2018

NUTech Ventures Annual Report 2017-2018

NUtech VENTURES®

2017-2018 | ANNUAL REPORT

About Us

NUtech Ventures is the nonprofit commercialization affiliate of the University of Nebraska–Lincoln. Our team evaluates, protects, markets and licenses Nebraska's intellectual property to promote economic development and improve quality of life.

Technology Commercialization Process

NUtech Ventures Team

From left: Mauricio Suarez, Courtney Grate, Rose Robotham, Arpi Siyahian, Jeewan Jyot, Cheryl Horst, Brad Roth, Alyssa Amen, Zane Gernhart, Joy Eakin and Luke Barnard
Not Pictured: Aaron Funk

On the Cover

Drone – Read more on page 6 | **Petri Dish** – Read more on page 8 | **Wheat Field** – Read more on page 10

Brad Roth

Executive Director, NUtech Ventures
Associate Vice Chancellor for Technology Development
University of Nebraska–Lincoln

As the University of Nebraska–Lincoln's technology commercialization affiliate, NUtech Ventures is committed to serving our university community. The NUtech team provides professional services related to intellectual property, licensing and entrepreneurship. Our vision is to see Nebraska innovation impacting the world—and with the dedication of university faculty, staff and students, this vision is becoming reality.

University technologies are emerging from across campus as part of an expanding innovation pipeline. Intellectual property is being protected, marketed and licensed, resulting in new products and services. Additionally, faculty and students are launching startup companies, commercializing technologies related to cell therapy, drone technology, turfgrass management, book publishing and pain management.

NUtech is also engaging graduate, professional and undergraduate students to help our campus achieve this vision. Since 2014, we've employed 41 Nebraska students from seven colleges. These students have played key roles to help us identify, protect and commercialize innovative research.

As we work to fulfill our role in this vision, we're grateful to everyone at the university who partners with us. Innovation starts with an idea. Translating that innovation takes teamwork and grit, as we work toward the ultimate goal: Nebraska innovation impacting the world.

Bob Wilhelm

Vice Chancellor for Research
and Economic Development,
University of Nebraska–Lincoln

Research at Nebraska is focused on growth and building on strengths. NUtech Ventures is a key partner in commercializing this research. In 2018, crops using NUtech-licensed technologies and germplasm were planted on nearly 50 million acres, benefitting farmers across the United States. In FY 2018, NUtech significantly increased its license revenue and industry-sponsored research funding, benefitting colleges across campus.

Meanwhile, a recent report ranks the Nebraska system, including NUtech, in the top 100 universities worldwide for issued U.S. patents. This success creates a strong pipeline from research to economic development and advances the impact of Nebraska research.

Ronnie Green

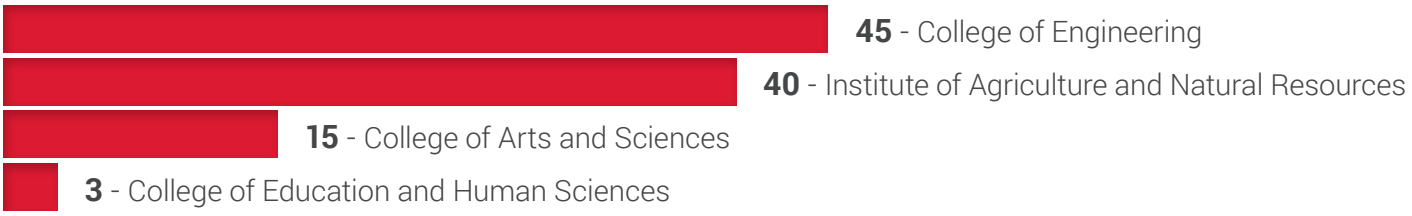
Chancellor,
University of Nebraska–Lincoln

The University of Nebraska–Lincoln is a growing top-tier research university with a land-grant mission. As part of that mission, we want Nebraska research innovations to benefit our state and beyond. NUtech Ventures collaborates with the university community and the private sector to make this possible. NUtech works with faculty and students to advance Nebraska research and discoveries into the marketplace, resulting in new products, services and jobs.

As we approach the 150th anniversary of our university, we remain focused on cultivating a culture of innovation and entrepreneurship for the future. With partners such as NUtech, the impact of Nebraska innovation extends far beyond our campus.

