent graduate from the University of Central Florida with a BS in Information Technology and a passion for web development.

Dr. Harry E. Law (Alumni Professor Emeritus) retires from his faculty position of over forty years. The Department of Mechanical Engineering will truly miss him and wishes him the best of luck for the next phase of his life.

Dr. Yong Huang (Professor), Carol Johnson (Website/Publications) have left the Department of Mechanical Engineering at Clemson University. We wish them all the success and luck for the new phase of their life.
Motivation

- The fundamental understanding of cell and particle electrokinetics in microchannel is critical to the design and electrical control of microfluidic devices.
- The approach exploits the cell and particle dielectrophoresis (induced by the electric field gradient inherent at the reservoir-microchannel junction) to selectively trap cells/particles and continuously separate them inside the reservoir. This approach is therefore termed reservoir-based dielectrophoresis (rDEP).
- Such an rDEP cell sorter can be readily integrated with other components into lab-on-a-chip devices for applications to biomedical diagnostics and therapeutics.

Size-based Separation

Comparison of experimentally obtained images (top row) and numerically predicted trajectories (bottom row) of 5 and 3 μm particles at the reservoir microchannel junction under various DC-biased AC electric field.

Charge-based Separation

Demonstration of surface charge based separation of 3 μm fluorescent and 3 μm non-fluorescent particles at the reservoir-microchannel junction by rDEP. (a) is the snapshot image of particle behavior at 50 V DC-biased 800 V ac voltage. The images (b) and (c) are comparison of experimentally obtained images (top row) and numerically predicted trajectories (bottom row).

Viability-based Separation

Demonstration of selective concentration and continuous separation of live and dead yeast cells at the reservoir-microchannel junction by rDEP. (a) is the snapshot image, (b) and (c) compare the experimentally obtained superimposed images (top row) of live (b) and dead (c) yeast cells with the numerically predicted trajectories (bottom row). The cell separation was driven by a 4 V dc-biased 47.5 V ac electric field at 1 kHz. The block arrow in (a) indicates the cell moving direction.

Conclusions

- A new method for continuous microfluidic separation of cells and particles using reservoir-based dielectrophoresis (rDEP) has been developed. This method exploits negative dielectrophoresis induced at the reservoir-microchannel junction.
- The dependence has been utilized to implement the selective concentration and continuous sorting of 5 μm and 3 μm polystyrene particles by size, 3 μm fluorescent and 3 μm non-fluorescent polystyrene particles by surface charge and live and dead yeast cells by viability.
Faculty on Sabbatical

Dr. Joshua Summers
Professor & CoES IDEaS Professor

After 10 years at Clemson, I took the opportunity this past year to do a sabbatical at INP-Grenoble with the GSCOP lab. My 10 months abroad has been a wonderful opportunity where I got the chance to teach classes on requirements in design, design research, design for assembly, and capstone design. In this time, I was able to work with several French graduate students on their projects ranging from modeling the relationships between artistic and engineering designers’ perceived requirements and product attributes to survey design and analysis of shared mental models developed throughout a design project of undergraduates; from developing a new representation language and grammar for modeling assembly activities to analysis of collaborative design review scenarios supported by interactive workbench tables. I have collaborated with several faculty, ranging from French faculty to British to American on various papers. I have had the chance to visit several other schools to present our work and to learn about their programs.

Two highlights of my stay include a new educational program and a dissemination of the CEDAR way. First, I am excited about the planned establishment of a new joint senior design program with Grenoble in which we will seek to bring 8-12 Clemson students to Grenoble for 5-6 weeks to work on industry sponsored projects in mixed teams with Grenoble students. This is an exciting opportunity to expand our international recognition, to introduce our students to European opportunities, and to foster deeper collaborations with our French colleagues.

Second, the collaborative design team within GSCOP will be implementing their first ever Write Week during the Fall 2013. This is a direct outgrowth of our way of emphasizing writing for graduate students as both our moral duty and as an effective research and teaching tool. They were intrigued by the idea of partnering senior and junior graduate students on writing papers, with an identified Knowledge Contributor and a Communication Contributor. This experimental idea was well received by the students in the lab as they are the driving force. I will be excited to follow the progression of this experimental effort to see how well the basic principles of our CEDAR lab translate.

