Electrical & Computer Engineering

# Spotlight


## THE PROBLEM SOLVERS PIONEERING QUANTUM COMPUTING

NC STATE UNIVERSITY

# In this Spotlight



*Creative Director:* Charles Hall • *Editors*: Daniel Stancil, Greg Byrd, Trudi Brown, Daniel Green

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# Department Head's Note

One of the things that makes the College of Engineering at NC State such an exciting place is Centennial Campus. Here the "triple helix" of university, industry, and government agencies intermingled within walking distance helps to fuel education, research, and entrepreneurship.

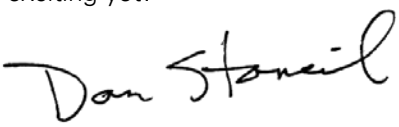
One of the people most responsible for the College of Engineering moving to Centennial Campus was Dr. Nino Masnari. It was under his leadership as Dean that the first engineering buildings were constructed and the first departments (including ECE) moved to Centennial Campus. Nino passed away earlier this year, and although he will be greatly missed, we celebrate his significant contributions to the College and Department.

His contributions to the ECE Department go far beyond his accomplishments as Dean, however. He was recruited from the University of Michigan to be ECE Department Head, and under his leadership we received the first of three NSF Engineering Research Centers. I personally owe him a debt as well. I came as Department Head several years ago, but this is not the first time I have been at NC State. My first job out of graduate school was as an assistant professor here, and Nino hired me. I had expressed interest in a faculty position I had seen advertised in IEEE Spectrum, and he made a point during his next trip to Boston to take my wife and me out to dinner so that he could tell me about the exciting things the future held for NC State ECE. Today, our department is indeed a very exciting place, and my wife and I love being back in Raleigh. It is likely that we would not be here if it weren't for Nino.

The Department has continued to build on the strong foundation that Nino helped to lay. We are now at 60 faculty (up from 35 according to my notes from dinner with Nino in 1981!), and we have been among the top 10 ECE departments in the country in research expenditures for the last three years, according to ASEE. Of particular significance is our placing #10 in the Shanghai Ranking Consulting's global rankings this year. I believe this level or recognition is important because it is based 100% on quantitative metrics. In contrast, most every other ranking (such as US News and QC Global rankings) are dominated by opinion surveys (US News is entirely determined by a survey at the program level).

One of the exciting new developments this past year has been the partnership between NC State and IBM to establish the IBM Q Hub at NC State for quantum computing. This is an interdisciplinary activity that is involving faculty from across the university, and several faculty in ECE are playing important roles in establishing this new direction. Quantum computing promises to radically change the face of computing over the coming decades, and our intention is to be a world leader in both quantum research and education.

The Department has come a long way during its first 100 years, but I believe the second 100 years will be the most exciting yet!



**Dr. Daniel D. Stancil**
ECE Department Head

## Stay Connected with @NCStateECE

Receive our bimonthly **email newsletter** to see what's happening at NC State ECE
**ece.ncsu.edu/newsletter**

Join the ECE Alumni LinkedIn Group to stay in touch and find out about alumni events
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# #5

best value among public universities nationally

according to US News & World Report

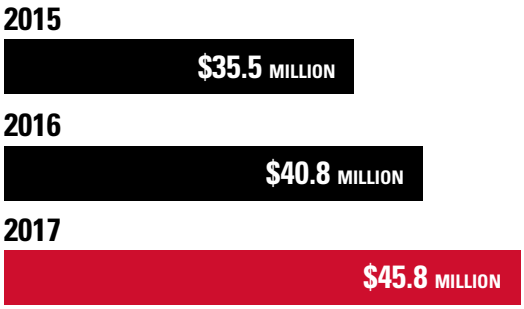
# 22

National Science Foundation CAREER Award Recipients

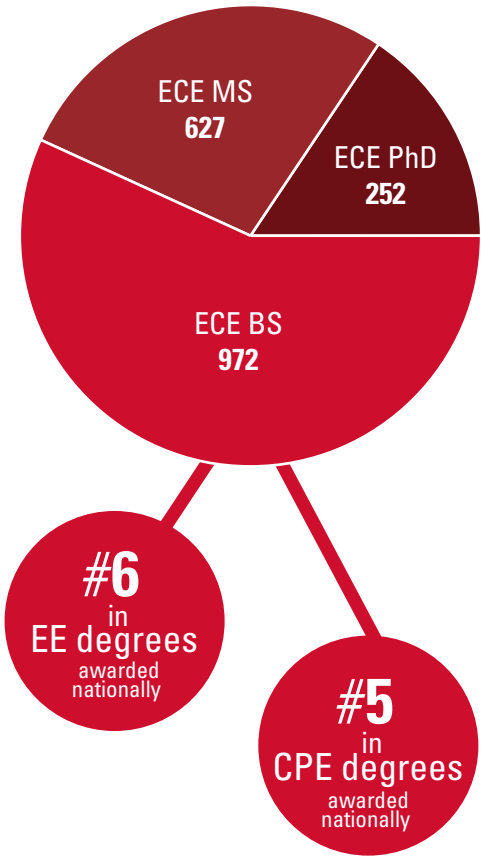
# 60

Tenured and Tenure-Track Faculty

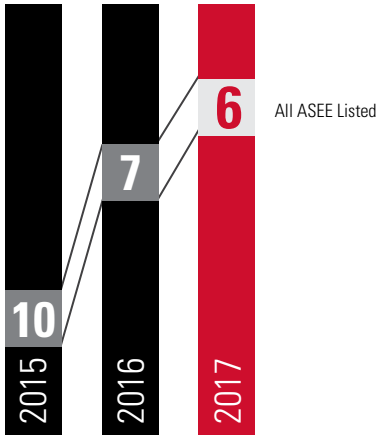
## Total ECE Research Expenditures




## Total ECE Enrollment by Degree for 2017




## Rank by Total Research Expenditures




Source: **American Society for Engineering Education**

# ECE Centennial Scholarship Endowment

Dr. Daniel D. and Mrs. Katherine E. Stancil established and endowed a scholarship for the NC State Department of Electrical and Computer Engineering in 2018. Named the ECE Centennial Scholarship Endowment, the fund will provide scholarship support to undergraduate students majoring in electrical or computer engineering at North Carolina State University. The scholarship will provide need-based support to one or more students for one academic year and may be renewable.

"Our hope is that the new endowment will give alumni and friends the ability to directly contribute to scholarships regardless of the size of the gift," explained Dr. Stancil.

Dr. Stancil is the Alcoa Distinguished Professor and Department Head of Electrical and Computer Engineering at NC State University. Prior to joining NC State as the ECE Department Head in 2009, he served as Associate Head of the ECE Department and Associate Dean for Academic Affairs in the College of Engineering at Carnegie Mellon University. He also served many years as a professor of electrical and computer engineering at both CMU and NC State.

Mrs. Stancil, a retired preschool teacher, was Head Teacher at the North Park branch of St. Paul's Preschool in Allison Park, PA. She also taught at Southminster Preschool in Mt. Lebanon, PA. She enjoys photography and is an avid participant in her neighborhood book club. She also is actively involved with ministries at Hayes Barton Baptist Church.

"We are pleased to make this gift," commented Mrs. Stancil, "and hope that it will play a small part in enabling future students to realize their dreams."

Although for the second year in a row, *Money* magazine identified NC State as the best value for students attending college in North Carolina, tuition and fees for in-state undergraduates for the 2018-19 academic year are estimated at $9,100. With their gift to support education at NC State, the Stancil family is a shining example of faculty making a very personal investment to ensure our students' educational aspirations are not constrained by financial burden.

"As a department head, Dan knows first hand the importance of scholarship support to help deserving undergraduate engineering students complete their degree without a financial burden," said Dr. Louis Martin-Vega, dean of the College of Engineering at NC State. "I'm thankful that he and Katherine decided to make this generous gift and hope that the department's alumni and friends will consider adding their support to the scholarship."

A gift to the Department of Electrical and Computer Engineering is an investment in the future. It demonstrates a shared vision of the importance of engineering education and research and a confidence in NC State's ability to execute that vision wisely.

We need our alumni, corporate partners, friends, and supporters to help the ECE Department continue to create opportunities, foster new research and technologies, and attract the brightest professors and students.

To support the ECE Centennial Scholarship Endowment, visit **go.ncsu.edu/give-engr**, select **Choose A Fund**, scroll to "**Other**" and indicate "**ECE Centennial Scholarship Endowment**" in the space provided.

