MAE NEWS

DEPARTMENT OF MECHANICAL AND AEROSPACE ENGINEERING

COLLEGE OF ENGINEERING

NORTH CAROLINA STATE UNIVERSITY | SPRING 2016

END OF AN ERA

NC State's iconic Harrelson Hall will be rolled up and recycled.

NC STATE Engineering

IN THIS ISSUE

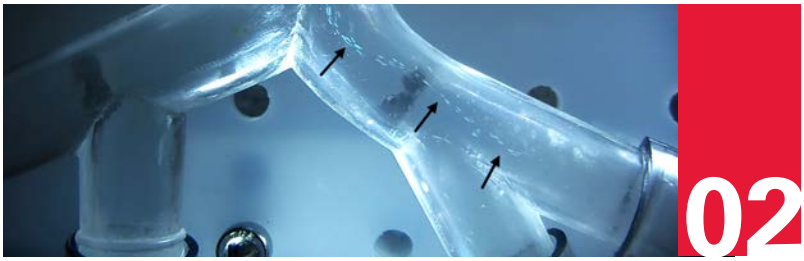
IN THE SPOTLIGHT

FEATURED ALUMNUS: DOUG YATES PAGE 06

Armed with a mechanical engineering degree, Doug Yates has become one of the most important leaders in NASCAR.

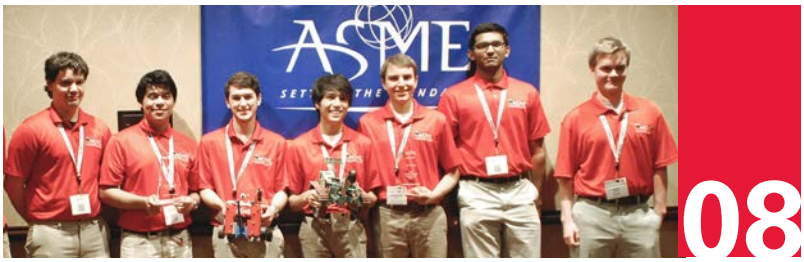
ABOUT THE COVER

The first round classroom building built on a college campus, Harrelson Hall had its fans and critics. Now the iconic NC State landmark is going to be taken down.



RESEARCH HIGHLIGHTS PAGE 02

Faculty members are changing our understanding of composites in extreme environments and engineering better treatments for liver cancer.



AWARDS AND HONORS PAGE 08

Three MAE faculty members take home NSF CAREER Awards.

ALUMNI EVENTS PAGE 13

Your department is on the move, with events connecting MAE alumni on campus and out of state.

UPDATE **FROM THE DEPARTMENT HEAD**

Richard D. Gould

DEAR FRIENDS AND ALUMNI,

Greetings from your home department at NC State!

This has been a very successful year in terms of student and faculty awards. Four of our young faculty members have received what are considered the most precious research awards available, the National Science Foundation Early Career Award and the Air Force Young Investigator Award. Winning one of these in a department in a given year is grounds for bragging rights; winning four in the same department is unprecedented. Not to be outdone, our ASME student design team won both first and third place in the ASME international design competition this past November – again unprecedented. Another seminal event was the establishment of the Hassan Distinguished Lecture Series named in honor of the exemplary career of Dr. Hassan A. Hassan. We also created a Corporate Advisory Board (CAB) chaired by Adam Hilton (BSME 2004) and held our inaugural meeting this past February. The function of the CAB is to provide curriculum advice, provide our students with professional development activities and facilitate engagement between corporate partners and the MAE department. Finally, we completed our first year of bimonthly MAE E-Briefs that hopefully are helping you stay informed of what is happening in the department throughout the year.

Every six years we undergo an accreditation review of our undergraduate programs by ABET. We are completing our self-study reports where we document our curriculum and student outcomes as well as facilities, faculty quality and continuous improvement procedures. Our on-campus review is planned for next fall. We continue to be very active in student education and research initiatives. In 2014–15, we completely revamped our first laboratory course (MAE 305) to give students more hands-on experience and exposure to modern data acquisition. We will be revamping the second laboratory course (MAE 306) this summer. On the graduate student front, you will note that we graduated 35 Ph.D. students this past year – the highest ever – placing the department in the upper echelon of research extensive departments. In 2014-15 the MAE department had research expenditures of nearly $12 million, a 10 percent increase over last year. Finally, our distance-delivered M.S. programs continue to be popular.

We were fortunate to be able to hire three outstanding faculty members this past year; Drs. Jun Liu, Kenneth Granlund and Pramod Subbareddy, whose brief biographies are presented in this newsletter. Several faculty members have new appointments: Dr. Matt Bryant was reappointed as a second term assistant professor while Dr. Shadow Huang was promoted to associate professor with tenure and Dr. Gracious Ngaile was promoted to professor. We also hired Katlyn Taylor and Elizabeth Baker.

In this newsletter, we have included a biography of one of the most beloved MAE faculty members, Dr. Richard Johnson, that we hope will bring back fond memories. You will also learn about many exciting things happening in the department, including our 2015 Hall of Fame ceremony; stories on groundbreaking research; and honors received by our students, faculty and staff. You will also learn more about Mr. Doug Yates, a featured MAE alumnus, and the demolition of Harrelson Hall.

We recently held an alumni tour of the Narrows Dam in Badin, NC and our 3rd Annual MAE Golf Tournament will be held in Raleigh on May 13th. Our alumni have been and will continue to be extremely important to our future. We sincerely hope that you join our efforts to improve our educational programs and student experiences. Your donations support critical activities that are not supported by state funds, including student scholarships and fellowships, endowed professorships, student clubs and organizations, student travel to conferences and senior design.

I hope that you enjoy this edition of our newsletter. If you have any questions or suggestions, or just want to know how you can help us, please contact me at gould@ncsu.edu.

Best regards,

Richard D. Gould
RJ Reynolds Professor and Head

RESEARCH HIGHLIGHTS

Understanding composites in extreme environments

Faculty: Dr. Mark Pankow
BLAST Lab (www.mae.ncsu.edu/pankow)

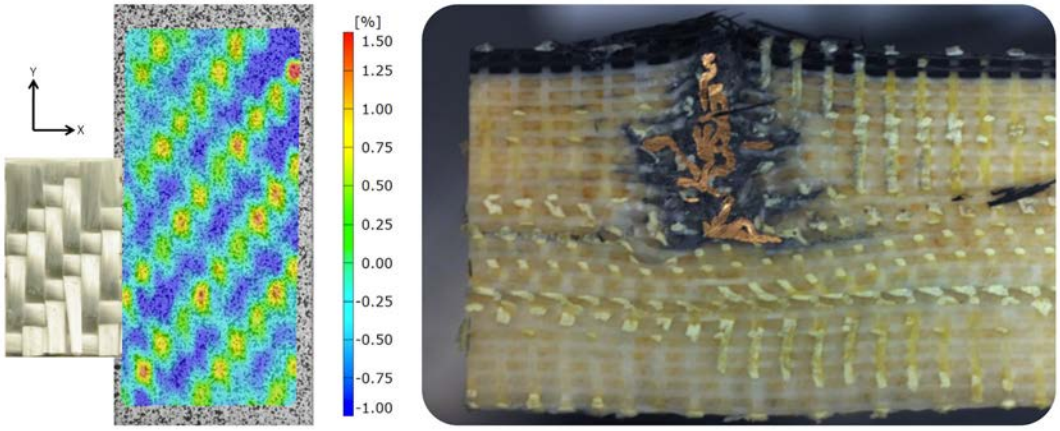
Materials often fail due to one-time loading events that are very short in duration. These events include ballistic loading, blast loading and high-speed impact. During these high-rate loading events material properties often change and once ductile materials become brittle. Understanding how materials behave when they are subjected to extreme loading environments is paramount to developing structures that are capable of withstanding new and emerging threats.

