NJIT

Center for Translational Research
New Jersey Institute of Technology

NSF ART
ACCELERATING RESEARCH TRANSLATION

NJIT New Jersey Institute of Technology
Chapter of the National Academy of Inventors

NJIT Center for Translational Research (CTR)

Funded by the U.S. NSF Accelerating Research Translation (ART) Program

Fall 2025 Innovation Day

2026 Innovation Pitch Competition and 2026 Technology Innovation Translation and Acceleration (TITA) Seed Grant Competition

November 10, 2025; 8.30 AM -4.00 PM
Atrium, Campus Center NJIT

Program

NJIT Center for Translational Research (CTR)
Funded by the U.S. NSF Accelerating Research Translation (ART) Program

Fall 2025 Innovation Day
with
2026 Innovation Pitch Competition
(Prize: $100,000 TITA-Advanced Seed Grant)

and

2026 Technology Innovation Translation and Acceleration (TITA)
Seed Grant Competition
(Up to four $75,000 TITA Seed Grants)

November 10, 2025; 8.30 AM – 4.00 PM; Atrium, Campus Center NJIT

CTR and TITA External Advisory Boards →

CTR Website

CTR Innovation Day Information Folder

Brief Description of the Event

The NJIT Innovation Day & TITA-2026 Final Pitch Competition is a premier showcase of translational research and technology innovation at NJIT. This full-day event will feature live presentations from finalists competing for the $100,000 TITA-Advanced Seed Grant, as well as Stage-4 Final Presentations for the 2026 TITA Seed Grant awards. These presentations spotlight the most promising faculty-led projects at NJIT that are tackling high-impact societal challenges through innovation and commercialization.

A major highlight of the day includes a showcase with e-Poster presentations by the awardees of previous Collaborative Early Research Translation (CERT) Seed Grants and Technology Innovation Translation Acceleration (TITA) Seed Grants. These presentations will highlight innovative projects funded by the NJIT Center for Translational Research (CTR), which is supported by the Accelerating Research Translation (ART) program of the Technology, Innovation and Partnerships (TIP) directorate of the U.S. National Science Foundation (NSF).

This is a unique opportunity for the NJIT community to explore a wide range of applied research innovations and understand the pathways from laboratory discoveries to market-ready technologies. The event will conclude with a combined meeting of the CTR advisory boards, bringing together faculty, industry experts, and NSF-aligned stakeholders to discuss the future of translational research at NJIT.

Who Should Attend?

Faculty, research staff, undergraduate and graduate students, and postdoctoral researchers who are pursuing or interested in applied and translational research, innovation partnerships, technology development, or commercialization are encouraged to attend.

Why You Should Attend

- Learn about innovative projects funded by the CERT, TITA, and URI Student Seed Grant programs.
- Understand the application and selection process for translational funding opportunities at NJIT.
- Network with faculty, student innovators, and the CTR-TITA External Advisory Board.
- Gain insights into the NSF ART program's role in fostering research translation through the CTR.
- Be inspired by real-world examples of high-impact technology commercialization and research innovation.

Program Agenda

Time	Agenda Item
8:30 AM – 9:00 AM	Registration and Breakfast
9:00 AM – 9:30 AM	**Welcome Remarks and Introductions** • Atam Dhawan, Senior Vice Provost for Research • Richard Calbi Jr. P.E., P.P., Director of Operations – Ridgewood Water – Distinguished Guest • Siavash Isazadeh, Ph.D., P.E., Sr. Technical. Director, Technical, Strategy & Innovation, Veolia – North America - Distinguished Guest
9:30 AM – 10:45 AM	**Innovation Pitch Competition Presentations** • Wen Zhang, Civil and Environmental Engineering – Ozone Nanobubble Disinfection Platform for Sustainable Water, Food, and Agricultural Applications • Eon Soo Lee, Mechanical and Industrial Engineering – Enhanced Phase Change Materials (PCMs) Composites with Functional Nanomaterials • Hai Phan, Data Science – NoirVPAI: The World's First Private and Secure AI Router • Somenath Mitra, Chemistry and Environmental Sciences – A Nanotechnology Approach to Developing Fast and High Dissolving Active Pharmaceutical Ingredients (APIs) • Roman Voronov, Chemical and Material Engineering – Automated 3D Microfluidic Platform for High-Throughput Cell Culture and Analysis • Arjun Venkatesan, Civil and Environmental Engineering – Chemical Defluorination of PFAS Under Ambient Conditions • Amir Miri, Biomedical Engineering – High-throughput Positioning of Tunable Organoids with Real-Time Monitoring
10:45 AM – 11:00 AM	Break
11:00 AM – 12:00 PM	**TITA-2026 Stage-4 Final Presentations** • Murat Guvendiren, Chemical and Material Engineering – Settable Bone Allograft Matrix Formulations • Arjun Venkatesan, Civil and Environmental Engineering – PFAScan: Portable Testing Kit for the Measurement of Total PFAS • Lin Dong, Mechanical and Industrial Engineering – Skin-Like Cardiac Patch for Personalized and Preventive Heart Care • Mengyan Li, Chemistry and Environmental Science – Thiol-Enabled Modular Bioreactor for PFAS Biodefluorination