# THE SMART PEOPLE BEHIND YOUR SMART PHONE

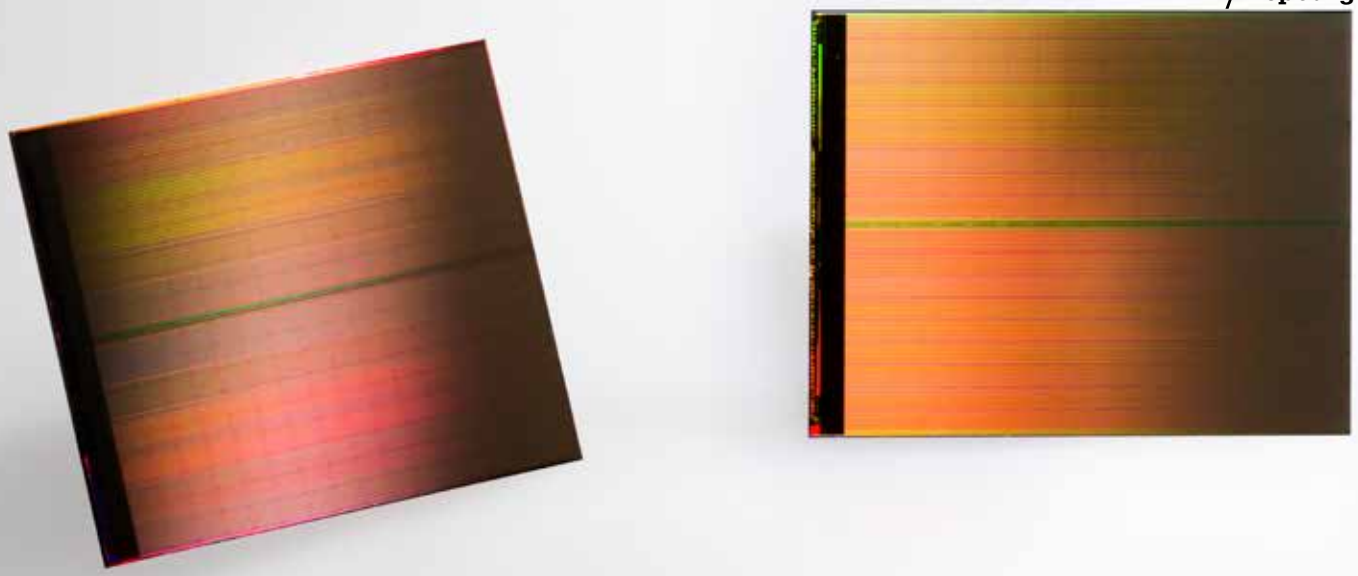

**The networks and hardware that power mobile technology – brought to you by ECE.**

It's your GPS, your tour guide, your camera, your assistant, your jukebox, and yes, sometimes it's even your phone. But who's making all those devices, networks and connections ring in perfect harmony?

We are. Electrical and Computer Engineers use bold thinking and tenacious ingenuity to cram a world of information and a universe of connections into the palm of your hand. All so you can experience your world in new and innovative ways you might never have imagined. More at ece.ncsu.edu/smart.

**ECE – THE FUTURE IS WHAT WE DO.**

**NC STATE** UNIVERSITY



3D XPoint Die. *Credit: Intel Corporation*

# Engineers Invent New Way to Speed Up Memory

New memory modules pioneered by Intel and Micron Technology using their new 3D XPoint technology are arriving, with significant advantages over the traditional DRAM chips found in conventional computers. Unlike those DRAM chips, 3D XPoint is non-volatile and recovers nearly instantly from power loss, meaning its data isn't lost when the computer loses power.

Additionally, "this kind of memory is cheaper and denser than DRAM," says **Dr. Yan Solihin**, adjunct professor of electrical and computer engineering at North Carolina State University. "So people are predicting—including myself—that eventually DRAM will gradually be replaced by this memory."

However, the new technology has its drawbacks—it uses more energy and takes longer to write data than traditional DRAM. But this is where research by Solihin, associate professor **Dr. James Tuck**, and doctoral candidate Mohammad Alshboul comes into play. In a paper presented at the 45th International Symposium on Computer Architecture in June, they showed how they had managed to significantly reduce the amount of writing needed, thereby speeding up the memory.

Storing data that is on a computer's memory on a solid-state (SSD) or hard disk drive—making it persistent—involves safeguards to avoid data corruption in the event of a crash. The data is copied from the memory to the processor's cache, and then when that process is complete, the data is sent on to the non-volatile memory (traditionally the hard disk or SSD). However, in the event of a power loss, some of that data may be lost in transit. To prevent that, "eager persistency" is used, at the expense of a nine percent increase in the transaction time. It also involves about 21 percent more writing to the non-volatile memory—a problem with SSDs with limited writing lifespans.

> The method proposed by the team is a significant shift—named "lazy persistency"—that leverages the thinking that normal operation should be considered the norm and crashes the exception.

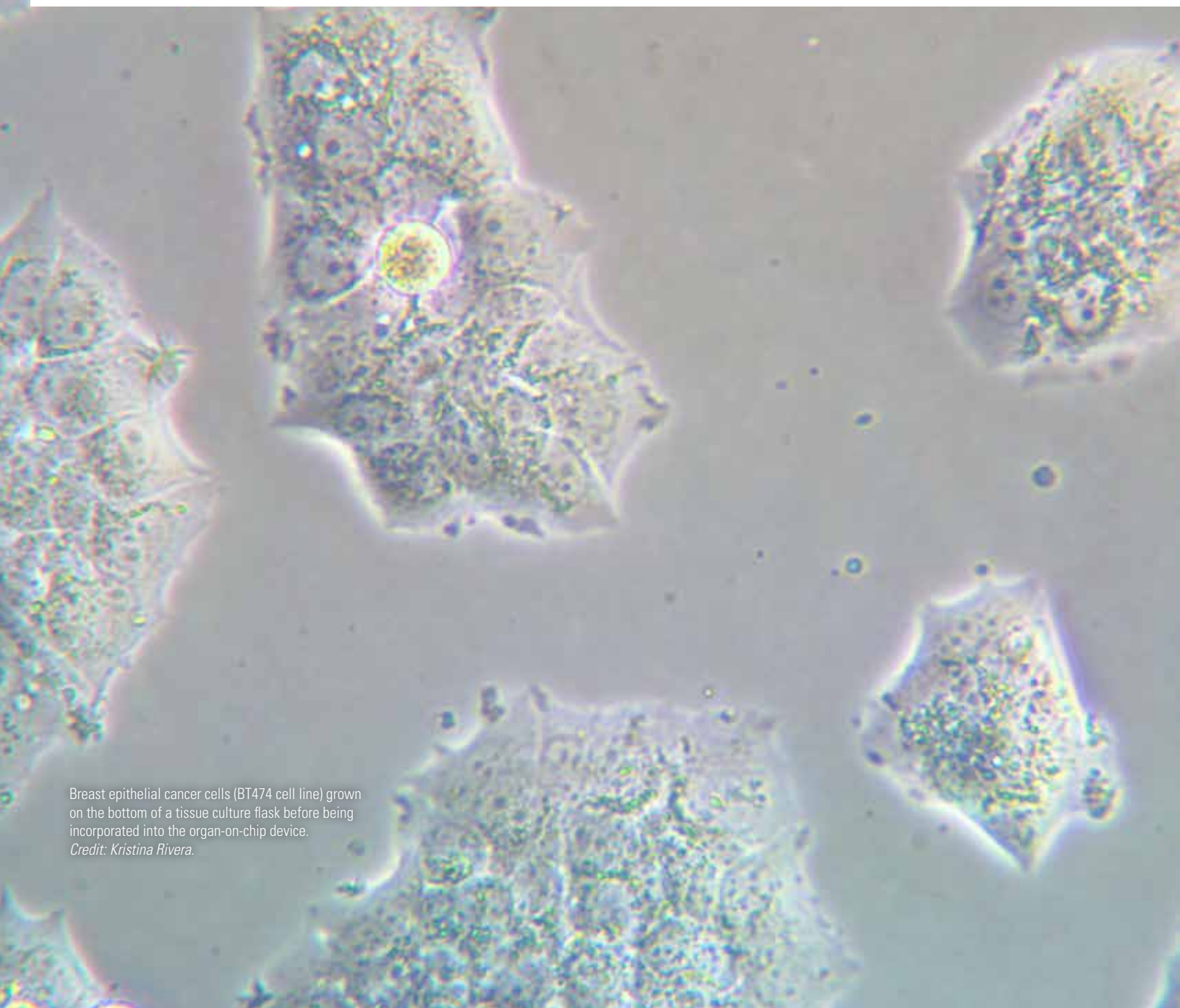
Therefore, rather than increasing the amount of work for each everyday operation, the extra work is put in to recover from a crash instead. "Crashes are rare," says Solihin, "so we want to make the common case really fast."

Whereas eager persistency uses the natural eviction of data from the cache to the main memory as tasks complete in addition to a high rate of artificial eviction that safeguards against data loss, the team's lazy persistency allows the natural cycle to simply work without additional effort. Instead, they add a checksum that, in the event of a crash, gets compared by the processor to determine if the data is matched on the non-volatile memory. If the number doesn't match, that data is recopied.

"The recovery process is more complex, but the common case execution becomes a lot faster," explains Solihin. Only one percent additional effort is added to the process—as opposed to the traditional nine percent—and uses only three percent more writes instead of 21 percent.

