NC STATE Engineering

Spring / Summer **2018**

MAETRIX

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Metal foam blocks blastwave, debris from high-explosive rounds

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Mechanical engineering seniors take real world problems to solve in senior design course

MAE **AT A GLANCE**

2017-18 QUICK FACTS

RESEARCH EXPENDITURES

$13 MILLION PER YEAR

More than $7 Million in external funding

(Federal, State and Industry)

44 TENURED AND TENURE-TRACK FACULTY

26 Full; **10** Associate; **8** Assistant

3 FULL TIME NTT TEACHING FACULTY MEMBERS

6 RESEARCH CONCENTRATIONS

4 PART TIME TEACHERS AND RESEARCHERS

UNDERGRADUATE

1150 Total number of undergraduate students

3.4 Average undergraduate GPA

282 Degrees conferred

330 ME / 93 AE New undergraduate students

320 MAE Intended Engineering First Year undergraduates

GRADUATE

385 Total number of graduate students

136 Degrees conferred

139 Ph.D. students

82 Aerospace graduate students

303 Mechanical graduate students

246 Master's degree students

102 Online graduate students

RESEARCH CONCENTRATIONS AND FACULTY MEMBERS

Aerodynamics, Fluid mechanics, Propulsion and Space Explorations Systems

Echekki, Edwards, Ekkad, Gopalarathnam, Granlund, Hall, Kleinstreuer, Luo, Mazzoleni, Narayanaswamy, Subbareddy, Yuan

Dynamics, Vibrations, Controls, and System Design

Buckner, Ferguson, Jing, Keltie, Ro, Saul, Silverberg, Tu, Wu

Structural Mechanics, Materials and Manufacturing

Bryant, Chang, Dow, Eischen, Grace, Huang, Jiang, Mazzoleni, Muller, Ngaile, O'Connor, Pankow, Peters, Rabiei, Ro, Strenkowski, Tu, Yuan, Zhu, Zikry

Thermal Sciences and Energy Systems

Bryant, Echekki, Edwards, Ekkad, Fang, Gould, Kuznetsov, Liu, Lyons, O'Connor, Saveliev, Terry

Biomedical and Biological Systems

Buckner, Huang, Kleinstreuer, Kuznetsov, Muller, Saul

Nanoscale Science and Engineering

Chang, Jiang, Jing, Liu, Zhu

RANKINGS

- ***U.S. News and World Report:*** ME ranked 38th out of 79 graduate programs; AE ranked 30th out of 66 graduate programs
- **College Choice:**
  - ME graduate program ranked 22nd out of 35 for Best Masters in ME
  - ME ranked 5th of 15 for Most Affordable Online Masters
- **SR Education Group's Top 25 Best Online Master's:** ME masters program ranked 14

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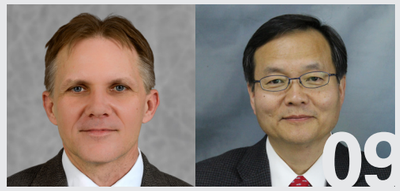

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02

UPDATE FROM THE **DEPARTMENT HEAD**

Dr. Srinath V. Ekkad

DEAR FRIENDS AND ALUMNI OF MAE,

Greetings from your department. Spring is always a great time to apprise you of all the great things happening in the department. As I look at my first academic year as head of the department, I am excited by the new ideas and initiatives that will keep us on the path to maintaining our stature as one of the premier mechanical and aerospace engineering departments in the nation, if not the world. In the past year, I have had the opportunity to learn about our storied history and all the intricate stories that make our department unique. One of the interesting things while reading the history of the department is that this is the 125th graduating class for mechanical engineering, which is something to be very proud of. We celebrated the class and our proud history at the Spring graduation this year on May 11th, 2018.

We entered this year with a huge spike in enrollment in both ME and AE programs. The demand for mechanical engineering is being felt across the nation. Our students are getting multiple offers from employers and more and more students are asking for mechanical and aerospace engineering as their first choice. So, we do have the best of the students in the College of Engineering, if not the state. We are working to ensure that the students have the best of experiences in spite of the increasing numbers. Our faculty is committed to providing a challenging and nurturing environment to our students. We started the MAE POP (Post Orientation Party) for incoming sophomores last year, which was a huge success and we plan to hold the event this year on September 20th. We are also creating a new student lounge on the 3rd floor this summer for both graduate and undergraduate students. The lounge will have a ping pong table, foosball tables, dart boards, etc. for students to relax and be entertained while they tackle our challenging program.

On the research front, we are solving societal and human problems through our various activities. Many of our faculty are focused on human health, novel materials, improved transportation, clean energy, and space exploration, and many other challenges. Our research is very connected to our ever-changing world and we are working with federal agencies, industry partners, and other university partners to solve these issues. We have very dynamic faculty members who are constantly collaborating and building multi-disciplinary teams to look at problems holistically. In addition, we have had many successes in our faculty members being recognized for their activities. Many are highlighted in this newsletter. One achievement I would like to point out is the NSF CAREER award for assistant professor Landon Grace. This is a prestigious award for a junior faculty member.

As many of you know, Dr. Gould stepped down last year as department head. However, Dr. Gould remains very active in the department. He is currently helping with MAE Motorsports and is also busy with his research program. MAE Motorsports is a very highly visible activity that our undergraduates take up and we need our alumni to come back and help them achieve their goals. We are also focusing on improving our facilities at MAE Annex or lovingly called MAE West. The location has huge potential but needs urgent help to develop into a fantastic facility for research and student team activities. We need our alumni to help us achieve this goal.

On the alumni front, we had a big class of inductees into the 2017 Alumni Hall of Fame. We are currently seeking nominations for our class of 2018 inductees. We are also merging the two boards (alumni and corporate) into one board that will work together on all goals. We are also planning to create a new recent alumni advisory board that comprises of graduates who are within five years from their B.S. This group will help in developing short-term goals in developing industry relations and also with the evolution of our curriculum. We are continuing many of the activities that we started in the past few years including MAE connect and "Lunch with Alumni."

As I am writing this letter, I am excited about the April 20th groundbreaking for the new Fitts-Woolard Hall and this will bring the rest of the college (except nuclear engineering) to the Centennial Campus. The new building will be a great addition to the Engineering Oval.

In closing, I want you to come visit and engage with your home department as much as possible. If you want to participate in our alumni activities or figure out how to attract more MAE students to be employed at your location, please contact us. We look forward to bringing you all home. We also need your help in providing more resources to the department be it through monetary donations, your time, or through equipment that will help improve our facilities. Many of the activities you associate with your college experience are not supported by state funds and will need to be covered by other sources. We hope you will keep us in mind next the time you want to contribute to some activity of greater good.