Overall, this past year has been a wonderful experience. However, I am excited to return now to Clemson and to the wonderful colleagues of CEDAR. I truly have missed my “walk and talks” and big coffees that can last an entire conversation. I look forward to reintegrating into the lab and to try to infuse some of the collaborative culture of GSCOP within CEDAR. While I have been productive in writing, proposal authorship, and research, I am ready to get back.

- Dr. Joshua Summers

With Dr. Ardalan Vahidi’s sabbatical for the 2012-2013 school year, the students in his research group had the opportunity to stay at Clemson or to move to experience something new. Every student chose to broaden their horizons by travelling to join research groups spread across academia, industry, and government.

Dr. Vahidi’s four PhD students, Nianfeng Wan, Yasha Parvini, Ali Fayazi and Grant Mahler, collaborated with universities and industries around the country. Wan and Fayazi worked with University of California, Berkley’s Institute of Transportation Studies (ITS). Parvini worked with Professor Anna Stefanopoulou’s group in the Mechanical Engineering department at the University of Michigan. Mahler joined the BMW Group Technology Office USA as a BMW Research Fellow for the year. All four students worked on industry relevant research. Some of the topics that were worked on were parameterization and validation of our proposed electro-thermal model for cylindrical ultracapacitors using pulse-relaxation and electrochemical impedance spectroscopy methods, hybridizing battery energy storage using ultracapacitors and connected vehicle technology. Parvini says, “The past one year has been a fulfilling experience in terms of progress in research and working with peers in the field of energy system and controls”. In addition to research, the students also had the opportunity to audit classes at the respective universities and also attend seminar series. Mahler’s words reflect the opinions of the entire research group - “This experience has provided direction to the skills I need to continue development in my doctoral studies at Clemson”.

Astronaut Award

Congratulations to Graham Yennie, for receiving a $10,000 scholarship from the Astronaut Scholarship Foundation (ASF). The Foundation was started in 1984 by the six surviving Mercury 7 astronauts to aid the US in retaining its world leadership in science and technology by providing scholarships to the very best and brightest STEM students. Now there are more than 80 astronauts from the Gemini, Apollo, Skylab, Space Shuttle and Space Station programs that have joined in supporting this educational program. Graham is one of only 22 students selected nationwide this year to receive this award.

Space Shuttle Astronaut Frank Culbertson publically presented the $10,000 scholarship check to Graham during the Clemson vs. Ball State football game on Saturday September 8th, 2012.

ME Graduate Poster Competition and Conference

On March 4th the second annual poster competition for ME graduate students sponsored by the Mechanical Engineering Graduate Student Council took place. The event was held in the atrium of the Fluor Daniel building to coincide with the External Advisory Board meeting. Students presented their work in the form of posters and explained them to the visitors. The External Advisory Board judged this competition and picked the top five Master’s level and top five PhD level posters. The top ten selected made an oral presentation at the ME Graduate Conference Session to a faculty group and one winner from each group was selected to receive an additional cash award for excellence in research. Rahul Renu won from the Master’s level. Saurin Patel won from the PhD level.

NSF Graduate Research Fellowship

Eleven Clemson students have been awarded National Science Foundation Graduate Research Fellowships (NSF GRFs), and 6 more were named Honorable Mention -- a new record for the University.

National Science Foundation Graduate Research Fellowships are awarded annually in nearly all fields of graduate education. Each awardee is provided three years of financial support, including stipend and tuition. Less than 20 percent of the 12,000+ annual applications are chosen.

Daniel Showers, a senior from Mechanical Engineering received an NSF Graduate Research Fellowship for his upcoming graduate study.

Amanda King, a Mechanical Engineering graduate student received an Honorable Mention.
During the 2013 Summer I Session, 24 students participated in the Mechanical Engineering Capstone Design Project ME402 Course, including three students from the Department of Electrical and Computer Engineering. The students were organized into six teams based on project preference and professional and educational skills and experience. Two industry-sponsored projects were solicited for the five-week course with each project addressed by three student teams. Each of the student teams addressed the assigned projects in parallel, adding a little healthy competition and increasing the value to the partner companies.

**BMW Manufacturing North America (BMWMC)** tasked the students with developing a robotic end effector to be used in conjunction with the Universal Robotic UR-10 robot to feed, orient, and install polymer plugs of varying sizes into the vehicle body after the painting process to alleviate ergonomic concerns and increase the efficiency of vehicle assembly (see Figure 1).

BMWMC loaned the student teams the UR-10 robot, enabling teams to develop functional prototypes and perform plug installation testing. The students fabricated a testing apparatus, learned to program the robot, and successfully tested each of the three prototypes (see Figure 2).