# Biosensor Allows Real-Time Oxygen Monitoring for 'Organs-On-A-Chip'

A new biosensor allows researchers to track oxygen levels in real time in "organ-on-a-chip" systems, making it possible to ensure that such systems more closely mimic the function of real organs. This is essential if organs-on-a-chip hope to achieve their potential in applications such as drug and toxicity testing.



Breast epithelial cancer cells (BT474 cell line) grown on the bottom of a tissue culture flask before being incorporated into the organ-on-chip device.
*Credit: Kristina Rivera.*

The organ-on-a-chip concept has garnered significant attention from researchers for about a decade. The idea is to create small-scale, biological structures that mimic a specific organ function, such as transferring oxygen from the air into the bloodstream in the same way that a lung does. The goal is to use these organs-on-a-chip – also called microphysiological models – to expedite high-throughput testing to assess toxicity or to evaluate the effectiveness of new drugs.

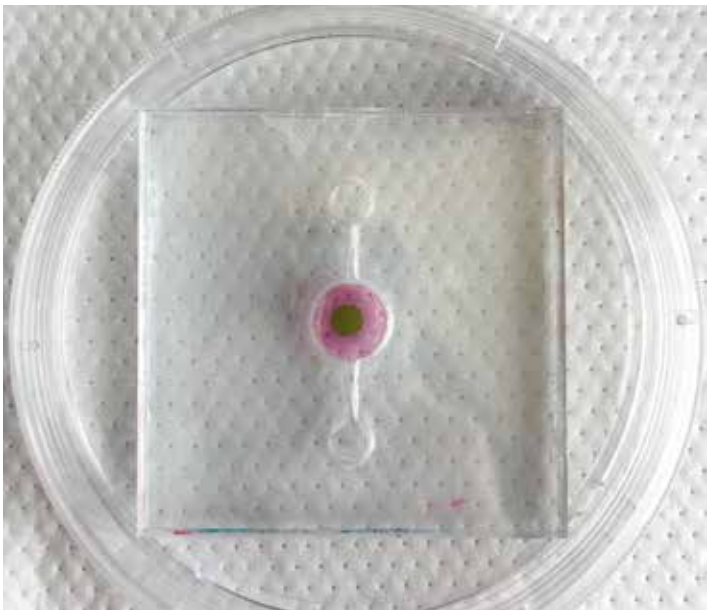
But while organ-on-a-chip research has made significant advances in recent years, one obstacle to the use of these structures is the lack of tools designed to actually retrieve data from the system.

"For the most part, the only existing ways of collecting data on what's happening in an organ-on-a-chip are to conduct a bioassay, histology, or use some other technique that involves destroying the tissue," says **Dr. Michael Daniele**, corresponding author of a paper on the new biosensor. Daniele is an assistant professor with a joint appointment with the Departments of Electrical and Computer Engineering and Biomedical Engineering at North Carolina State University.

> "What we really need are tools that provide a means to collect data in real time without affecting the system's operation," Daniele says. "That would enable us to collect and analyze data continuously, and offer richer insights into what's going on. Our new biosensor does exactly that, at least for oxygen levels."

Oxygen levels vary widely across the body. For example, in a healthy adult, lung tissue has an oxygen concentration of about 15 percent, while the inner lining of the intestine is around zero percent. This matters because oxygen directly affects tissue function. If you want to know how an organ is going to behave normally, you need to maintain "normal" oxygen levels in your organ-on-a-chip when conducting experiments.

"What this means in practical terms is that we need a way to monitor oxygen levels not only in the organ-on-a-chip's immediate environment, but in the organ-on-a-chip's tissue itself," Daniele says. "And we need to be able to do it in real time. Now we have a way to do that."



Biosensor developed in Dr. Michael Daniele's lab

The key to the biosensor is a phosphorescent gel that emits infrared light after being exposed to infrared light. Think of it as an echoing flash. But the lag time between when the gel is exposed to light and when it emits the echoing flash varies, depending on the amount of oxygen in its environment. The more oxygen there is, the shorter the lag time. These lag times last for mere microseconds, but by monitoring those times, researchers can measure the oxygen concentration down to tenths of a percent.

> In order for the biosensor to work, researchers must incorporate a thin layer of the gel into an organ-on-a-chip during its fabrication.

Because infrared light can pass through tissue, researchers can use a "reader" – which emits infrared light and measures the echoing flash from the phosphorescent gel – to monitor oxygen levels in the tissue repeatedly, with lag times measured in the microseconds.

"One of our next steps is to incorporate the biosensor into a system that automatically makes adjustments to maintain the desired oxygen concentration in the organ-on-a-chip," Daniele says. "We're also hoping to work with other tissue engineering researchers and industry. We think our biosensor could be a valuable instrument for helping to advance the development of organs-on-a-chip as viable research tools."

This article originally appeared in *NC State News* on August 20, 2018.

# Model Fuses Social Media, Remote Sensing Data to Identify Nuclear Threats

A new computational model allows researchers to draw on normally incompatible data sets, such as satellite imagery and social media posts, to answer questions about what is happening in targeted locations. The researchers developed the model to serve as a tool for identifying violations of nuclear nonproliferation agreements.

"Our goal was to develop a working framework that uses information from a variety of sensors and data sources to identify these potential violations of nuclear nonproliferation," says **Dr. Hamid Krim**, co-author of a paper on the work, professor of electrical and computer engineering at North Carolina State University and director of the VISSTA Laboratory. "Some of these data may be conventional, such as Geiger counter readings or multispectral data from satellite imagery. But many of these data sources may be nontraditional, such as social media posts. And these sources provide a wide variety of data that are not normally compatible, such as the text included on Twitter posts and the images posted on Flickr.

"By making these different inputs compatible with each other, we are able to accept a broader range of data inputs and use that data in a meaningful way that, ultimately, can help authorities reach more reliable conclusions," Krim says.

The researchers say the model can be used to work with any data that can be identified as coming from the targeted area. For example, satellite images are clearly identifiable, but they may also draw on social media posts that are actively or passively tagged as coming from the relevant area.

> The question then becomes: how do you work with incompatible data? To explain, we'll use a proxy problem that the researchers used in their paper: identifying a flood. They chose a flood because data on flooding is not classified, whereas data regarding nuclear activity is.

The first step in the process is to use mathematical equations to translate each type of data into a useful format. For example, images may be run through models to determine whether they are images of flooding, whereas text posts may be run through models to determine whether they include references to flooding. Once those data streams are translated into a neutral format – meaning they indicate flooding or no flooding – they can be compared to each other to answer basic questions such as: do the data support each other?

But it's not quite that simple. For example, people may be tweeting about a flood that is taking place hundreds of miles away, which could skew any calculation by the overarching model. To address this, the researchers incorporated mathematical elements that account for the complexity of the data they are drawing on.

"Addressing complexity is particularly important in the context of nonproliferation enforcement," Krim says. "Relevant data inputs may include photos of particular types of technology, references made in conversations caught on audio, and so on. A model like the one we developed needs to be flexible enough to account for the variability and complexity of both varied types of data and the varied clues we are looking for."

The researchers tested their model using data from a 2013 flood that took place in Colorado, and were able to resolve the incompatibility of multi-modal data in order to accurately estimate the location of the flooding.

Next steps for the project include evaluating nuclear facilities in the West to identify common characteristics that may also be applicable to facilities in more isolated societies, such as North Korea.

"We want to find ways of transferring information from known environments to a hidden one," Krim says. "How can we determine what information and which models are transferable from one place to another, given incompatible or inconsistent data? What's normal, and what's not? It's not an easy problem."

This article originally appeared in *NC State News* on July 23, 2018.

# Tech Bends Light More Efficiently, Offers Wider Angles for Light Input

Engineering and physics researchers at North Carolina State University have developed a new technology for steering light that allows for more light input and greater efficiency – a development that holds promise for creating more immersive augmented-reality display systems.

At issue are diffraction gratings, which are used to manipulate light in everything from electronic displays to fiber-optic communication technologies.

"Until now, state-of-the-art diffraction gratings configured to steer visible light to large angles have had an angular acceptance range, or bandwidth, of about 20 degrees, meaning that the light source has to be directed into the grating within an arc of 20 degrees," says **Dr. Michael Escuti**, a professor of electrical and computer engineering at NC State University and corresponding author of a paper on the work. "We've developed a new grating that expands that window to 40 degrees, allowing light to enter the grating from a wider range of input angles.

> "The practical effect of this – in augmented-reality displays, for example – would be that users would have a greater field of view; the experience would be more immersive."

The new grating is also significantly more efficient.

"In previous gratings in a comparable configuration, an average of 30 percent of the light input is being diffracted in the desired direction," says Xiao Xiang, a Ph.D. student in the Physics department at NC State and lead author of the paper. "Our new grating diffracts about 75 percent of the light in the desired direction."

This advance could also make fiber-optic networks more energy efficient, the researchers say.

The new grating achieves the advance in angular bandwidth by integrating two layers, which are superimposed in a way that allows their optical responses to work together. One layer contains molecules that are arranged at a "slant" that allows it to capture 20 degrees of angular bandwidth. The second layer is arranged at a different slant, which captures an adjacent 20 degrees of angular bandwidth.