We hope you continue to keep yourself updated with our MAE news. We are constantly updating our website and, through this newsletter, telling a few in-depth stories. If you ever want to stop by and visit, please email me at **sekkad@ncsu.edu**.

Best Regards,
Srinath V. Ekkad
Department Head and R.J. Reynolds Professor

04

MAE IN THE WORLD

The Future of Armor

Lightweight Metal Foam Blocks Blastwave, Debris From High-Explosive Rounds

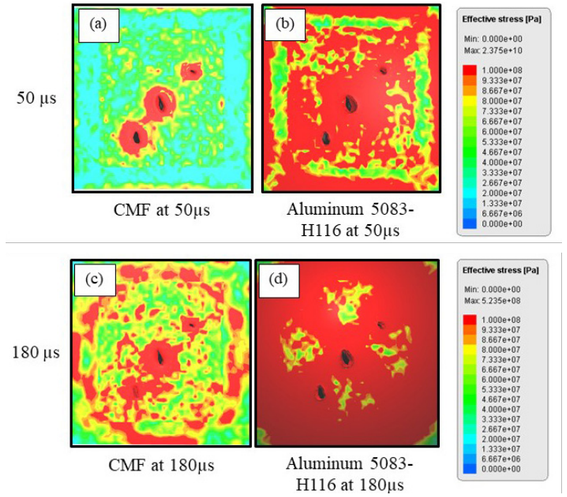
Faculty: Dr. Afsaneh Rabiei

Dr. Afsaneh Rabiei checks on metallic foam created in her lab.

NEW RESEARCH FROM NC STATE UNIVERSITY and the U.S. Army's Aviation Applied Technology Directorate shows that stainless steel composite metal foam (CMF) can block blast pressure and fragmentation at 5,000 feet per second from high explosive incendiary (HEI) rounds that detonate only 18 inches away.

"In short, we found that steel-CMF offers much more protection than all other existing armor materials while lowering the weight remarkably," says Dr. Afsaneh Rabiei, senior author of a paper on the work and a professor of mechanical and aerospace engineering at NC State. "We can provide as much protection as existing steel armor at a fraction of the weight — or provide much more protection at the same weight.

"Many military vehicles use armor made of rolled homogeneous steel, which weighs three times as much as our steel-CMF," Rabiei says. "Based on tests like these, we believe we can replace that rolled steel with steel-CMF without sacrificing safety, better blocking not only the fragments but also the blast waves that are responsible for trauma such as major brain injuries. That would reduce vehicle weight significantly, improving fuel mileage and vehicle performance."



Left: This image shows the CMF panel after the test. The black marks are fragments trapped inside the panel. The image shows there are no cracks or physical bowing -- even after the frags struck at speeds of 5000 feet per second.

Right: Comparison of the stress distribution in CMF (a,c) and aluminum 5083-H116 (b,d) panels upon interaction with blast wave and fragment impacts resulted from HEI round at 50 µs (a,b) and 180 µs (c,d). Note that the CMF and aluminum panels had the same thickness and mass.

For this study, researchers fired a 23×152 millimeter (mm) HEI round — often used in anti-aircraft weapons — into an aluminum strikeplate that was 2.3 mm thick. Ten-inch by 10-inch steel-CMF plates — either 9.5 mm or 16.75 mm thick — were placed 18 inches from the aluminum strikeplate. The researchers assessed that the steel-CMF held up against the wave of blast pressure and against the copper and steel fragments created by the exploding round, as well as aluminum from the strikeplate.

"Both thicknesses of steel-CMF stopped the blastwave, and the 16.75 mm steel-CMF stopped all of the fragments from 15 mm^2 to over 150 mm^2 sizes," Rabiei says. "The 9.5 mm steel-CMF stopped most, but not all, of the fragments. Based on the results, a 10 mm steel-CMF plate would have stopped all of the frag sizes."

The researchers also developed computer models of how the steel-CMF plate would perform. When compared to the experimental results, the model matched very closely. The researchers then used the model to predict how aluminum 5083 armor — a type of armor already on the market that has a similar weight and thickness to the 16.75 mm steel-CMF — would perform against HEI rounds.

The model showed that, while aluminum armor of similar weight to the steel-CMF panels would stop all of the frags, the aluminum armor would buckle and allow fragments to penetrate much deeper. This would result in more damage to the panel, transferring large amounts of stress to the soldiers or equipment behind the armor. The steel-CMF, on the other hand, absorbs the energy of the blast wave and flying fragments through local deformation of hollow spheres, leaving the steel-CMF armor under considerably less stress — offering more protection against fragments and blast waves.

Next steps include testing the steel-CMF against improvised explosive devices (IEDs) and high-caliber, mounted ballistics. The researchers have already tested the CMF's performance against hand-held assault weapons, radiation and extreme heat.

The paper, "A study on blast and fragment resistance of composite metal foams through experimental and modeling approaches," is published in the *Journal of Composite Structures*. Lead author of the study is Jacob Marx, a Ph.D. student at NC State. The paper was co-authored by Marc Portanova of the Aviation Applied Technology Directorate. The work was done with funding from the Department of Defense's Joint Aircraft Survivability Program under grant number JASPO-V-15-03-001. ■

Research Highlights

Dr. Scott Ferguson

THE SCIENCE OF ENGINEERING DESIGN

Dr. Scott Ferguson's research addresses the science of engineering design and is motivated by the challenge that engineers must constantly balance tradeoffs. These tradeoffs result from the organizational, political and human interactions that serve to define the criteria under which the system operates. For any engineering problem, even the most basic decisions require making tradeoffs to maximize the value of the design.

Lately, Ferguson has been emphasizing how to balance efficiencies in product line manufacturing with preference optimization in terms of consumer demand. Product lines that create cost efficiencies by sharing key and costly components across multiple products create much more value for the firm while also improving the array of offerings for consumers. Ferguson recently also served on an expert panel during the recent Turbo Choice Modeling seminar at the 2018 Sawtooth Software Conference. "We are extremely grateful to the generosity and expertise of academics like Scott who are making important contributions to marketing sciences and economics," said Bryan Orme, president of Sawtooth Software.

WHAT DO YOU GET WHEN YOU CROSS AN AIRPLANE WITH A SUBMARINE?

