

# NC STATE

OFFICE OF RESEARCH COMMERCIALIZATION | **IMPACT REPORT** | 2023

## INNOVATION HIGHLIGHTS

Celebrating 10+ Years of Impactful CIF Projects

Page 10

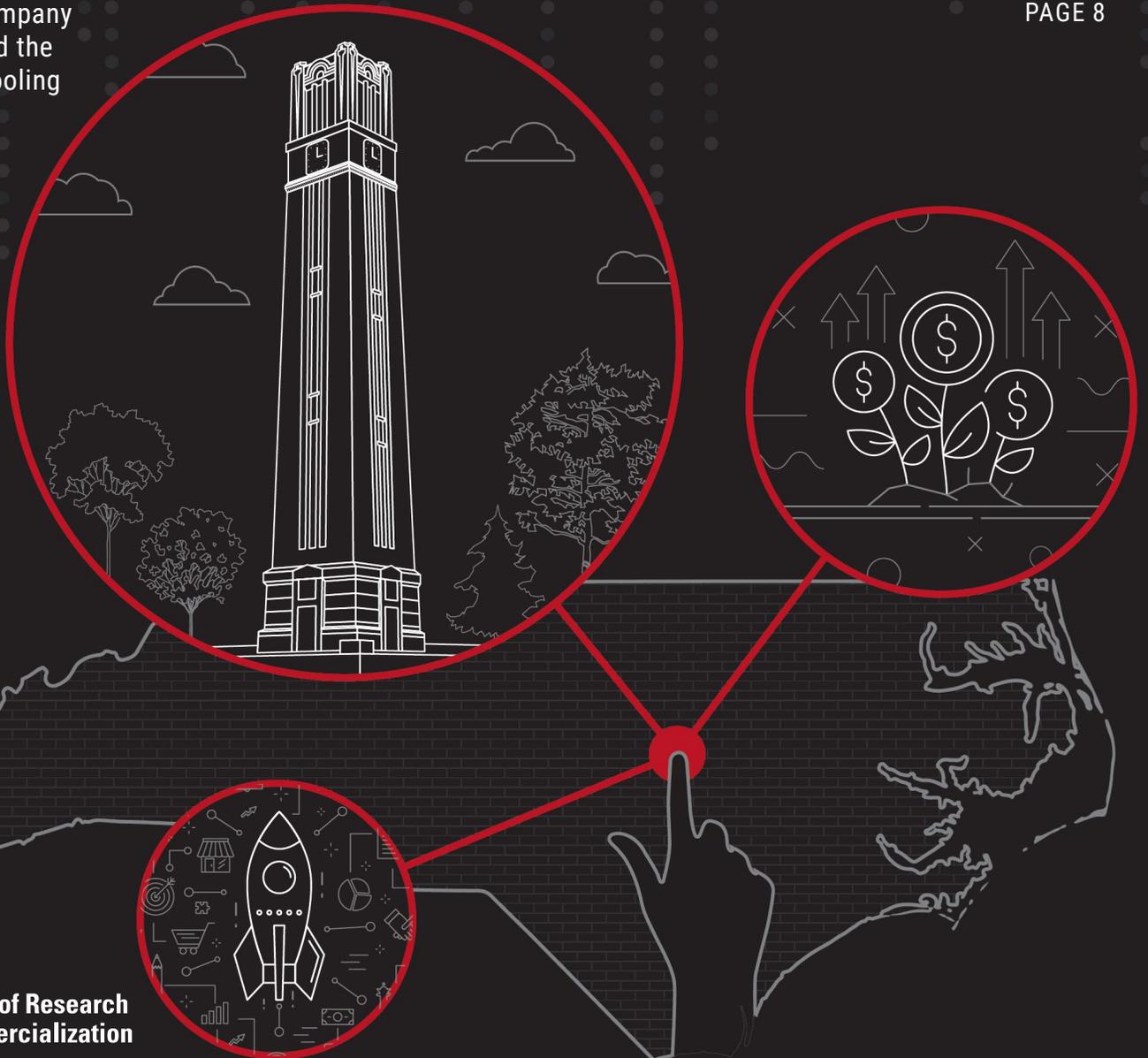
Trusting Their Gut: NC State Spinout Company Knows Cows Hold the Key to Quickly Cooling the Climate

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# Major Gift Expands Support

FOR COMMERCIALY FOCUSED NC STATE RESEARCH

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# A SHARED VISION

## FOR NC STATE INNOVATION

FROM VICE  
CHANCELLOR  
**MLADEN VOUK**

As vice chancellor of Research and Innovation, I'm proud of the thriving infrastructure for commercialization we have established at NC State. By creating a strong pipeline to the marketplace for our researchers, we make good on the think and do promise at the heart of the university's culture.

NC State continues to make big investments in research. I'm confident that these investments will result in the university taking even bigger strides to develop commercial intellectual property as a vital economic engine for our state and our nation.

Our commercialization ecosystem works as a part of this larger research enterprise at the university and feeds the future of our work to bring more research spin-outs, more advancements and more corporate agreements that bring economic, intellectual and academic prosperity.

Our leadership in this arena drives success for our business and educational partners throughout the region. NC State is the lead for the regional NSF I-CORPS hub, and as a result we are helping develop entrepreneurship and nurture investments in innovation both inside and outside the university setting.

FROM ASSISTANT VICE CHANCELLOR  
**WADE FULGHUM**

Dear Innovators, Partners, and Friends,

First of all: I'm back and healthy. After a traumatic injury and subsequent surgery and hospitalization following a bike accident in September 2023, I am back at work and am blessed to provide you with the Office of Research Commercialization's second annual impact report, which is designed to highlight the impressive and innovative work that has occurred at NC State within the last year.

2023 saw many advances, chief among them the formalization of entrepreneur and investor Bill Spruill's support of innovation at NC State through his philanthropic gift to support Chancellor's Innovation Fund (CIF) awardees. Bill's family foundation 2ndF is poised to supercharge deep tech commercialization in the Triangle, and he and his team have generously pledged not only funding but also time, expertise, and connections to our innovators. 2ndF is also passionate about training new entrepreneurs – and the traction shown by university startups such as Hoofprint Biome, which recently raised \$4.5 million in private investment, shows the impact CIF funding and ecosystem support can have on young technical founders.

The strength of our ecosystem was also highlighted in the Wolfpack Investor Network (WIN) investment in NC State startup Sonovascular last summer, supporting the medical device company as they pursue clinical trials to improve treatment of venous thromboembolism. WIN continues to grow as new members join at record rates, thanks in part to its expanding partnership with Habright Ventures.

Research also continues to transition to the marketplace through more traditional means, with an engineered bacteria strain from Rodolphe Barrangou's lab being licensed to an industrial partner to create a probiotic supplement product – now commercially available for consumer purchase – to reduce gastrointestinal inflammation.

I am confident that with the collective expertise and enthusiasm for innovation both at NC State and within the local ecosystem, we will continue to push new technologies forward, support new entrepreneurs and founders, and grow the reputation of the university on a national scale.

Thank you for your continued support and commitment to innovation at NC State.

Go Pack!

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**NC STATE**  
UNIVERSITY

**OFFICE OF RESEARCH  
COMMERCIALIZATION**

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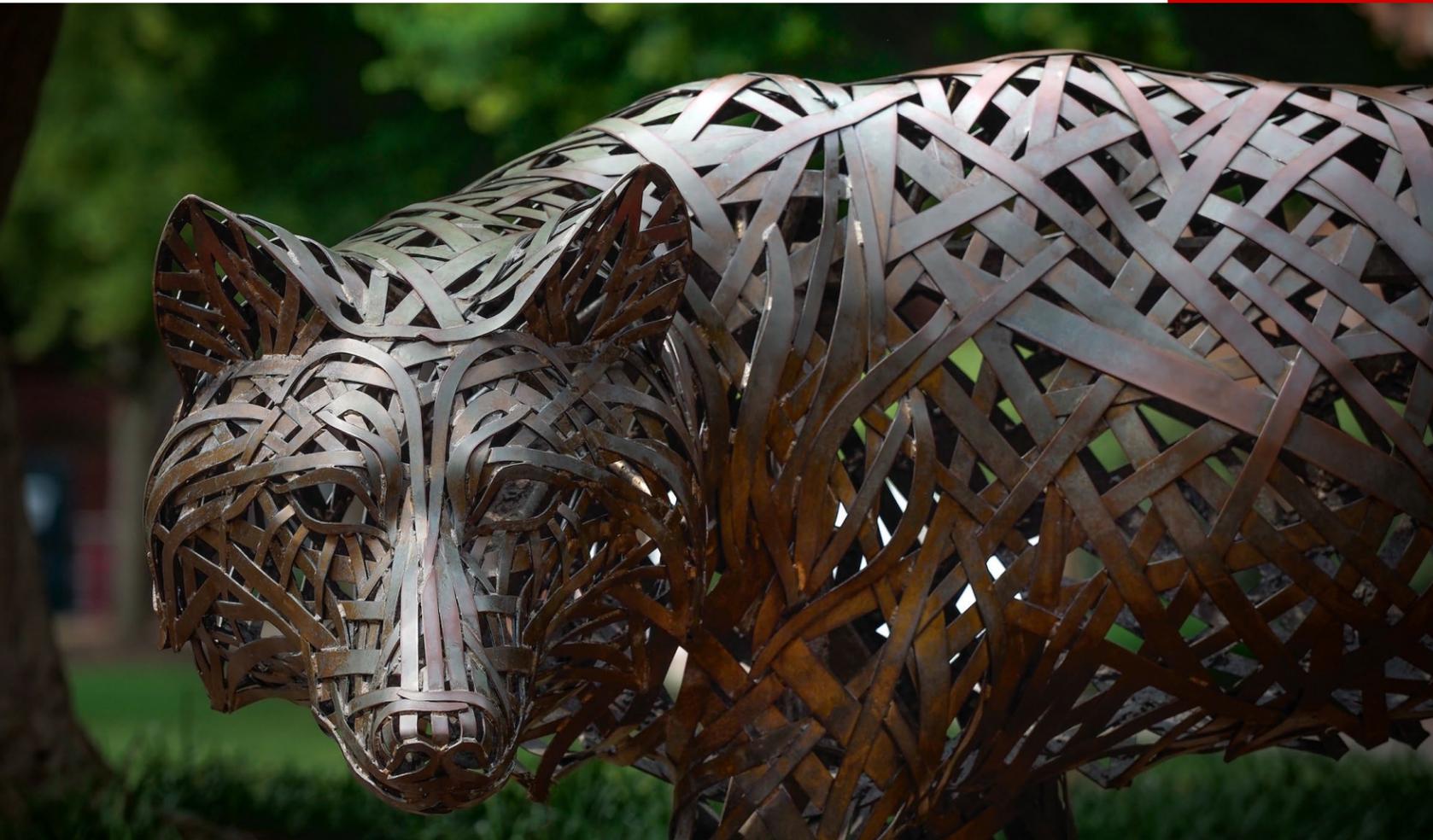
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# ABOUT US

## HISTORY AND MISSION

NC State's Office of Research Commercialization (ORC) acts as the steward of all intellectual property generated and owned by the university. Since its formation in the 1980s, it has worked to promote economic growth by facilitating the commercialization of research discoveries, leading to the launch of over 170 new startup companies and 600 commercialized products. ORC's mandate includes protecting and promoting university-owned research discoveries and innovations, engaging with industry partners, and supporting the launch and growth of startup companies commercializing university intellectual property.



## LICENSING

ORC's Licensing team is tasked with strategically managing invention disclosures submitted by faculty, staff, and students from all colleges, departments, and units on NC State's campus. Their responsibilities include the evaluation of new inventions, managing patent protection for novel innovations, identifying potential technology licensing partners, and working to negotiate license agreements that enable technology commercialization.