The higher efficiency stems from a smoothly varying pattern in the orientation of the liquid crystal molecules in the grating. The pattern affects the phase of the light, which is the mechanism responsible for redirecting the light.

"The next step for this work is to take the advantages of these gratings and make a new generation of augmented-reality hardware," Escuti says.

This article originally appeared in *NC State News* on May 8, 2018.

Dr. Michael Daniele in his lab. *Credit: NC State News.*

# Out of the Lab and Into the World

Groundbreaking research happens every day at NC State, and a growing number of important technologies are making the leap from the lab to the marketplace. It's no surprise that adequate funding is crucial to this transition.

While grants and other funding may initiate research and get the ball rolling, there's a real need for continued funding to take something from an idea and a set of data to a fully fledged market-ready product. That's where the Chancellor's Innovation Fund comes in.

NC State established the fund in 2010 with support from Chancellor Randy Woodson to help fill the gap between public and private funding and help bring new products and technologies to the marketplace. Over the past eight years, the fund has awarded $2.6 million to 40 projects that have attracted more than $33 million in follow-on research funding — money given after the initial investment.

The funding enables NC State researchers to invest in testing and prototyping — critical for helping to prove market viability. Existing companies may choose to license the resulting research or prototypes, or developers may decide they want to launch a startup on their own.

Recipients for 2019, including three faculty members from the Department of Electrical and Computer Engineering, are tackling everything from blood-clotting nanomaterials and canine cancer vaccines to more efficient electric vehicle chargers.

## Microneedle Patches for Painless Fluid Extraction

**Dr. Michael Daniele**, assistant professor in the Departments of Electrical and Computer Engineering and Biomedical Engineering, has developed microneedle patches for biofluid extraction. Many diagnostic tests rely on blood, but interstitial fluid, or ISF, contains many of the same compounds in an easier-to-access form.

Standard ISF sampling methods are painful and risk infection. Daniele has developed swellable microneedles made with durable nanomaterials that successfully extract ISF by drawing it to the surface of the patches. Such painless and easy processes will eventually enable development of do-it-yourself diagnostics.

Funding from the Chancellor's Innovation Fund will go toward demonstrating an industry-specified rate of fluid extraction. Currently, the patches are being tested at 30-minute intervals for extraction, but researchers are hopeful that can be reduced.

## Electric Vehicle Fast Chargers

**Dr. Srdjan Lukic** and **Dr. Srdjan Srdic**, associate and research assistant professors, respectively, in the Department of Electrical and Computer Engineering, have developed a prototype fast charger for electric vehicles. Sales for electric vehicles are climbing steadily, and nations around the world have signaled their commitment to the development of this new technology. As electric vehicles (E.V.) become more popular, there's a need for a refueling infrastructure similar to the network of traditional gas stations.

Lukic and Srdic have developed an efficient modular E.V. fast charger that is cheaper to install and operate than existing charging stations. It has a smaller footprint and higher charging efficiency, which will benefit both E.V. owners through faster and cheaper charging options, and charging station owners with cheaper installation costs, better site utilization and higher revenue.

The Chancellor's Innovation Fund will support efforts to develop a prototype for industry testing.

This article originally appeared in *NC State News* on August 15, 2018.


# NC State Named First University-Based IBM Q Hub in North America

NC State will be the first university in North America to establish an IBM Q Hub as part of the global IBM Q Network, a collaboration between tech powerhouse IBM and top Fortune 500 companies, national research labs and leading universities to advance quantum computing.

The network provides early access to IBM's quantum computing systems, with the goal of exploring practical applications important to business and science.

Starting this fall, NC State will have access to IBM Q commercial quantum computing devices, including the most advanced and scalable universal systems available. The current 20 qubit IBM Q system will be followed by a 50 qubit prototype in the next generation.

# What is quantum computing?

While the field is still in its infancy, quantum holds the promise of solving problems far beyond the capabilities of ordinary computers. Instead of relying on conventional bits (binary digits, ones and zeroes) to store information, quantum computers use quantum bits, or "qubits," which can represent multiple states at once — a phenomenon known as superposition. They can work on problems in parallel and potentially find solutions to problems too complex for any classical machine to compute.

Quantum computing could prove momentous for complex optimization, molecular modeling, machine learning, physics, materials science, chemical simulations and data discovery. By better understanding molecular interactions, quantum computing could:

- Help researchers create new medicines or materials
- Deliver a product across the globe with the least amount of fuel
- Manage risk in constantly fluctuating financial markets
- Train artificial intelligence


# The latest in a long partnership

For three decades, IBM and NC State have worked together across research, education and advanced technology development, yielding breakthroughs in cloud computing, advanced analytics, cybersecurity, renewable energy, advanced networking and healthcare IT. In 2016, IBM opened its Education Innovation Center on Centennial Campus, a collaboration space for NC State students and faculty and IBM employees to uncover solutions.

In this latest partnership, NC State joins three established university-based quantum computing hubs worldwide: the University of Oxford, Keio University and the University of Melbourne. Hubs within IBM's network are critical for accelerated learning, skills development and the global rollout of quantum computing.

"Academic collaborations are essential to growing the quantum computing community as we look to discover practical quantum applications and drive business and scientific breakthroughs," said Bob Sutor, vice president of IBM Q Strategy and Ecosystem, IBM Research. "Building on a 30-year research and education partnership, NC State will play a key role in helping IBM continue to extend our quantum computing ecosystem."

"The hub will create a unique opportunity for NC State to address its strategic plan of supporting interdisciplinary scholarship and preparing students for the future," said Alan Rebar, vice chancellor for research and innovation at NC State. "Our researchers and students will work with IBM scientists, engineers and consultants to further explore and advance quantum computing. The hub, which will be operated from NC State's Centennial Campus, will also drive new curriculum development at NC State, focused on quantum computing."

This article originally appeared in *NC State News* on May 9, 2018.

# ONWARDS AND UPWARDS

## Christina Hammock Koch

Photo Credit: NASA

She's gone from studying at a desk in Daniels Hall to a remote outpost in the Antarctic and is about to go even farther. Breaking the bounds of Earth aboard Soyuz MS-12 and docking at the International Space Station will be just the beginning of the fullfilment of a lifelong goal of one NC State alumna.

NASA has chosen a graduate from NC State's Department of Electrical and Computer Engineering, Christina Hammock Koch, to be a flight engineer for an upcoming spaceflight. She has been assigned to Expeditions 59 and 60, set to launch to the International Space Station in April 2019 for a six-month mission.

Koch, who grew up in Jacksonville, North Carolina, earned bachelor's degrees in electrical engineering and physics (2001), and a master's degree in electrical engineering (2002) from North Carolina State University.

Encouragement from mentors like Cecilia Townsend, director of undergraduate advising in ECE, helped to keep her on track.

> "I told my advisors that I wanted to be an astronaut, and they never discouraged me," she says. "They found opportunities for me that were within the space field and encouraged me to go after it."

Koch started her career as an electrical engineer focusing on space science instrument design at NASA's Goddard Space Flight Center in Greenbelt, Maryland. She went on to work as a research associate with the United States Antarctic Program, completing several deployments including spending the winter at the South Pole. She returned to space science instrument design at the Johns Hopkins University's Applied Physics Laboratory, contributing to such missions as the Juno probe to Jupiter. She then returned to her work at remote scientific research stations, including sessions as a field engineer in the Arctic and as station chief with the National Oceanic and Atmospheric Administration in American Samoa.

NASA selected Koch from among 6,100 applicants, as one of the eight astronaut candidates making up the 2013 astronaut class which graduated two years later—notably, the first NASA class made up evenly of men and women.

As a child, Koch dreamed of becoming an astronaut. A summer at Space Camp in Huntsville, Alabama, reshaped her plan to get there. During an appearance at Talley Student Union in 2016, Koch recalled to the audience being shown a checklist of essential skills and experiences for a future astronaut.

> "I thought that living your life according to a checklist wouldn't be worthy of someone who could have the responsibility to actually become an astronaut."

Koch went on to explain, "so I decided then and there to live my life according to my interests and passions. Down the road, if I looked at the experiences that I had gathered, and I thought that I really could contribute to the human spaceflight program as an astronaut, I would apply."

That philosophy led her to NC State and a diverse set of experiences. Some, like double-majoring in physics and electrical engineering or interning for a summer at NASA, checked the traditional boxes for future astronauts. Others, like being a staff photographer for the student newspaper or volunteering with social justice organizations, strayed outside those boxes. Through them all, Koch focused on the moment in front of her but kept a future in space travel in mind, and that dream is now about to become reality.


# From Theory to Practice: ECE Senior Design

As the end of each semester approaches, undergraduate seniors in NC State's Department of Electrical and Computer Engineering capstone engineering course get to demonstrate the skills they have come away with in the pursuance of their degree.

Students spend two semesters working as teams with industry partners, university departments, non-profits, and start-ups working on projects that aim for them to create, design and develop a real world solution to a proven problem.