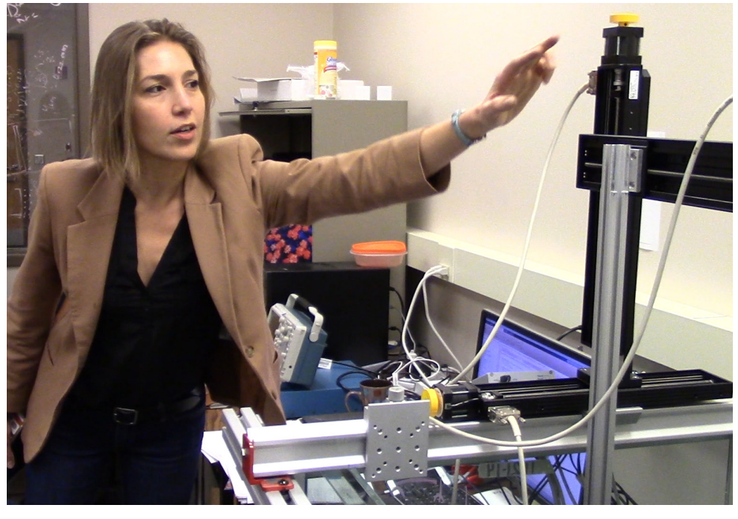
Dr. Matthew Bryant and his team have developed the first unmanned, fixed-wing aircraft that is capable of traveling both through the air and under the water — transitioning repeatedly between sky and sea. The EagleRay XAV, which was developed with funding and assistance from Teledyne Scientific, holds promise for use in applications such as tracking and observing wildlife. "A key point regarding the EagleRay design is that it is scalable — you can make larger or smaller models as needed," says William Stewart, a Ph.D. student who worked on the project. "It really depends on the size of the desired payload, how long you'd need it to operate, and so on."

The current model of EagleRay has a wingspan of 59 inches and is 55 inches long, weighing in at 12.6 pounds. It has a dual-use propeller, powered by an electric motor, that propels it through both air and water. The researchers are also refining a dynamic model of the EagleRay, for use in simulations that can be used for training purposes, to predict performance under various conditions and to refine the vehicle design. "Seeing it fly during field trials was exhilarating," says Stewart.

Dr. Matthew Bryant, left, and his team.

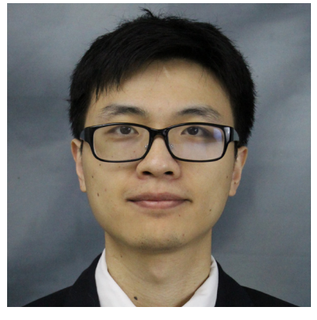
NEW SOURCES OF IMAGING CONTRASTS

The focus of **Dr. Marie Muller**'s research is on the development of new sources of imaging contrasts that provide diagnostically relevant information. Her approach is based on understanding the propagation of ultrasound and elastic waves in biological tissue, and to establish quantitative relationships between ultrasound parameters and the microarchitecture of tissue. Ongoing research in her lab addresses bone, soft tissue and porous materials. Her projects include: bone microarchitecture modelling and assessment, characterizing vascular networks, and the fundamentals of multiple scattering in tissue.



Dr. Marie Muller

ULTRASOUND DRUG DELIVERY AND HIGH INTENSITY ULTRASOUND



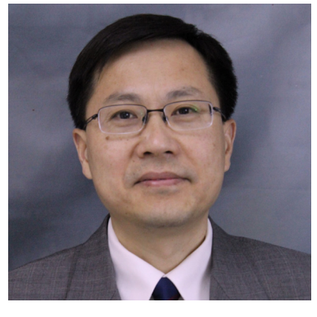
Dr. Yun Jing

Dr. Yun Jing is currently contributing to the development of ultrasound drug delivery and high intensity focused ultrasound, developing numerical algorithms for predicting acoustic wave behavior in various media, studying the acoustic meta-materials for sub-wavelength imaging, noise reduction and cloaking, and designing noise insulation materials. In MAE, he collaborates with Drs. Xiaoning Jiang, Fuh-Gwo Yuan, Yong Zhu and Marie Muller. Other research collaborators at NC State include Dr. Zhen Gu, associate professor in the Joint UNC / NC State Department of Biomedical Engineering.

Jing recently developed an "ultra-thin" sound diffuser that is 10 times thinner than the widely used diffusers found in recording studios, concert venues and movie theaters to reduce echoes and improve the quality of sound. The new design uses less material, which would reduce cost, as well as taking up far less space.

NEW ULTRASOUND "DRILL" TARGETS DEEP VEIN BLOOD CLOTS

Dr. Xiaoning Jiang and researchers at NC State and the University of North Carolina at Chapel Hill have developed a new surgical tool that uses low-frequency intravascular ultrasound to break down blood clots that cause deep vein thrombosis. The tool is the first ultrasound "drill" that can be aimed straight ahead, allowing doctors to better target clots —which holds promise for significantly reducing treatment time. To date, the technology has been tested only in synthetic blood vessels. "Our new ultrasound tool is forward-facing, like a drill, but still breaks down clots into very fine particles," says Jiang. Our approach improves accuracy without relying on high doses of blood thinners, which we hope will reduce risks across the board." The tool also incorporates an injection tube that allows users to inject microbubbles at the site of the clot, making the ultrasound waves more effective at breaking down the clot.



Dr. Xiaoning Jiang

Jinwook Kim, lead author of the paper and a Ph.D. student in

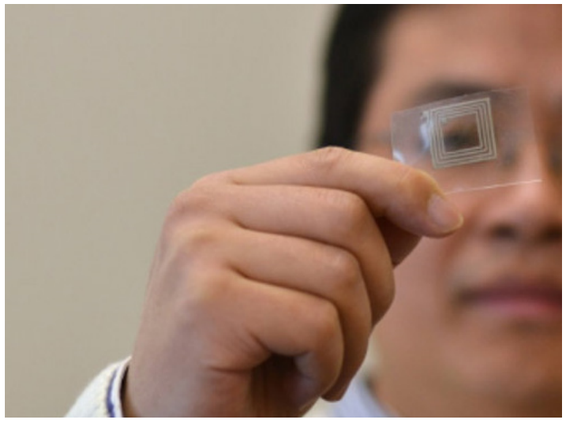
Research Highlights

Jiang's lab said, "We found that we could dissolve 90 percent of a clot in 3.5 to 4 hours without using any blood thinners at all — that's compared to 10 hours for the combination of conventional ultrasound tools and blood thinners."