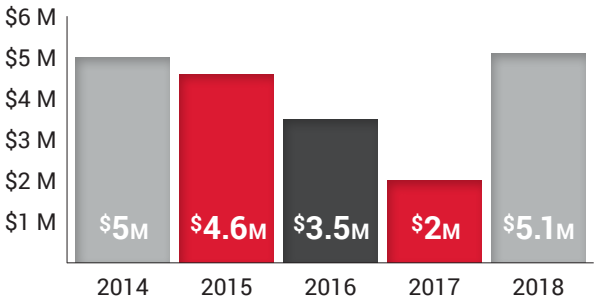
FY 2018 in Review

Invention Disclosures by College *

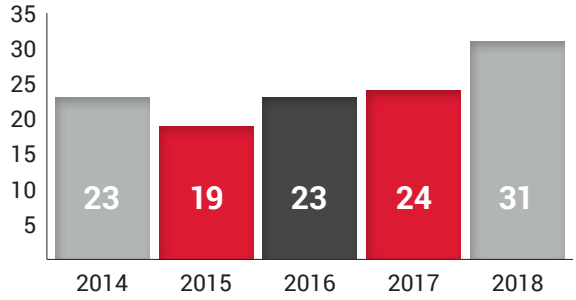


** The total disclosure number is over 93, because several inventions stemmed from collaborative efforts involving more than one college or unit.*

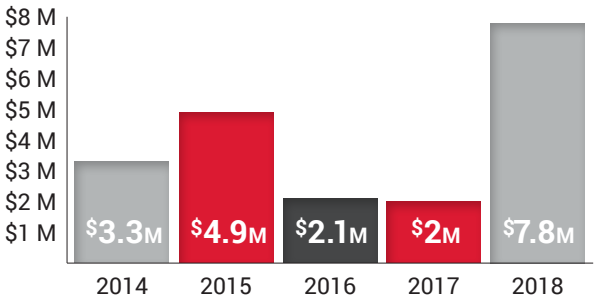
License Revenue



License Agreements



Industry-Sponsored Funding



93

Invention Disclosures

$5.1M

License Revenue

$4M

Royalty Distribution

to inventors, colleges and university

In 2017, the University of Nebraska system ranked in the top 100 academic institutions worldwide for issued U.S. patents.

U.S. Patents Issued

Below are the U.S. patents issued to University of Nebraska–Lincoln inventors during the 2018 fiscal year.

NO.	INTELLECTUAL PROPERTY TITLE	INVENTOR(S)
9,708,672	Plants with Useful Traits and Related Methods	Sally Mackenzie, Roberto De la Rosa Santamaria
9,719,062	Gas Generation	Haorong Li, Daihong Yu, Yanshun Yu
9,718,700	Magnetoelectric Chromia Having Increased Critical Temperature	Christian Binek, Peter Dowben, Kirill Belashchenko, Aleksander Wysocki, Sai Mu, Mike Street
9,724,833	Shape-Adaptive Mechanism for Robotic Grasping	Carl Nelson
9,739,710	Optical Sensing and Separation Based on Ordered Three-Dimensional Nanostructured Surfaces	Mathias Schubert, Tino Hofmann, Daniel Schmidt, Patrick Dussault, Andrea Holmes, Rebecca Lai
9,738,541	Synthesis of Cerium Oxide Nanorods	Barry Cheung, Zane Gernhart
9,743,987	Methods, Systems and Devices Related to Robotic Surgical Devices, End Effectors and Controllers	Shane Farritor, Thomas Frederick, Joe Bartels, Eric Markvicka, Jack Mondry
9,757,187	Methods, Systems and Devices Relating to Surgical End Effectors	Shane Farritor, Thomas Frederick, Joe Bartels
9,770,305	Robotic Surgical Devices, Systems and Related Methods	Shane Farritor, Erik Mumm, Philip Chu, Nishant Kumar, Jason Dumpert, Yutaka Tsutano
9,786,857	Floating-Gate Transistor Photodetector	Jinsong Huang , Yongbo Yuan
9,812,660	Method for Single Crystal Growth of Photovoltaic Perovskite Material and Devices	Jinsong Huang, Qingfeng Dong
9,829,487	Self-Assembled Monolayers and Methods for Using the Same in Biosensing Applications	Patrick Dussault, Rebecca Lai, Thomas Fisher, Anita Zaitouna
9,831,812	Direct Torque Control of AC Electric Machines	Wei Qiao, Zhe Zhang, Liyan Qu
9,883,911	Multifunctional Operational Component for Robotic Devices	Shane Farritor, Amy Lehman, Mark Rentschler
9,888,966	Methods, Systems and Devices Relating to Force Control Surgical Systems	Shane Farritor, Thomas Frederick, Kearney Lackas, Joe Bartels, Jacob Greenburg
9,925,574	Modular Oxidant Delivery System	Mark Christenson, Steven Comfort
9,951,444	Method of Fabricating a Continuous Nanofiber	Yuris Dzenis
9,951,149	Reversible Heparin Molecules and Methods of Making and Using the Same	Jian Liu, Yongmei Xu, Robert Linhardt, Edward Harris
9,956,043	Methods, Systems and Devices for Surgical Access and Procedures	Shane Farritor, Mark Rentschler, Amy Lehman, Stephen Platt, Jeff Hawks
9,969,492	Crop Height Estimation with Unmanned Aerial Vehicles	Carrick Detweiler, David Anthony, Sebastian Elbaum
9,976,266	System Including Adjustable Continuity Joints and/or Rotation Mitigation Sliding Posts for Rail Elements	Scott Rosenbaugh, Jennifer Schmidt, Robert Bielenberg, Ronald Faller, Karla Lechtenberg, John Reid, Jim Holloway
9,985,231	Compositionally Graded Bulk Heterojunction Devices and Methods of Manufacturing the Same	Jinsong Huang, Zhengguo Xiao
9,994,844	Parental RNAi Suppression of Chromatin Remodeling Genes to Control Coleopteran Pests	Blair Siegfried, Kenneth Narva, Kanika Arora, Sarah Worden, Chitvan Khajuria, Elane Fishilevich, Nicholas Storer, Meghan Frey, Ronda Hamm, Ana Velez
9,995,628	Fiber-Optic Temperature and Flow Sensor System and Methods	Ming Han, Guigen Liu, Weilin Hou
10,008,966	Drive Systems Including Sliding Mode Observers and Methods of Controlling the Same	Long Wu, Yue Zhao, Wei Qiao