## NEW VENTURES

ORC's New Ventures team works to support university faculty and student innovators and entrepreneurs seeking to launch a new company to commercialize university-owned research. Their work includes strategic planning and business model support, assistance with new company incorporation, entrepreneurial training, development of logos and websites for new startups, and connections to startup funding and mentorship resources.



## FINANCE AND OPERATIONS

ORC's Finance and Operations team plays a critical role in assisting innovators and industrial partners with license payment, billing, and royalty collection and distribution, as well as maintaining compliance with federal sponsors. The team also manages the patent application process and correspondence, oversees reporting and tracking of products that arise from NC State intellectual property, and records and reports NC State commercialization data to internal and external stakeholders.

# OUR IMPACT BY THE NUMBERS

NC State is creating real-world impact through innovative ideas and action. Our faculty, students and staff are at the forefront of progress, and the Office of Research Commercialization helps accelerate those ideas to the market. See how we are making a difference locally, nationally and globally.



**1.7B+**  
FINANCING RAISED  
BY NC STATE STARTUPS



**800+**  
COMMERCIALIZATION  
AGREEMENTS



**1.5K+**  
PATENTS  
ISSUED



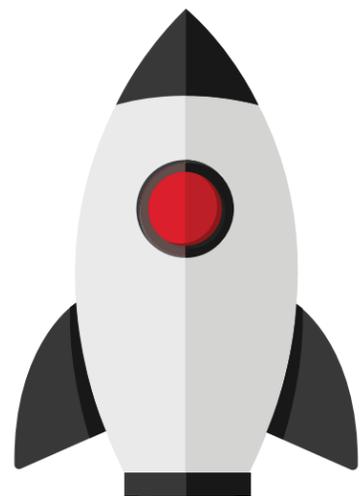
**8.5K+**  
TOTAL JOBS  
CREATED



**600+**  
PRODUCTS  
TO MARKET



**5K+**  
INVENTION  
DISCLOSURES



**200+**  
STARTUPS LAUNCHED

## OUR RANKINGS

AUTM FY21 | UNIVERSITIES WITHOUT MED SCHOOL

**#3**

STARTUPS LAUNCHED

**#2**

ACTIVE LICENSES  
AND OPTIONS

**#4**

TOTAL  
LICENSES

**#6**

TOTAL  
DISCLOSURES

**#1**

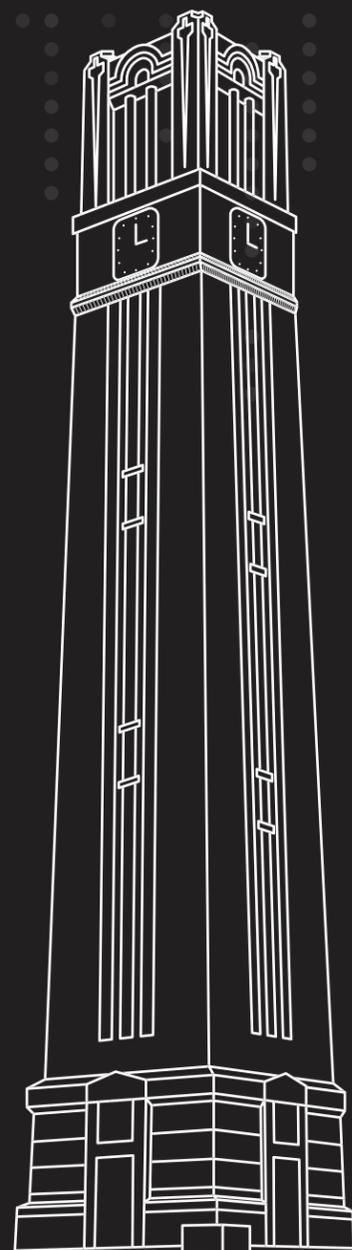
TOTAL  
OPTIONS

**#6**

RESEARCH  
EXPENDITURES

# Major Gift Expands Support for Commercially Focused NC State Research

BY: TAYLOR PARDUE



**Spruill's 2ndF Research Commercialization Fund will support CIF awardees who launch research-based startups**

A major gift to NC State's Office of Research Commercialization will enable even more Wolfpack innovators to conduct commercially focused research in the coming years.

Entrepreneur and investor Bill Spruill recently donated \$900,000 toward the Chancellor's Innovation Fund (CIF), which awards annual grants to Pack members in order to further their cutting-edge work. Spruill hopes his gift will not only help these projects come to fruition faster and more easily that might otherwise be possible but will also inspire others to join him in supporting this important fund.

Important for NC State, and important for the surrounding area.

"Of course, the primary point of this gift is to stimulate the commercialization of real science-based technology opportunities out of the university environment," Spruill said. "But the secondary purpose is to get the rest of the NC State community, as well as the Triangle investing community, to rally around bigger investments in this type of area and this type of work."

To that end, Spruill's gift created the 2ndF Research Commercialization Fund. The name is derived from 2ndF, a family office that Spruill started in 2022 following the sale of a company he cofounded with fellow NC State supporter Charles Gaddy. 2ndF's mission: to grow the Triangle ecosystem through focused execution on education, investment and global collaboration.

Distributions from the 2ndF Research Commercialization Fund will be used to support programmatic efforts and awards related to CIF.

CIF was established in 2010 and provides grants of up to \$50,000 to university researchers working on short-term, commercially viable projects. Students and faculty who have disclosed their inventions to the Office of Research Commercialization can apply for CIF grants in order to bridge the gap between the public and private funding they need to succeed. Proposals are submitted explaining how the technology the researchers are developing will fill a real-world need, followed by an in-person pitch for finalists to explain their research to the CIF selection committee in greater detail.

In 2022, for instance, CIF awarded grants to projects involving research into better COVID-19 antibody tests, enhanced Bluetooth EKGs, nanogels that could one day be used to kickstart the body's production of healing cells and more.

"The 2ndF Research Commercialization Fund will likely provide the first funding and support for university spinouts – helping transformative research cross the 'valley of death' and enter the real world," Kyle Tomek, cofounder of DNali (a CIF finalist), said. "This donation will exponentially increase the force of the impact of NC State's CIF, extending its reach and impact on early-stage innovations. Bill is setting the tone for the NC State and Research Triangle Park entrepreneurial ecosystem and helping make our region more competitive with traditional tech and biotech hubs like Boston and the Bay Area."

"Bill Spruill's generous gift recognizes CIF's success and is aimed at amplifying these efforts to increase the program impact and more quickly transition university research into the market," Wade Fulghum, assistant vice chancellor for

research commercialization, said. "His vision matches ours.

"We hope to be good stewards of the funding dedicated to this vision," Fulghum added, "and are very grateful for this fuel to amplify NC State's commitment to deep technology commercialization. Bill stepped up in a big way, and it will result in a major impact for the Triangle."

With the additional support for CIF that the 2ndF Research Commercialization Fund is providing, Spruill hopes to see even more groundbreaking and life-changing research ideas come to market soon as commercially viable products.

He also hopes they lead to the launch of even more companies that can help Raleigh and surrounding cities realize their innovative potential – especially ones that play to NC State strengths such as chip manufacturing, textile design and battery technology.

"Building these types of platforms, these types of companies, over the long haul will actually yield more Red Hats, more SASs, more Quintiles, more PPDs for the Triangle," Spruill said. "If we make those investments now – it won't be an overnight thing, but over the next 10, 15, 20 years, that will help us remain strong and competitive with communities such as Seattle, Austin and Boston.

"Let's work together to grow bigger businesses headquartered here for the betterment of the community," Spruill added. "Specifically, so they can employ our kids, grandkids, nieces, nephews, cousins and so forth and help the Triangle become a greater community. We need more of that."



# CELEBRATING 10+ YEARS OF IMPACTFUL CIF PROJECTS

BY: AMY PARKER

The Chancellor's Innovation Fund (CIF) was established in 2010 by Chancellor Randy Woodson to support and accelerate the development of the most promising early stage research with commercial potential at NC State, and 75 research teams have received funding to date. Notable successes in which technologies have transitioned to market include a software innovation that was integrated into Samsung's Knox security system and a canine cancer diagnostic test, while startup companies Locus Biosciences and SinnovaTek are both gaining traction through industry partnerships worth \$35 million and the opening of a new \$20 million, 62,500-square-foot production facility, respectively.

CIF has been successful for many reasons, chief among them the pool of research talent present at NC State, as well as strong engagement and support from investors and partners within the ecosystem who volunteer their time and expertise to evaluate and select projects for funding. The program has also grown in scope since its inception, with two

funding tracks – one for life science innovations and another for physical science and software innovations – being implemented in 2020 to better account for the potential impact of innovations, and now supplemental funding being provided through a 2023 philanthropic gift from entrepreneur and investor Bill Spruill's 2ndF family office to help CIF awardees pursue market-focused activities.

In September, current and past CIF awardees joined university leadership, members of the CIF selection committee, and Spruill's 2ndF team to celebrate the fund's impressive history and look to a vision for the future of the fund. Past awardees Dr. Joshua Pierce from the Department of Chemistry and Dr. Jack Wang from Forest Biotechnology each spoke regarding the impact of CIF funding on their research and how it helped to move their respective projects forward. Both faculty members are founders of deep technology startup companies that are developing intellectual property generated at NC State and funded by CIF, and cited the importance of the CIF funding in helping them to generate critical

research data to support the formation of a new company and secure additional follow-on grant funding to continue pursuit of commercialization.

Spruill also addressed the audience of 80+ stakeholders and outlined his goals for CIF and the newly established 2ndF Research Commercialization Fund, highlighting how funds and resources from his 2ndF team will help to strengthen and support deep technology research commercialization both at NC State and within the Triangle. Past CIF awards were limited to research support activities while the new 2ndF Research Commercialization Fund will supplement CIF research dollars with funding dedicated towards activities that support the launch and growth of new startup companies.

The CIF program is still growing after ten plus years, and through the support of advocates like Spruill and increasing engagement with deep tech investors on a national scale, its support of early-stage research will continue to expand and drive increased growth of early-stage NC State research teams and startup companies.

# CHANCELLOR'S INNOVATION FUND (CIF) IMPACT SUMMARY

## FUNDED PROJECTS

**75**

PROJECTS FUNDED

**62**

PROJECTS STILL ACTIVE

**620**

PROPOSALS SUBMITTED

**44**

TECHNOLOGIES LICENSED

**35**

STARTUP COMPANIES FORMED

**\$4.5M**

TOTAL AWARDS FUNDED

**FINANCIAL SUCCESS**



**\$80.7M**

IN FOLLOW-ON FUNDING

**\$5.1M**

IN LICENSING REVENUE

# WAYS TO ENGAGE

## CHANCELLOR'S INNOVATION FUND

The Chancellor's Innovation Fund accepts applications in October of each year as part of its funding cycle that supports university innovations with commercial applications and the potential to address meet market needs. Each year, a select number of finalists are invited to pitch their project to the CIF Selection Committee, a group consisting of investors, entrepreneurs, and entrepreneurial support organization leaders.

All NC State innovators eligible to serve as a Principal Investigator can apply to the CIF and an invention disclosure for the technology must be on file with the Office of Research Commercialization (ORC) to be considered for funding.