12:00 PM – 12:30 PM	Lunch and Networking
12:30 PM – 2:00 PM	**TITA-CERT Seed Grant Projects Showcase** • **e-Poster Presentations** by past recipients of CERT and TITA Seed Grants, highlighting innovative translational projects funded by CTR through the NSF ART program
2:00 PM – 3:30 PM	**CTR-TITA Advisory Board Meeting** *(Advisory Board Members Only)*
3:30 PM	**Closing Remarks**

Innovation Day TITA and CERT Showcase

Technology Innovation Translation Acceleration (TITA) 2025 Seed Grants

Table 1: Title of the Technology: n-Fast - A Nanotechnology Approach to Developing Fast Dissolving Active Pharmaceutical Ingredients (APIs)
Proposers and Affiliations: Somenath Mitra, PhD, Distinguished Professor, Chemistry and Environmental Sciences, NJIT
Partnership Team: Sai Rangarao, Senior Vice President of Commercialization, Pelthos Therapeutics; Marc Long, Executive Vice President, Research & Development, Clinical & Medical Affairs, MTF Biologics

Table 2: Title of the Technology: Functional Nano-carbon Enhanced Phase Change Materials (PCMs) for Improved Thermal Properties, and Long-term Durability
Proposers and Affiliations: Eon Soo Lee, Ph.D., Associate Professor, Mechanical and Industrial Engineering, NJIT
Partnership Team: Swati Agarwala, Ph.D., Technical Solution Manager, Phase Change Solutions Inc.

Table 3: Title of the Technology: Rapid Detection of Per- and Polyfluoroalkyl Substances (PFAS) Using Paper Spray-Based Mass Spectrometry
Proposers and Affiliations: Hao Chen, Ph.D., Professor, Department of Chemistry & Environmental Science, NJIT
Partnership Team: Charmi Chande, CEO, PFASolve, LLC

Table 4: Title of the Technology: Revolutionizing Cardiac Care with Heart Energy
Proposers and Affiliations: Lin Dong, PhD, Assistant Professor, Department of Mechanical & Industrial Engineering, NJIT
Partnership Team: Huzaifa Shakir, MD, MHA, FACS; Associate Professor, Department of Cardiac Surgery, Rutgers-New Jersey Medical School

Technology Innovation Translation Acceleration (TITA) 2024 Seed Grants

Table 5: Title of the Technology: SonoNanoArgon – Destruction of Emerging Contaminants using Ultrasound and Argon Nanobubbles
Proposers and Affiliations: Jay N. Meegoda, PhD, PE, FASCE, Distinguished Professor, Civil and Environmental Engineering, NJIT
Partnership Team: Marc Ottolini, Strategy and funding advisor, Portfolio of AIRLABS, RENSAIR, SUSURRO, NANOVISION, London, UK

Table 6: Title of the Technology: Rapid, Robust, Cost-effective, Field-based, AI-integrated point-of-use Electrochemical Platform Technology for in-situ detection and quantification of PFAS in source water.
Proposers and Affiliations: Sagnik Basuray, Associate Professor, Chemical and Materials Engineering, NJIT; and Joshua Young, Assistant Professor, Chemical and Materials Engineering, NJIT
Partnership Team: Charmi Chande, co-founder and C.T.O., ESSENCE DIAGNOSTICS LLC., NJ

Table 7: Title of the Technology: Climate-Smart Electrocatalytic Membrane Technology Transforms Nitrate Pollution into Enhanced Ammonium Salt Fertilizer
Proposers and Affiliations: Wen Zhang, Ph.D., P.E., BCEE, Professor, Department of Civil and Environmental Engineering, NJIT
Partnership Team: Ed Weinberg, P.E. President ESSRE Consulting, Inc.