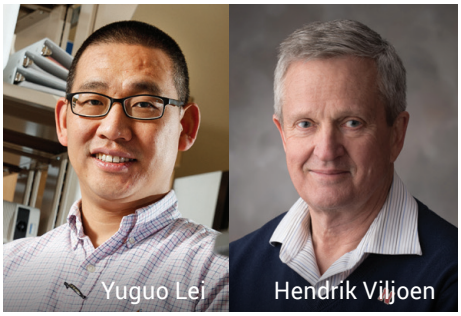
University Startup Companies

NUtech licensed technologies to five university startup companies in fiscal year 2018: Archer Jockers, CellGro, Drone Amplified, Neurocarrus and TurfGrade. Several companies are in the early stages of commercialization, while others are selling their products. All are working toward the same goal—bringing their innovation to the world.


Matt Jockers and Jodie Archer

Archer Jockers

Archer Jockers is co-founded by author Jodie Archer and Matt Jockers, who developed the technology as an English professor and associate dean at Nebraska. Their technology uses a data-driven algorithm to analyze and rank manuscripts according to aspects of bestselling fiction, including plot and emotion, character personality, style and setting. The team aims to help writers and publishers in developing the next literary success.


Yuguo Lei Hendrik Viljoen

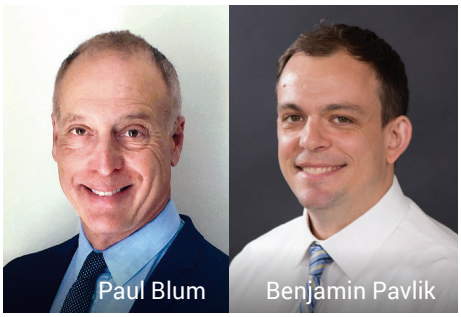
CellGro

Nebraska chemical engineers Yuguo Lei and Hendrik Viljoen co-founded CellGro to consistently and cost-effectively produce cells for the cell therapy industry. Their technology includes a process to manufacture cells inside hollow fibers, enabling large-scale manufacturing. Their technology also includes devices that culture cells in a hydrogel medium, reducing contamination and providing applications for personalized medicine.


Carrick Detweiler and Sebastian Elbaum

Drone Amplified

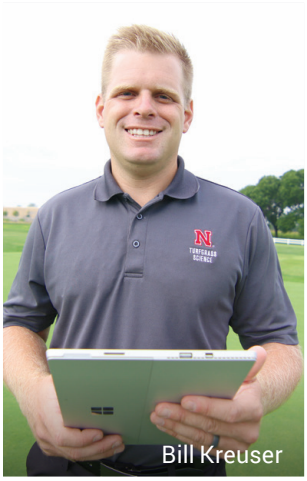
Drone Amplified is co-founded by Carrick Detweiler, Susan J. Rosowski Associate Professor of computer science and engineering, and Sebastian Elbaum, a former Nebraska researcher. Their startup focuses on drone technology that makes it easier and safer to manage prescribed burns and monitor fires. Their startup also has drone technologies for estimating crop height and collecting water samples from remote areas.


Paul Blum Benjamin Pavlik

Neurocarrus

Neurocarrus is led by Paul Blum, professor of biological sciences, and Benjamin Pavlik, doctoral graduate in chemical and biomolecular engineering. They are developing a targeted drug-delivery technology to safely disrupt pain signals without addicting medications or disruption of muscular control. The team aims to make their technology commercially available as an alternative for opioids.

> We're taking our research and turning it into a tool industry can use.


Bill Kreuser

TurfGrade

It's the last thing on a golfer's mind while watching a ball glide toward the hole: the turf itself. Maintaining turfgrass, however, requires spreadsheets, calendars—and often, guesswork—to determine when to apply fertilizer and other products.