Dr. Mark Pankow's BLAST (ballistic loading and structural testing) Lab uses experimental techniques to understand what is happening to these materials during dynamic deformation. Specialized equipment such as the Hopkinson bar, which can provide uni-axial tensile and compression testing, is used to extract material properties as a function of loading rate. A shock tube is used to generate the same pressure and thermal profile that is seen in a bomb blast. This equipment provides a unique bi-axial loading that simulates more realistic loading conditions.

Research in the BLAST lab is currently investigating how body armor deforms during high speed impact from projectiles. Understanding how these systems dissipate energy will lead to a better understanding of the mechanisms at play along with clues on how to design the next generation of protection systems.

His lab also works extensively with through-thickness reinforcement in composite materials. These include things like 3D weaving, stitching and z-pinning. This work is both experimental and computational in nature. These methods prevent the delamination that plagues many composites in service.

Dr. Pankow's research has been supported from sources including NSF, ARMY Research Laboratory, and Air Force Research Laboratory. He was recently an ASEE AFOSR Summer Faculty and was awarded the Theodore von Karman Fellowship. ▪



Strain contours in a 3D woven composite subject to tensile loading and projectile impact.

Dynamic fracture of a pumpkin subjected to a simulated bomb blast.

Engineering better treatments for liver cancer

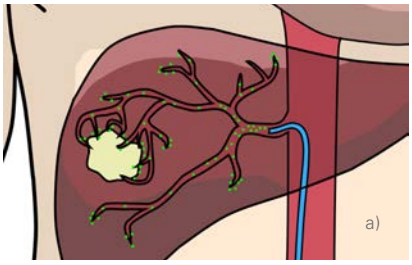
Faculty: Dr. Gregory Buckner and Dr. Clement Kleinstreuer

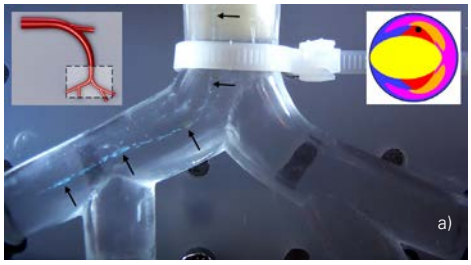
Primary liver cancer (hepatocellular carcinoma) is the sixth most common form of cancer worldwide, but is the second leading cause of cancer death. Each year, more than 780,000 new liver cancer cases are diagnosed, and more than 740,000 deaths are linked to the disease. In the U.S., nearly 40,000 new cases of primary liver cancer are diagnosed annually, with more than 26,000 deaths. Metastatic forms of the disease (primarily from colorectal, neuroendocrine and breast cancers) account for more than 40,000 additional deaths in the U.S. each year.

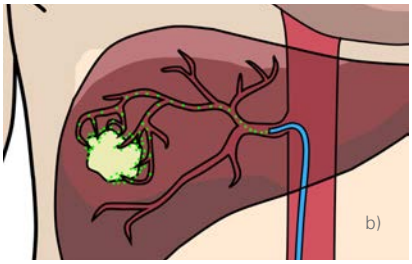
While surgical resection is the preferred (and most effective) treatment approach for primary and metastatic liver malignancies, 80-90 percent of patients are precluded from surgical intervention due to tumor size, location or complexity. Although chemotherapy is an effective treatment option for many cancer types, more than 50 percent of patients with solid liver tumors experience full resistance to chemotherapy. And though liver tumors are sensitive to radiation, external radiation therapy can't be used at high doses because normal liver tissue is also easily damaged.

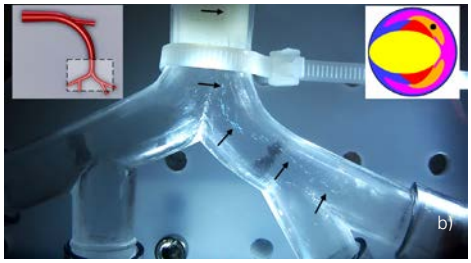
In recent years, hepatic radioembolization (or selective internal radiation therapy, SIRT) has emerged as an effective treatment option for patients with liver malignancies. During this procedure, millions of radioactive microspheres (20-30 μm in diameter) are injected into the hepatic artery (a primary blood supply to the liver) to irradiate liver tumors from within (Figure 1). Its minimally invasive approach and efficacy across a wide range of cancer types have expanded its application; multiple studies have demonstrated improvements in tumor response and overall survival, while associated clinical toxicity is mild. Despite the documented benefits of SIRT, the inability to accurately target tumor sites (Figure 1a) causes damage to healthy tissue and has limited its advancement.

Dr. Gregory Buckner and Dr. Clement Kleinstreuer, both professors in MAE, are working with physicians and medical device companies to better understand the physics of SIRT and improve the clinical targeting of cancer tumors (Figure 1b). Sirtex Medical, one of two international suppliers of radioactive microspheres for SIRT, has provided financial and technical support for this work. Professor Kleinstreuer, working with researchers in his Computational Multi-Physics Laboratory, has developed computational models from patient scans that predict the trajectories of microspheres during SIRT procedures. Professor Buckner, working with researchers in his Electro-Mechanics Research Lab, has developed experimental models and techniques for controlling microsphere injections and quantifying their distributions (Figure 2). Together, their research seeks to enhance the efficacy of SIRT through the development of patient-specific computational models and catheter positioning technologies that could enable direct tumor targeting. Their central hypothesis is that patient-specific modeling, coupled with precise control of the infusion location, will improve patient outcomes while minimizing side effects and reducing treatment costs.









Left: Figure 1. Transarterial delivery of radioactive microspheres for liver tumor treatment: a) suboptimal delivery to tumor and non-target tissue, and b) optimal targeting showing delivery solely to tumor **Right**: Figure 2. Microspheres traveling through the hepatic artery model during benchtop experiments: a) targeting a left vascular branch, b) targeting a right vascular branch. Inset graphics indicate model location (top left) and injection location (top right). Arrows indicate the microsphere stream.