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Table 8: Title of the Technology: DermaMech: Kirigami-Inspired Skin Grafts that Enhance Graft Success and Reduce Donor Site Morbidity
Proposers and Affiliations: Farid Alisafaei, Mechanical Engineering, NJIT
Partnership Team: Guy Genin, Professor, Washington University St. Louis

Table 9: Title of the Technology: An Intelligent Unmanned Aerial Vehicle (UAV) Drone Robotic System Featuring Dynamic Sensor Reorientation Apparatus, Multimodal Sensor Fusion, and Artificial Intelligence (AI) for Smart and Automated Infrastructure Asset Management
Proposers and Affiliations: Rayan Hassane Assaad, Civil and Environmental Engineering, NJIT
Partnership Team: Wei Wang, CEO and founder Operating Officer, UrbanTech Consulting Engineering

Table 10: Title of the Technology: Toward the Development of an Interactive Virtual Environment for Motor Activity Deficits Assessment and Rehabilitation in Children with ADHD
NJIT Principal Investigator: Xiaobo Li, Biomedical Engineering , NJIT
Partnership Team: Qinyin Qiu, Assistant Professor, School of Health Professions, Rutgers University

Table 11: Title of the Technology: Bonepihist: new biomarkers for osteoporosis prediction and prognosis
Proposers and Affiliations: Sara Casado Zapico, Chemistry and Environmental Science, NJIT
Partnership Team: Victoria Dominguez, Assistant Professor, Lehman College-CUNY

Table 12: Title of the Technology: AgriTech in the era of AI: Vertical Farming Innovation and Implications
Proposers and Affiliations: Jae-Hyuck Park, MTSM, NJIT; and Jim Shi, MTSM, NJIT
Partnership Team: Bryan Santos, Director of Corporate Development at Aerofarms

Table 13: Title of the Technology: Bone Allograft Composite Inks for 3D Printing of Bone Grafts
Proposers and Affiliations: Murat Guvendiren, Chemical and Material Engineering, NJIT
Partnership Team: Dave Washburn, Chief Operating Officer, Acuitive Technologies

Table 14: Title of the Technology: Empowering Grid Innovation: Collaborative Research and Industry Partnership in Power Systems Engineering
Proposers and Affiliations: Philip Pong, Electrical and Computer Engineering, NJIT; and NJIT Co-Principal Investigators: Mohsen Azizi, School of Applied Engineering and Technology; Marcos Netto, Electrical and Computer Engineering; SangWoo Park, Mechanical and Industrial Engineering, Joshua Taylor, Electrical and Computer Engineering.
Partnership Team: Andrew Chad Watson, Renewables Development Manager, PSEG; Rafael Wilches, Senior Development Manager, PSEG; Jason Kalwa, Offshore Wind Department Director, PSEG; Sid Parmar, Senior Manager, Invenergy; Wesley Jacobs, Senior Project Director, Invenergy; Michael Porto, Senior Director (External Engagement), Invenergy; Mahdiyeh Khodaparastan, Senior Interconnection Engineer, TotalEnergies; Favio Geran, Community Engagement Manager, TotalEnergies; Doug Copeland, Business Development & Strategic Partnerships Manager, Atlantic Shores Offshore Wind, David Wang, O&M Engineer – Offshore Projects Delivery, Atlantic Shores Offshore Wind; Tony Appleton, Offshore Wind Director, Burns & McDonnell

Table 15: Title of the Technology: Developing an Intelligent Multi-Modal, IoT-enabled, AI-integrated, Sensor Fusion-based Wearable Device for Improving Human-Robot Interaction
Proposers and Affiliations: Rayan H. Assaad, Civil and Environmental Engineering, NJIT
Partnership Team: Gilles Albeaino, Director of the Construction Automation, Safety, and Education (CASE) Lab, Texas A&M University

Table 16: Title of the Technology: Algorithm-guided Geotechnical Surveying using Wearable Miniaturized Sensors
Proposers and Affiliations: Petras Swissler, Mechanical and Industrial Engineering, NJIT; and Oladoyin Kolawole, Civil and Environmental Engineering, NJIT
Partnership Team: Nejm E. Jundi, Principal, JZN Engineering

Table 17: Title of the Technology: Development of a Novel Peptide Tracer for Tracing Potential Septic Pollution Sources
Proposers and Affiliations: Hao Chen, Chemistry and Environmental Sciences, NJIT; and Zeyuan Qiu, Chemistry and Environmental Sciences, NJIT
Partnership Team: Bob Averill, the Cupsaw Lake Improvement Association (CLIA); Maureen Jobrack, The Environmental Commission Chair, CLIA; Alan Fedeli, New Jersey Coalition of Lake Associations; Alan Fedeli, New Jersey Coalition of Lake Associations; Tom Conway, North America Lake Management Society

Table 18: Title of the Technology: XCopilot: Private Code Generation with Large Language Models
Proposers and Affiliations: Hai Phan, Data Science, NJIT; and Cristian Borcea, Computer Science, NJIT; Abdallah Khreishah, Electrical and Computer Engineering, NJIT
Collaborators/Partners and Affiliations: Ruoming Jin, Professor, Computer Science, Kent State University; Jonathan Maletic, Professor, Computer Science, Kent State University; Yelong Shen, Principal Research Manager, Microsoft