STEP  
**01**

**INVENTION DISCLOSURE**

Submit a disclosure through the ORC Innovator's Portal if you do not already have a disclosure on file

STEP  
**02**

**PRE-PROPOSAL**

Complete a two page pre-proposal using the template on the CIF webpage

STEP  
**03**

**FULL PROPOSAL**

Semi-finalists invited by ORC to submit a five page full proposal

STEP  
**04**

**INNOVATOR'S PITCH**

Finalists selected and invited to pitch to CIF Selection Committee



**Learn more about the Chancellor's Innovation Fund and how to apply by visiting:**

[go.ncsu.edu/cif-funding](http://go.ncsu.edu/cif-funding)



## WOLFPACK INVESTOR NETWORK Continues to Thrive

  
**24M**  
IN TOTAL  
INVESTMENT

  
**41**  
NEW  
MEMBERS

  
**450K**  
AVERAGE  
INVESTMENT

### NEW WIN PORTFOLIO COMPANIES

#### Flux Hybrids

Raleigh, NC: (Automotive Manufacturing): Converting gas fleets to zero emissions vehicles through its plug-in hybrid powertrains that increase fuel economy while reducing fuel expenses. Flux Hybrids was founded by five NC State undergrads and the company received investment from WIN in November 2023.

#### Voxel Innovations

Raleigh, NC: (Industrial Manufacturing): Machines high-quality metal components for medical device, aerospace, and energy industries using proprietary versions of pulsed electrochemical machining. CEO Daniel Herrington is an NC State alum and Voxel received two investments from WIN in 2023.

### WIN PORTFOLIO COMPANY UPDATES

#### Conductor Technologies

Oakland, CA: (Software): Secure cloud-based platform that enables VFX, VR/AR and animation studios to seamlessly offload rendering and simulation workloads to the public cloud. CEO Mac Moore is an NC State alum and Conductor was acquired by CoreWeave in 2023.

#### Deep Blue Medical

Durham, NC: (Medical Device): Developing a novel hernia mesh to prevent hernia recurrence. Deep Blue is commercializing research developed at NC State and received additional FDA clearance for its product in late 2022.

#### NatrX

Raleigh, NC (Software): Creating nature-based solutions for climate resilience and restoration. CEO Leonard Nelson is an NC State alum and the company raised \$3.5 million in 2023 to scale its operations.

Portfolio companies must meet the following criteria:



#### Wolfpack Connection

Have a founder, executive, or board member who is a NC State alumnus, faculty, staff, student, or parent, or have licensed NC State University intellectual property.



#### Funding

Raising seed or Series A equity capital of \$250,000 to \$5 million or syndicating later-stage equity financings with an existing or new lead investor.



#### Location

To help build economic development and support the land grant mission of the university and the company must be location in the United States.



WIN BACKS

# SonoVascular Ahead of Clinical Trials

Research Triangle Park medical company SonoVascular is one step closer to improving treatment for those with venous thromboembolism after securing capital and resources from the Wolfpack Investor Network.

BY: MARGARET HUFFMAN

The Wolfpack Investor Network (WIN) announced its newest investment in SonoVascular, an early-stage medical device company that offers a novel approach for the treatment of pulmonary embolism and deep vein thrombosis caused by blood clots in the lungs or legs.

Venous thromboembolism – deep vein thrombosis and pulmonary embolism – affects about 900,000 Americans each year and costs the U.S. approximately \$10 billion. SonoVascular aims to reduce the impact of venous thromboembolism by uniquely combining multiple mechanisms of action; (i) ultrasound, (ii) microbubbles, (iii) low dose thrombolytic drug, and (iv) mechanical retrieval and aspiration – delivered through an integrated intravascular catheter system in a single treatment. The SonoThrombectomy™ platform can be used in a catheterization lab and requires no ICU stay and has been designed to enable the safe and effective treatment of all types of blood clots, while reducing the amount of thrombolytics to levels that optimize safety and effectiveness.

WIN chose a long-term investment in SonoVascular for several reasons including the product’s large total and serviceable addressable market, excellent unit economics, and all-star leadership and technical teams.

The core ultrasound technology, spun out of the Joint Department of Biomedical Engineering Department (Joint BME) and the Department of Mechanical and Aerospace Engineering (MAE), is being developed under a leadership team with

decades of experience in the MedTech industry. Daniel Estay, founder and CEO, started his career in 1987 working for his father in a family business that developed the Latin American market for leading global medical device companies, including Boston Scientific and St. Jude Medical. Cardiovascular products became Estay’s early passion, and he had a successful career in corporate development and commercial operations with Johnson & Johnson and Abbott.

Luke Harada, the COO of SonoVascular, has over 25 years of experience in corporate development and finance in the MedTech industry.

In 2017, while reviewing a vascular medicine journal, Estay read about the research that would eventually lead to the formation of SonoVascular in early 2018. Since then, Estay has assembled a robust technical team with an impressive combined MedTech background to develop and test the technology, and secure regulatory approval. The company has also assembled a highly experienced board of directors that is led by Chairman, Bill Starling, who is one of the MedTech industry’s most successful entrepreneurs. Starling also serves as the chair of the Industrial Advisory Board for the Joint BME.

As interest in SonoVascular increased across the Triangle, investments followed. An early partnership with the NC State Office of Research Commercialization led to the development of the business plan and the first license agreement in 2018. In 2019, Innovate Carolina issued

SonoVascular a Commercial Award via its Kickstart Venture Services program to develop a prototype and conduct in-vitro bench testing in Professor Xiaoning Jiang’s Micro/Nano Engineering Lab at NC State. The sponsored research agreement with NC State led to proof of concept and a new relationship with WIN.

In the first quarter of 2022, WIN members invested \$85,000 in seed capital for SonoVascular, supporting the initial phase of the company’s development. In the second quarter of 2023, WIN members invested over \$325,000 as part of the company’s current convertible note financing. To date, SonoVascular has raised over \$5 million and is now poised to achieve key product development milestones. The company is planning to raise over \$10 million via a Series A financing in the fourth quarter of 2023 to support first-in-human clinical studies in New Zealand in the third quarter of 2024, followed by a U.S. clinical study in 2025 which will be required to secure FDA approval for its first clinical indication.

During ongoing development and preclinical/clinical trials, WIN will support SonoVascular with its organizational and business development goals to ensure the longevity and success of the company and the technology.

WIN recently partnered with Harbright Ventures to increase its reach and scope. The team approach will increase the investment power of WIN, boost member investment opportunities and help more companies like SonoVascular with counsel and support.

**To date, SonoVascular has raised over \$5 million and is now poised to achieve key product development milestones.**



# NC State Licenses Supplement Reducing GI Inflammation

BY: DEBORAH STRANGE

NC State researchers have created a new probiotic supplement that reduces gastrointestinal inflammation. The supplement was developed by engineering a strain of bacteria, and it's now licensed and commercially available for purchase.

Rodolphe Barrangou, the Todd R. Klaenhammer Distinguished Professor in Food, Bioprocessing and Nutrition Sciences, led a team of researchers studying the bacterium *Lactobacillus acidophilus*. A strain of this bacterium, *L. acidophilus* NCFM, was discovered at NC State in the 1970s and has been studied extensively since. NCFM stands for North Carolina Food Microbiology, the lab where this strain was discovered.

"For 40-plus years, this strain from the NC Food Microbiology Lab has been investigated and subjected to hundreds of scientific studies," Barrangou said "There's a legacy here, a history."

Barrangou and his team genetically edited *L. acidophilus* NCFM to prevent it from producing lipoteichoic acid, which is found in the outer layer of cell walls in some bacteria. While it occurs naturally, lipoteichoic acid has been correlated with inflammation inside human and animal bodies in some instances, including in the gastrointestinal tract.

"We always have some level of inflammation – there's a homeostasis for each individual," Barrangou said.

"Occasionally, it gets out of control. There are live microorganisms, probiotics, that, when administered correctly, will instill a health benefit."

When researchers removed lipoteichoic acid from *L. acidophilus* NCFM in the lab, they found the cell's surface had changed, altering the reactions between the bacterium and its host. Without the gene that produces lipoteichoic acid, the edited strain of *L. acidophilus* NCFM reduces inflammation in the gastrointestinal tract and reduces symptoms of GI distress in an animal model.

Because a gene was removed from a well-researched bacterium, the supplement is deemed generally recognized as safe, given the regulatory status and consumption history of the parent strain. The supplement was licensed to biotechnology company Provacus and is now sold under its CodonRx brand.

Kevin White, founder of Provacus, said licensing the supplement allowed the company to continue its mission of developing affordable products using advanced technologies in order to help the most number of people.

"We believe that, as a patented probiotic that has been shown in a wide variety of experiments to have anti-inflammatory effects, this supplement will be useful for a broad spectrum of people," White said. "We have an all-star group of medical and

scientific advisors who are excited about this product."

Sarah O'Flaherty, a senior research scholar in Barrangou's lab, came to NC State to study probiotic bacteria. Witnessing the licensing of a product she worked on is a unique experience.

"It's not typical working in academia that you get to experience being part of a team at Step One in genetic engineering and go all the way to the end to work on a product, when people can buy it and potentially improve their quality of life," O'Flaherty said. "It's an honor, in a way, to see it go from A to Z."

Further research can determine whether the supplement could address gut diseases like irritable bowel syndrome, Crohn's disease and colon cancer. On a larger scale, Barrangou and his team are seeking more scientific solutions to improve health by continuing to study microorganisms in the body.

"We're ushering in a new era of engineering the microbiome," Barrangou said. "On a larger level, we want to modulate the human gut microbiome to promote the growth of beneficial bacteria and engineer them to become more beneficial – to help digestion, overall wellbeing, gut brain access, sleep, diet, metabolism, nutritional value."



“It’s not typical working in academia that you get to experience being part of a team at Step One in genetic engineering and go all the way to the end to work on a product, when people can buy it and potentially improve their quality of life, It’s an honor, in a way, to see it go from A to Z.”

- Sarah O'Flaherty



**INTERESTED IN LICENSING UNIVERSITY RESEARCH?**  
VIEW OUR PORTFOLIO OF AVAILABLE TECHNOLOGIES: [NCSU.PORTALS.IN-PART.COM](https://ncsu.portals.in-part.com)



# NC State Expands Role in Regional Innovation Training Hub

BY: AMY PARKER

NC State continues to expand its role in the National Science Foundation (NSF) Mid-Atlantic I-Corps Hub, a partnership with eleven other leading research institutions aimed at leveraging NSF's I-Corps programming to create and sustain a diverse, inclusive innovation ecosystem in the United States. NC State hosted members of the Mid-Atlantic Hub in Raleigh in December 2022 for the first Mid-Atlantic Hub Annual Meeting, which was attended by 24 Hub member and partner institutions who shared best practices and collaboration opportunities

to increase the impact of I-Corps programming, which trains researchers in evaluating market opportunities for new technologies.

NC State offers multiple opportunities each year for university-affiliated research teams to learn how to assess commercial applications of their research innovations through its I-Corps regional training program. The NC State program has run 21 total cohorts and trained over 150 teams since its launch in 2017, and 30 new startups have been formed following participation in the program.

Participating teams have also gone on to secure 19 SBIR/STTR awards and have generated \$61.5 million in follow-on funding.

Completion of NC State's regional I-Corps program also qualifies teams for NSF's I-Corps Teams Program, which provides \$50,000 in grant funding and challenges participants to complete 100 interviews with potential customers and partners of a new technology over seven weeks to inform commercial pathways.

## Five teams with ties to NC State successfully completed the intensive Teams program in 2023:

### Elysia Bio

using plant biotechnology to eliminate livestock methane emissions

### MagRing

developing a 3D printed magnetic assembly for minimally invasive cardiac surgery

### SensNet

developing next-generation, radar absorbing stealth materials for aerospace and naval applications.

### Soteria Formulations

developing biodegradable and microplastic-free delivery platforms for controlled and targeted delivery of agricultural active ingredients that increase crop yield.