Their research is progressing from benchtop models to explanted animal livers and live animal studies at the NC State College of Veterinary Medicine. Several project-related papers appear in biomedical and clinical journals, invited review articles and book chapters. Dr. Kleinstreuer's US patent 9,149,605, issued 10/06/2015, describes the methodology of optimal drug targeting and the associated micro-catheter for direct drug delivery. Recently, one of Dr. Buckner's papers investigating the dependence of microsphere properties (density and diameter) on treatment efficacy received a "Distinguished Laboratory Investigation for 2015" award from the *Journal of Vascular and Interventional Radiology*, the top clinical journal in its field. ▪

HARRELSON HALL
END OF AN ERA

Harrelson Hall, opened in 1962, will be deconstructed over the next year, with 90 percent of nonhazardous waste being recycled.

After more than a half century of standing as a round peg in the square hole of NC State's University Plaza, Harrelson Hall is finally being sent to the circular file.

Over the coming year much of the building will be rolled up, recycled and reused before the final skeleton is ultimately removed next summer.

"We're aiming for 90 percent diversion of nonhazardous materials through recycling and reuse efforts," says Steve Bostian, a project manager for NC State's Capital Project Management.

Deconstruction (not demolition) already has begun at the first round classroom building ever tried on a college campus. Much of the reusable materials — desks, chalkboards, whiteboards, doors, security cameras and some electric metering and fire protection equipment — has been removed and will be used elsewhere on campus or donated to Habitat for Humanity.

All other nonhazardous building material will be taken to a facility that specializes in construction and demolition waste, where it will be crushed or otherwise turned into reusable materials.

"[They] are sorted and sent to various markets for reuse and recycling," says Liz Bowen, a university program coordinator specializing in sustainable buildings. "For example, the concrete blocks making up Harrelson's structure can be crushed and reused as roadbed."

That would be perfect for a traffic circle.

For some, it may be a sad farewell to the building named after Col. John Harrelson, NC State's fifth executive officer, first chancellor and first alumnus to lead the school.

The visually appealing building, designed by lead architect Ralph Reeves, opened in November 1961 with 109,000 square feet of classroom space. At the time, it was hailed as being both "strikingly attractive" and "extremely functional."

It didn't take long, however, before the building became roundly criticized.

By 1972, the history department's annual report described Harrelson as "one of the most unsatisfactory academic buildings imaginable." Low-hanging ceilings, pie-shaped classrooms, confusing corridors and an interior ramp that tractor-beamed skateboarders and grocery-cart racers eventually made it one of the least-loved buildings on campus.

Harrelson's inner hallways.

In 1983, the interior doors and outdoor benches were little more than kindling for four consecutive weeks of bonfires in celebration of the men's basketball team's march to the ACC and NCAA championships, events from which the Brickyard and Harrelson never fully recovered.

By the 1990s, the building that opened with such great fanfare was facing an uphill struggle to be accepted around campus. After two feasibility reports concluded the building could not be successfully renovated and updated, the NC State Board of Trustees decided in 2003 that the building would eventually be removed.

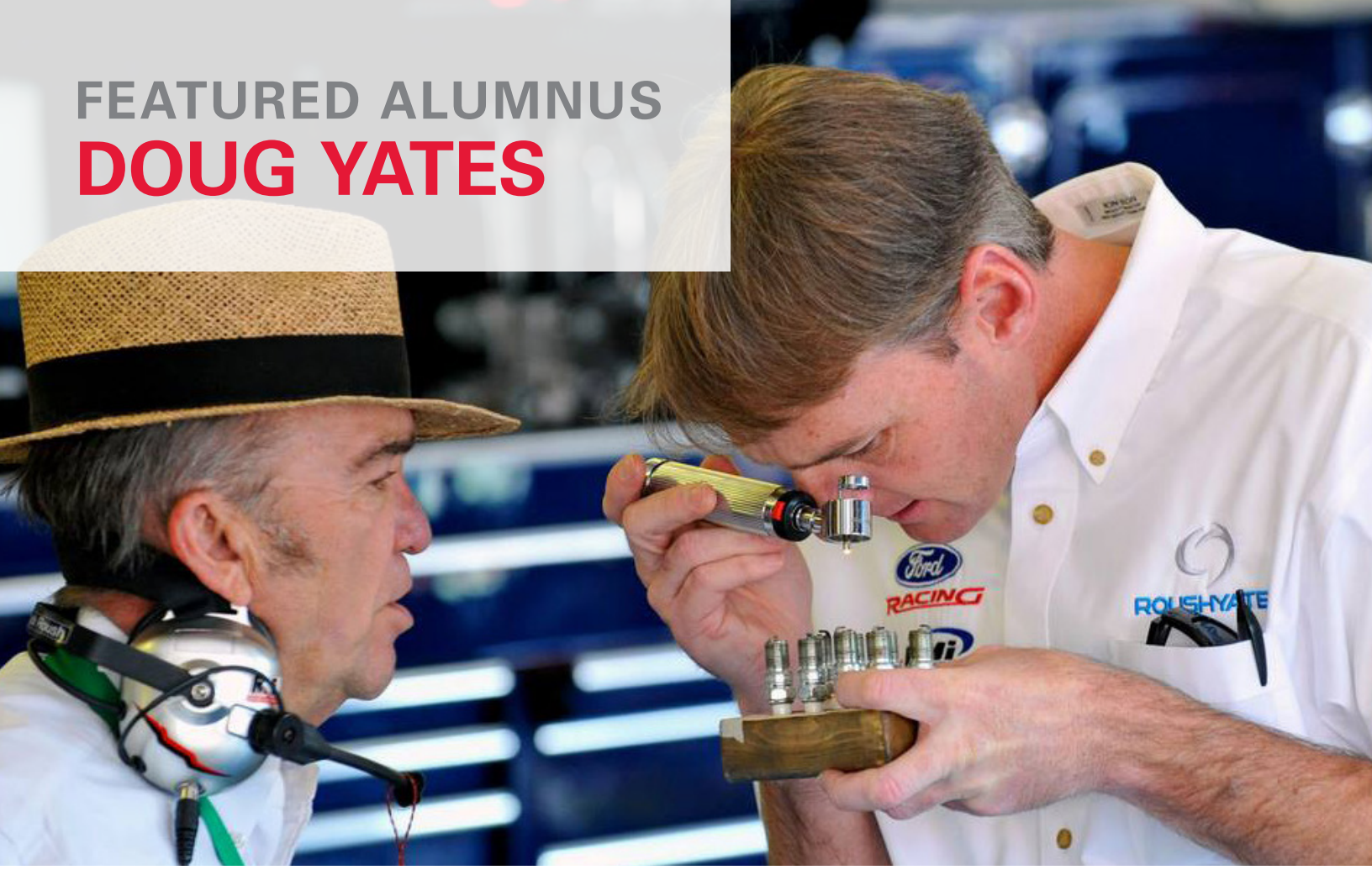
After years of use primarily for classes, Harrelson became the temporary home for the university bookstore and student activities offices during the renovation of the Talley Student Union. Those organizations relocated back in Talley in June, kicking off the deconstruction of Harrelson.