Table 19: Title of the Technology: Deep Learning and Large Language Models for Personalized Cancer Vaccine Design
Proposers and Affiliations: Zhi Wei, Computer Science, NJIT
Partnership Team: Dr. Hakon Hakonarson, The Center of Applied Genomics (CAG), the Children's Hospital of Philadelphia

2025 Innovation Pitch Competition

Table 20: Title of the Technology: Ozone Nanobubble Disinfection Platform for Sustainable Water, Food, and Agricultural Applications
Proposers and Affiliations: Wen Zhang, Civil and Environmental Engineering, NJIT
Partnership Team: Yuhong Jiang, CEO, PureNanoTech Inc

Table 21: Title of the Technology: NoirVPAI: The World's First Private and Secure AI Router
Proposers and Affiliations: Hai Phan, Data Science Department, NJIT; Ruoming Jin, Computer Science Department, Kent State University; My Thai, Computer & Information Sciences & Engineering Department, University of Florida; Mike Doyle, Department of Biology, New Mexico Institute of Mining and Technology.
Industry Partner: Yelong Shen, Microsoft Azure AI and Hai Phan, OppyAI Inc.

Table 22: Title of the Technology: High-throughput Positioning of Tunable Organoids with Real-Time Monitoring
Proposers and Affiliations: Amir Miri, Biomedical Engineering, NJIT; and Leila Donyaparastlivar, PhD, Mechanical Engineering at NJIT
Partnership Team: Dr. Fariborz Soroush, Senior Scientist, Bristol Myers Squibb

Table 23: Title of the Technology: Automated 3D Microfluidic Platform for High-Throughput Cell Culture and Analysis
Proposers and Affiliations: Roman Voronov, Chemical and Material Engineering, NJIT
Partnership Team: Mark Volosov, CEO, AltVIVO, Inc.

Table 24: Title of the Technology: Chemical Defluorination of PFAS Under Ambient Conditions
Proposers and Affiliations: Arjun Venkatesan, Civil and Environmental Engineering Industry, NJIT
Partnership Team: Charmi Chande, CEO, PFASolve Inc

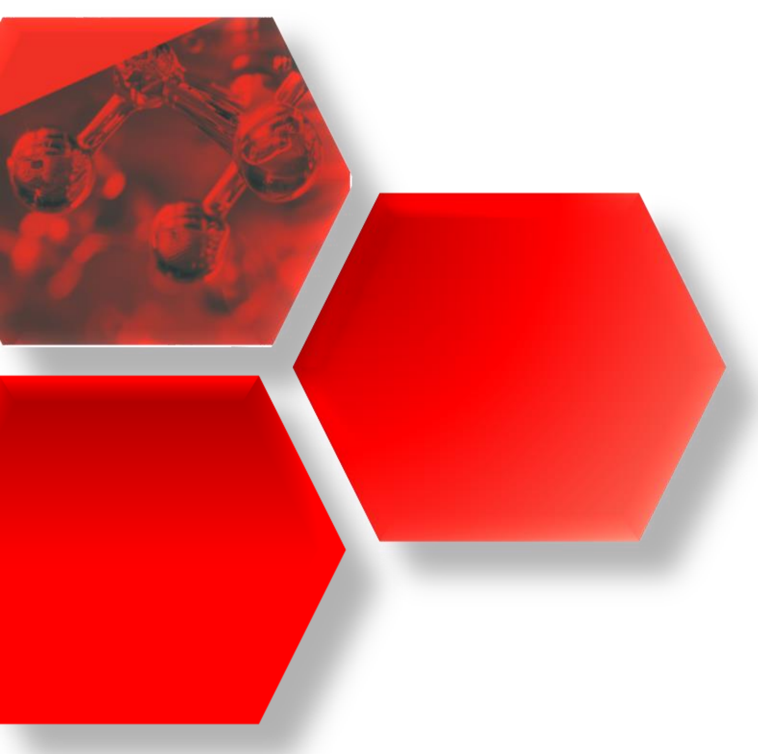
Table 25: Showcase Title: Center for Student Entrepreneurship
Presenter: Kathy Naasz, Research Professor | Exec Director Entrepreneurship, Martin Tuchman School of Management, NJIT

TITA and CERT Seed Grants Executive Summaries

NJIT Technology Innovation Translation and Acceleration (TITA) Program

The **NJIT Technology Innovation Translation and Acceleration (TITA) Seed Grant** program will enable faculty and students to successfully accelerate the translation of their innovation to enterprise development and business incubation. The TITA seed grant program will foster entrepreneurial pathways from research and innovation to business and value creation with the acquisition of intellectual property, market validation, and engagement of stakeholders towards commercialization.