APPLYING MECHANICAL ENGINEERING TECHNOLOGY

Dr. Katherine Saul's research applies mechanical engineering techniques to improve treatment outcomes for neuromusculoskeletal disorders of the upper limb across the lifespan, using both computational dynamic simulation and experimental methods (including imaging, motion capture, and functional assessments of musculoskeletal performance). She uses computational simulation of muscle mechanics and the dynamics of functional movement to compare treatment options and predict functional outcomes, and explores muscle control strategies and movement compensations exhibited by healthy and impaired patients to provide a foundation for clinical practitioners to optimize rehabilitation for their patients. Recently, her work has focused on characterizing shoulder movement and neuromuscular control and compensations due to rotator cuff impairment in older adults and peripheral nerve injury in the upper limb. She is also interested in identifying general principles of scaling for upper limb musculoskeletal anatomy, useful for developing patient-specific approaches to clinical research.

Dr. Katherine Saul



Dr. Yong Zhu

NEW TECHNIQUE ALLOWS PRINTING OF FLEXIBLE, STRETCHABLE SILVER NANOWIRE CIRCUITS

Dr. Yong Zhu and Dr. Jingyan Dong, associate professor in the Edward P. Fitts Department of Industrial and Systems Engineering, have developed a new technique that allows them to print circuits on flexible, stretchable substrates using silver nanowires. The advance makes it possible to integrate the material into a wide array of electronic devices.

Silver nanowires have drawn significant interest in recent years for use in many applications, ranging from prosthetic devices to wearable health sensors, due to their flexibility, stretchability and conductive properties. While proof-of-concept experiments have been promising, there have been significant challenges to printing highly integrated circuits using silver nanowires.

The researchers have used the new technique to create prototypes that make use of the silver nanowire circuits, including a glove with an internal heater and a wearable electrode for use in electrocardiography. NC State has filed a provisional patent on the technique.

"Given the technique's efficiency, direct writing capability, and scalability, we're optimistic that this can be used to advance the development of flexible, stretchable electronics using silver nanowires — making these devices practical from a manufacturing perspective," Zhu says. ■

09

PROGRAM **UPDATES**

Undergraduate news from Dr. Jack Edwards, Associate Department Head and Director of Undergraduate Programs

The MAE Undergraduate Program welcomed a record number of new students in the 2017-18 academic year, 423 total with 330 ME and 93 AE. Currently, we have about 1,150 undergraduate students in the department with 320 Engineering First-Year students that intend to matriculate into the program. Our students are high performers with an average GPA near 3.4. We awarded 59 B.S. degrees in December 2017 and 223 B.S. degrees in May 2018. On September 8, 2017, our inaugural POP (Post Orientation Party) event was held as part of our sophomore orientation. We set up on the Oval outside EB III with live music, NC BBQ, student club and groups exhibits along with games and activities. For Fall 2018, we plan to invite corporate sponsors and hold the event in conjunction with the bi-annual Engineering Career Fair. Our student clubs are more active than ever — from ASME Design Team to High Powered Rocketry to Aerial Robotics to MAE Motorsports, Formula and Baja to Solar Car. Every year we try to expose our students to as many professional development events as possible. In the fall, United Technologies Aerospace Systems presented on Professionalism and Diversity in the Workplace along with Work Life Balance. This spring, 2011 AE alumna Dr. Whitney Lohmeyer came to speak about Space Systems, Satellites and Accessible Internet for the Globe.

Graduate news from Dr. Paul Ro, Associate Department Head and Director of Graduate Programs

The MAE Graduate Program offers master's and doctoral degrees in both aerospace engineering and mechanical engineering with 385 students currently enrolled. We also have the largest distance education program in the College with 102 students currently enrolled. Our Ph.D. students have been very successful in representing our department in conference presentations and journal publications with a total of 92 journal papers published, 74 submitted, and 157 conference presentations. We have 43 tenure-track faculty members conducting active and cutting-edge research projects in more than 30 sub-concentration areas and offering more than 50 graduate courses that span all topics of aerospace engineering and mechanical engineering. In March of 2018, we held the 4th annual graduate research symposium that featured 74 poster presentations and 10 keynote oral presentations all by current Ph.D. students. In Fall 2018, the MAE graduate program will be home to two recipients of the Graduate Research Fellowship by the National Science Foundation and three recipients of the Provost Doctoral Fellowship. ■

From top, Drs. Jack Edwards and Paul Ro.

10

FEATURE
STORY

Interview

Dr. Srinath Ekkad's First Year as Department Head

Halen Mattison, left, interviews Dr. Srinath Ekkad in his office.

By: Halen Mattison,
a sophomore in mechanical
engineering from Monroe, NC.

Halen is a Goodnight Scholar and student-leader in several organizations on campus, including the National Academy of Engineering Grand Challenge Scholars Program. He serves as a College of Engineering Ambassador and undergraduate researcher in the Engineering Mechanics and Space Systems Laboratory. Halen was recently elected president of Pi Tau Sigma, the Mechanical Engineering Honor Society at NC State.

Halen Mattison: What got you interested in engineering, specifically mechanical?

Dr. Srinath Ekkad: I grew up in India, and the system there is very different. You basically go to take an entrance exam and you get a discipline given based on your ranking. In my case, luckily, my ranking matched my interest, which was mechanical. I was always mechanically inclined. My father liked to tinker with things and he had directed me that way, and had instilled that mechanical guys could do anything, whereas other disciplines were too specific. So I had that lodged in my mind and I was excited that everything lined up perfectly to be a mechanical engineer. I've enjoyed it for the last 34 years now.

H: Could you give a brief overview of your career leading up to this position?

E: I got my undergrad in India, and I started thinking about what I should do from there. Everybody was doing GREs and I thought I should check that out, because in India graduate work is almost impossible, at that time at least, now it's better. So, I took the exam and got admitted to Arizona State to do my master's. I came to do advanced manufacturing, what that meant at the time I don't know, but it seemed like a cool thing to do—the program with robots and assembly-line manufacturing. And that's what I thought I'd do. Somehow I ended up in a professor's lab doing heat transfer, and I didn't realize at the time that he was a world-famous guy doing gas turbines. I started to think, "Maybe I'm not ready for a job," and at the end of my master's I didn't see why I shouldn't get a Ph.D.

Initially, I wanted to stay at Arizona State, but my advisor told me I ought to look elsewhere, and that's how I ended up at Texas A&M. I was working under a professor that was young and hungry, ready to do more, and he's actually now the world-famous guy in gas turbines. So it became that my career would be in gas turbines. When I finished my Ph.D. and it was time to look for work, the economy was bad, around 1995, and companies weren't hiring. Especially those with foreign visas. So I stayed back with my professor and did a post-doc, which got me a green card. That got me interviews in industry and I ended up with Rolls-Royce. But, then I didn't really enjoy the industry job, it felt too simple and straightforward. So I started applying for faculty positions and ended up at Louisiana State University. Initially I thought I'd made a mistake and I should go back to industry, but I decided to stay on and struggle through those years until I got tenure. Then after about six or seven years, I decided I wanted to go to a better school and "play in the big leagues."