Engineering student Dana Shrader and group partners Tim Alexander, Carina Selph and Kev Ficker worked to design a device to prevent unattended cooking fires. Their Kitchen Safety Assistant detects presence in the kitchen when cooking, and avoids potentially dangerous cooking situations that could lead to a fire—alerting users both locally and remotely. Their technical solution will be able to confront the real-world problem of kitchen fires, which are the number one cause of home fires and injuries.

This past year saw students working on a variety of projects, including smart recycling, smart plumbing, utility grid control, robotic assistants for construction, a voice activated wheelchair and even a wine blending device.

Alex Nowinski, a student involved in the Smart Plumbing Project believes that his group's project will contribute to solving real-world problems where unaccounted water usage can be linked to leaks within plumbing designs.

With the Smart Plumbing Project, the group created a device to detect leaks and notify the user in a wide range of situations from small holes in a toilet flapper to a burst pipe.

> Cameron Rouse, also a member of the Smart Plumbing Project explains that, "reducing the amount of water wasted in the typical American household is making progress towards a more complete picture of the smart home."

One team came away from the Spring 2018 ECE Senior Design Day with the first-place overall ribbon for their unique cocoa bean moisture meter project. They were then given the rare privilege of being selected by the Capstone Design Conference as one of the few student teams around the world to attend their international conference in Rochester, New York this past summer.

This biennial conference has the goal of providing a forum for the extended capstone design community to share ideas about improving design-based capstone courses.

The conference brings faculty, administrators, industry representatives, and a select group of students to showcase their work, projects, and program objectives.

"I believe exposure and collaboration with other capstone programs is extremely important," explained **Dr. Rachana Gupta**, Associate Director of ECE Senior Design. "This is the second ECE senior design project which has been selected to present at the capstone conference. I am very glad that our ECE Senior Design program is being represented well in the International Capstone community."

The Handheld, Noninvasive Cocoa Bean Moisture Meter Project was created to solve a problem that cocoa bean farmers in Africa experience—that they lack an inexpensive, accurate, and noninvasive way to measure the moisture content of their crop, resulting in waste and difficulties at scale. The team created an app-based solution that couples a tiny moisture meter in a 3D-printed enclosure with their CocoaMax Android app to deliver a simple color-coded readout of the moisture levels in bags of cocoa beans. The team was mentored by Dr. William Carr of RFID Sensor Systems, and **Dr. W. Shep Pitts**, a research assistant professor in electrical and computer engineering.

Team members Kevin Acken, Eric Barrow, Brad Beard, as well as their instructor, Dr. Gupta, represented NC State and their project sponsor, RFID Sensor Systems at the Capstone Design Conference. The team's fourth member, Christopher Lawrence was unable to attend the conference.

They presented their project at a poster session as one of only 20 teams from around the world that were invited. As examples of those students who flourished in a capstone course, the student representatives weighed in on how to improve capstone courses in the future, along with the challenges they met and overcome through the experience.

"The conference was a great opportunity to learn about the pedagogy behind capstone courses, the challenges it poses, and the rewards it can bring," extolled Acken.

> "It was inspiring to see the passion and willingness to improve exhibited by the instructors attending. The conference was very accessible and everyone seemed to value my opinions and the work we did to improve the lives of cocoa bean farmers worldwide."

Acken was also selected to participate in a panel discussion entitled, "What I Wish I Had Known Before I Took Capstone" on the closing day, in which he discussed some of the expectations and concerns leading up to starting the Senior Design courses, and the learning curves involving working on a real-world project with a team of peers.

Learn more about NC State ECE Senior Design at ece.ncsu.edu/seniordesign

From left, Chunkyun Seok, Nasie Constantino and Marzana Mahmud
*Photo Credit: College of Agriculture and Life Sciences.*

# NC State Team Wins BASF Plant Science Competition

A cross-pollination between electrical engineers and plant scientists at NC State proved itself as BASF Corporation selected a graduate student team from North Carolina State University as the winner of its fourth annual North American Science Competition.

The team was selected from 13 teams from the US and Canada that submitted projects to the competition. The winning team members, Dr. Nasie Constantino (Postdoctoral researcher in CALS), Marzana Mantasha Mahmud and Chunkyun Seok (both Ph.D. students in ECE), each received a $1,000 cash award. The task of this year's competition was to develop solutions to identify plant responses to stress.

By the time crops show physical symptoms that they've been attacked by insects, plant pathogens or other stressors, it is often too late.

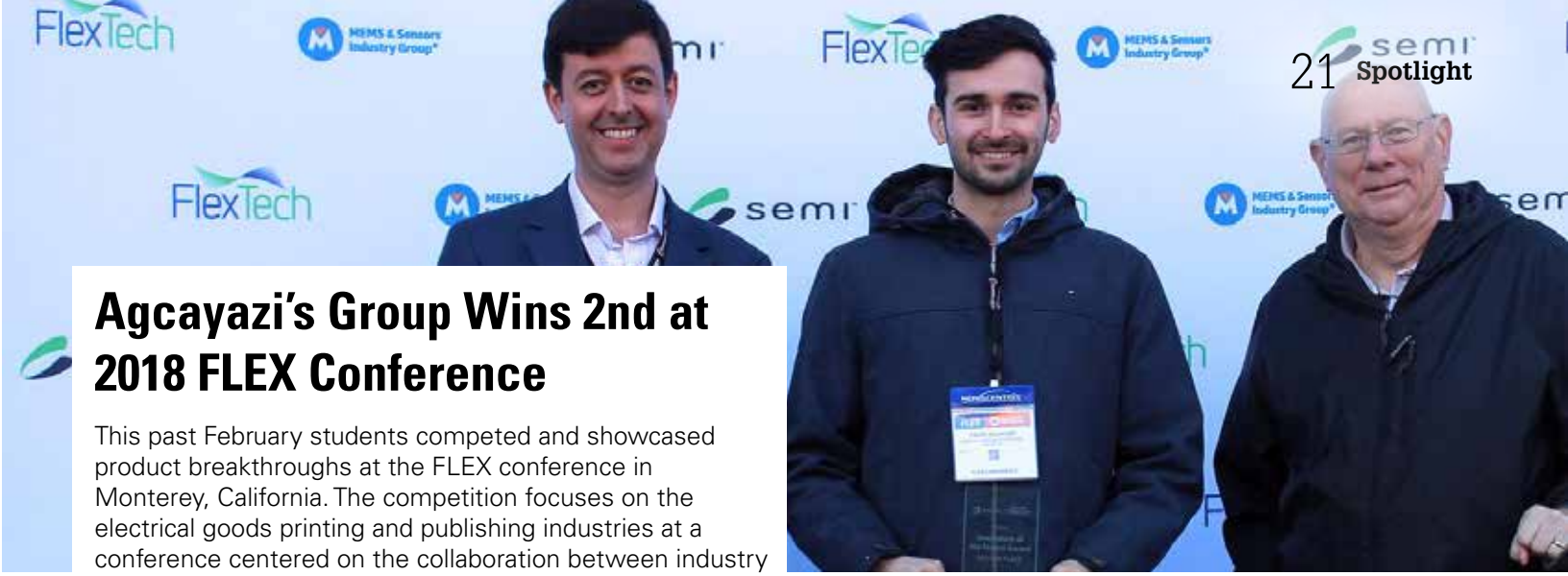
Working together, the two engineers and plant science researcher created a tiny array of sensors coated with polymers that can detect the unique bouquet of volatile organic compounds, or VOCs, that plants emit in response to different stressors. VOCs activate the plant's molecular defense systems, attract beneficial insects and warn surrounding plants of an impending attack.

"We are continually trying to find ways to equip our customers with the tools they need to get ahead of plant health issues," said Luke Bozeman, BASF Director, Research and Development, U.S. Crop Protection, headquartered in the Research Triangle Park. "This competition provided a unique opportunity for young academic researchers to work in teams to help identify solutions to a real global plant health concern."

With multiple factors affecting a plant's ability to grow to maturity, the team's sensor technology could allow for a timely and targeted response which ultimately helps improve a farmer's ability to produce healthier and more robust crops.

The team successfully created a quarter-sized sensor that could immediately detect the VOCs emitted by corn plants when wounded or attacked by an insect. To further their research and refine the sensor array, the team has received additional funding from BASF.

"With the cash prize and mentorship from BASF scientists, we can further our research now," said engineer Marzana Mantasha Mahmud. "As electrical engineers, we are so excited that we can contribute to this project. It's a whole different field of study for us."