Nebraska's Bill Kreuser has launched a startup company, TurfGrade, to make turfgrass management simpler and more sustainable.

Kreuser has developed an app, GreenKeeper, that provides guidance for applying fertilizer and plant growth regulators: products that make grass grow slower. The app is based on research models that use weather data to determine how long managers should wait before reapplying products.

"Our goal is to take all this research and put it into an interface that is intuitive, quick and easy to use," said Kreuser, assistant professor of agronomy and horticulture. "We're taking our research and turning it into a tool industry can use."

The company has nearly 6,000 customers globally—with 1,000 weekly users—spread across six continents and almost all 50 U.S. states. These customers include high-end golf, football and softball facilities that host major championships, as well as nine-hole golf courses in small communities, including several in Nebraska.

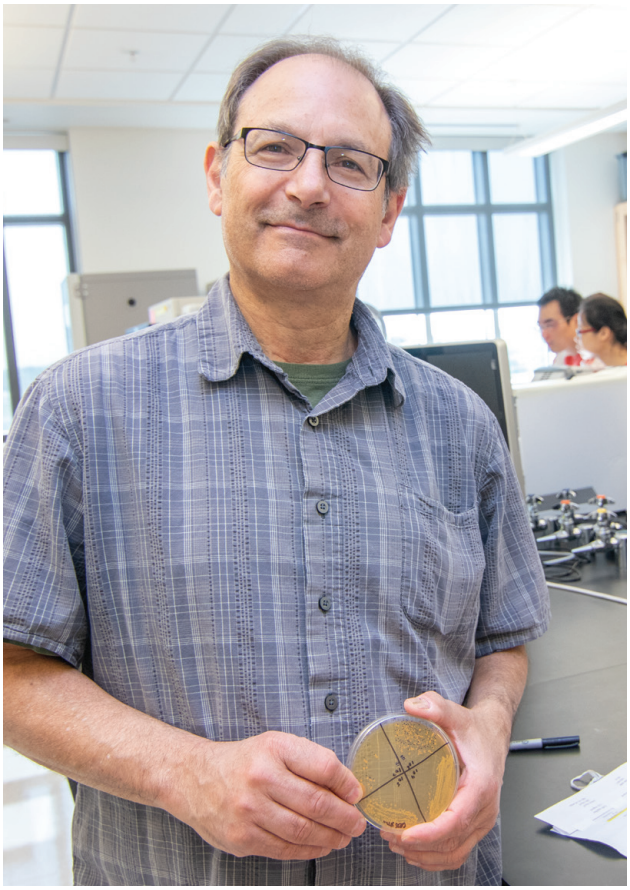
"With apps and websites, many customers expect services to be free until you're more established," said Kreuser, who is also a turfgrass specialist with Nebraska Extension. "The structure of our startup license is allowing us to reinvest money into developing our business and grow."

As a result of that growth, Kreuser has hired recent graduates from computer science programs at the University of Nebraska–Lincoln and the University of Nebraska at Kearney. He is also considering industry partnerships to reach more customers.

"NUtech has your back as a new business owner," Kreuser said. "They explain how to look at business decisions for the long term, which helps us make decisions that are right for our company and product."

Users enter information into GreenKeeper's web-based application and receive customized guidance.

Licensed Technology



Bob Hutkins

> “It’s important to have a commercial path to turn new research discoveries into a product.”

Probiotic Outperforms Competition

Nebraska researchers have developed a probiotic—sometimes referred to as beneficial bacteria—inside the competitive environment of the human gut, where it successfully competed against trillions of microorganisms.

Working with microbiologists Bob Hutkins and Jens Walter, NUtech received a patent for the probiotic technology and signed a licensing agreement with Viva 5 Corporation, a company dedicated to developing and manufacturing probiotic products.

“It’s important to have a commercial path to turn new research discoveries into a product,” said Hutkins, Khem Shahani Professor of Food Science and Technology. “Our ultimate goal is to develop dietary strategies for improving human health, and gut health products are a promising approach.”

Nebraska researchers discovered their probiotic strain while studying prebiotics: fiber-like carbohydrates intended to feed beneficial gut bacteria but not competing microbes. By feeding adults prebiotics and analyzing DNA from their fecal samples, the researchers identified a probiotic strain now known as IVS-1.

In a 2018 clinical study led by Hutkins and Walter, adults consumed the IVS-1 probiotic, a commercial probiotic and a prebiotic. Researchers then used DNA sequencing to analyze how many of each bacterium remained in their gastrointestinal tracts. Among the results, the team found that the Nebraska-developed IVS-1 outperformed its commercial counterpart.

The clinical study also showed that IVS-1 improved the body’s gut barrier function: a layer of beneficial bacteria lining the gastrointestinal tract. This barrier prevents harmful bacteria and toxins from leaking through, guarding against inflammation and potential health issues that include obesity, Type 2 diabetes and inflammatory bowel disease.