After deconstruction the footprint of the building will be landscaped into green space and footpaths, which will improve stormwater management in the area. The signature Science Commons classroom building is on the university's list of potential capital projects. It will be located on the southern edge of the Brickyard and serve as a space for interdisciplinary collaboration.

Current plans are for a rectangular building. ▪

Construction of Harrelson's inner core. Photo by Ralph Mills.

FEATURED ALUMNUS
DOUG YATES



Jack Roush and Doug Yates in the NASCAR garage.

Doug Yates

With a record of success that is rarely matched in modern motorsports, Doug Yates has been around race engines for as long as he can remember. This comes as no surprise when you happen to be the son of a living legend, namely famed engine builder and team owner Robert Yates.

With a passion for stock car racing and making horsepower, Doug not only carries on a deep rooted father-and-son heritage of winning, he continues to build a solid reputation in motorsports as both a respected businessman and marketing professional.

Born and raised in the heart of Charlotte, NC, Doug graduated from North Carolina State University in 1990 with a degree in mechanical engineering. With his education in hand coupled with a keen fascination with making horsepower, Doug soon became head engine builder at Robert Yates Racing.

By 1999, Doug's knowledge and responsibility culminated in one of his proudest on-track moments when, as head engine builder for team driver Dale Jarrett, the group combined for the overall Winston Cup (now Sprint Cup) championship. This crowning achievement in Doug's life didn't lead to complacency, as the young engine master wanted to go even faster the next year.

In an effort to combine knowledge and technology, known adversaries Jack Roush and Robert Yates combined forces in 2004. In this new alliance, Doug took on a new role and was named CEO and president of Roush & Yates Racing Engines.

When Robert Yates retired as owner of Robert Yates Racing in 2007, Doug assumed all responsibility for his father's team, a powerhouse that won a remarkable 57 races and the 1999 championship. The team's name became Yates Racing in 2008

and Doug officially had his own two-car team. With Ford power provided by Roush Yates Engines, Yates Racing quickly became a notable contender in the NASCAR Sprint Cup series.

In 2009, Doug purchased his father's half of Roush Yates Engines to become a co-owner in the company. Today, as CEO, Doug leads a staff of around 180 employees who work out of three separate state-of-the-art facilities.

In January 2010, Doug formed a partnership with Front Row Motorsports and Richard Petty Motorsports to field more Fords in NASCAR's Sprint Cup series. Some Sprint Cup teams that run engines built by Roush Yates include: Roush Fenway Racing, Team Penske, Richard Petty Motorsports, Woods Brothers Racing and Front Row Motorsports.

Doug's continuous commitment to Ford and its racing program is respected all over the world. Ford has always been his manufacturer of choice, and he is especially proud to be part of a team that developed the first purpose-built race engine designed by Ford, the "FR9."

Roush Yates achieved its 100th Sprint Cup Series win by capturing the Daytona 500 in 2015. Roush Yates Engines made history by sweeping all four major races at Daytona International Speedway in 2015 including the NASCAR Sprint Cup Series™ Daytona 500, NASCAR XFINITY Series™ Alert Today Florida 300, NASCAR Camping World Truck Series™ NextEra Energy Resources 250 and the Rolex 24 at Daytona for the TUDOR United Sports Car Championship.

May 2015 marked 25 years Doug Yates has worked in the motorsports industry. Whether he is running a race team or building champion caliber engines, Doug continues to exemplify tradition and success that will follow him well into the future. ▪

Brad Keselowski, left, is congratulated by Doug Yates after winning the pole for the NASCAR Sprint Cup Series at Darlington Raceway (Sept 5, 2015).

Doug Yates receiving the MAHLE Engine Builder of the Year award for the NASCAR Sprint Cup Series.

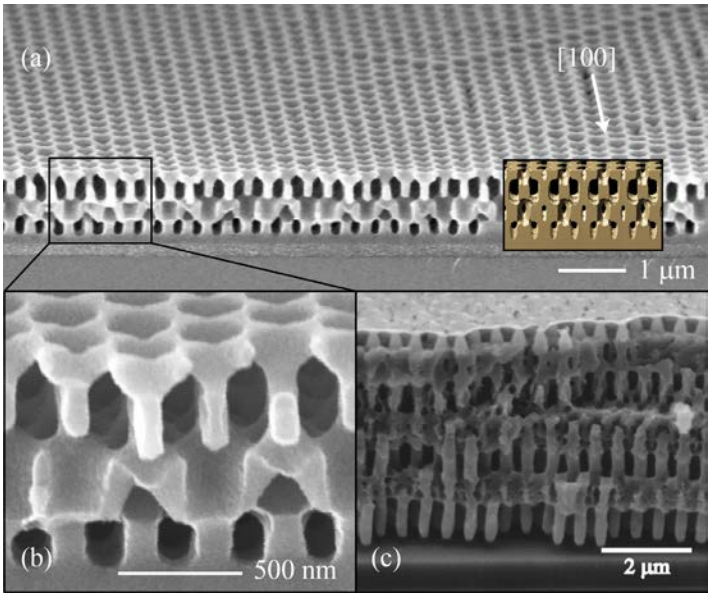
(From left to right) Jack Roush, Doug Yates, Robert Yates.

AWARDS AND HONORS

Dr. Chih-Hao Chang

NSF CAREER Award
Dr. Chih-Hao Chang

This Faculty Early Career Development (CAREER) grant will pioneer a novel three-dimensional (3D) nanolithography system using light interactions with colloidal elements. The ability to create a 3D object at the nanoscale has enabled unique material properties and device performances. However, almost all of the existing lithography systems are based on complicated mechanical, electronic, and optical hardware that can be prohibitively expensive. This award supports fundamental research to provide the required knowledge for low-cost 3D nanolithography that is based solely on colloid-light interactions. The new process focuses on colloidal nanoparticles, which will serve as elementary building blocks that can manipulate and shape light for nanoscale patterning. This research is interdisciplinary and will increase understanding in nanotechnology, physics, materials science and engineering. This system will enable scalable printing of complex 3D nanostructures for needleless drug delivery, multifunctional materials and stretchable sensors. The result of this research can find broad application in biomedical, energy, electronic and aerospace industries, and will benefit the U.S. economy and advance its manufacturing sector. The integrated research and educational goals will also greatly increase engineering education in society through direct engagement of K-12 students, teachers, parents and the local community in nanotechnology and nanomanufacturing.



Cross-sectional electron micrographs of periodic nanostructured materials using light interactions with nanoparticles.