So I did a few interviews and ended up at Virginia Tech (VT). I worked 10 years there and built a fantastic lab, worked with great people and great companies. Last year, this opportunity [to become department head] came up and I thought, "let's see if I can do something in leadership."

Interview with Dr. Srinath Ekkad

H: You had actually interviewed with NC State at one point years ago, correct?

E: That's right, in 1996 I had gotten my Ph.D. and I interviewed with NC State and got turned down, they said I wasn't good enough for the job. So, I came back with a vengeance this time.

H: How has your first year as department head of MAE been?

E: I came in this September, a little late because I was wrapping things up at VT and getting my kids started in school. So it's been eight months, and I've been having a lot of fun. The faculty, the students, and the environment is great. There is a lot of potential here. I think there are a lot of great stories to tell, and it's my job to be the cheerleader for them. In my first year here I've seen some changes that needed to be made and ways we can enhance what we are already doing well — we don't want to lose what we are doing well. We don't want to change for the sake of change. I'm hoping we'll turn that corner in the next couple of years, and get the accolades we know we deserve.

H: I think that's a great way of putting it. During a meeting I had with Chancellor Woodson he said something very similar, that when he came in he saw a prestigious university that didn't quite know how to sell itself and get that well-deserved praise.

E: It's the exact same thing with our department. I think the faculty here are much better than those at Virginia Tech, but Virginia Tech is higher ranked. It's much more visible. They do a much better job of telling their story. I think NC State would easily walk all over our competition if we tell our stories.

H: Coming into this role of department head, have there been any surprises, or unexpected factors?

E: I'm very impressed with the state funding for this program. For many schools, they're losing their state funding and here in MAE, it is the opposite. The University is very supportive, you just have to ask. The best part has been getting to work in EB III (Engineering Building 3), such a great space and environment. We get the best students in the state here, and we have very, very, very, good faculty. They say that when faculty stay in a place for many years it's a good sign and we have so many faculty that have been here 15-20 years and it's an indicator of people wanting to stay. That was a surprise for me, especially in recruiting faculty, how people see living and working here as such a big plus.

H: Who all have you had the chance to meet this year, and how have they impacted your work?

E: The two most interesting people I've gotten to meet this year have been Chancellor Woodson and Dean Louis Martin-Vega. They both really appreciate me. I didn't know Chancellor Woodson at all initially and got invited to the new faculty orientation at his house. I was there picking up one of the beers that he brews, and this guy comes and taps me and says "Where are you from?" and introduced himself, "I'm Chancellor Woodson." So I said "I'm from Virginia Tech" and he said "I already know about you, I talked to the President at Virginia Tech, he said you were coming and that we're lucky to have you". From that point onwards, Chancellor Woodson and I have had a few interactions and they've always been very positive and jovial.

Dean Louis is such an inspiration. Every time I speak with him I learn something new that I can carry with my life, he's so wise. He's a really good man and I enjoy interacting with him. I've also enjoyed meeting the other department heads in the College of Engineering as well. They're very helpful and always willing to give direction. In the department, the young faculty here have been a huge inspiration, they're very good and I'm interested in what they're doing. And of course, students. Working with students is great and makes you feel young. I'm trying to increase interactions with students. We sent out a community survey and found that this is something we're lacking in. There are going to be some changes this summer, so when you come back in the fall you can expect some interesting changes.

H: What's your favorite part of the job?

E: It'd have to be interacting with students. I like coming every day and knowing each day will be different. Different people, different issues, different possibilities. That part keeps me excited, and no day is similar, I love getting to meet new people each day.

H: What do you expect for the department and for yourself in the next year?

E: One of the things is to tell the stories more effectively. I've been to meetings with the American Society of Mechanical Engineering (ASME) and the American Institute of Aeronautics and Astronautics (AIAA) and tried to really tell our story. I hope to get people [nationally] to know about us more. I want people in this department, students and faculty, to be proud to be in MAE. To know that we are good and we don't bow down to anyone else.

We are equal, if not better, than all the top schools. We get the best students in North Carolina and many great students from elsewhere. Our students could easily go to other schools in other states, especially the "top" programs, but they stay here because of our great value. Why would you go anywhere else? I want to also keep ourselves ahead of the learning needs of our students. Looking at what's coming up the pipeline so they're ready for those new challenges in industry and jobs. So the curriculum will need to be updated, not that it's behind now but that we'll need to always ensure we're teaching the most modern and useful knowledge. This way students from MAE are the best at their jobs and we're also doing a service to our industry partners. I'd like to continue to build strong ties with our industry partners, and improve prospects for internships and co-ops from our students, keeping them coming back for more.

I want to build our alumni base to support this. We have close to 12,000 living alumni and we are barely connected with 500 of them. So there's huge potential here. We've started initiating contacts and going to alumni events around the state. We have a Hall of Fame where we bring in esteemed alumni and give them a chance to better connect with the department. As we consider the changes to the department and our representation with industry and alumni, I think we can only say that things are going to get better. So in the next few years all these great things will become routine and normal.

There is so much potential and our degrees are so highly demanded. I want to make sure our students are proud of their department, keeping that flag flying. When they graduate I want students to have enjoyed their time here and want to return and visit with their former professors and peers. I want them to have a bond that you still feel 25 years down the road. I think decades ago that bond existed here and somehow has become lost, and I'd like to see your generation of students become more connected with the department and to really never leave in spirit. So for the next year, I think the prognosis is very, very, good. ■

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STUDENT SPOTLIGHT

Madison Maloney

Year of Accomplishments with Madison Maloney

Madison Maloney of Greenville, NC, a junior majoring in aerospace engineering, received a 2018 Goldwater Scholarship.