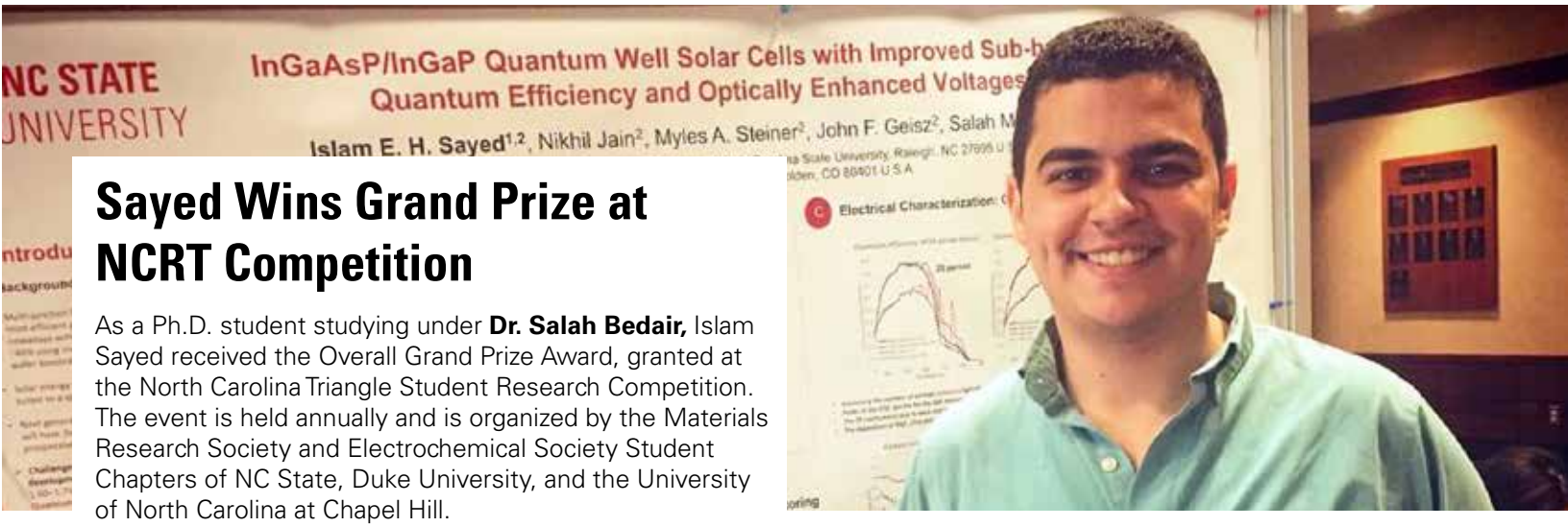



# Agcayazi's Group Wins 2nd at 2018 FLEX Conference

This past February students competed and showcased product breakthroughs at the FLEX conference in Monterey, California. The competition focuses on the electrical goods printing and publishing industries at a conference centered on the collaboration between industry professionals and academia members who come together to share ideas about flexible electronics and sensors.

North Carolina State University Ph.D. student in electrical engineering, Talha Agcayazi (center in photo), placed second in the poster session of the 2018 FLEX conference. Agcayazi is part of the iBionicS lab which focuses his research efforts on making sensors and actuators for biological systems. Group members include Jordan Tabor, Michael McKnight, Max Gordon, and Corey White, advised by Helen Huang, Tushar Ghosh, and **Dr. Alper Bozkurt,** associate professer in electrical and computer engineering.

The poster for the 2018 FLEX conference was titled: Multi-Modal Array Sensing with Smart Textiles. The work included results from a textile sensor that could sense wetness, force and biopotential signals in an array fashion. Agcayazi and his group want to utilize this sensor to measure the interface quality for prosthetic limbs. This research group is a collaboration between the Electrical and Computer Engineering and Biomedical Engineering departments and the College of Textiles. About his experience, Agcayazi said, "FLEX conferences are very specialized yet very well attended. The mixture of people from the industry and academia is a big reason for the excitement. Most people that come are managers at growing companies so there is a lot for a student to learn."




# Sayed Wins Grand Prize at NCRT Competition

As a Ph.D. student studying under **Dr. Salah Bedair,** Islam Sayed received the Overall Grand Prize Award, granted at the North Carolina Triangle Student Research Competition. The event is held annually and is organized by the Materials Research Society and Electrochemical Society Student Chapters of NC State, Duke University, and the University of North Carolina at Chapel Hill.

During the competition, 61 presenters showed their research in five categories covering different aspects of materials science, physical electronics, and electrochemistry.

An award was granted for the best presenter of each category, and in addition an overall grand prize award was presented to the best presenter at the event, and Islam was honored to receive this prestigious award from amongst the other 60 competitors. Posters were judged by professors from UNC-Chapel Hill, Duke, and NC State, in addition to representatives from the Eastman Chemical Company.

Sayed was also selected as a finalist in NC State's 2017 Three Minute Thesis Competition, where he represented the ECE Department while presenting on his research to a non-technical audience and received the Exemplary Student Poster award at the 2017 State Energy Conference of North Carolina. He is currently a postdoctoral researcher at the University of California, Santa Barbara.

# Byrd Elected as First Vice President of IEEE Computer Society

**Dr. Gregory Byrd**, professor and Associate Department Head of the electrical and computer engineering department at NC State University was elected by the IEEE Computer Society as the 2018 First Vice President.

IEEE Computer Society, the computing industry's unmatched source for technology information and career development, offers a comprehensive array of industry-recognized products, services and professional opportunities. Known as the community for technology leaders, IEEE Computer Society's vast resources include membership, publications, a renowned digital library, training programs, conferences, and top-trending technology events.

As an officer and member of the Board of Governors, Byrd's role as the First Vice President is integral to setting the direction and determining the strategy for the Computer Society, and provides guidance at the policy level to all Society organizational entities.

Previously, Byrd was a member of the CS Board of Governors (2015-2017), and a member-at-large of the Publications Board (2012-2016). In 2016, he served as Computer Society Secretary. He is a member of the Computer magazine editorial board, as computer architectures area editor (2013-14, 2017) and as creator and editor of the Student Design Showcase column (2015-16).

Byrd's research is primarily in the area of parallel computer architecture. He received a Ph.D. in electrical engineering from Stanford University. Prior to joining NC State, he worked at Celotek, MCNC, NC Supercomputing Center, and Digital Equipment Corporation. He has been general chair and program chair of the IEEE International Conference on Computer Design, and has served on program committees of several IEEE conferences. He received an Outstanding Teacher Award at NC State (2011) and the IEEE CS Golden Core Award (2016).

# Misra Selected as Distinguished Lecturer for IEEE Sensors

**Dr. Veena Misra**, Distinguished Professor of Electrical and Computer Engineering at NC State University and the Director of the NSF ASSIST Nanosystems Center has been selected by the IEEE Sensors Council as a Distinguished Lecturer for 2018-2020, on the subject of Self-Powered Wearable Sensors for Health and Environmental Monitoring.

The IEEE Sensors Council's Distinguished Lecturer Program (DLP) promotes the field of sensors to the broad engineering and scientific community, and to the public at large by providing lecturers who are acknowledged and eminent scholars in pure and applied sensors and sensors related technical fields, and who can be selectively invited by "local" entities globally. Lectures are meant to be public events and can be given at local IEEE chapters, universities and companies, high schools, and science fairs.

Misra has made significant contributions to NC State, not the least of which has been leading the proposal effort establishing the ASSIST Center and subsequently leading it successfully through its last critical review and renewal.

Misra's awards and recognitions include the 2001 NSF Presidential Early CAREER Award (PECASE), the 2002 ALCOA Research Achievement Award, the 2007 NCSU Alumni Research Award, and the 2011 ALCOA Distinguished Research Award. She was elected IEEE Fellow in 2012. In 2016, Misra was named a Distinguished Professor of Electrical and Computer Engineering at NC State.

# Solihin and Veliadis Elevated to IEEE Fellows

Two NC State ECE professors were honored with elevation to IEEE Fellow in recognition of their outstanding contributions to the field of electrical and computer engineering. **Dr. Yan Solihin** was nominated for his contributions to shared cache hierarchies and secure processors, and **Dr. Victor Veliadis** for his contributions to the development of SiC power devices.

The IEEE Grade of Fellow is conferred by the IEEE Board of Directors upon persons with an outstanding record of accomplishments in any of the IEEE fields of interest. The total number selected in any one year cannot exceed one-tenth of one percent of the total voting membership. IEEE Fellow is the highest grade of membership and is recognized by the technical community as a prestigious honor and an important career achievement.

"Becoming an IEEE Fellow is a particular honor since it is the result of peers recognizing the significance and impact of one's contributions," said **Dr. Dan Stancil**, the ECE Department Head, "It also reflects well on the department and university by demonstrating once again that our faculty and students are involved in innovative and cutting-edge research."

The IEEE is the world's leading professional association for advancing technology for humanity. Through its more than 400,000 members in 160 countries, the association is a leading authority on a wide variety of areas ranging from aerospace systems, computers and telecommunications to biomedical engineering, electric power, and consumer electronics.

# Dai Named as University Faculty Scholar

NC State's 2017-2018 class of University Faculty Scholars including **Dr. Huaiyu Dai**, professor of electrical and computer engineering, represent early- and mid-career faculty dedicated to serving the university community and their respective fields through scholarship, research, and engagement.

The University Faculty Scholars program, established by Chancellor Randy Woodson in 2012, recognizes and rewards emerging academic leaders at NC State. So far 126 members of the faculty have received this honor. Faculty members selected as University Faculty Scholars carry the title for the duration of their faculty appointment at NC State and receive an increase to their base salary.