Dr. Hsiao-Ying "Shadow" Huang

NSF CAREER Award
Dr. Hsiao-Ying "Shadow" Huang

Dr. Huang has been awarded a National Science Foundation CAREER Award for her project, "Restoring Function in Chronic Venous Insufficiency: Unraveling the Structural-Mechanics of Venous Valve Tissues." The award supports young faculty members in their efforts to build a successful research enterprise and comes with a five-year, $500,000 grant. This award will help support our ongoing investigation of structural-mechanical aspects of the venous valve tissues. The aim is to restore function in chronic venous insufficiency (CVI). CVI is a debilitating vascular disease with a prevalence estimated to be twice as high in women; risk increases with pregnancy, age, and occupations involving standing. CVI is considered a disabling condition by the US Social Security Administration; however, increasing prevalence has not been met with commensurate increases in rehabilitation research. This project will provide a detailed compositional, structural and biaxial mechanical characterization of venous valve leaflet, sinus and associated vein tissues. Thus, this research will fill a critical gap in the basic science of venous valves, as well as serve as a springboard for innovation, informing approaches to the treatment of CVI. Collectively, results will provide a much-needed comprehensive basis for understanding venous valve physiology, pathology, and for the advancement of both palliative and restorative therapies, including pharmacological, surgical and rehabilitation interventions to combat CVI.

NSF CAREER Award
Dr. Brendan O'Connor

The objective of this CAREER grant entitled Mechanical Behavior of Flexible Electronic Films is to improve the understanding of the mechanical behavior of polymer (organic) semiconductor films. Insight into the relationships between mechanical and electrical properties will provide guidelines to achieve mechanically

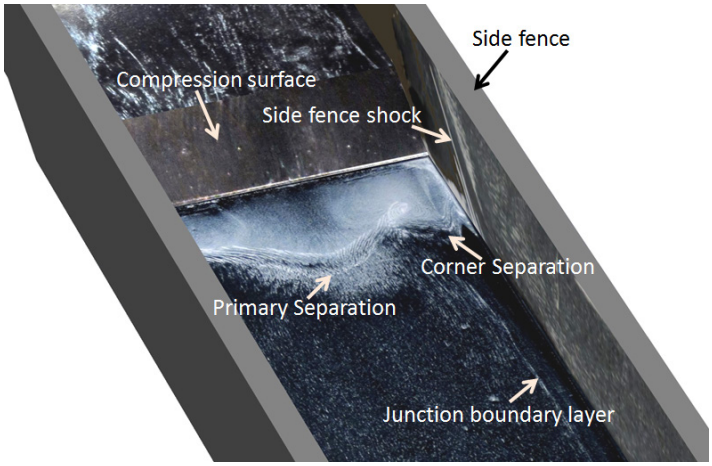
Dr. Brendan O'Connor

robust flexible electronics for applications such as wearable electronics and low cost solar power. Organic semiconductors are particularly promising for flexible electronics due to their relatively compliant nature associated with their molecular structure. In practice, mechanical failure has hindered the commercial adoption of these films for flexible electronic applications. This award provides support to investigate the impact of molecular structure, film microstructure, and device design on performance variation and failure modes of devices under flexure. Research will also include the role of cyclic bending and environmental factors such as moisture on mechanical stability. Through providing a fundamental framework relating polymer semiconductor structure to mechanical and optoelectronic characteristics, this research will help realize the enormous potential of flexible electronics. This grant also provides a wonderful opportunity for students to be engaged in research that crosses multiple disciplines including mechanics of materials, materials processing and semiconductor device physics. Lastly, the education plan includes the development of a certificate program in manufacturing and mechanics of emerging thin film electronics to train future leaders in this emerging field.

Dr. Venkat Narayanaswamy

AFOSR Young Investigator Award (YIP) Award – Dr. Venkat Narayanaswamy

Developing autonomous hypersonic platforms can make a game-changing impact on missile propulsion (global strike and reconnaissance), hypersonic cruises and commercial space access propulsion systems. Of particular interest in future scramjet technology is decreasing the lower operating Mach number limit to M=3.5, which closes the gap between low speed propulsion systems (e.g., turbojets) and scramjet engines. This has direct advantages by eliminating a number of components required for ramjet operation, which can result in overall weight reduction, more available payload weight and fewer components that must reliably function (thereby improving overall safety). However, an important bottleneck with decreasing the starting Mach number is the significantly higher propensity for the inlet to unstart during off-design and off-cruise (e.g., pitch up, climbing maneuvers) conditions. Inlet unstart denotes the disgorging of inlet/isolator shock train to result in fully subsonic flow inside scramjet engine, which results in catastrophic failure of the engine. To delay/offset the inlet unstart at low Mach numbers, an excessively long isolator section is required, which offsets the gains obtained from lowering the starting Mach number. Hence, there is a critical need to obtain basic understanding of unstart physics as well as develop tools to predict and control unstart, which forms the overall vision of this research effort. This research effort, funded through the AFOSR YIP award, will bring in state-of-the-art measurement tools and computational capabilities to develop unprecedented insights into the interactions between different separated flow units that result in inlet unstart. The figure below shows the different separated flow units that occur in a rectangular inlet. These separation units have very distinct individual characteristics in terms of their mean and unsteady motions and the driving flow features. The aim of this effort is to obtain critical details into how the different units mutually influence one another. The larger aim of this effort is to extend the findings made in rectangular inlets to axisymmetric inlets, which will be the most prevalent in future generation supersonic/hypersonic commercial platforms.



Schematic of different separation units generated during unstart in rectangular inlets.

Dr. Thomas Dow wins Lifetime Achievement Award

The American Society for Precision Engineering (ASPE) Lifetime Achievement Award is presented to individuals who have made significant contributions to the field of Precision Engineering. Dr. Thomas A. Dow is regarded worldwide as a founding father, a leading spokesperson and a top expert in the field of precision engineering.

aspe.net/technical-meetings/past-aspe-meetings/30th-aspe-annual-meeting/awards

Dr. Mohammed Zikry wins 2015 RJR Tobacco Company Award for Excellence in Teaching, Research and Extension

The award was established in 1981 within the College of Engineering to honor a member of the engineering faculty who has demonstrated superiority in several areas of activity that relate to the University's three-fold mission of teaching, research and extension. The annual award is supported by the R.J. Reynolds Tobacco Company through the NC State Engineering Foundation to recognize scientific and educational achievements in fields of engineering. The recipient is given a $25,000 prize distributed over five years.

news.engr.ncsu.edu/2015/11/zikry-receives-2015-rj-reynolds-award

Dr. Hassan A. Hassan: Distinguished Lecture

The inaugural Professor Hassan A. Hassan Distinguished Lecture "Breaking the sound barrier: The intellectual breakthroughs in aerodynamics that made it possible" was presented on Friday, November 13, 2015, at the James B. Hunt Jr. Library on NC State's Centennial Campus. The Professor Hassan A. Hassan Distinguished Lecture Series was established in 2015 through the generosity of his former students, fellow faculty members and other alumni at NC State University as a recognition of his dedication to the field of aerospace engineering.

news.engr.ncsu.edu/2016/03/hassan-lecture-series-honors-mae-professor

Dr. Yong Zhu: 2015 Sia Nemat-Nasser Early Career Award

The Sia Nemat-Nasser Early Career Award was established in 2008 by the Materials Division as a divisional award. In 2012, it was elevated to a Society award to recognize early career research excellence in the areas of experimental, computational, and theoretical mechanics and materials.