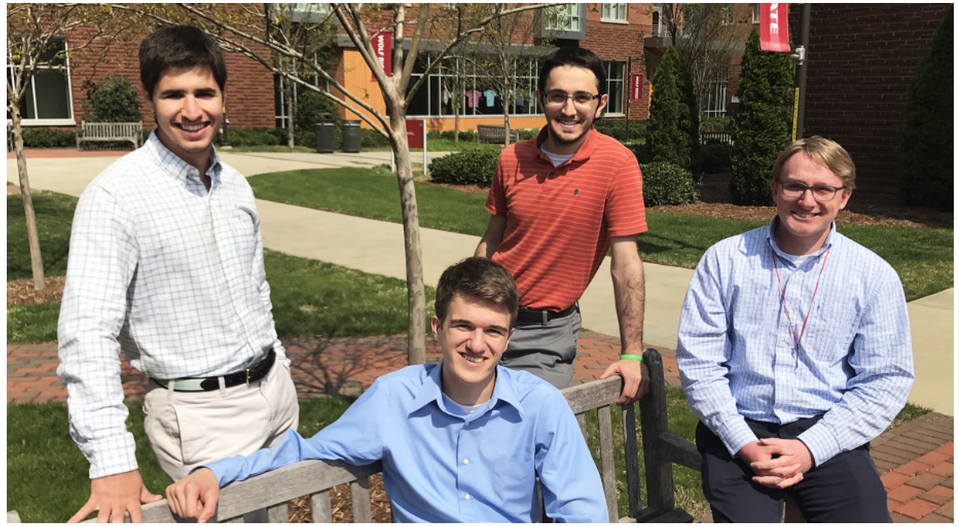
Distributed by The Barry Goldwater Scholarship and Excellence in Education Foundation, the award includes up to $7,500 annually in eligible education expenses for college sophomores and juniors currently studying the natural sciences, mathematics and engineering in the United States who have potential to conduct research and plan to pursue research careers in those fields.

Maloney was one of 211 students selected from an applicant pool of 1,280.

She is a Park Scholar and is part of the University Honors Program. She was selected as a 2017 Astronaut Scholar and intends to earn a Ph.D. in aeronautics and astronautics, with the goal of conducting research on human space exploration systems at either NASA or a national lab.

Maloney has conducted research under the mentorship of Dr. Scott Ferguson within the MAE department.

She is an engineering ambassador and serves as director of the Student Government Athletics Department. She is also treasurer for the campus chapter of aerospace honors society Sigma Gamma Tau.



From left, Scott Cronson, Stephen Scheuerle, Nicholas Mazzoleni, and Raven Lauer.

Nicholas Mazzoleni

Bryon Spells

Mazzoleni, Spells Earn 2018 NSF Graduate Fellowships

The National Science Foundation's (NSF) Graduate Research Fellowship Program (GRFP) has announced the offer of 2,000 fellowship awards, following a national competition. Mechanical Engineering undergraduate seniors, Nicholas Mazzoleni and Bryon Spells, are recipients of the 2018 NSF GRFP Award.

The program recruits high-potential, early-career scientists and engineers and supports their graduate research training in science, technology, engineering and mathematics (STEM) fields. Launched in 1952 shortly after Congress established NSF, GRFP represents the nation's oldest continuous investment in the U.S. STEM workforce.

The new awardees were selected from more than 12,000 applicants and come from all 50 U.S. states, as well as the District of Columbia and U.S. territories. Honorable mention recognition went to 1,459 individuals. GRFP provides three years of financial support within a five-year fellowship period — $34,000 annual stipend and $12,000 cost-of-education allowance to the graduate institution. That support is for graduate study that leads to a research-based master's or doctoral degree in a STEM field. ■

Senior award recipients

Each year the College of Engineering recognizes the accomplishments of graduating senior students with the Engineering Senior Awards. Receiving these awards is one of the highest forms of recognition for a senior in the College. The awards are presented by the dean of engineering at the Engineers' Council Annual Spring Banquet. The MAE nominees for the college wide competition are: Nicholas Mazzoleni – Scholarly Achievement, Scott Cronson – Citizenship and Service, Raven Lauer – Humanities, and Stephen Scheuerle – Leadership. We are extremely proud of our student's achievements and wish them the best in their future endeavors.

Q&A

Behind Dash-X with Tyler Jenkins

Tyler Jenkins

TYLER JENKINS is an aerospace graduate student in the MAE department. Tyler recently finished co-leading a project that resulted in the development of the highly anticipated Dash-X drone. He also co-supervised three half-time graduate students and several part-time undergraduate students. Working alongside Drs. Matt Bryant, Mark Pankow, Larry M. Silverberg, and VX Aerospace, the team was able to provide Northrop Grumman with a drone that will play a vital role in the development of U.S. Navy tactics. The Dash-X, which has been tested by the U.S. Navy, but not confirmed for use, has the ability to release from any fighter jet or bomber.

WE ASKED TYLER A FEW QUESTIONS ABOUT HIS EXPERIENCE WITH DASH-X. HERE'S WHAT HE HAD TO SAY:

1. Describe the unique experience of co-leading the development effort.

Co-leading the development effort presented many unique experiences. In particular, our team had the rare opportunity to design a UAV concept, manufacture the aircraft, and conduct flight tests. Leveraging VX Aerospace's manufacturing know-how in conjunction with NC State's research and design capabilities led to an incredibly rapid timeline. It took only nine months to go from the white board to a flying, folding, full-scale vehicle — a true testament to the NC State team members, professors, and VX Aerospace staff.

2. What did you learn in this capacity?

The professors did a fantastic job building the team. The importance of having resilient, team-oriented individuals was repeatedly shown. In co-leading the development effort, I also learned the significance of solving non-technical problems. Ineffective communication can derail a project as easily as a technical hang-up, especially with a geographically distributed team spanning multiple universities, companies, and organizations. Concise communication and effective visual aids were key in working through these challenges.

3. How would you describe the experience of working with the other students?

I was consistently impressed by the team's diverse skill set and motivation to do great work. A large part of my job was orienting the team members towards the correct problem to solve. When the team worked in sync on the highest priority design problem, difficult technical challenges were repeatedly overcome.

4. What did you learn about design?

Our team quickly learned the value of mocking up physical prototypes. A large portion of the design involves mathematical and computer modeling. However, what is possible in a computer model is not always practical to manufacture. Creating quick physical mock-ups allows the design team to gain intuition and discover potential pitfalls in a technical solution. I firmly believe that creating is the best way to learn design.

5. How does this change your understanding of engineering? How did it help prepare you for the Ph.D.?

I now view engineering methods such as Computer Aided Design (CAD), Finite Element Analysis (FEA), analytic modeling, and prototyping as design tools within a toolbox. Understanding the fundamental strengths and weaknesses of each tool allows the designer to more effectively solve a problem. Using the design tools appropriately can lead to a strong concept that is straightforward to manufacture and test. This experience prepared me for the Ph.D. program in a few different ways. I have learned to approach design problems more creatively and with a wider array of techniques. I also plan to recruit undergraduate students through the MAE 496: undergraduate project work course, and use a team approach to accomplish research goals. ■

Senior Design

MAE 416 Capstone Design

Each semester, mechanical engineering seniors are given a real world problem to solve in the MAE 416 Capstone Design course, and showcase their solutions during Senior Design Day. The semester-long project is designed to prepare students for the workplace through hands-on experience in the design and prototyping of real-world solutions to industry-sponsored projects. The event starts in the morning with formal presentations where each team outlines their design process, describes the proposed device, and advocates for how their work has satisfied the project goals and constraints.