The TITA Seed Grants will increase awareness of the potential commercial benefits at earlier stages of the translation and market validation process and allow researchers and stakeholders to collaborate for entrepreneurial success. It will also help faculty to submit competitive translational research proposals to external grant funding opportunities. Each CERT Seed Grant is awarded $25,000 with which is funded by the NSF Accelerating Research Translation (ART) grant and NJIT Collaborative Research and Innovation Strategic Partnership (CRISP) investment plan through the NJIT Center for Translational Research.



NJIT Technology Innovation Translation and Acceleration (TITA) Program

TITA-2025 Seed Grants

1

Title of the Technology: *n*-Fast - A Nanotechnology Approach to Developing Fast Dissolving Active Pharmaceutical Ingredients (APIs)

Proposers and Affiliations: Somenath Mitra, PhD, Distinguished Professor, Chemistry and Environmental Sciences, NJIT

Partnership Team: Sai Rangarao, Senior Vice President of Commercialization, Pelthos Therapeutics; Marc Long, Executive Vice President, Research & Development, Clinical & Medical Affairs, MTF Biologics

Executive Summary:

The United States maintains a dominant position in the global pharmaceutical industry, accounting for 42.6% of the $1.48 trillion global pharmaceutical market. The country hosts some of the largest pharmaceutical companies globally, and American consumers have access to the most cutting-edge pharmaceutical products worldwide. A significant challenge currently confronting the pharmaceutical industry and drug development pertains to a substantial proportion (40 to 70%) of active pharmaceutical ingredients (API) exhibiting low water solubility, resulting in poor bioavailability and often therapeutic ineffectiveness. These hydrophobic molecules fall within the Biopharmaceutics Classification System (BCS) categories II and IV drugs. In light of this, the global market for BCS Class II and IV drugs could range from $600 billion to $1.036 trillion. The text later presents selected candidate APIs and their respective market sizes.

In addition to developing new drug molecules, the drug delivery market is experiencing a Compound Annual Growth Rate (CAGR) of 6.5%, with projections to exceed $375 billion by 2027 (see Table 1). Another important consideration is the growing demand for rapid drug release, as illustrated in Table 2, which anticipates this market to reach over $32 billion by 2027. Faster release is especially critical for BCS Class II and Class IV drugs, and the accelerated release proposed here will further propel the growth of this market segment. In summary, these represents our target market.

There are several conventional technologies that are employed to enhance the solubility, dissolution, and bioavailability of poorly soluble drugs. These are: Particle Size Reduction, Solid dispersions, Lipid based delivery systems, co-crystallization and complex formation. Using TITA Phase I funding we have been able to compare our technology to our competition, the data is presented in our progress report.

We have developed a nanotechnology approach referred to as n-Fast to enhance the bioavailability and effectiveness of Active Pharmaceutical Ingredient (API) crystals by improving their water solubility, essentially creating a fast-dissolving version of the drug (1-10). Our technology aims to reformulate various insoluble APIs, falling under BCS Class II and IV, with bioabsorbable,

functionalized nanoparticles (FNPs) featuring surface hydrophilization to enhance solubility, and ultimately efficacy. We propose the direct incorporation of FNPs into drug crystals during their formation in a way that preserves the crystal structure, polymorph, and physicochemical properties. The mechanism of fast dissolution

Our initial work involved functionalized carbon nanotubes (fCNTs) and nano graphene oxide (nGO) as FNPs. While fCNTs and nGO showed excellent results, their potential cytotoxicity raised significant concerns. Consequently, partially using Phase I TITA funds we have commenced the development of FNPs using FDA-approved bioabsorbable polymers.

2

Title of the Technology: Functional Nano-carbon Enhanced Phase Change Materials (PCMs)
for Improved Thermal Properties, and Long-term Durability

Proposers and Affiliations: Eon Soo Lee, Ph.D., Associate Professor, Mechanical and Industrial Engineering, NJIT

Partnership Team: Swati Agarwala, Ph.D., Technical Solution Manager, Phase Change Solutions Inc.

Executive Summary:

The need for effective thermal energy management is growing across sectors such as insulated packaging, cold chain logistics, temperature-sensitive product storage, building materials, and electronics cooling, aiming to boost energy and cost efficiency. As a result, demand for phase change materials (PCMs) that enhance thermal energy storage and management is on the rise. However, widespread adoption of PCMs in these fields remains limited due to the lack of materials that are economical, safe, environmentally friendly, high in heat storage capacity, and durable for long-term use.