Dr. Zhu has been selected to receive the award "for outstanding contributions to the mechanics of nanomaterials including interfacial mechanics with applications to nanomaterial-enabled stretchable electronics."

www.mae.ncsu.edu/news/article/27911/dr-yong-zhu-receives-the-2015

Annie Erwin: SPA Engineering Award of Excellence

The MAE department congratulates our own Annie Erwin, graduate services coordinator, on receiving the Engineering SPA Award for Excellence.

www.mae.ncsu.edu/news/article/27915/annie-erwin-receives-spa-engineering-awards?from=rss

High Powered Rocketry Club and AE senior design students join forces and win a $25,000 prize

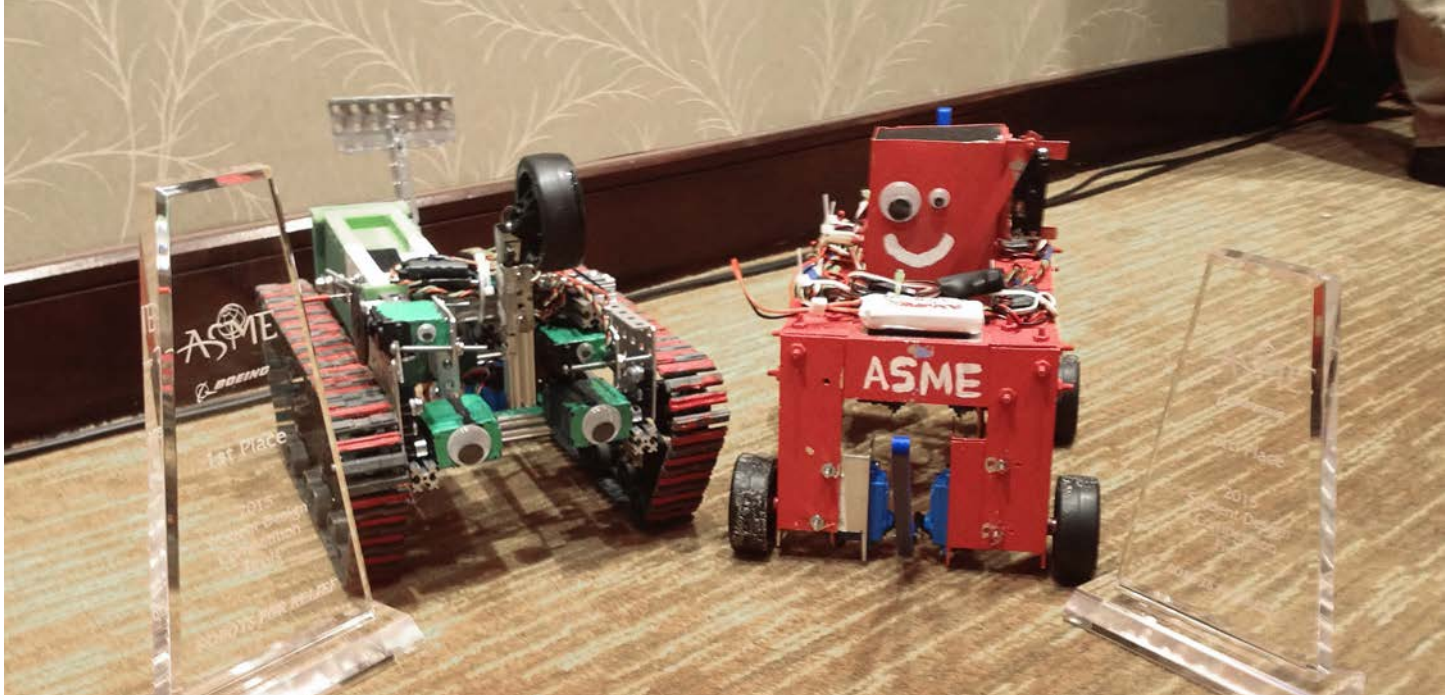
The HPRC and Space Senior Design Team 1 competed in the NASA Student Launch competition this year. It is an eight-month design challenge and this year they combined with the NASA Mars Ascent Vehicle Centennial Challenge for a greater challenge for the teams that chose to compete.

www.mae.ncsu.edu/news/article/27865/high-powered-rocketry-club-and-ae

ASME Student Section wins 1st and 3rd place at International Student Design Competition

The ASME Student Section competed in the International Student Design Competition at the IMECE meeting in Houston, Texas on November 15 and won both 1st and 3rd place. The two teams competed against 16 schools around the world in a competition called Robots for Relief. The robots, aptly named Red Rescue Rover (1st) and Wolftank (3rd), navigated a ramp, water box, sand box and two stair steps before dropping a payload of dried beans on target.

Team members at the ASME International Student Design Competition at the IMECE 2015.