The engineers at BMWMC were extremely pleased with the prototypes and have identified follow-up tasks to refine the prototypes with an external engineering contractor for line-side testing and several follow-up projects associated with integrating collaborative robotics to automotive assembly including additional benchmarking with the Baxter robot. The student teams presented to engineers from the Plant in Greer, SC and the director of their collaborative robot center from Munich, Germany (see Figure 3).

![Figure 1 - Picture of BMW X3 wheel well with polymer plugs installed; Illustration of UR-10 collaborative robot.](image1)

![Figure 2 - Two students from Team C performing testing using the UR-10 and functional prototype (left); Team B functional prototype installed on UR-10.](image2)

![Figure 3- Students teams at BMW Zentrum in South Carolina after final presentation to sponsors with prototypes.](image3)

![Figure 4- Students team at BMW Zentrum.](image4)
**E-Z-Go: A Textron Company** charged the students with increasing the comfort level of their gasoline powered RXV model golf cart by reducing vibration felt by the driver in the steering wheel, floor pan, and seatback (see Figure 4).

The teams were tasked with formulating a problem description and engineering requirements, developing prototypes, and integrating their prototype into a feasible design solution. Additionally, the teams worked closely with engineers from the project sponsors. The teams updated and communicated regularly through telephone and email, visited the sponsors and toured their facilities, gave formal presentations, and successfully delivered solutions to the problems they challenged.

The E-Z-Go student teams worked on an analysis focused project to reduce vibration in the RXV model golf cart. The student teams initially visited the E-Z-Go facility in North Augusta, South Carolina to benchmark several golf carts in operation. Students drove and evaluated vibration in the golf carts on E-Z-Go’s test track.

E-Z-Go then loaned a gas powered RXV golf cart to the students in order to perform field and laboratory testing on their design solutions on the Clemson campus (see Figure 5 and 6).

All the student groups were able to apply the knowledge they gained from academic coursework and internships and cooperative educations to address industry sponsored projects. The teams were able to successfully design and test design solutions and represented the Department of Mechanical Engineering at Clemson University at the highest level.

If you are interested in learning more about the Mechanical Engineering Capstone Design Program at Clemson University, please contact Dr. Gregory Mocko at (864) 656-1812.
Alumni Spotlight:

ME and MS Alumni Otha H Vaughan Jr and co-workers from his Engineering and Geology team working for the NASA Marshall Space Flight Center in Huntsville, AL, developed the criteria document “Lunar Environment: Design Criteria Models for use in Lunar Surface Mobility Studies, NASA TM X 53661, September 28, 1967”. This document was used as the criteria design document for the design of the Lunar Rover vehicles. After retiring from NASA in January 1999, Mr. Vaughan serves as a volunteer at the US Space and Rocket Center in Huntsville, AL, answering questions from the visitors about the design and development of the full size Lunar Rover replica that is on display there.

Faculty Listing:

From left to right: Michael Justice, Technical Support; Kathryn Poole, Administrative Assistant; Jamie Cole, Technical Lab Manager; Janeen Putman, Undergraduate Student Services Program Coordinator; Tameka Boyce, Graduate Student Services Program Coordinator; Teri Garrett, Office Manager; Gwen Dockins, Administrative Assistant; Steven Bass, Technical Support; Renee Gibson, Administrative Assistant; Corbin Kolehmainen, Administrative Assistant

Battiato, Ilenia
Beasley, Donald
Biggers, Sherrill
Choi, Hongseok
Coutris, Nicole
Daqaq, Mohammed
Delhaye, Jean-Marc
Fadel, Georges
Figliola, Richard
Grujicic, Mica
Joseph, Paul
Li, Gang
Martinez – Duarte, Rodrigo
Miller, Richard
Mocko, Gregory
Ochterbeck, Jay
Qiao, Rui "Jim"

Saylor, John
Schweisinger, Todd
Summers, Joshua
Tallapragada, Phanindra
Thompson, Lonny
Tong, Chenning
Vahidi, Ardalan
Wagner, John R.
Wang, Yue "Sophie"
Xuan (Schwann), Xiangchun
Zhao, Huijuan “Jane”
Zumbrunnen, David

Emeritus Faculty

Huey, Cecil
Law, Harry
Dixon, Marvin

Ramasubramanian “Ram”, Melur K.