As the application of PCMs continues to grow across a wide range of industries, there is an increasing demand for materials that possess specific properties tailored to the unique needs of these applications. However, the producers of PCMs are facing significant challenges due to the limited variety of materials available that meet both environmental and safety regulations. These stringent regulations, which are designed to ensure that materials are safe for human health and the environment, are restricting the ability of manufacturers to develop and offer a broader range of PCMs. As a result, there is a growing need in the market for more diverse PCM options that not only comply with these regulatory standards but also exhibit a high degree of versatility, making them suitable for a wider array of applications.

The PI proposes developing advanced PCMs with superior thermal properties and operational durability by integrating various PCMs, particularly bio-based types, with functional nano-carbon materials. As shown schematically in *Figure 1*, functional nano-carbon materials are integrated with a base PCM to ensure both physical and chemical interactions, enabling enhancement and adjustment of thermal characteristics to meet specific application requirements. This approach aligns with regulatory requirements, as the base PCMs can be selected from environmentally safe materials. The enhancements are achieved through the specific functionalities of nano-carbon materials tailored to application needs, thereby expanding material choices across a wide range of applications.

The proposed PCMs are cost-effective, safe, and environmentally friendly. By leveraging interactions between nano-carbon materials and carefully selected base PCMs, these advanced PCMs achieve targeted thermal properties while preserving structural integrity, enhancing durability during operation.

3

Title of the Technology: Rapid Detection of Per- and Polyfluoroalkyl Substances (PFAS) Using Paper Spray-Based Mass Spectrometry

Proposers and Affiliations: Hao Chen, Ph.D., Professor, Department of Chemistry & Environmental Science, NJIT

Partnership Team: Charmi Chande, CEO, PFASolve, LLC

Executive Summary:

PFAS are of great concern due to their persistence, toxicity, and potential for bioaccumulation in the environment. Exposure to per-fluorooctanoic acid (PFOA) and per-fluorosulphonic acid (PFOS), two specific PFAS compounds, has been linked to adverse effects on fetal development, such as decreased birth weight, and has also been shown to suppress vaccine responses, resulting in lower serum antibody concentrations in children. In addition, studies have shown that the presence of PFAS can increase the production of reactive oxygen species (ROS) through oxidative stress, induce DNA damage, and cause cancer and inflammation.14 Traditional PFAS analysis by mass spectrometry (MS) is time-consuming and takes a few hours according to the EPA method referred by 533 where prior run in LC-MS takes laborious sample preparation by solid phase extraction (e.g., extraction and desalting) technique.

In the PI's laboratory at NJIT, we developed a fast detection of PFAS by paper spray (PS)-based MS techniques, which only takes 1-3 min for detection of PFAS from a variety of different samples (water samples, soils, food packaging materials, etc.) In addition, our method is highly sensitive (limits of detection:1-4 ppt for PFOA and PFOS). These results suggest the high potential of our new technique in real-world environmental screening and analysis of PFAS. This work was published in Journal of Hazardous Materials (JHM, 2024, 465, 133366; Journal impact factor 14.2 in 2021).

This TITA grant aims to 1) Enhance the sensitivity of PFAS detection protocol to go beyond 1 ppt, which would be crucial for detecting PFAS in urine to track exposure patterns and evaluate kidney function's role in PFAS elimination in the future. 2) Build a position-controlled PSI and DPS platform for gaining high signal reproducibility for improving quantitative PFAS analysis 3) Identify the key partner and develop the PFAS detection protocol compatible with on-site MS.

At the conclusion of the TITA grant, we are expected to develop a more robust, sensitive, and selective protocol for PFAS detection from real-world samples, such as drinking water. Additionally, the protocol must be optimized for compatibility with an on-site mass spectrometer developed by our identified key partner.

4

Title of the Technology: Revolutionizing Cardiac Care with Heart Energy

Proposers and Affiliations: Lin Dong, PhD, Assistant Professor, Department of Mechanical & Industrial Engineering, NJIT

Partnership Team: Huzaifa Shakir, MD, MHA, FACS; Associate Professor, Department of Cardiac Surgery, Rutgers-New Jersey Medical School

Executive Summary:

Heart disease is the leading cause of death globally. The global cardiovascular devices market was valued at $63.49 billion in 2024 and is projected to reach $104.08 billion by 2031, with a compound annual growth rate (CAGR) of 7.03% during this period. This growth is primarily driven by the high prevalence of cardiovascular diseases, an aging population, and the increasing demand for innovative, cost-effective treatment options that minimize the need for surgical interventions. Cardiac pacemakers and implantable cardioverter-defibrillators are effective tools for treating heart block and ventricular dysrhythmias in patients with heart disease. Notably, leadless pacemakers (LPs), which are 90% smaller than traditional transvenous pacemakers, have demonstrated excellent safety and efficacy in both short-term and intermediate follow-ups. However, the clinical utility of all those cardiovascular devices is compromised by the limited battery life.