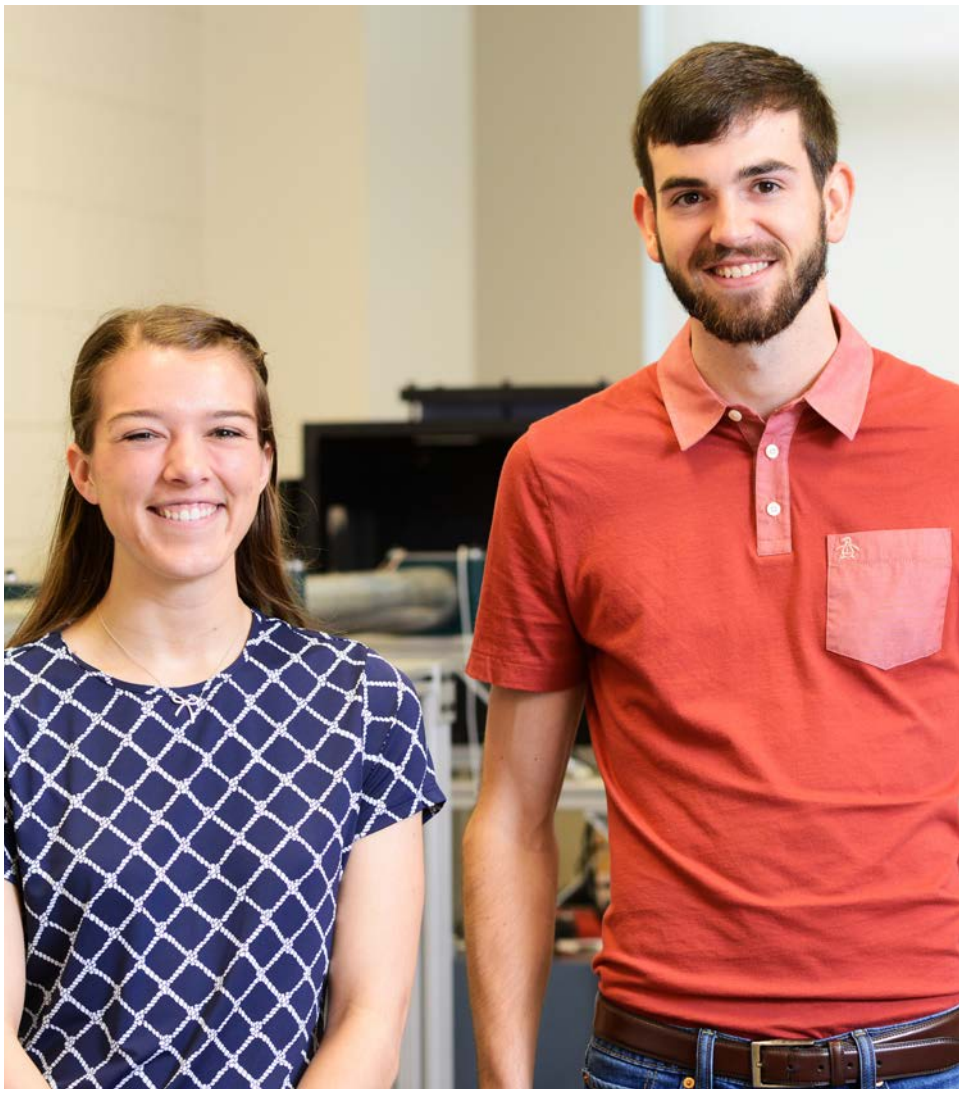


Red Rescue Rover (1st) and Wolftank (3rd)

This was a culmination of more than a year's engineering effort and winning a regional competition last spring at Embry Riddle University in Daytona Beach, Fla. Dr. James Kribs was the faculty adviser and Warren Weisler was the team lead.

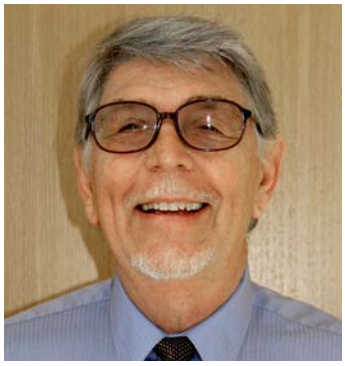
Two students receive graduate research fellowships

Two of our mechanical engineering graduate students, Ms. Samantha White and Mr. Tyler Goode, were selected to receive the National Science Foundation Graduate Research Fellowship. Samantha joined our department in the fall after finishing her undergraduate degree in mechanical engineering at Tennessee Tech. Her research topic is exploring "Strategic Excess Placement for Engineered System Evolution" (Adviser: Dr. Scott Ferguson). Tyler also joined our department in the fall after finishing his undergraduate degree in mechanical engineering at the University of Alabama. His research topic is "Modeling 3D Woven Composites Using Virtual Weaving and Isogeometric Analysis" (Adviser: Dr. Mark Pankow). ▪



Ms. Samantha White and Mr. Tyler Goode

Richard Johnson: an emeritus faculty member who continues to educate



Richard R. Johnson, professor emeritus and forever student, MAE Department

Like our graduates, I remember how it was when MAE was in Broughton Hall. We, faculty and students, take great pleasure telling what we endured back then. Current students still endure late study nights, pressing deadlines, terrible tests, frustrating faculty office hours, differential equations and the struggle to grasp those abstract concepts, but at the department's new home on Centennial Campus there are at least great classrooms, equipment that works, attractive space and now a spectacular new library. Additionally, the MAE 416 senior design space has vastly improved.

I was not around in 2010 when the move was made out of Broughton because I had already retired and was spending time in Africa as a "trailing spouse". I had a great time overseas with opportunities to teach in Mozambique, Kenya, Rwanda and Tanzania. However, after we returned home to North Carolina in Fall 2010, I felt the nostalgia for teaching at NC State. I really enjoy teaching and most of what goes with it. I find excitement in interacting with students and have an enthusiasm for learning. If only we did not have the tests, and the grading that goes with them!!! As a retiree I am pleased to be back in the classroom. The classroom has changed and is now often a recording studio in which students both in class, and those receiving synchronous classes online, still have to endure the professor's jokes. Every semester I make a "New Semester's Resolution" to finish class on time, and finally I am getting help from the automatic cut-off of the online connection. If only I could now get help to design a test to fit the time constraints of a class period we would have made progress.

Engineering basics remain unchanged but there is a dramatic change in what we can accomplish with our electronic devices and new materials. As a result there is also an enormous increase in scope and complexity of what is expected of a student. I find I have to regularly recalibrate my thinking and what I use as a classroom example. In fluid mechanics I quickly realized that the carburetor I carried to class to illustrate the usefulness for venturi flow was foreign in a world in which fuel injection is the way to go. How about all those homework problems involving a mercury manometer when pressure is measured with a sensor? In teaching thermodynamics and excitedly talking about the Otto cycle I was asked "what is the Atkinson cycle and why is it popular in the new hybrids." Great stuff. It is a brave new world that our students are living in and it is fun for us as teachers and researchers to both respond and to lead.

For many years I was advisor to the ASME student section, where I enjoyed the fun of getting to know students outside the classroom. Now ASME has a great advisor in Dr. Jeff Eischen, who has just had ASME student design teams win both the first and third places in the ASME National Design Competition … fantastic. Whether you were part of ASME, Wolfpack Motor Sports, AIAA or any of the many other specialty and honor societies it is time to come to Centennial and reminisce about the old times. We enjoy making the contact. How about sitting in on a class to feel the nostalgia, enjoy the excitement and realize the relief of no pending tests. Expect things to be both different and the same because we have all learnt to upgrade while hanging on to techniques that work. ▪

Johnson on Centennial Campus.

ALUMNI EVENTS

Drs. Rich Gould, John Anderson, Hassan Hassan and Mohammed Zikry.

» **September 4th —** Dr. Richard Gould, MAE department head, and Michael Walsh, MAE director of development, attended the National Corvette Museum Hall of Fame Ceremony in Bowling Green, Kentucky to welcome Mr. Herb Fishel (BSME '63) to its newest class of honorees. Mr. Fishel retired from General Motors after a 40-year career as executive director of GM Racing. Dr. Gould and Mr. Walsh were guests of Dr. Roland Yow (BSME '63, ME Ph.D. '70), who was Mr. Fishel's roommate at NC State.

» **October 7th —** Dr. Richard Gould presented to a group of 40 alumni at the National Institute of Aerospace in Langley, Va. The topic covered the long history between NASA-Langley and NC State. The Tidewater area of Virginia has a large concentration of NC State engineering alumni, especially from the MAE Department.

» **October 30th —** The MAE Department welcomed its newest class of Hall of Fame members during the College of Engineering's Homecoming festivities. Fourteen MAE alumni were honored as a crowd of 75 family members and friends celebrated the third annual event.