A committee of senior faculty reviews nominations submitted by the colleges. Assistant professors appointed for a second term, all associate professors and professors within the first three years of appointment at that rank may receive nominations. The committee evaluates nominees on their research and scholarship productivity, excellence in teaching and mentoring, and leadership in extension, professional societies, and public service initiatives.

Dr. Dai received his Ph.D. in Electrical Engineering from Princeton University in 2002. His research interests include Adaptive Signal Processing, Digital Communications, Digital Signal Processing, and Multidimensional Signal Processing. He was awarded the IEEE VTC Service Award in 2005 and elevated to IEEE Fellow last year for his contributions to MIMO communications and wireless security.

# Buckner Granted GAANN Fellowship

Eli Buckner, a Ph.D. student in electrical engineering was recently granted placement in the Graduate Assistance in Areas of National Need (GAANN) Fellowship program. Buckner's focus for this program is in Molecular Biotechnology: he works in the EnBiSys Lab, which specializes in the application of signal analysis techniques in the fields of electrical engineering and then applies them to biological system signals. Buckner's focus is specifically a computer vision application to observe gene expression levels from microscopy images of plants.

"I think receiving this fellowship has given me a lot of confidence in many areas including my academic career and even my faith," explained Buckner. "I hope to make an impact by fulfilling a need of some sort. I want to provide a small piece of a large puzzle that solves a huge problem". One of the big goals of his advisor **Dr. Cranos Williams**' lab is to be a part of developing a species of crops that can help feed many people in areas where crop growth is scarce.

# Dayerizadeh Awarded NSF Graduate Fellowship

Electrical Engineering Ph.D. student Alireza Dayerizadeh was awarded a National Science Foundation Graduate Research Fellowship. The NSF Fellowships are prestigious awards offered to students with outstanding academic achievements and who show promise for future innovations and inventions within their field.

The NSF Graduate Research Fellowship recognizes and supports graduates students who are pursuing research-based Master's and Doctoral degrees in science, technology, engineering, and mathematics (STEM) or in the STEM education field.

Along with his research activities at the FREEDM Systems Center, Dayerizadeh works with a cohort of undergraduate research scholars on developing wireless power transfer capability on the upcoming EcoPRT personal transit system, which is being developed within the College of Engineering.

Regarding his award, Dayerizadeh said, "I am very honored and excited to be fortunate enough to receive the Graduate Research Fellowship. I hope that it will provide me with a broad platform to share my research, mentor other students, and continue my outreach activities."

# Ali Awarded Astronaut Scholarship

Ziad Ali, a senior studying electrical engineering and biomedical engineering has been selected as one of the 2018-19 Astronaut Scholars.

Astronaut Scholarships are awarded to college juniors and seniors studying science, technology, engineering, or mathematics with the intent to pursue research or advance their field upon completion of their final degree. This year's Astronaut Scholars include 50 scholarships to students from 36 universities in the U.S. Ali is joined by Madison Maloney, a senior studying aerospace engineering as the scholarship recipients from NC State.

From a research perspective, Ali wants to look further into the intersection between electrical engineering and neuroscience. Specifically, he wants to investigate how we can create circuits and devices that can allow us to better probe and interface with the human brain so as to better diagnose and treat neurological disorders.

# ECE Alumnus Mattauch Receives IEEE Microwave Pioneer Award

Dr. Robert J. Mattauch (M.S. '64, Ph.D. '67), has been selected to receive the 2018 Microwave Pioneer Award of the IEEE Microwave Theory and Techniques Society (MTT-S). Mattauch was honored with the award for theoretical and experimental work on the development of Schottky diode technology for scientific applications throughout the millimeter—and submillimeter—wave bands.

The Microwave Pioneer Award recognizes outstanding pioneering technical contributions that advance microwave theory and techniques, which are described in an archival paper published at least 20 years prior to the year of the award.

"We are exceptionally proud of these seminal technical contributions from one of our outstanding alumni," said **Dr. Dan Stancil**, Alcoa Distinguished Professor and Department Head of Electrical and Computer Engineering at NC State. "His considerable contributions to educational leadership and the engineering discipline at the University of Virginia and Virginia Commonwealth University are truly exemplary."

Mattauch, with the help of over 100 graduate students carried out research on millimeter wave and THz receiver elements from 1969 through 1995 while at the University of Virginia. Mattauch and his team collaborated with NASA's Jet Propulsion Lab on millimeter wave device designed and fabrication for detection of chlorine monoxide, responsible for the disassociation of stratospheric ozone molecules (ozone hole). Devices from his lab were used in receivers at radio astronomy installations around the world and on the Upper Atmospheric Research Satellite of STS-48, launched in 1991.

Mattauch earned M.S. and Ph.D. degrees in electrical engineering from North Carolina State University before joining the electrical engineering faculty of the University of Virginia. In 1996 he moved to the Virginia Commonwealth University in Richmond, Virginia where he served as founding Chair of the Electrical and Computer Engineering department. Subsequently, he served as Dean of the School of Engineering at VCU from 1999 until his retirement in 2007.

Mattauch was inducted into the NC State ECE Alumni Hall of Fame in 2017.

# Aydin Aysu Assistant Professor

**Dr. Aydin Aysu** received his B.S degree in microelectronics engineering with a mathematics minor and his M.S degree in electrical engineering from Sabanci University, Istanbul, Turkey. He received his Ph.D. degree in computer engineering from Virginia Tech and was a post-doctoral researcher at the University of Texas at Austin.

Dr. Aysu conducts research on cybersecurity with an emphasis on hardware-based security. The focus of his research is the development of secure systems that prevent advanced cyber attacks targeting hardware vulnerabilities. To that end, his research interests cover applied cryptography, computer architecture, and digital hardware design.

Dr. Aysu's most recent work showed the first successful attacks on post-quantum key-exchange protocols, which was selected as the best paper runner-up at the International Conference on Hardware-Oriented Security and Trust (HOST'2018).

Aysu joined the faculty as a tenure-track Assistant Professor in August 2018.

# #10 Globally in Electrical Engineering

NC State routinely ranks among the United States' premiere electrical and computer engineering programs, and now a new listing of the best universities around the world confirms that NC State is one of the finest places anywhere to become an electrical engineer.

The renowned ShanghaiRanking Consultancy published their 2018 rankings of universities around the world in various academic subjects, including Electrical and Electronic Engineering in which they ranked **NC State University as number ten in the world**.

The ARWU Shanghai Ranking is published annually and gives an insight into the academic quality of the world's leading institutions. General university rankings are provided, as well as global rankings on specific academic subjects. Topics covered are the number of scientific publications, citation impact, the number of paper in top-rated journals and internationally collaborated papers.

The groundbreaking work being done by faculty and researchers was recognized with NC State receiving the **third-highest score for citation impact**, and the **fourth-highest for number and impact of awards** received by faculty.

## Online Master's Ranked #1

The online Master's Degree in Electrical Engineering offered by the Department of Electrical and Computer Engineering at North Carolina State University has been **named the top program** in Best College Reviews' ranking of the Top 30 Online Master's programs.

NC State while securing the number one spot, was chosen for the University's overall outstanding reputation, as well as the electrical engineering program's rock-solid core curriculum, for its faculty's excellence and the commitment to providing non-traditional students with all of the tools that they need to achieve their educational and career goals.

## NC State Climbs on Best Value List

NC State is among the **top 10 best values** in public higher education for both in-state and out-of-state students, according to Kiplinger's Personal Finance. The annual ranking measures both academic quality and affordability.

For in-state students, NC State jumped from 18th place last year to ninth on this year's list. The university rose from ninth to seventh place for out-of-state students. Among all colleges — public and private — NC State moved up 10 spots this year to rank 66th overall out of 300 schools.

## Online Graduate Degree in Electrical Engineering Earns Top Ranking

SR Education Group's Guide to Online Schools' 2017 rankings placed the online master's degree program in electrical engineering **at No. 12 nationally** for best value, based on academic strength and tuition rates.

The College of Engineering placed **No. 9** in the U.S. News & World Report 2019 list of Best Online Graduate Engineering Program.

## Inc. Cites Centennial Campus in Raleigh's Rise as a Startup Hub

Inc., a national outlet focused on innovation news, outlines 'Why Raleigh Will Be the Next Startup Hub'. NC State's Centennial Campus—home to the Department of Electrical and Computer Engineering—along with its industry partnerships, and entrepreneurship assets, are cited in the city's rise as a **top startup hub**.

"NC State's Centennial Campus, just west of downtown, looks and feels like Silicon Valley."

# 2018 HALL OF FAME

The Department of Electrical and Computer Engineering at NC State University is proud to announce the 2018 inductees to the **ECE Alumni Hall of Fame**. The purpose of this extraordinary honor is to celebrate the accomplishments of our outstanding graduates who have used their education to excel in a profession, career, or service. Additionally, this recognition will serve as an inspiration for current students.