“These translational outcomes are important,” said Hutkins, a member of the Nebraska Food for Health Center. “We’re learning, in this study and others, that it is possible for probiotics to shift the bacterial ecosystem in a predictable way for the betterment of the host.”

Christopher Tuan and Lim Nguyen on a test slab of conductive concrete

Conductive Concrete De-Ices, Protects Against EMP

By mixing up the recipe for concrete, Nebraska engineers have developed a formula that safely and efficiently conducts electric current while maintaining superior strength as a construction material.

The formula, known as conductive concrete, is being used for two primary applications: heating, including de-icing roads and walkways, and shielding from electromagnetic pulses (EMP), which can cripple power grids and other critical infrastructure.

In Nebraska, the conductive concrete has been used in the Roca Spur Bridge south of Lincoln—where the technology de-iced the bridge for a decade—and the north, handicap-accessible entrance for Howard L. Hawks Hall, home to Nebraska’s College of Business.

Working with co-inventors Christopher Tuan and Lim Nguyen, NUtech has received patents for the technology and executed multiple licensing agreements.

NUtech licensed the heating technology to Tuan, professor of civil engineering, for a new startup company: Conductive Concrete Technologies.

NUtech also licensed the EMP-shielding concrete to American Business Continuity (ABC) Group, a company that builds disaster-resistant structures. The technology exceeds military shielding requirements and, especially for large buildings, is more cost effective than existing methods.

“It is very satisfying that we’re able to show conductive concrete can perform EMP shielding in a practical way,” said Nguyen, professor of electrical and computer engineering.

Nguyen is conducting sponsored research with ABC Group, focusing on innovation with commercial potential.

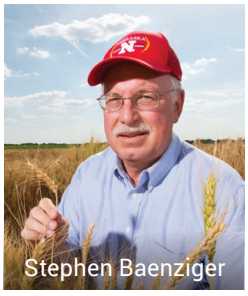
“The most rewarding aspect of this research is seeing something you do in the lab being used in the field,” Nguyen said.

Agriculture Innovation

University of Nebraska–Lincoln researchers are advancing innovation in herbicide tolerance technology and plant varieties. NUtech is commercializing this innovation to make it available for farmers, helping them produce higher yields and feed a growing global population.

Herbicide Tolerance Technology

Agriculture technology developed by Nebraska researchers has emerged from the innovation pipeline and is now being used across North America. Farmers have planted more than 40 million acres of herbicide-tolerant Roundup Ready 2 Xtend® soybeans and more than 5 million acres of Roundup Ready 2 Xtend cotton. The gene technology helps farmers improve yields by controlling weeds, including several that have become resistant to the herbicide glyphosate. It was developed by Donald Weeks, emeritus Maxcy Professor of Agriculture and Natural Resources, and Tom Clemente, Eugene W. Price Distinguished Professor of Biotechnology.



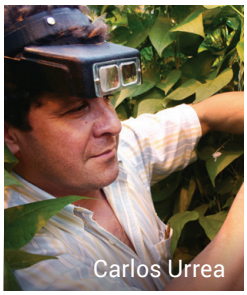
Wheat and Small Grain Varieties

More than 50 percent of the wheat acres in Nebraska are planted with University of Nebraska–Lincoln varieties. Stephen Baenziger, professor of agronomy and horticulture, leads research and development for many of the university's wheat varieties. Baenziger is an expert small grains breeder focused on wheat, barley and triticale, a hybrid of wheat and rye. His research focuses on improving breeding efficiency and methodology, as well as the use of molecular techniques. Baenziger's research objective is to improve yields, insect and disease resistance, and stress tolerance.

George Graef

Soybean Varieties

Nebraska has a large collection of high-yielding soybean germplasm, the genetic material used for new varieties. The collection has been developed by George Graef, professor of agronomy and horticulture, and his team. It includes herbicide-tolerant, food-grade and other conventional soybean varieties. Through a 2013 licensing agreement with Bayer Crop Science, now transferred to BASF, Graef's soybeans are available to farmers throughout the United States.



Carlos Urrea

Dry, Edible Bean Varieties

Farmers in Nebraska and other states are using bean varieties developed by Carlos Urrea, associate professor of agronomy and horticulture. Urrea breeds dry peas, garbanzo beans and dry beans, including kidney, pinto and red beans. Several varieties from his program have been licensed and commercialized. Urrea is also collaborating with the Nebraska Food for Health Center to study how beans may affect the genetic diversity of microorganisms in the human gut.

Emerging Technology

Enhancing Accuracy, Safety of Damage Detection

Nebraska civil engineers have developed 3-D software that can visually identify damage in a range of structures, from multi-story buildings to grain silos.