» **November 13th —** The MAE Department held its first distinguished lecture, the Dr. Hassan A. Hassan Distinguished Lecture, in the Hunt Library auditorium. Dr. John Anderson, curator of aerodynamics at the Smithsonian National Air and Space Museum was the featured speaker. Dr. Anderson presented "Breaking the Sound Barrier: the intellectual breakthroughs in aerodynamics that made it possible" to a crowd of 300 alumni, students, faculty members and friends. The lecture was established by alumni, faculty members and friends as a way to honor Dr. Hassan's contributions to the MAE department. Dr. Hassan has been with the MAE department for more than 50 years. If you missed the lecture, you can view it at **vimeo.com/145683013**

» **February 9th —** The MAE department partnered with NC State's Alumni Association to co-host an event at the NASCAR Hall of Fame in Charlotte, NC that feature alumni who have impacted the motorsports industry. A panel of distinguished NC State alumni including MAE graduates Herb Fishel (BSME '63), Eric Warren (BSAE '91, MSAE '93, Ph.D. AE '97) and Patrick Canupp (BSAE '91, MSAE '93) talked about their experiences in the motorsports industry.

» **April 20th —** The MAE Department held an alumni event at the historic Narrows Dam in Badin, NC. The event featured a presentation and tours of the dam.

» **May 13th —** The MAE department will be holding its Third Annual Golf Tournament at Lonnie Poole Golf Course located on NC State's Centennial Campus. Details will be coming soon! ▪

NEW FACULTY AND STAFF

Dr. Jun Liu

Dr. Jun Liu received his B.E. in thermal engineering from Huazhong University of Science and Technology (Wuhan, China) in 2008 and Ph.D. in mechanical engineering from University of Colorado at Boulder in 2013. Prior to joining the MAE faculty, he was a postdoctoral research associate in the Materials Science and Engineering Department at the University of Illinois at Urbana-Champaign. He received the Outstanding Dissertation Award from the College of Engineering at CU-Boulder in 2013. His research interests include atomistic simulation and ultrafast-laser characterization of thermal transport, thermal energy conversion and storage, thermal management of microelectronics and nanoscale thermal transport phenomena in advanced materials.

Dr. Granlund

Dr. Kenneth Granlund received his M.S. in vehicle engineering from the Royal Institute of Technology in Sweden and a Ph.D. in aerospace engineering from Virginia Tech in 2003. Prior to joining the NC State faculty, he was a research engineer at the Air Force Research Laboratory at Wright-Patterson AFB in Ohio. Presently, he studies the influence of streamwise velocity fluctuations on airfoils undergoing unsteady pitching and plunging. This is a natural extension of the "dynamic stall" problem and it applies mainly to helicopters and wind energy. Another topic is the theoretical concept of apparent mass and under what conditions it can be treated as a separate entity from circulatory force and off-body vortices.

Dr. Pramod Subbareddy received a BTech in aerospace engineering from the Indian Institute of Technology, Madras and a Ph.D. in aerospace engineering from the University of Minnesota. Prior to joining NC State in the fall of 2015, he was a research associate at the University of Minnesota. His interests are in the simulation and analysis of transitional and turbulent high speed flows. Currently, he is involved in projects that involve the construction of high-fidelity tools for the efficient solution of these problems and in work that uses these tools to study a wide range of flowfields.

Dr. Pramod Subbareddy

Katlyn Taylor is the undergraduate administration support specialist for the MAE undergraduate office. She is responsible for the day to day operations of the office, which include answering student inquires, helping with student communications and the registration process. Katlyn also coordinates with Annie Erwin, the graduate services coordinator, to plan both the fall and spring MAE graduation ceremonies. As an NC State alumnus, she enjoys being able to still be on campus and interacting with students. Katlyn received a B.S. in sport management in 2014, after moving to Raleigh in 2012 once she completed her Associate in Arts from Lenoir Community College. In her free time, Katlyn enjoys spending time with her husband, Jacob, and their husky named Cooper.

Katlyn Taylor

Elizabeth Baker

Elizabeth Baker is a contracts & grants manager for the MAE Department. She is responsible for managing the pre- and post-award side of the grants. Elizabeth works with the faculty on applying for research grants, developing budgets/justifications and making sure proposals are processed through the University. On the post-award side, Elizabeth sets up the new accounts, helps manage the budgets and approves spending on the accounts. Elizabeth enjoys working on campus and is a big Wolfpack fan. Elizabeth received a B.S. in business administration, as well as an M.A. in accounting, from the University of North Carolina at Wilmington. Prior to joining the MAE staff, Elizabeth worked as an auditor with KPMG and also represented the town of Garner in 2014, where she competed in Miss North Carolina. Outside of work, Elizabeth enjoys dancing and running in her free time. ▪

DONOR LIST

The Department of Mechanical & Aerospace Engineering at NC State is grateful to our donors for their generous support. This list represents donations between January 2015 and December 2015. While we make every effort to be accurate and thorough, it is possible to accidentally omit or misspell a name. Please contact 919.515.3241 with any additions or corrections.

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MAE 2015 Hall of Fame inductees

The MAE Hall of Fame was established to inspire our current students and to celebrate accomplishments of those extraordinary graduates who have used their education to excel in a profession, career or service. The nomination is based on professional and service achievement, entrepreneurship and contributions to professional societies.

The MAE department would like to congratulate the 2015 Hall of Fame Inductees. Learn more at:
www.mae.ncsu.edu/news/article/28836/congratulations-to-the-2015-mae-hall

Congratulations to the following MAE Hall of Fame inductees for 2015!

Andrew Adams
BSME '62

Bill Ailor
BSAE '67 and
MSAE '69

Tom Brooks
BSME '68 and
Ph.D. ME '74

Chris Collins
BSME '72

Doug Utley
BSME '73

Doug Yates
BSME '90

John Korte
Ph.D. AE '89

Jerry Hester
BSME '53

James Redmond
BSAE '87, MSME '89,
Ph.D. ME '92

Zan Smith
BSME '65, MSME
'68, Ph.D. ME '77

Lonnie (Ven) Poole
BSAE '85

W.W. Griffin
BSAE '65

Eric Warren
BSAE '91, MSAE '93,
Ph.D. AE '97

Tom Smith
BSME '88

We are now accepting nominations for our 2016 Hall of Fame class. Please go to **mae.ncsu.edu/alumni** to submit your nomination today!

QUICK FACTS

A look at some of the figures that shape the Department of Mechanical and Aerospace Engineering at NC State.

1

An ASME Student Section team took first place in the International Student Design Competition at the IMECE in a competition called Robots for Relief with its robot Red Rescue Rover. A second NC State team took third place with a robot called Wolftank.

Aerospace Engineering	**B.S.**	**M.S.**	**Ph.D.**
	53	14	7
Mechanical Engineering	**B.S.**	**M.S.**	**Ph.D.**
	173	66	28

Total 2014-2015 MAE Graduates

341

2014-2015 Research Expenditures

$11,996,500

Research Proposals in 2014-2015

151 submitted valued at **$41.5 M**

77 new awards valued at **$7.4 M**

MAE Hall of Fame Alumni

80

NC STATE Engineering

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Gifts support scholarships, fellowships, professorships, academic programs, faculty and student research and other initiatives that are not typically supported through state appropriations. This private philanthropy creates excellence in research and education.

To learn more about supporting the Department, contact Michael Walsh.

Michael Walsh
919.515.7237
mpwalsh2@ncsu.edu

www.mae.ncsu.edu

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