### Structeryx

commercializing a self-healing, fiber-reinforced composite material technology with applications in the aerospace, naval, and automotive industries.

## Overall program impact includes:



**30 Startups**

have been launched by I-Corps participants



**\$61.5 Million**

in follow-on funding generated by I-Corps teams



**\$6.1 Million**

of which was received in FY23



**19 SBIR/STTR**

grants awarded to companies following I-Corps participation

TO LEARN MORE ABOUT I-CORPS @ NC STATE, VISIT [GO.NCSU.EDU/I-CORPS](https://go.ncsu.edu/i-corps)



## 2023 Awardee Highlights:

### Helixomer

a startup launched out of NC State's Materials Science and Engineering Department in 2021, secured a \$2 million SBIR Direct-to-Phase 2 SBIR from the National Institute of Health (NIH) to further develop its functional nucleic acid nanostructures for human health applications.

### Teen Health Research

a startup spun out from NC State's Psychology Department, landed a \$340,000 Phase I STTR award from the National Institute of Health (NIH) to further develop its platform to improve adolescent sexual and relationship health through evidence-based programs.

# Companies Gain Traction Following Funding Spark

BY: AMY PARKER

Funding for technology development is a highly sought-after resource for early-stage companies seeking to de-risk technologies developed in university labs and ultimately attract further partnerships and investment. Through its SparkPlug Program – and with support from NC State's Kenan Institute for Engineering, Technology, and Science (KIETS) – ORC provides annual awards to NC State startups formed within the last five years that are pursuing federal Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) funding, a critical funding mechanism that supports small business research and technology development. SparkPlug funds can be utilized by awardees to engage with professional grant writers to bolster the competitiveness of their SBIR/STTR proposals.

\$152,500 total in funds have been deployed to sixteen startups since the program's inception in 2019 and awardees have gone on to secure \$6.8 million total in SBIR/STTR funding.

TO LEARN MORE ABOUT THE SPARKPLUG PROGRAM, VISIT:

[GO.NCSU.EDU/SPARKPLUG](https://go.ncsu.edu/sparkplug)



BY: AMY PARKER

## Commercialization Network Grows

The Office of Research Commercialization Advisors (ORCA) Network celebrated its first full year of operation in 2023. Designed to better connect university research teams and startup companies with relevant subject matter experts and advisors, ORCA now boasts 68 active members, with 17 new members joining in 2023.

Through ORCA, mentors engage with NC State startups and research teams through a tiered model that includes

diverse engagement opportunities to serve advisors with varying availability and interests. ORCA held three "happy hour" events in 2023 to connect members with NC State-affiliated teams seeking mentor connections, and also held its first ever round "Think and Do" meetings. Four early-stage companies had the opportunity to engage with a subset of ORCA members with relevant industry expertise to help answer questions related to commercialization next steps. As a result of the meetings, one

company later secured \$100,000 in seed funding while another secured its first paying customer.

ORC is excited to continue expansion of the network in 2024 through a variety of events and engagement opportunities for advisors and startups alike.

TO LEARN MORE ABOUT THE ORCA NETWORK AND WAYS TO GET INVOLVED, VISIT [GO.NCSU.EDU/ORCA-NETWORK](https://go.ncsu.edu/orca-network)



**HOOFPRINT**  
BIOME

# Trusting Their Gut:

NC State Spinout Company Knows Cows  
Hold the Key to Quickly Cooling the Climate

Hoofprint Biome, which recently closed a \$4.25M pre-seed round of venture capital funding, was founded by two NC State Ph.D. grads with the mission to improve cattle's gut health and, as a result, reduce methane — a major contributor to climate change.

BY: MATT SIMPSON



For almost as long as NC State University has existed, sports rivals have teasingly called us Moo U or Cow College, thanks to our strengths in agricultural research and education.

So it's only right that decades of groundwork at NC State might one day help cattle farmers worldwide better control their livestock's gut microbiome — a collection of microbes that aid digestion — and cool the climate as a result.

Cows pass a lot of gas. And the methane that gas puts out has been proven as one of the main drivers behind climate change. The average cow belches around 220 pounds of methane a year — helping make cattle the largest agricultural source of greenhouse gasses across the globe.

"About 30% percent of current warming is from methane," says Scott Collins, co-founder and chief scientific officer of a startup called Hoofprint Biome, who holds a Ph.D. from NC State in chemical and biomolecular engineering.

Hoofprint — a biotech company Collins and fellow alum Kathryn Polkoff launched this year, which is licensing NC State research-based patents through the university — has discovered novel enzymes that could naturally prevent methane production in cattle.

Others have tried to reduce methane emissions from cattle in the past, with varying degrees of success. But what sets Hoofprint's proposed approach apart from all others is that it seeks to improve cattle's health at the same time.

"Methane production comes at a cost to the cows," says Hoofprint co-founder and CEO Kathryn Polkoff, who holds a Ph.D. from NC State's top-ranked College of Veterinary Medicine. "In fact, it takes up to 10% of the cow's energy."

Hoofprint plans to use a yeast probiotic to transport its special enzymes to cows' stomachs, where it will then release the enzymes and provide other potential perks. The startup wants its enzyme-infused probiotic to not only eliminate methane

but also further aid animal health and nutrition.

Collins says 75% of cows' energy comes from their microbiome.

"As humans, we think of gut microbes as just a part of being healthy. But for cattle, they're completely reliant on their microbiome," Collins says. "So for us, it's the most obvious place to deploy probiotics — it's going to have the largest impact."

Polkoff and Collins founded Hoofprint in the spring, and the nascent company currently calls the NC State Plant Sciences Building home.

"We felt like NC State was the perfect place to do this," Collins says. "How many places in the world could you start this company?"

As part of a \$4.25M pre-seed funding round, Hoofprint received \$2.5 million in August from a New Zealand-based investment fund named AgriZero — which, according to its website, aims to "reduce agricultural emissions by 30% by 2030." AgriZero was joined in this pre-seed round by Ponderosa

Ventures, Good Growth Capital and the Twynam Earth Fund.

Polkoff knows the enzymes Hoofprint has discovered represent a “huge opportunity” to “drastically minimize the impact” that beef and dairy consumption has on the climate. She and Collins realize, though, that the solution they propose must also make sense for farmers.

To be successful, Polkoff says they need to eliminate methane from cows while simultaneously offering advantages to the people who rear them.

That’s largely the reason why they’ve chosen a certain type of yeast – *Saccharomyces boulardii* – to carry their methane-preventing enzymes. *Saccharomyces boulardii*’s probiotic effects have been scientifically proven to increase feed efficiency in cattle.

“If we give farmers a way to help their business at the same time, they can be a critical part of both feeding the world and helping stave off climate change,” Collins says.

Like many Ph.D. students, Polkoff envisioned a career in academia after graduation. She knew she wanted to stick with translational research and remain “close to the clinic or close to the field.” But Polkoff says she never considered starting a business until being introduced to Collins, who “didn’t take no for an answer.”

“I convinced her to abandon her dream of being a professor and start a company with me instead,” Collins says.

Collins had been looking for a co-founder for some time when he and Polkoff were connected by Kultaran Chohan, executive director of NC State’s Office of Research Commercialization (ORC).

Chohan knew both of them through the Chancellor’s Innovation Fund (CIF), a competitive seed funding

**“If we give farmers a way to help their business at the same time, they can be a critical part of both feeding the world and helping stave off climate change”**  
- Scott Collins

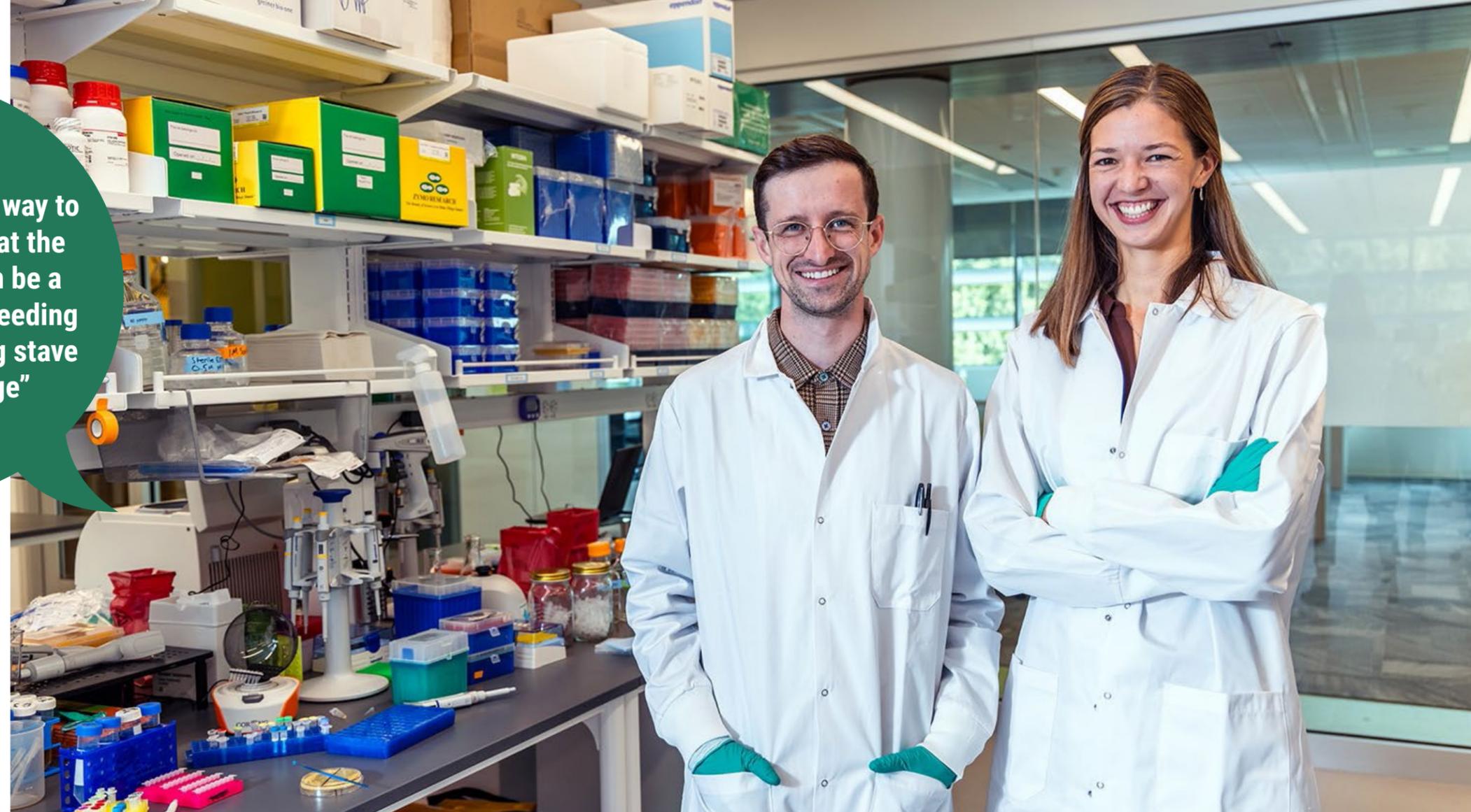
program ORC manages. The university established the CIF to help commercially focused research bridge the gap from public to private funding – and, if successful, one day become a product, technology or another form of intellectual property with tangible benefits to society.

“Realistically, we wouldn’t be here if it wasn’t for the CIF,” Polkoff says.