Our alumni are at the core of the Department, representing the agents and ambassadors that have made groundbreaking contributions in the study of electrical and computer engineering and beyond.

## Mr. James F. Collins
Founder
Applied Signal Technology
**B.S. EE 1964; M.S. EE 1966**

## Mr. Tim Humphrey
Senior Location Executive
IBM Research Triangle Park
**B.S. EE 1996**

## Ms. Patti Key
Senior Vice President Sales
Keysight Technologies
**B.S. EE 1987**

## Dr. Tony Montalvo
Fellow
Analog Devices
**Ph.D. EE 1995**

## Dr. Andrew Mueller, M.D.
Senior Vice President
Novant Health
**B.S. EE 1992**

## Dr. Robbie Troxler
Director of Advanced Technology
Troxler Electronic Laboratories
**B.S. EE 1983**

## Mr. David R. Wooten
Partner Architect, Ret.
Microsoft Corporation
**B.S. EE 1974**

## Mr. J. Nick England
Founder
3rdTech, Inc.
**B.S. EE 1969**

## Mr. Patrick Hutchins
President
Staco Systems
**B.S. EE 1985**

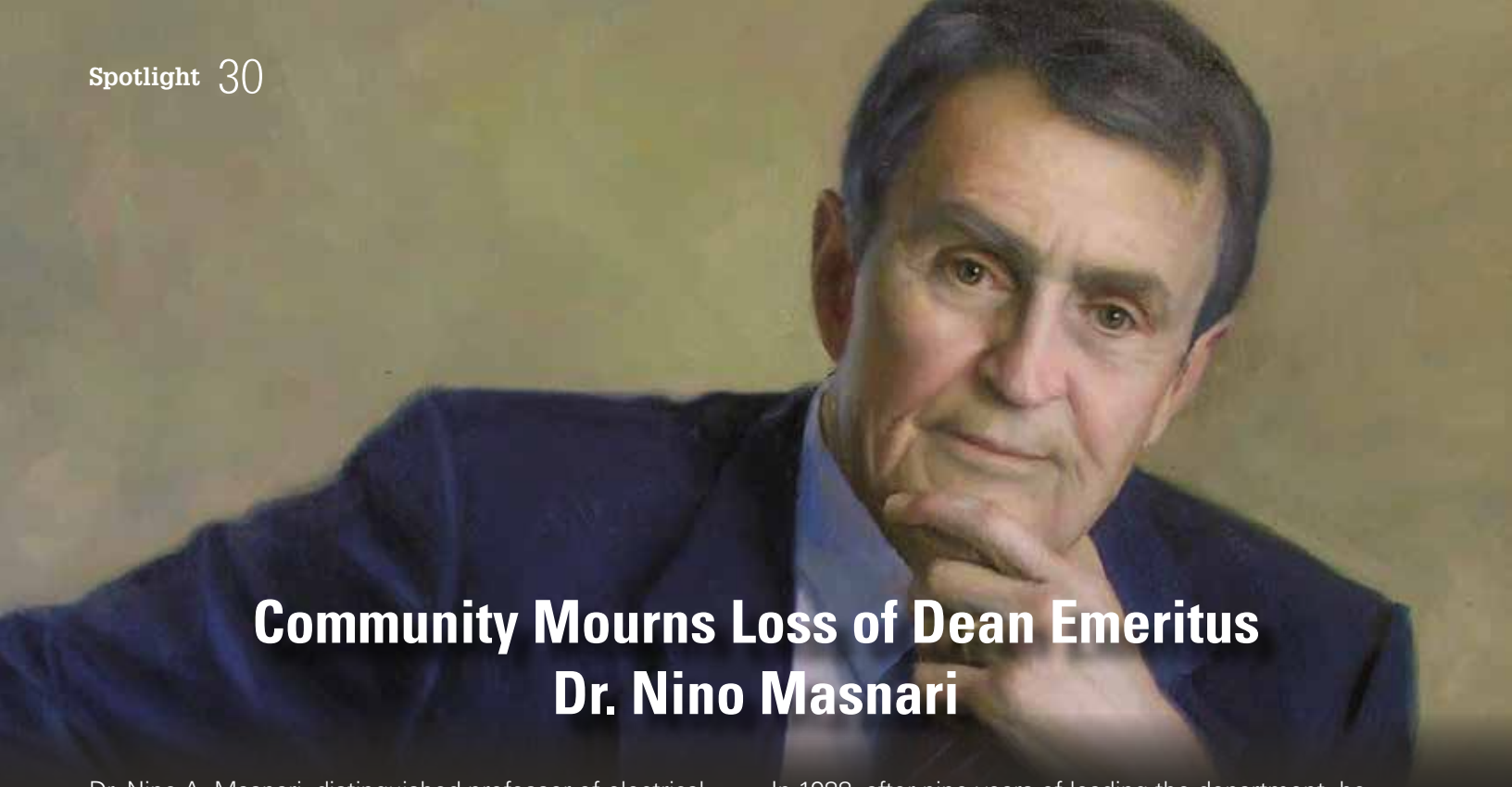
## Dr. Raymond Leopold
Co-creator
Iridium Satellite Communication System
**M.S. EE 1968**

## Dr. Robert J. Moorhead, II
Billie J. Ball Distinguished Professor, Electrical and Computer Engineering
Mississippi State University
**M.S. EE 1982; Ph.D. EE 1985**

## Dr. Gaurav Sharma
Professor, Electrical and Computer Engineering
University of Rochester
**Ph.D. EE 1996**

## Mr. Jim L. Wall, II
Director of Powertrain
Hendrick Motorsports
**B.S. EE 1985; M.S. EE 1988**

Learn more at **go.ncsu.edu/HallOfFame**



# Community Mourns Loss of Dean Emeritus Dr. Nino Masnari

Dr. Nino A. Masnari, distinguished professor of electrical and computer engineering and dean emeritus of the College of Engineering at North Carolina State University, passed away on May 19, 2018.

Born in Three Rivers, Michigan, September 20, 1935, Nino Antonio Masnari was the second son of Antonio and Giovanna (Lupato) Masnari. He is survived by his wife, Judy, their three children Michael, Jeffrey and Maria and grandchildren.

Masnari received his bachelor's, master's and doctoral degrees, all in electrical engineering, from the University of Michigan in Ann Arbor in 1958, 1959 and 1964, respectively. His research interests were in the areas of silicon processing technologies and solid-state electronic devices. Following graduation, he began his career as a lecturer and research associate at the University of Michigan from 1964 to 1967. In 1967, he joined General Electric in Schenectady, New York, as an electronics engineer in research and development. In 1969, he joined the faculty of the University of Michigan as an associate professor, later being promoted to professor and director of the Electron Physics Laboratory.

Masnari joined NC State in 1979 as the head of the Department of Electrical Engineering. During his tenure as department head, the Department of Electrical Engineering was renamed in 1983 as the Department of Electrical and Computer Engineering, reflecting the growth and influence of computing. Other milestones included the hiring of the first woman faculty member in the department as well as the establishment of the National Science Foundation (NSF) Center for Communications and Signal Processing, the Microelectronics Center for North Carolina, and the Electric Power Systems Research Center.

In 1988, after nine years of leading the department, he was awarded leadership of a prestigious NSF Engineering Research Center (ERC) and became the founding director of the NSF ERC on Advanced Electronic Materials Processing and the SEMATECH Center of Excellence on Advanced Single Wafer Processing, both at NC State.

In 1996, Masnari was appointed dean of the College of Engineering at NC State, a position he held from August 1996 through June 2006, when he returned to the faculty of the Department of Electrical and Computer Engineering.

During his tenure as dean, the College of Engineering experienced a new era of growth and accomplishment. In 1997, the College held the grand opening for the Engineering Graduate Research Center, now the Monteith Research Center, and established the Women in Engineering Program. With the passage of a bond referendum in November 2000, the College began its move to NC State's Centennial Campus. Masnari oversaw the construction of the first two academic engineering buildings to be constructed at NC State since 1964. Engineering Buildings I and II opened in 2004 and 2005, respectively. Funding was secured and construction began on Engineering Building III under Masnari's leadership and opened in 2010.

With Masnari at the helm, the College of Engineering grew into the third largest producer of engineering and computer science degrees in the nation and research expenditures in the College nearly doubled to more than $90 million annually. Scholarship funding more than quadrupled, with total endowments growing to more than $51 million. The quality of entering freshmen improved, 112 new faculty members were hired, and national recognitions by NSF tripled.

This article originally appeared in the College of Engineering News.

# ECE CONNECTIONS PARTNERS

The ECE Connections corporate program is designed to develop and sustain strong collaborations between industry and the Department, offering meaningful engagement and recruiting events and activities.

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# Support ECE

**A gift to the Department of Electrical and Computer Engineering is an investment in the future.**

Through generous alumni, corporate partners and friends, the Department has been able to create new education opportunities, develop new research and technologies and attract the brightest faculty and students.

To learn more about supporting the Department, contact the NC State Engineering Foundation.

**ece.ncsu.edu/donate**