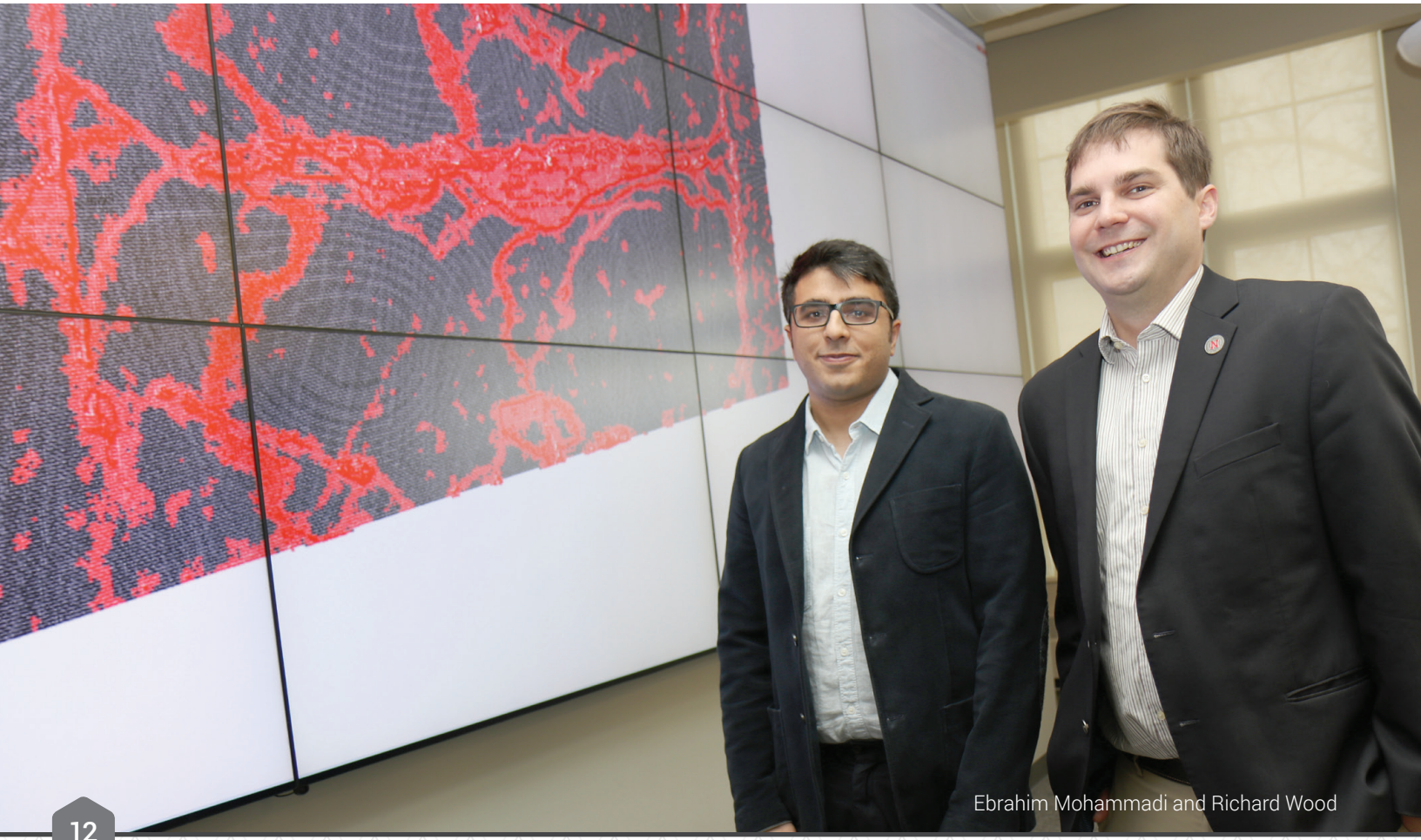
Invented by Richard Wood, assistant professor of civil engineering, and doctoral student Ebrahim Mohammadi, the software analyzes data collected from remote sensing technology, including unmanned aircraft systems such as drones. It then creates 3-D structural renderings and uses a blend of statistics and computer science to illustrate areas that are likely damaged.

The software provides an alternative method for conducting visual inspections, which are usually completed up close and in person—a subjective, time-consuming task made potentially hazardous after natural disasters.