Polkoff worked on a CIF project in 2019 during her Ph.D. with her advisor, Jorge Piedrathita, the Randall B. Terry Jr. Distinguished Professor of Translational Medicine and director of the Comparative Medicine Institute. And Collins worked on a CIF project in 2021 as a postdoctoral researcher with his former co-advisor Chase Beisel, who was an associate professor in the Department of Chemical and Biomolecular Engineering and now works at the Helmholtz Institute for RNA-Based Infection Research, in Germany.

Based on similarities between their CIF research projects, Chohan had a hunch that Collins and Polkoff would make a good team.

He was right. And ever since Collins and Polkoff’s partnership reached the point where



they were ready to start a company, ORC has been there to assist every step of the way. Polkoff says that Chohan played a crucial role in helping the pair secure their first patent early on, for example.

However, Polkoff and Collins also say they owe significant thanks to two faculty members who’ve mentored them from day one – and have been researching related topics since well before their startup was born.

Cows are one of many mammals known as ruminants. That means, among other things, they depend on microbes in their rumen – the largest of their four stomach chambers – to digest grass and other feed.

Vivek Fellner, a professor in the

Department of Animal Science, has been studying ruminant nutrition for over 40 years.

“We’re so lucky to have him nearby,” Collins says.

When they first started Hoofprint, Collins says he and Polkoff asked Fellner to tell them “everything everyone has ever done and tried that didn’t work.”

“I think that’s a very important consideration,” Fellner says. “Not everyone is willing to look behind in order to move ahead.”

“They’re enthusiastic, and they’re clearly competent and capable of making some substantive progress in this area,” Fellner says. “So I believe

strongly in what they are planning to do – and what they might achieve.”

Collins also credits his former Ph.D. co-advisor Nathan Crook, an assistant professor in the Department of Chemical and Biomolecular Engineering, with pioneering “a lot of the early techniques” for how to use *Saccharomyces boulardii* – which has long been used to treat and prevent diarrhea in humans – as a way to “deliver therapeutic proteins.”

Hoofprint is licensing Crook’s patented techniques to help create what the company is calling an “engineered probiotic,” which will deliver its methane-preventing enzymes along with other benefits once it reaches the cow’s rumen.

Collins worked as a researcher in Crook’s lab for several years throughout and after his doctorate; his time there helped Collins see the potential *Saccharomyces boulardii* might hold for cattle farmers.

“Scott was really clever and realized that *boulardii* is also used in agriculture and animal agriculture, as a general-purpose growth promoter,” Crook says. “And he was very passionate about methane sequestration.”

“Hoofprint’s goal is to engineer this particular yeast to secrete an enzyme that can reduce methane emissions from cattle. Because this yeast can actually get into the rumen of the cattle and live there,” Crook says.

In addition to the multimillion-dollar venture capital deals they recently struck, Collins and Polkoff were named to the latest cohort of Breakthrough Energy Fellows, as “Innovator Fellows” – which the Fellows program’s website defines as “world-leading scientists and engineers who enter the program with a critical climate technology to commercialize.”

Founded by Bill Gates to support “the best early-stage clean-tech innovations,” the Fellows program is “designed to ensure early-stage entrepreneurs working on groundbreaking scientific solutions have the R&D funding, educational resources, and network they need to realize the full potential of their technology,” according to the program’s website.

“I’m most excited about the opportunity to make technical

progress during the program and then share perspectives and insights with the [agricultural] community,” Polkoff said in a news release from the Fellows program. “These farmers are the ones tackling the toughest challenges humanity has ever faced.”

Since Hoofprint was founded, Polkoff says their primary focus has been on “building the technology around the problem.”

“What tools do we need to license? What tools do we need to build? That’s what we’ve been doing,” Polkoff says.

And Polkoff and Collins consider themselves fortunate to be somewhere it’s so easy to soak up the collective creativity of collaborators and others nearby with similar skills or complementary capabilities and knowledge.

“You walk around campus and you just have so many brilliant people with so many amazing, different areas of expertise,” Polkoff says.

“We get to work in this beautiful building, where there are a lot of others working in parallel tracks or in similar spaces. So it’s been fun to collaborate and get to know people in the building who understand the same kinds of problems we’re working on. We’re really lucky to be here.”

That’s why, for the near term, Hoofprint intends to stay rooted in the Plant Sciences Building – a \$160M research and innovation facility positioned in the heart of Centennial Campus, which aims to make North Carolina a global hub for plant sciences.

The Plant Sciences Building serves as

a state-of-the-art headquarters for the N.C. Plant Sciences Initiative.

Representing the latest thinking in design and construction to meet the complex needs of team-based plant science, the unique building – which contains 185,000 square feet of greenhouse, lab and office space for faculty, students and partners – provides maximum potential for collaboration, interdisciplinary activities and innovation.

Hoofprint is one of the inaugural tenants in the building’s incubator space for startup companies.

The company will continue to work closely with the Fellner lab and the Office of Research Commercialization, as well as other groups at the university.

“I’m set up to do a lot of in vitro and in vivo testing on feed additives, and their plan fits right into my regular program here, where we look at how we can manipulate microbes,” Fellner says. “We can do a lot of screening, in several ways, looking at different additives and how they might work in the gut.”

With all the work they have ahead of

them, Hoofprint will be looking to hire more help. Thanks to the significant financial support they’ve secured, Collins and Polkoff expect to double the size of their four-person team by sometime next year.

But Collins says they still like to spend as much time in the lab or field themselves as time allows – and certainly don’t mind doing the dirty work.

His CEO “will still put her arm in a cow” whenever needed, Collins says.

Polkoff and Collins plan to put most of their current capital toward initial in vivo trials. They’re currently testing the efficacy of their probiotic using stomach fluid samples from the Fellner lab’s cows.

“We can culture samples in the lab, and that allows us to do some in vitro testing without having to shovel poop or milk the animal – which makes it a little more convenient,” Fellner says.

Likewise, Hoofprint knows the product it ultimately brings to market needs to be as convenient as possible for cattle farmers.

The company wants its probiotic to

be “easy to deploy” – not a “fancy medicine” – Collins says. If everything goes according to plan, farmers will be able to simply mix dried yeast into the feed – and cows won’t taste the difference.

“It’s kind of crazy to say out loud, but we want to have a product that’s fed to every cow in the world,” Polkoff says.

Years of sweat equity and many hurdles lie ahead before their lofty goals can reach reality – but Collins knows that Hoofprint’s mission to reduce methane emissions is the fastest way we can stem the tide of climate change.

“The beauty of eliminating methane is that it actually can help cool the climate within 10 years,” Collins says.

“Methane breaks down over 10 years,” Collins says. “If we eliminate those methane emissions, the climate actually cools. It is the most impactful thing we can do in the short term.”





# Ship Repair Startup Forging Its Way to Market

BY: AMY PARKER & MATT SIMPSON

**W**hat if an app could get more U.S. Navy ships back to sea sooner?

The co-founder of startup company Washington's Hammer knows just how hard it can be to get an aircraft carrier, battleship or destroyer back in sailing shape. That's why the NC State University College of Education grad decided to launch a tech company dedicated to developing a maritime collaboration platform.

The startup's software solution — Keelblok — seeks to streamline naval ship repair by making it easier for mechanics to make decisions, track progress and communicate updates. Keelblok was commissioned for beta testing on a naval aircraft carrier in 2023.

"It all started with NC State," says Valeni Felton, who co-founded Washington's Hammer with his wife

Chana Ruiz-Felton while earning his master's of education in training and development at NC State.

The husband-and-wife team launched Washington's Hammer in 2021, shortly after completing the National Science Foundation's I-Corps training program at NC State. The NSF I-Corps program, managed at NC State by the Office of Research Commercialization, aims to help researchers transition their ideas and inventions into the marketplace through customer discovery and market research.

In December, the startup successfully completed the Techstars Washington DC Powered by J.P. Morgan Accelerator; the company was one of only 24 in the country selected to participate in the 13-week program, which provides funding, startup education and mentorship connections. Washington's Hammer received \$120,000 in funding from

the program and says it has now established itself in an entrepreneurial network that will support its continued growth.

## HOW THEY GOT HERE

Felton started his career in 2009 as an apprentice in the naval ship repair industry. During his time repairing ships, he saw firsthand the growing shortage of industrial workers in the United States. Recognizing that he wouldn't be where he is now without the talented mechanics who trained him, Felton foresaw that a lack of experienced laborers to teach the next generation of naval workers could one day impact national security.

Washington's Hammer envisions itself as critical to our country's security and defense — and the company's name reflects that vision,

"Everyone has a hammer in their house. It is the essential tool," Felton

says, "We see ourselves as being that essential, that valuable to our nation."

When Felton first got to NC State, he had designs of starting his own ship repair service company. But he soon decided to pivot to creating a technology-based company — because he believed it could scale faster and make a broader impact across the industry.

In 2021, Felton and Ruiz-Felton applied to NC State's SWEAT Equity Program, a software development program designed to help turn innovative ideas from the NC State community into new companies. With direct knowledge of the challenges faced by the Navy and federal contractors that most often cause project delays, Felton submitted his idea for a software application to streamline ship maintenance — which would come to be known as Keelblok.

As part of their time in SWEAT, Felton and Ruiz-Felton completed the NSF I-Corps program, which helped them engage with prospective customers and partners. By the end of the SWEAT Equity Program, with some seed funding and guidance from the Office of Research Commercialization, the team had developed a clickable prototype it could use for pitches and client demos. With a prototype in hand, Felton and Ruiz-Felton ultimately decided to form Washington's Hammer to commercialize Keelblok.

Shortly after its formation two years ago, the company secured a competitive NC IDEA Micro grant; in 2022, Washington's Hammer also completed the Council for Entrepreneurial Development's twelve-week GRO Incubator Program for early-stage startups.

## WHERE THEY ARE NOW

Washington's Hammer officially launched Keelblok in 2023.

Felton describes it as a collaborative platform not built for the C-suite but specifically for deck-plate mechanics.

"SaaS products [in the ship repair industry] are built for upper management...it's just data collection that sits dormant," Felton said. "We want to take that data through Keelblok and utilize it to empower the people who are actually performing the work."

Keelblok has already been beta-tested aboard the USS George Washington. The platform was commissioned last year to support two separate \$2 million projects on the Nimitz-class nuclear-powered aircraft carrier.

Through data aggregation, Keelblok aims to identify the best repair methods and the optimal tools to use. The goals are twofold: enable efficient maintenance and improve information sharing between the Navy and federal contractors. The company also wants Keelblok to bring mechanics the added benefit of being able to track their professional development.

"More attention needs to be brought to blue-collar industrial work," Felton says. "There are so many products and applications and platforms meant for white-collar labor." Yet, there are also a lot of blue-collar occupations that "aren't going anywhere."

"You're not getting rid of plumbers, carpenters, welders — but we neglect them," Felton says. "We're not doing anything to build their skills up."

The company hopes that if its platform becomes broadly utilized throughout the Navy, it can also turn into a tool that's widely used by workers across the industry to grow in their careers.

Washington's Hammer looks to deepen its partnership with the Navy in 2024 and is exploring collaboration opportunities on the West Coast, while also continuing to develop relationships on the East Coast with larger Department of Defense contractors. Additionally, the startup sees expansion opportunities within the private sector through the support of "mom-and-pop" shipyards, Felton

**"We want to take that data through Keelblok and utilize it to empower the people who are actually performing the work."**

-Valeni Felton



Valeni Felton (left) and Chana Ruiz-Felton pose for a picture at the Techstars Accelerator. He and Ruiz-Felton cited the strength of their marriage as a key element to their business partnership and progress to date.

says.

Felton has continued to engage with NC State and the Office of Research Commercialization (ORC), which has provided design resources and connections to advisors for Washington's Hammer as it has grown from a graduate student's idea to a company with a fully realized software product.