Studies show that over 40% of LPs fail within three years, despite manufacturers' claims of longer longevity, while the average post-implantation longevity of traditional pacemaker recipients has increased to over 15 years. This creates a significant mismatch that impacts clinical practice and incurs substantial economic costs. Battery depletion or malfunction necessitates new implantations due to limited retrieval experience. Although LPs represent an advancement in cardiac pacing, they also come with complications. Clinical trials report major issues, such as device dislodgement and cardiac perforation, as well as infection at the implantation site, which can lead to longer hospital stays. Therefore, the risks, costs, and complications of LP surgeries highlight the need for alternative power solutions to extend the longevity of cardiovascular devices, reduce the need for replacements and surgeries, and improve patient care.

Dr. Dong's lab is developing advanced energy harvesting technology that significantly extends the lifespan of LPs by transforming the heart's natural mechanical energy into electrical power. Designed to revolutionize LPs, this technology leverages advanced functional nanomaterials, innovative geometric designs, and seamless integration with existing systems to significantly enhance patient care. The key breakthrough lies in the incorporation of cardiac energy harvesters optimized for the heart's dynamic environment. By leveraging flexible, biocompatible materials to capture even subtle cardiac motions, this technology converts them into electrical energy to sufficiently autonomously power the pacemakers. The energy harvesters maintain the compact form factor of existing LPs while enhancing functionality through sustainable energy solutions.

This cardiac energy harvesting strategy addresses the most pressing challenges of energy consumption and the need for pacemaker replacement surgeries. With anticipated success, it promises to transform the lives of individuals facing the burden of periodic pacemaker replacements, offering longer-lasting implantable biomedical devices that reduce both surgical risks and costs. Ultimately, this innovation not only enhances patient outcomes but also elevates the overall quality of life, marking a significant leap forward in medical technology.

NJIT Technology Innovation Translation and Acceleration (TITA) Program

TITA-2024 Seed Grants

1

Title of the Technology: *n*-Fast - A Nanotechnology Approach to Developing Fast Dissolving Active Pharmaceutical Ingredients (APIs)

Proposers and Affiliations: Somenath Mitra, PhD, Distinguished Professor, Chemistry and Environmental Sciences, NJIT

Partnership Team: Ms. Rachel Theka, Thive Consulting, Middlesex, NJ

Executive Summary:

A significant challenge currently faced by the pharmaceutical industry and drug development is the substantial proportion (40 to 70%) of active pharmaceutical ingredients (API) and new chemical entities (NCE) that exhibit low water solubility. This leads to poor bioavailability and often results in therapeutic ineffectiveness. These hydrophobic molecules fall within the Biopharmaceutics Classification System (BCS) categories II and IV drugs, with a potential global market ranging from \$600 billion to \$1 trillion. Alongside the development of new drug molecules, the drug delivery market is experiencing a Compound Annual Growth Rate (CAGR) of 6.5%, with projections to exceed \$375 billion by 2027. Additionally, the rapid drug release market is expected to reach over $32 billion by 2027. Faster release is particularly critical for BCS Class II and Class IV drugs, and this acceleration can further propel the growth of the overall pharmaceutical market.

Current technologies for enhancing drug solubility, including milling, spray drying, salt formation, supercritical fluid processing, nanosuspension, homogenization, lipid formulation, and cocrystal formation, have limitations as they often lead to alterations in crystal structure, polymorph, or require the use of additional chemicals. What the market currently needs are API crystals that dissolve rapidly while preserving the original crystal structure and polymorph.

Dr. Mitra's group at the New Jersey Institute of Technology (NJIT) is developing a nanotechnology approach to enhance the solubility, bioavailability, and effectiveness of API crystals by improving their water solubility without altering the crystal structure. Essentially, this involves creating a fast-dissolving version of the drug. The technology aims to reformulate various insoluble APIs falling under BCS Class II and IV with bioabsorbable, functionalized nanoparticles to enhance solubility and ultimately efficacy. These fast-dissolving APIs will be applicable in oral, transdermal, inhalation, and injectable formulations, lowering the required dosage and thereby reducing side effects and toxicity.