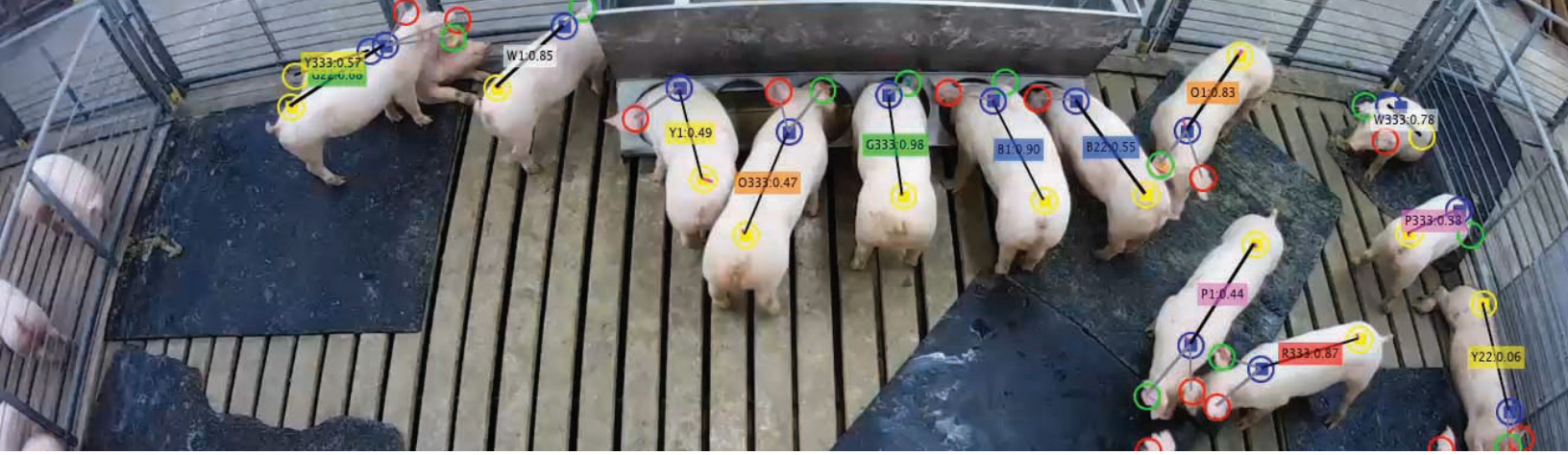
"We want to modernize structural assessments," Wood said. "This technology is unique because it provides a robust, automated way to conduct visual inspections, which remain the most common way to assess structures."

The software can analyze data gathered under any lighting conditions, including at night—a feature that could enhance accuracy and objectivity, Wood said. By using data collected from drones and lidar, which measures distance using lasers, the software also allows inspectors to assess structural damage while standing safely away.

"We are very interested in continuing this research," Wood said. "Working with NUtech has helped us understand what industry is looking for and has helped us refine our scope. It has also changed how we present our work, such as the language we use for specific audiences, presentations and even funding proposals."



Ebrahim Mohammadi and Richard Wood



The system uses machine learning to identify pigs as they eat, sleep and move.

Monitoring Animals to Improve Health

Even for the smallest livestock producers, monitoring animal behavior is labor intensive. It relies on occasional observations to determine which animals are aggressive, sick or showing abnormal behavior.

An interdisciplinary Nebraska team has invented a system to streamline this task, making it easier for producers to monitor animals and improve animal wellbeing. The team includes animal scientist Ty Schmidt and electrical and computer engineers Lance C. Pérez, Eric Psota and Mateusz Mittek, who developed their system using video footage of pigs.

The system takes raw video footage from livestock facilities and applies machine learning, which uses statistics to help computer systems improve without being explicitly programmed. It can identify individual pigs and monitor their physical location, eating, drinking and movement over time.

Based on this data, the system can also approximate how much each pig weighs and how fast it is growing.

“Our system provides a pattern of typical behavior,” said Psota, research assistant professor of electrical and computer engineering. “When an animal deviates from that pattern, then it may be an indicator that something’s wrong. It makes it easier to spot problems before they get too big to fix.”

The team aims to advance the system’s ability to identify animal illness and aggression. That research requires a larger dataset and further development, which they are pursuing with the help of NUtech.

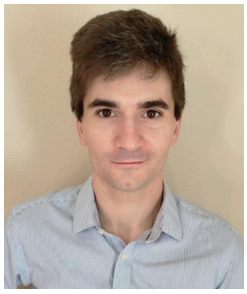
“NUtech provides a valuable service and opens us up to conversations with people outside the university,” said Schmidt, associate professor of animal science. “Ultimately, we want to make a tool that is available to industry and improve animal wellbeing.”

> “NUtech provides a valuable service and opens us up to conversations with people outside the university.”

Ty Schmidt

Lance C. Pérez

Eric Psota



Mateusz Mittek

Student Interns by College

12	College of Engineering
10	College of Arts and Sciences
7	College of Law
5	College of Journalism and Mass Communications
3	College of Business
2	College of Education and Human Sciences
2	Institute of Agriculture and Natural Resources
41	Total student interns since 2014

NUtech Intern Program

Providing Learning Opportunities

NUtech offers internships for undergraduate, graduate and professional students enrolled at the University of Nebraska–Lincoln. Interns come from diverse academic backgrounds, including law, science, business and communications. As alumni, they go on to pursue equally diverse careers in academia, industry, law and nonprofits.