Current NC State students who are interested in learning more about the services and support ORC has to offer should contact a member of the Office of Research Commercialization's New Ventures Team.

As for Felton's advice to students considering forming their own company: "Experience life."

"Go out there and get real-world experience. Study abroad or donate your time to an organization," Felton says.

Then, he says, let those experiences inform the next great idea worth pursuing.



# Modified DNA Startup Awarded Competitive Seed Grant

NC State startup DNALI Data Technologies was one of six startup companies announced as a recipient of NC IDEA's SEED grant for its Fall 2023 cycle.

BY: AMY PARKER

NC State startup DNALI Data Technologies was one of six startup companies announced as a recipient of NC IDEA's SEED grant for its Fall 2023 cycle. A private foundation that supports North Carolina-based entrepreneurs and companies poised to make an impact, NC IDEA's SEED grant provides non-dilutive awards to early-stage companies seeking to grow and scale quickly. 100 plus companies from across the state apply for SEED funding during each of its two annual funding rounds, with five to seven awardees chosen each cycle.

DNALI, a startup launched based on interdisciplinary research from NC State's College of Engineering, is developing a technology that enables production of chemically modified DNA not previously possible and affordable production of all modified DNAs. Modified DNA plays a key role in scientific advances in research, molecular diagnostics, and cell-based manufacturing, but existing synthesis methods are limited in their ability to synthesize modified DNAs and those DNAs that can be produced are often unaffordable. DNALI uses a proprietary biological process to create robust, modified DNA, unlocking the over 99% of DNAs not previously able to be made, and with a drastically reduced turnaround time and price point compared to conventional methods.

Albert Keung, a professor in the Department of Chemical and Biomolecular Engineering, received funding from NC State's Chancellor's Innovation Fund (CIF) in 2023 to support work involving

optimization of the modified DNA production process to achieve commercially-relevant benchmarks comparable to existing industry standards. DNALI – which was launched in 2021 based on a DNA-based data storage innovation from Keung; James Tuck, a professor in the Department of Electrical and Computer Engineering; and Kyle Tomek, a CBE PhD alumnus – cited the support of ORC programming in helping the company to build a strong foundation for market-relevant technology development.

"The ORC's work in bringing and connecting university scientists and engineers with opportunities to train and pursue commercialization of their technology has been instrumental in our growth as entrepreneurs and for DNALI as a company." Tomek said. "The NSF I-Corp program at NC State got us started both learning about entrepreneurship and honing the identification of the core competencies and customer problems that DNALI's technologies solve. And the CIF program provided us the resources to develop that technology to a point where we could produce actual products customers can buy and demonstrate their advanced properties over industry standards." The company also received support from ORC's SparkPlug Program in 2021 and won one of the top three prizes in NC State's 2022 Daugherty Endowment business plan competition.

FY2023 NEWLY LAUNCHED

# STARTUPS

## Aja Labs

College of Textiles, Textile Engineering,  
Chemistry & Science

Aja Labs is utilizing materials science innovations to create plastic-free synthetic fibers for the consumer beauty industry.

## Ajax Bio

College of Agriculture & Life Sciences, Prestage  
Department of Poultry Science

Ajax Bio is commercializing a novel probiotic for use in farm animals.

## Ancilia Biosciences

College of Agriculture & Life Sciences, Food,  
Bioprocessing, & Nutrition Sciences

Ancilia Biosciences is developing a new class of Live Biotherapeutics (LBPs) and other bacterial products with engineered immunity against destructive viruses.

## Hoofprint Biome

College of Engineering,  
Chemical & Biomolecular Engineering

Hoofprint Biome is developing probiotics and natural enzymes that improve cattle health and digestive efficiency by eliminating methane.

## Landeu

College of Engineering,  
Materials Science & Engineering

Landeu is commercializing a technology that enables the efficient recycling of e-waste through landscape energy inversion.

## NC Solar Inverters

College of Engineering,  
FREEDM Systems Center

NC Solar Inverters is improving the reliability of solar photovoltaic (PV) systems through development of a more reliable inverter for utility and large commercial PV installations.

## Redeem Solar Technologies

College of Engineering,  
Chemical & Biomolecular Engineering

Redeem Solar is developing patent-protected modular and stand-alone photocatalytic reactors that run on solar energy to produce hydrogen, fertilizers, and chemicals.

## SelSym Biotech

College of Engineering,  
Biomedical Engineering

SelSym Biotech is commercializing a suite of hemostatic healing hydrogels, which can be easily tuned to address a wide range of clinical needs in bleeding management and wound healing, including hemorrhage control, drug delivery, infection control, and long-term healing support for chronic wounds.

## BASEwise Solutions

College of Agriculture & Life Sciences,  
Horticultural Science

BASEwise Solutions is developing a novel technology for Next-Generation Sequencing (NGS) based genotyping and metagenome profiling that mitigates current challenges and limitations of other NGS-based applications.

## Cervu

College of Design, Industrial Design, College of  
Engineering, Biomedical Engineering

Cervu is developing pelvic floor physical therapy solutions for female cancer survivors suffering from chronic pelvic pain and dyspareunia.

## Depict Bio

College of Veterinary Medicine,  
Molecular Biomedical Sciences

Depict Bio performs high-throughput immunoprofiling assays that provide insights on the effects of viral infections on immune cells and their gene expression. These assays can also be used to test vaccines and immunotherapies.

## Deploycrete

College of Engineering, Civil, Construction &  
Environmental Engineering

Deploycrete is commercializing a deployable concrete structure to enable rapid, automated, and low-cost construction.

## Emperor Spirits

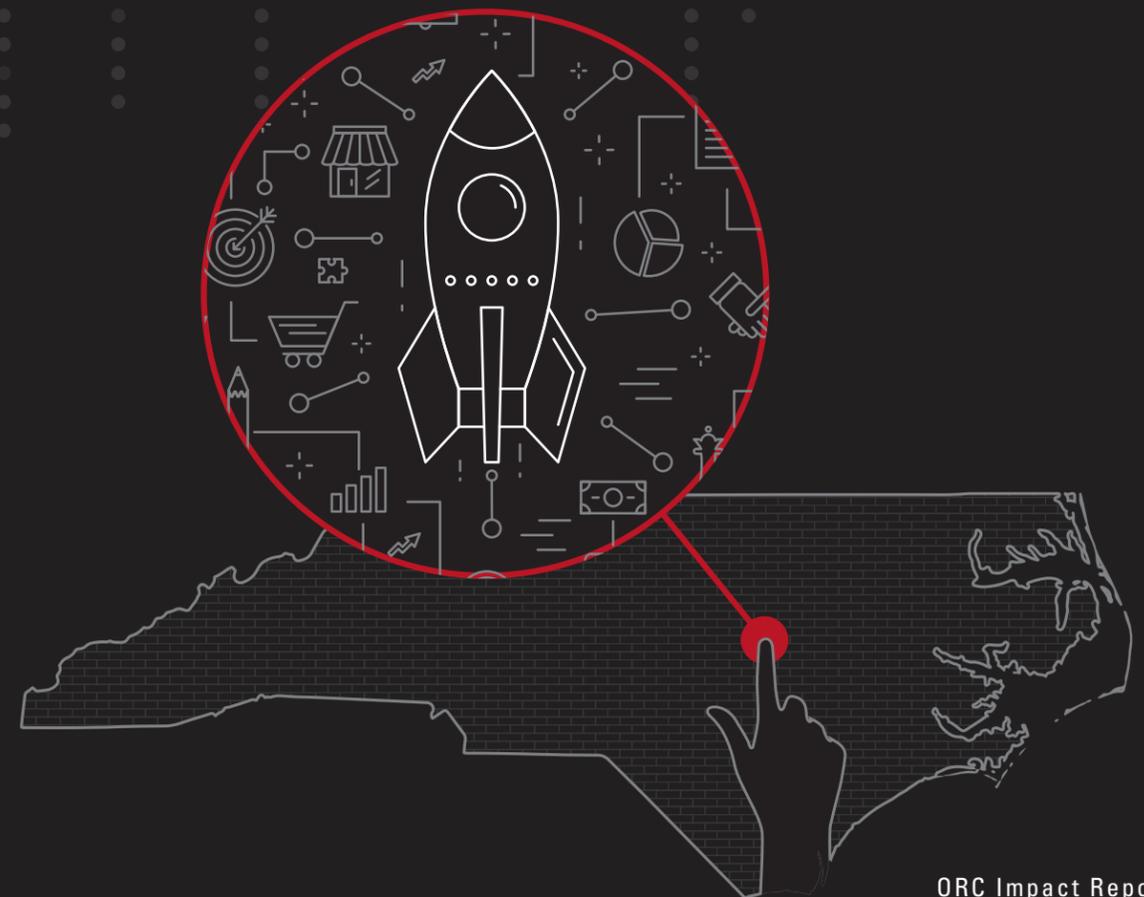
College of Natural Resources,  
Forest Biomaterials

Emperor Spirits is developing a technology that enables oak barrel CO2 extraction for whisky manufacturing.

## Freescale

College of Engineering,  
Materials Science & Engineering

Freescale is working to commercialize a smart, automated spin coater technology.



## CHANCELLOR'S INNOVATION FUND (CIF)

Six projects secured support from the CIF this year, and for the first time in the CIF's history, awardees will receive supplemental resources through local entrepreneur and investor Bill Spruill's 2ndF Research Commercialization Fund.

BY: MATT SIMPSON

**B**ig ideas are born at NC State on a regular basis. Bill Spruill knows that – which is why he decided to donate close to a million dollars to the university in support of the Chancellor's Innovation Fund (CIF).

Starting this year, Spruill's 2ndF Research Commercialization Fund will provide additional support to annual awardees of the CIF.

"When I looked at where might the next SAS, where might the next Cree (now Wolfspeed), where might the next Quintiles (now IQVIA) come from, I think focusing on NC State technology is a no-brainer," Spruill told the News & Observer. "NC State is the place where we generate the most promising technology in the state."

The 2ndF Research Commercialization Fund has committed to providing \$900,000 in financial support over the next three years.

"The transformation of university research into commercially viable businesses is the best way for North Carolina to be a globally competitive juggernaut in workforce development, wealth creation, and economic development," says Spruill, a tech inventor turned investor and philanthropist from Goldsboro, North Carolina.

"We are grateful for the generous support from Bill and the 2ndF team, and we're excited to use his gift to expand the Chancellor's Innovation Fund program," says Amy Parker, assistant director of research

commercialization programs in NC State University's Office of Research Commercialization. "In addition to the funding provided, the industry knowledge and connections that 2ndF can share with CIF-funded researchers who may be exploring commercialization for the first time will be a critical asset as we work to successfully transition NC State innovations to market."

The CIF, established in 2010, awards support to short-term, commercially focused research projects. Each year, a select few promising proposals are chosen based on their likelihood of market success – as well as their potential societal benefits.

The CIF seeks to help this research bridge the gap between public and private funding. For every dollar the CIF awards, it generates close to \$20 in additional funding or investment.

To date, the CIF has granted nearly \$4.5 million to 75 projects – which have attracted over \$78 million in follow-on funding. These projects have led to 34 startup companies, 63 commercialization agreements and \$2.5 million in licensing revenue.

This year's CIF awardees are working on a wearable EKG for dogs, better ways to capture carbon dioxide and synthesize or modify DNA, new tools to detect plant disease and bridge failure sooner, and a game-changing technique that could help drastically cut the costs of cutting-edge cancer treatment.



### Wearable "EKG" for Dogs

**N**owadays, a wristwatch can track your heart rate, measure your blood oxygen level and even give you an electrocardiogram test (commonly abbreviated as "EKG" or "ECG"). And plenty of pet owners probably wish they could afford to track their furry friend's health in real-time the same way, too. Thanks to David Roberts and Alper Bozkurt, maybe one day they can.