A two-semester long course sequence, Aerospace Vehicle Design I and II (MAE 480/481), gives aerospace engineering undergraduates the option between a focus on aircraft or space. During the first semester, the space students spend most of their time designing, manufacturing and launching the sub-scale model. The second semester is dedicated to putting it all together for the full-scale launch, which for this year's class, was quite a success and doesn't happen every year.

After presentations are complete, everyone breaks for the annual Burger Bash lunch provided by the American Society of Mechanical Engineers (ASME) student chapter. Then it's right back to the action as the student groups demonstrate the designs for their sponsor. The top three teams for each project are recognized by the sponsors with certificates and a monetary award. This year, DENSO awarded "The Temper Tran-Trums" team first place, and ALoft awarded first place to "Team 1," proving they're number one for a reason. ■

For more information on how your company can participate in and sponsor a Senior Design Project, contact Mike Walsh at mpwalsh2@ncsu.edu.

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FACULTY AND **STAFF**

New Staff

Vincent Chicarelli
Specialty Trades Technician

Derek Delong
Contracts and Grants Manager

Tamera Green
Administrative Support Specialist

Kelly Petersen
Graduate Services Assistant

Aslyn Rau
Undergradaute Programs and Communications Coordinator

Awards and Honors

NARAYANASWAMY NAMED DURIP AWARD RECIPIENTS

Dr. Venkat Narayanaswamy, assistant professor, was named a recipient of the Defense University Research Instrumentation Program (DURIP) award from the Air Force Office of Scientific Research. The DURIP supports university research infrastructure essential to high-quality Navy relevant research. The research instrumentation that is necessary to carry out cutting-edge research.

Narayanaswamy's DURIP award will be used to acquire a high-speed laser system for performing time-resolved velocity field imaging. This tool will significantly broaden our understanding of scramjet propulsion and help develop strategies to widen the scramjet operation to lower Mach numbers.

PETERS ELECTED SPIE FELLOW, DURIP AWARD RECIPIENT

Dr. Kara Peters, professor, was elected to the position of Fellow by the International Society for Optics and Photonics (SPIE). Fellows of the society are recognized for their significant scientific and technical contributions in each of the multidisciplinary fields of optics, photonics, and imaging. SPIE Fellows are honored for their technical achievements and for their service to the general optics community and to SPIE in particular. Peters was recognized for her achievements in fiber optic sensors and smart structures.

Peters was also named a recipient of the DURIP award from the Air Force Office of Scientific Research. Peters' DURIP award will be used to purchase a 3D Microsystem Laser Doppler Vibrometer to characterize the signal transfer to a structural health monitoring (SHM) network of sensors mounted to the surface of naval structures. The equipment will support ongoing research at NC State, sponsored by the Office of Naval Research, to increase the quality of the signals received by the sensors and therefore the quality of the damage identification in the underlying naval structure.

BRYANT RECEIVES OUTSTANDING TEACHER AWARD

At the annual spring faculty meeting, Dr. Matthew Bryant, assistant professor, was named an Outstanding Teacher for 2017-18. The award recognizes excellence in teaching at all levels and is a prerequisite for being considered for the Board of Governors Award for Excellence in Teaching and the Alumni Distinguished Professor Award. Recipients become members of the Academy of Outstanding Teachers for as long as they are NC State faculty members.

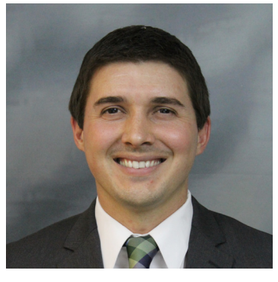
HOWARD RECEIVES OUTSTANDING MID-CAREER TEACHING AWARD BY ASEE-SE

Dr. Anna Howard, teaching associate professor, received the American Society for Engineering Education Southeastern (ASEE-SE) Outstanding Mid-Career Teaching Award at the 2018 ASEE Conference. The Outstanding Mid-Career Teaching Award recognizes faculty members who have demonstrated exceptional contributions to engineering or engineering technology education through outstanding classroom performance. The award includes a certificate and a $500 cash prize, which are presented at the annual section meeting.

ADDITIONAL DEPARTMENT HONORS

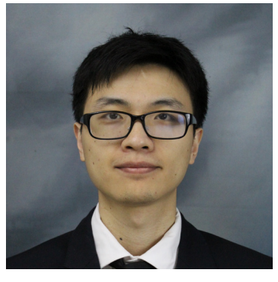
- **1 AIAA** Fellow
- **8 AIAA** Associate Fellows
- **8 ASME** Fellows
- **6 NSF CAREER** Awardees
- **1 AFOSR YIP**
- Several **ASME/AIAA** level awards
- Several **best paper** awards
- **17** faculty members with **H-index** of 20 or more

GRACE NAMED NSF CAREER AWARD RECIPIENT



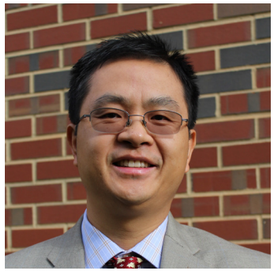
Dr. Landon Grace, assistant professor, has received the National Science Foundation's (NSF) Faculty Early Career Development Program award. Known as the NSF CAREER Award, it is one of the most prestigious awards for early-career researchers. NSF will provide $500,000 for his project to improve the safety and performance of polymer composites by discovering the fundamental mechanisms governing the evolution of damage in these next-generation materials. Grace's research will be complemented by an effort to provide access to K-12 summer engineering camp activities at NC State for students from rural and isolated urban communities.

JING EARNS R. BRUCE LINDSAY AWARD



Dr. Yun Jing, associate professor, was named the recipient of the 2018 R. Bruce Lindsay Award for his contributions to acoustic metamaterials and numerical modeling of wave propagation in rooms and complex media. The R. Bruce Lindsay Award, formerly the Biennial Award, is presented in the spring to a member of the Acoustical Society of America who is under 35 years of age and who, during a period of two or more years immediately preceding the award, has been active in the affairs of the Society and has contributed substantially, through published papers, to the advancement of theoretical or applied acoustics, or both.

ZHU NAMED ASME FELLOW, RECIPIENT OF ESHELBY MECHANICS AWARD FOR YOUNG FACULTY



Dr. Yong Zhu, professor, has been elected a fellow to the American Society of Mechanical Engineers (ASME), an honor bestowed on only 3 percent of members. Zhu's research on experimental nanomechanics and nanomaterial-enabled stretchable electronics has resulted in key contributions to the field of mechanical engineering.