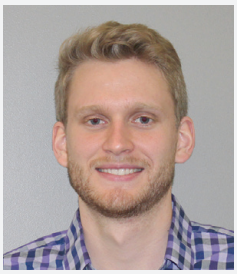
The program includes five to seven commercialization analyst internships each year, which are available to graduate students in chemistry, biology, engineering, food science and other technical fields. These students work closely with NUtech's technology managers to evaluate newly disclosed technologies and conduct research on intellectual property, market potential and commercialization readiness.

The program also includes internships in law, business and communications. Students in these roles gain experience assisting with legal contracts, developing stakeholder reports and creating content. Additionally, all NUtech interns participate in professional development training and attend presentations from guest speakers.

> "I chose my career in technology transfer as a direct result of my internship at NUtech."
>
> *– Lauren Segal*

NUtech 2018 interns, from left: Kazi Jahan, Brian Paden, Max Qiu, Nataliia Vorobeva, Katie O'Neil, Weiya Wang and Camden Bilyeu

Intern Alumni



Connor Hansen

Law Clerk; Finnegan, Henderson, Farabow, Garrett & Dunner, LLP | Washington, D.C.

B.S. in Biological Systems Engineering, University of Nebraska–Lincoln
J.D., George Washington University Law School

Commercialization Analyst Intern, 2014-2015

"NUtech helped me realize I wanted to work in patent law. I began with a general interest in patents and left with the confidence that I could attend law school and pursue a career in patent law. From working at NUtech, I also learned that communication and collaboration are key to the success of any office."

Ellen Emanuel

Program Coordinator, Daugherty Water for Food Global Institute | Lincoln, Nebraska

B.S. in Biological Systems Engineering, University of Nebraska–Lincoln
M.S. in Biological Systems Engineering, University of Nebraska–Lincoln

Commercialization Analyst Intern, 2016-2017

"NUtech helped me build the professional skill set I use every day and gave me experience working in a professional setting. The internship improved my abilities to present, research new material and learn quickly. Overall, I enjoyed knowing I was making a difference by helping new technologies become available to the world."

Forouzan Aboufazeli

Scientist I, KBI Biopharma | Durham, North Carolina

B.S. in Chemistry, University of Tehran
Ph.D. in Chemistry, University of Nebraska–Lincoln

Commercialization Analyst Intern, 2017-2018

"Through my internship at NUtech, I had the opportunity to understand research and innovation from a big-picture perspective. I also learned how to approach problems creatively and introduce academic research findings to the industry as real-world solutions. I loved being part of an experienced group and helping turn innovative discoveries into life-changing products."

Lauren Segal

Associate Technology Manager,
University of Illinois-Chicago's Office of Technology Management | Chicago, Illinois

B.S. in Integrative Biology, University of Illinois at Urbana-Champaign
Ph.D. in Plant Pathology, University of Nebraska–Lincoln

Commercialization Analyst Intern, 2017-2018

"I chose my career in technology transfer as a direct result of my internship at NUtech. I learned how to work in cross-functional teams, because our internship was based on collaboration with technology managers and interns from different backgrounds. The skills I learned as a commercialization analyst intern are useful in my day-to-day tasks as an associate technology manager."

NUtech Ventures Team

Alyssa Amen
Marketing & Communications Manager

Luke Barnard
Accountant

Joy Eakin
Operations Manager

Aaron Funk
Contracts Negotiator

Zane Gernhart
Technology Manager

Courtney Grate
Intellectual Property Specialist

Cheryl Horst
Assistant Director

Jeewan Jyot
Senior Technology Manager

Rose Robotham
Compliance Coordinator

Brad Roth
Executive Director

Arpi Siyahian
Technology Manager

Mauricio Suarez
Director of Licensing

Board of Directors

Michael Boehm
University of Nebraska–Lincoln

Ronnie Green
University of Nebraska–Lincoln

Brad Korell
Olsson

Marc LeBaron
Lincoln Industries

Abe Oommen
MatMaCorp

Thomas Sattler
Sattler & Bogen

Bob Wilhelm
University of Nebraska–Lincoln

Jay Wilkinson
Firespring

Corporate Officers

Marc LeBaron
Chairman

Bob Wilhelm
Vice Chairman

Brad Roth
President

William Nunez
Treasurer

Mary LaGrange
Assistant Treasurer

Mike Zeleny
Secretary

Becky Zavala
Assistant Secretary

NUtech VENTURES®

2021 Transformation Drive, Suite 2220 | Lincoln, NE 68508
(402) 472-1783 | info@nutechventures.org

nutechventures.org

@NUtechVentures

Writer/Editor: Alyssa Amen | Designer: Stephanie Severin | Content Contributors: Courtney Grate, Katie O'Neil, Rose Robotham
Photography: Alyssa Amen, Archer Jockers, Craig Chandler, Drone Amplified, Greg Nathan, David Ostdiek, Suzanne Spiehs