Roberts, an associate professor in the Department of Computer Science, and Bozkurt, a Distinguished Professor in the Department of Electrical and Computer Engineering and co-director of the ASSIST Center and IConS, have developed an algorithm that can monitor cardiac activity in dogs – consistent with an EKG – using inertial sensors already employed in pet activity trackers available on the market today. Their software enables EKG measurement via existing low-cost, generic hardware. All of this means you might be able to eventually keep much better track of your canine companion's heart health just by attaching an affordable device to their collar.

CIF support will be used to expand Bozkurt and Roberts' proof-of-concept to a larger, more diverse population of dogs and test the system on other commercially available collars, which will include shipping samples to potential partners.



### Cotton-Based Biocatalytic Filter to Capture Carbon

**T**raditional types of power plants aren't going away anytime soon. Even as new, more eco-friendly forms of energy like wind and solar continue to grow, combustion power looks to remain part of the picture for the foreseeable future. So in the near term, we'll need better ways to capture, remove or sequester carbon dioxide from the atmosphere.

Nearly all combustion power plants lack existing methods to capture carbon dioxide due to high costs. But Sonja Salmon, an associate professor in the Department of Textile Engineering, Chemistry and Science, and her research team have discovered how to potentially make it cheaper – by improving carbon capture efficiency. Their textile-based chemical filter technology combines cotton fabric and an enzyme called carbonic anhydrase – found naturally in the human body to help it exhale carbon dioxide – to selectively remove CO<sub>2</sub> from biomass, coal or natural gas power plant emissions. The filter could be produced using traditional textile manufacturing facilities.

CIF support will be used to help scale up the filter to handle commercial levels; a full-scale operation processes more than 10 million liters of flue gas per minute.



## An Entirely New Way to Synthesize or Modify DNA

**M**odified and synthetic DNA have become pivotal parts of processes across the life sciences, from fundamental research to biotechnology. But the way synthetic DNA is created – and natural DNA is modified – currently comes down to a set of chemical reactions, which can have harsh consequences on the genetic material itself. Ultimately, that means scientists have a relatively limited number of modifications available at their disposal. Specifically, it’s only possible to target one letter – A, C, T or G – at a time. It’s also not currently possible to make more granular modifications; that is, at specific points within a letter.

Albert Keung, a professor in the Department of Chemical and Biomolecular Engineering, has discovered a way to use enzymatic synthesis – a gentler process – to make modifications. His technique could open the door to over a hundred new kinds of modifications – and allow the industry as a whole to synthesize or modify DNA more sustainably and for far less money.

CIF support will be used to help establish quality control measurements that will prove whether the new technique can achieve product specifications comparable to the industry standards of today’s market.



## New System to Scout for Bridge Scour Sooner

**O**ne of the leading causes of bridge failure in the U.S. is “scour,” when water washes away the sediment surrounding structural supports. Over time, fast-flowing water can carve out “scour holes” – and climate change appears to be accelerating this natural erosion process. More than 20,000 bridges have been declared scour-critical, with thousands more likely to follow suit in the coming years.

The tools currently used to monitor bridge scour largely rely on either sonar or flotation devices to measure water levels, which doesn’t work under today’s severe storm conditions. As a result, they’re error-prone and becoming increasingly unreliable.

Chadi Sayde, Celso Castro-Bolinaga and Mahmoud Shehata, researchers in the Department of Biological and Agricultural Engineering, have developed a monitoring device that aims to detect bridge scour – and warn decision-makers – sooner. The device measures changes in temperature – which differs for sediment, water and air – through a fiber optic cable.

CIF funding will be used to test and optimize the device under different environmental conditions – across a range of riverbed materials – and develop a user-friendly software interface to make it possible for those of all experience levels to operate the control system.

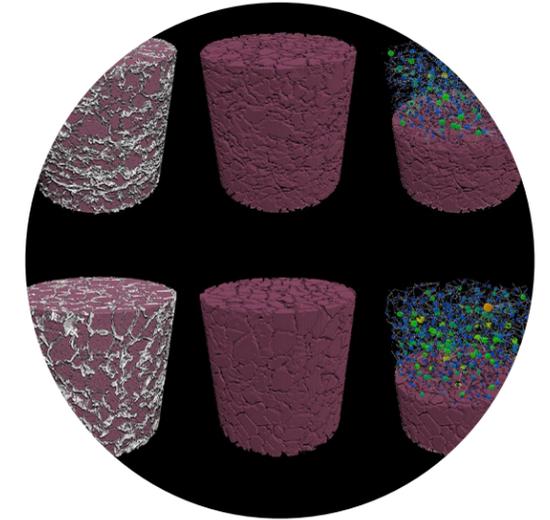


## Disease-Detecting Drones for Cucurbit Farmers

**M**elons, pumpkins and cucumbers are all part of the gourd family of plants, known in technical terms as “cucurbits.” Cucurbit crops are prone to a disease called Cucurbit Downy Mildew, which afflicts over 2.5 million acres of farmland across the globe annually, resulting in losses of up to 20% – or roughly \$1,000 per acre. Current fungicide treatments are so expensive and time-intensive, though, that farmers have to balance the costs of prevention with the potential costs of crop yield loss.

Right now, the disease can only be detected visually and fungicide has to be sprayed frequently. Researchers affiliated with the Plant Sciences Initiative – Lina Quesada, Lirong Xiang, Hunter Brown and Ramya Vijapurapu – hope to change that, using drones. Equipped with their spore-capture technology, a drone flying at low altitude could collect data overhead much faster than commercially available traps can on the ground below. The novel disease management platform aims to empower farmers to detect CDM sooner – and, in turn, more effectively determine when to deploy which type of fungicide treatments.

CIF support will be used to conduct field trials at local commercial-scale plots operated by one of the country’s largest pickle companies.



## Implantable CAR T-Cell Scaffolds

**C**himeric antigen receptor targeted (CAR T) cell therapy is a revolutionary cancer treatment that’s already in use against lymphomas. However, still in its early days, the therapy’s price remains too high for the average patient to afford. Part of the problem is the CAR T-cell manufacturing process is time-intensive and complex.

Currently, CAR T cells are custom-manufactured in a lab and then infused into the bloodstream. Yevgeny Brudno and Pritha Agarwalla, faculty in the Joint Department of Biomedical Engineering, aim to dramatically change things by making the body a CAR T-cell factory of its own. Their technology could eventually turn what now takes weeks into days. If everything goes according to plan, doctors will be able to one day deliver the treatment through an outpatient surgery in which they implant an algae-based “scaffold” – a piece of spongy biocompatible material roughly the size of a mini marshmallow – designed to reprogram the body’s natural T cells into CAR T cells, which then find and destroy cancer cells.

The CIF supported the precursor to this technology in 2021. And last year, Brudno, Agarwalla and researchers from UNC-Chapel Hill published a paper that found – in a proof-of-concept study involving lymphoma in mice – the implantable alternative was faster and more effective than conventional CAR T-cell cancer treatment. However, further pre-clinical trial data is required to ensure the scaffold’s safety and efficacy.

CIF support will be used to help the team address FDA feedback in hopes of moving toward clinical trials. Specifically, the goal will be to demonstrate that the scaffold can be produced in a GMP-compliant facility.



## Innovator of the Year

**DR. BRIAN FLOYD**

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING



**B**rian Floyd, the Alton and Mildred Lancaster Professor in the Department of Electrical and Computer Engineering, was recognized with the Innovator of the Year award for his trailblazing work in the areas of radio frequency (RF) and millimeter-wave (mmWave) integrated circuits.

Over the course of his career as a researcher at IBM and NC State, Floyd created several of the first solutions for mmWave radios in silicon technology. Historically, solutions using these frequencies required costly technologies and, therefore, were limited to the military

or other specialized applications. At least until Floyd and his colleague's groundbreaking work, which discovered how to create mmWave radios and radars by utilizing the same low-cost silicon technology found in affordable 3G cell phones – thus enabling new, large markets for mmWave frequencies. Floyd also played a key role in the creation of some of the first solutions for 60 gigahertz (GHz) radios and phased arrays in silicon, which have been licensed to several companies. These also provided a foundation for the industry's first 5G cellular solution, at 28 GHz, marketed by IBM, Ericsson,

and Verizon. His 60 GHz radios are still in production today.

Floyd's innovative work in high-frequency integrated circuits and mmWave radio and radar systems has enabled improvements in wireless communication rates and improved safety in vehicular radar systems. Floyd's leadership of impactful research programs at IBM and NC State has resulted in over \$30 million in funding. Floyd is also an inventor on 32 issued patents and his IBM patents served as the foundation for several IBM licensing agreements.

NC STATE

# Celebrates Innovation and Entrepreneurship

Brian Floyd was honored with the Innovator of the Year award, and Franky So received the Entrepreneur of the Year award.

BY: AMY PARKER

**N**C State held its 32nd Celebration of Innovation Tuesday to recognize the achievements of faculty inventors and startup founders, as well as announce an innovator of the year and an entrepreneur of the year.

As a leading institution in research commercialization nationwide, NC State is home to infrastructure and ideas that have served as a

springboard for innovations ranging from new CRISPR gene-editing technologies to canine cancer diagnostics. On the evening of Oct. 3rd, Chancellor Randy Woodson presented this year's awards to two successful researchers in an event at his residence on Centennial Campus, The Point.

This year, Woodson announced Brian Floyd as the winner of the 2023

Innovator of the Year award and Franky So as the winner of the 2023 John S. Risley Entrepreneur of the Year award.

Woodson also recognized the six winning projects of the Chancellor's Innovation Fund, as well as the 14 research-based startups that were launched within the last year.