Zhu was also named a recipient of Eshelby Mechanics Award for Young Faculty. This award is given annually to rapidly emerging junior faculty member who exemplify the creative use and development of mechanics. The intent of the award is to promote the field of mechanics, especially among young researchers.

ZIKRY RECEIVES ASME THURSTON LECTURE AWARD

Dr. Mohammed Zikry, the Zan Prevost Smith Professor, was named the recipient of the 2017 Robert Henry Thurston Lecture Award from the American Society of Mechanical Engineers (ASME). The award was established in 1925 in honor of Robert Henry Thurston, ASME's first president and a leader in engineering and science. The lecture is presented annually at the International Mechanical Engineering Congress and was elevated to a Society award in 2000. Zikry was presented with a plaque, certificate, $500 and travel expenses. ■

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ALUMNI SPOTLIGHT

"You can achieve anything you put your mind to and you control your own journey. You are the greatest influence on your career by every choice you make."

Name: Brandi Smith
Graduating Class: BSME 2002
Hometown: Fayetteville, NC

Career Overview

Brandi Smith is the Director of Quality Control at Newport News Shipbuilding (NNS) in Newport News, Va. Newport News Shipbuilding is the sole designer, builder and refueler of U.S. Navy aircraft carriers and one of two providers of U.S. Navy submarines. With approximately $4 billion in revenues and more than 20,000 employees, Newport News Shipbuilding is the largest industrial employer in Virginia and the largest shipbuilding company in the United States.

In her current role, Smith has responsibility for more than 500 nuclear and non-nuclear inspectors and source inspectors covering all NNS Programs onsite in Newport News, as well as offsite work supported by NNS. Smith joined Newport News Shipbuilding in 2002 as a mechanical system engineer.

Five Questions with Brandi Smith

Throughout her career at Newport News Shipbuilding, she has held progressively responsible positions within the Engineering and Design Division, including integrated digital shipbuilding engineering lead and (acting) construction engineering director most recently prior to her current assignment in the Quality Division.

In 2007, she received a master's degree in business administration from the College of William and Mary. Active in STEM initiatives, Smith is a founding member of a partner program started between Newport News Shipbuilding and the Newport News Public Schools, called GEMS, standing for Girls with Engineering Minds in Shipbuilding. This is a volunteer group of women engineers who mentor local middle school girls with several STEM activities throughout the school year. She also mentors several early-career engineers at NNS.

Additionally, Smith was recognized as one of the honorees for Hampton Roads' Inside Business Women in Business Achievement Award in 2014.

1. What is the single most important experience or understanding you gained during your time in the MAE department?

I believe the experience most impactful to me was my Senior Design project. For the years leading up to it, most of the time was spent reading books and working through hypothetical problems. For the Senior Design project, it was the first time I was putting that into practice and everything just seemed to come together. That's when I knew I needed to work in a position that allowed me to have less desk time and more hands-on opportunities!

2. What would you like to accomplish in your career? What are you most proud of so far?

I want to be able to look back on my career and know that I left a significant impact on the major transformation my company is going through right now. My company is 132 years old and has started into a digital transformation that will take several years to fully accomplish. We are moving from 2D drawings used to build ships to mechanics having devices in hand looking at 3D work instructions! The cultural change is probably the hardest part and I am excited about leading my team through this transition.

3. What is the best book you have ever read (can be professional or personal)?

"Crucial Conversations," it was part of training provided to our division about five years ago and it was the most practical information I had received that applies both personally and professionally. It has helped me hold so many difficult conversations with the right mindset to get to the necessary conclusion.

4. What advice do you have for current MAE students?

You can achieve anything you put your mind to and you control your own journey. You are the greatest influence on your career by every choice you make. You have the ability to wake up every morning and influence how that day works out. You determine your comfort level and when you leave your comfort zone. You determine the level of risk you take and you determine what personal sacrifices you are willing to make to get there. You influence the group you surround yourself with. Don't wait until the end of your career to look back and determine if you were successful. All of the fun is in the journey you take, so make every day count and measure your success as you make your journey.

5. If you were not in the engineering field, what would you likely be doing?

I would likely be a CPA. That's the field I first thought I wanted to enter until my guidance counselor talked to me about engineering with my love for math and science. ■

2017 **Alumni Hall of Fame**

The Department of Mechanical and Aerospace Engineering at NC State is proud to honor the accomplishments of our outstanding graduates through the MAE Alumni Hall of Fame.

The MAE Alumni 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.

With more than 12,000 MAE alumni, only 116, including this year's class, have been inducted into the MAE Alumni Hall of Fame. The MAE Department honored the 2017 class through the prestigious Alumni Hall of Fame ceremony on November 3rd, 2017.

Dr. Rolin F. Barrett Sr.
BSME '59, MSME '62, PhDME '65

Mr. Bobby Berrier
BSME '63, MSAE '68

Mr. Venable B. Burwell
BSME '61

Dr. Mehmet Caliskan
PhDME '83

Mr. Matthew T. Carey
BSME '83

Mr. John H. Croom
BSME '59

Mr. Laurence D. Leavitt
BSAE '75

Mr. Kevin McCraw
BSME '93

Mr. Garry D. Miller
MSME '80

Dr. Michele Miller
MSME '91, PhDME '94

Dr. Padmakar Niskode
BSME '64, MSME '68, PhDME '72

Dr. John S. Stewart
BSME '69, PhDME '72

Ms. Lisa J. Teague
BSME '81, MSME '82

Ms. Carol S. Vercaemert
BSME '76

Mr. Philippe H. Vercaemert
BSME '76

Dr. Brian Vick
BSME '76, MSME '78, PhDME '81

Dr. Richard A. Wahls
BSAE '84, MSAE '86, PhDAE '89

Mr. W.F. (Buzz) Wilson Jr.
BSAE '66

Mr. Douglas L. Wolford
BSME '83

Mr. David Ronald Yelton
BSAE '66

THE YEAR AHEAD: UPCOMING EVENTS

MAE Golf Tournament	Friday, September 7th
MAE POP (Post Orientation Party)	Thursday, September 20th
MAE Alumni Hall of Fame	Friday, November 2nd
Hassan A. Hassan Lecture Series	Friday, November 16th

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MAE TOP EMPLOYERS

- ABB
- AFL
- All Nippon Airways
- Altec
- Alternative Energy Systems Consulting
- American Airlines
- Anheuser-Busch
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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, at 919.515.7237 or mpwalsh2@ncsu.edu.

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