## Entrepreneur of the Year

**DR. FRANKY SO**

DEPARTMENT OF MATERIALS SCIENCE AND ENGINEERING

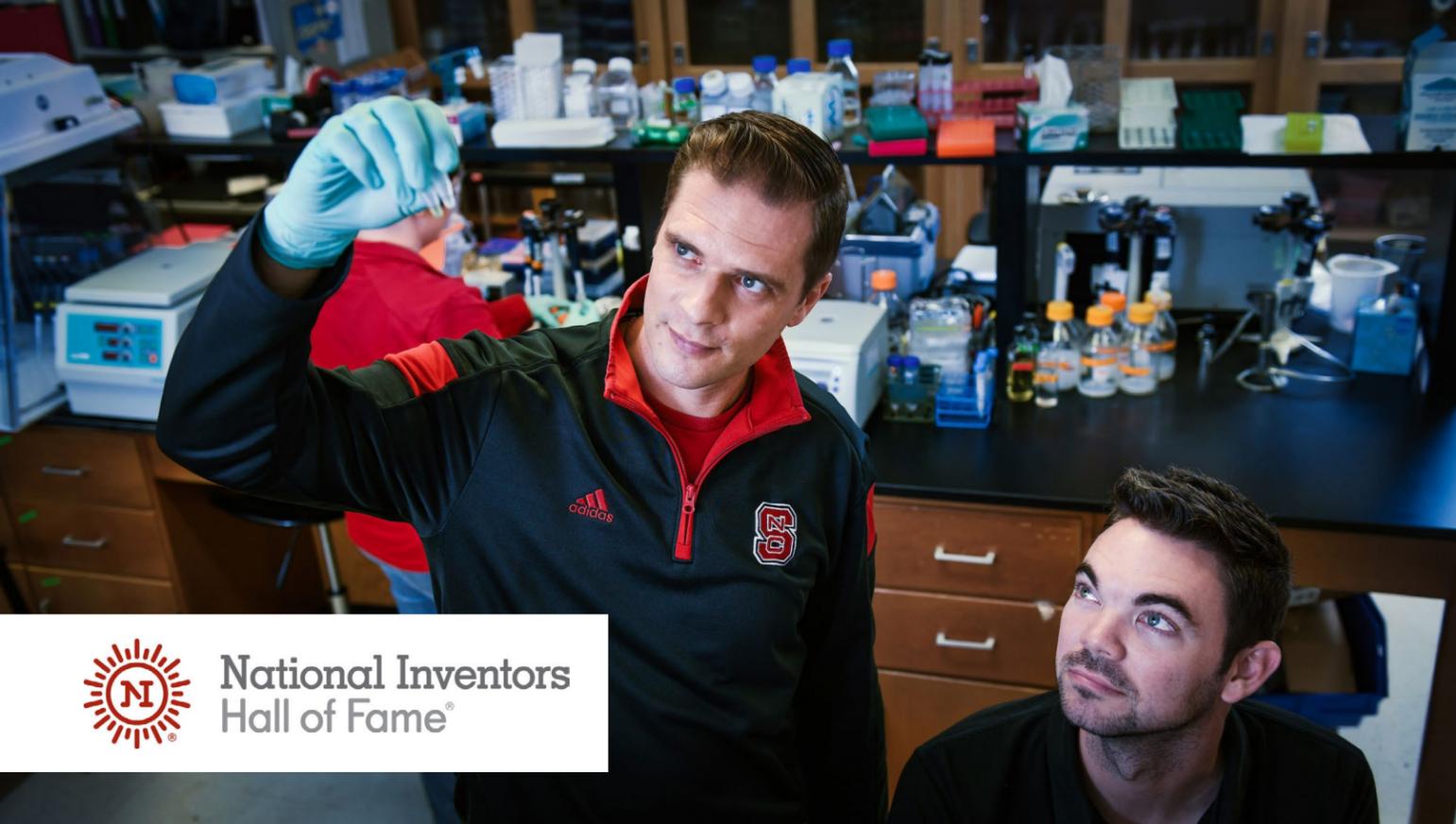
**F**ranky So, the Walter and Ida Freeman Distinguished Professor in the Department of Materials Science and Engineering, was recognized with the John S. Risley Entrepreneur of the Year award for his work with organic light-emitting diode (OLED) technologies and the role of his research in the founding of five startup companies.

A pioneer in the field of OLED technology, So's time in industry with companies such as Motorola

yielded major contributions to the field, including inventions that greatly increased the flexibility and operating lifetimes of OLED displays. Displays found in today's iPhones, Samsung Galaxy phones and Apple Watches are all a direct result of So's innovations. An inventor on over 100 issued patents, So was appointed as a Fellow to the National Academy of Inventors (NAI) in 2012.

So has launched two startup companies since he joined NC State in

2015. The first company has licensed So's polymer solar technology to develop more efficient solar cells at a lower cost, targeting applications ranging from electric vehicles to wearable electronics. The second company focuses on the development of next-generation OLEDs, aiming to significantly increase the operational lifetime and efficiency of these devices. Both companies have collaborated with NC State on research projects exceeding \$3 million in total.



National Inventors  
Hall of Fame®

## Barrangou Named to Inventors Hall of Fame

BY: MICK KULIKOWSKI

**R**odolphe Barrangou, Todd R. Klaenhammer Distinguished Professor in the Department of Food, Bioprocessing and Nutrition Sciences at North Carolina State University, has been inducted into the National Inventors Hall of Fame in recognition of his inventions, creativity, and spirit of innovation and entrepreneurship.

Barrangou becomes the seventh NC State faculty member to be elected into the hall. He is one of 16 new members elected this year.

Barrangou focuses on understanding the genetic basis for health-promoting and fermentative properties of beneficial bacteria used in foods. A pioneer in the discovery of the adaptive bacterial immune system

known as CRISPR, Barrangou has shown that CRISPR-Cas systems defend bacteria against unwanted invaders such as viruses called phages. Possible applications include genome editing, antibacterial and antimicrobial production, food safety, food fermentation, and plants, trees and livestock breeding.

While working at Danisco, a food ingredients company now owned by DuPont and recently acquired by IFF, Barrangou and colleagues – including fellow National Inventors Hall of Fame inductee Philippe Horvath – published a seminal CRISPR paper in the journal *Science* in 2007. That paper showed that CRISPR is an adaptive immune system that can acquire genetic snapshots of bacterial attacks by viruses. The related technology

covering the use of CRISPR-Cas systems in dairy bacteria to enhance starter cultures’ resistance to viruses was patented in 2005 and has been widely commercialized for cheese and yogurt fermentation.

Barrangou has received numerous prestigious honors for his work on CRISPR-Cas systems. He was elected to the National Academy of Engineering in 2019 and was elected into the National Academy of Sciences (NAS) in 2018. He also received the NAS Prize in Food and Agriculture Sciences in 2018 and the NAS Award in Molecular Biology in 2017. He also received the 2016 Warren Alpert Foundation Prize and the 2016 Canada Gairdner International Prize, and was elected to the National Academy of Inventors in 2019.



## Zhu named National Academy of Inventors Fellow

BY: AMY PARKER

**Y**untian Zhu, Distinguished Emeritus Professor in the Department of Materials Science and Engineering, has been named as a Fellow of the National Academy of Inventors (NAI) in its 2022 class.

Zhu’s research focus include deformation mechanisms at dislocation level and mechanical behaviors of heterostructured materials, nano/ultrafine-grained materials, and synthesis and processing of carbon nanotube and CNT composites.

Zhu is the 11th current or emeritus faculty member in the College of Engineering at NC State to be named as an NAI Fellow.



AFSANEH RABIEI



ZLATKO SITAR

## Rabiei and Sitar Named Senior Members of National Academy of Inventors

BY: BRENT LANCASTER

**T**wo faculty members in the College of Engineering at NC State have been named senior members by the National Academy of Inventors in the organization’s 2023 class.

Afsaneh Rabiei, professor in the Department of Mechanical and Aerospace Engineering, and Zlatko Sitar, Kobe Steel Distinguished Professor in the Department of Materials Science and Engineering, are among 95 of the world’s foremost emerging academic inventors to earn the prestigious distinction, which seek to recognize inventors who have made real and significant contributions to their communities and the rest of the world.

The NAI established the Seniors Members program in 2018 to recognize the rising young stars of the Academy’s Member Institutions, and currently recognizes just 334 senior members internationally. This recognition is intended to provide some of the world’s greatest inventors with a pathway to greater success and NAI Fellowship.

Rabiei, a 23-year veteran of the MAE Department, heads the Advanced Materials Research Laboratory (AMRL) and much of her research focuses

the processing and characterization of advanced materials, metal foams, coatings and composites.

“We cover materials’ manufacturing, characterization and failure analysis from nanoscale to micro and macro scales to address the needs of biomedical, mechanical, aerospace and nuclear engineering,” the lab website states.

Sitar founded the Wide Band Gaps research laboratory that focuses on bulk and thin film growth, characterization, and device development in wide bandgap semiconductors: GaN, AlN, and their alloys.

Sitar directs the Materials Research Center at NC State and holds joint appointments in the Physics Department at NC State and Electrical Engineering at the University of Nagoya, Japan. His collaborative network spans all four inhabited continents. Based on his research, he founded HexaTech, Inc., an NC State spin-out focusing on AlN crystal growth and wafer production, and Adroit Materials, Inc., which is focusing on the development of UV-light-emitting devices on the AlN platform and vertical devices on native GaN substrates.

# 2023 Daugherty Endowment Awardees

BY: MARGARET HUFFMAN

The Daugherty Endowment awards ventures that have licensed NC State technology in the past three years. This category is made possible through The Richard and Marlene Daugherty Entrepreneurialism Endowment and the Kenan Institute for Engineering, Technology and

Sciences and is held in partnership with NC State's Centennial Campus' Office of Partnerships and Economic Development and the Office of Research Commercialization.

Officially registered startup companies who have licensed NC State

intellectual property in the past three years were allowed to compete in the Daugherty Endowment track, offering \$50,000 in prize money to winners of this track.



## \$25,000 First Place: **Hoofprint Biome**

Hoofprint Biome is engineering probiotic feed additives for more efficient and sustainable ruminant livestock production.

## \$15,000 Second Place: **Vetletics**

Vetletics produces a recovery device for hard working horses to keep them in great shape, reduce inflammation and promote their overall health.

## \$10,000 Third Place: **SelSym Biotech**

Selsym is a biotech startup focused on the development of therapeutics for the treatment of uncontrolled bleeding.

# Supplement Your Lawn & Garden

WITH NC STATE INNOVATIONS

# ORNAMENTAL SWEETPOTATO CULTIVARS



## Sweet Caroline Upside Key Lime

“Great foliage component plant in combinations; excellent heat tolerance and good vigor. This variety features a unique climbing habit that is a twist on the usually trailing plant. Even with the climbing habit, the plant also trails nicely from the pot as well. It is unlike any sweet potato vine you've ever seen!”

**Licensed to and made available by Proven Winners**  
gardencrossings.com/product/sweet-caroline-upside-key-lime-ipomoea



## Sweet Caroline Upside Black Coffee

“Great foliage component plant in combinations; excellent heat tolerance and good vigor. This variety features a unique climbing habit that is a twist on the usually trailing plant. Even with the climbing habit, the plant also trails nicely from the pot as well. It is unlike any sweet potato vine you've ever seen!”

**Licensed to and made available by Proven Winners**  
provenwinners.com/plants/ipomoea/sweet-caroline-upside-black-coffee-ornamental-sweet-potato-vine-ipomoea-batatas



## Illusion Penny Lace

“Great foliage component plant in combinations; excellent heat tolerance and good vigor. The Illusions have finely cut foliage, reminiscent of Japanese maple foliage. It's a unique look for ornamental sweet potato vine.”

**Licensed to and made available by Proven Winners**  
provenwinners.com/plants/ipomoea/illusion-penny-lace-ornamental-sweet-potato-vine-ipomoea-batatas



# SWEET PRINCE TOMATO HYBRID

“A basic-looking tomato that tastes anything but, combining uniform abundance in the field with sweet and vibrant flavor. Very versatile in the kitchen—if you can resist eating them raw. Resistant to verticillium wilt, fusarium wilt and late blight, with moderate resistance to early blight foliage symptoms.”

**Licensed to and made available by Row 7 Seed Company**  
row7seeds.com/products/sweet-prince-tomato-seeds



# FLAME THROWER CERCIS

This redbud out of Dr. Denny Werner's breeding program was named Plant of the Year at the 2021 Chelsea Flower Show.

“This highly impressive redbud boasts perfectly pink flowers and show-stopping foliage that emerges burgundy-red and turns bright yellow and green as it ages. Stunning color display is persistent throughout the season, often showing four to five different shades on a single branch!”

**Licensed to and made available by Star Roses and Plants**  
starrosesandplants.com/plants/flame-thrower-cercis



# LOBO™ ZOYSIAGRASS

“This release is NC State's first warm-season turfgrass cultivar... Zoysiagrasses are warm-season, perennial turfgrasses often used in home lawns, commercial landscapes, and golf courses across the southern U.S. They are generally known for their low maintenance requirements but slow establishment. Lobo is unique because it is fast to establish, drought-tolerant, and maintains good color and quality under very low inputs.”

“Lobo is a true, low-input grass and has been a consistent top performer in trials with the North Carolina Department of Transportation. Lobo is fast to establish, drought-tolerant and maintains good color and quality under very low inputs.”

**Licensed to and made available by Sod Solutions**  
sodproducers.com/grass/lobo-zoysiagrass



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