5

Title of the Technology: SonoNanoArgon – Destruction of Emerging Contaminants using Ultrasound and Argon Nanobubbles

Proposers and Affiliations: Jay N. Meegoda, PhD, PE, FASCE, Distinguished Professor, Civil and Environmental Engineering, NJIT

Partnership Team: Marc Ottolini, Strategy and funding advisor, Portfolio of AIRLABS, RENSAIR, SUSURRO, NANOVISION, London, UK

Executive Summary:

Destruction of emerging contaminants such as PFAS, microplastics, pharmaceuticals, and pathogens demands robust and energy-intensive methods. Specifically for PFAS cleanup DoD is expected to spend over $32B. This does not include much higher amount that is expected to be spent by water and wastewater treatment facilities and landfills. Currently, ultrasound technology is s a promising solution to address this challenge.

Ultrasound waves induce the formation of nano-sized cavities. These nanobubbles, under the continuous application of ultrasound energy, undergo compression and relaxation, resulting in energy accumulation inside nanobubbles. Eventually, these nanobubbles reach a state of instability, causing them to implode rapidly at bubble locations, generating temperatures of up to 5000°C. These extreme temperatures pyrolyze emerging contaminants and pathogens into individual atoms making emerging contaminants harmless products. Nanobubbles made of Argon gas enhance the destruction of emerging contaminants and pathogens with the application of ultrasound. The combination of argon nanobubble with ultrasound is bolstering the destruction capabilities of ultrasound while simultaneously reducing energy consumption. The presence of Argon gas nanobubbles results in the supersaturation of Argon gas in the solution containing emerging contaminants, which, in turn, creates additional cavitation sites for ultrasound-induced reactions. Additionally, the hydrophobic nature of the gases contained within nanobubbles, coupled with their negative zeta potential, enhances the adsorption of emerging contaminants and pathogens onto argon nanobubble surfaces. As ultrasound energy continues to drive the implosion of nanobubbles, it paralyzes these harmful substances absorbed onto Argon nanobubbles, presenting a more efficient, cost-effective, and environmentally friendly method for eliminating emerging contaminants and pathogens when compared to only ultrasound. This approach requires significantly less energy and fewer resources, making it an ideal solution for addressing the contemporary environmental challenges of destroying emerging contaminants.

Dr. Jay Meegoda of the New Jersey Institute of Technology (NJIT) is developing a system for a continuous supply of Argon nanobubbles in ultrasound reactors to enhance destruction of emerging contaminants and pathogens. With the commercialization of the technology, we are attempting eliminate the PFAS in the USA to significantly improve the health of humanity.

6

Title of the Technology: Rapid, Robust, Cost-effective, Field-based, AI-integrated point-of-use Electrochemical Platform Technology for *in-situ* detection and quantification of PFAS in source water.

Proposers and Affiliations: Sagnik Basuray, Associate Professor, Chemical and Materials Engineering, NJIT and Joshua Young, Assistant Professor, Chemical and Materials Engineering, NJIT

Partnership Team: Charmi Chande, co-founder and C.T.O., ESSENCE DIAGNOSTICS LLC., NJ

Executive Summary:

Recent market analysis reports show that the United States PFAS (per- and polyfluoroalkyl substances) Analytical Instrumentation Market exceeded USD 75 million in 2021. It is projected to experience substantial growth at a compound annual growth rate (CAGR) of more than 20% from 2021 to 2028. By 2028, the market is anticipated to achieve revenues exceeding USD 350 million. Several factors are primarily driving the demand for PFAS analytical instrumentation, like increased awareness of the widespread prevalence of PFAS contamination, the approval of the PFAS Action Act of 2021 by the US House of Representatives, $10.0 billion in funding through President Biden's Bipartisan Infrastructure Law. The market is anticipated to experience an initial surge in growth, primarily fueled by commercial testing laboratories, utilities, and regulatory bodies. Commercial testing laboratories have emerged as the largest end-user segment in 2021, followed closely by wastewater treatment utilities. Manufacturers of products containing PFAS are also showing a growing interest in PFAS testing to understand the presence of PFAS and adhere to contamination guidelines, which could help them avoid fines and litigation. Long-term market growth is expected to be sustained by industries, academia, and regulatory bodies. Some of the key factors influencing the future sales of PFAS testing devices will include ease of use, data reproducibility and reliability, low cost of ownership, and on-site rapid testing.

The existing PFAS analytical instrumentation market is constrained by its reliance on laboratory-based methods, resulting in a lengthy 15-day wait time for results and a substantial cost ranging from $300 to $400 per sample analysis. Hence, a highly sensitive, selective, low-cost, maintenance-free, and user-friendly portable sensor capable of detecting per- and poly-fluoroalkyl substances (PFAS) at current federal limits in various environmental matrices is urgently required. We propose to address this challenge by developing an integrated electrochemical sensor platform (ESSENCE) for rapid, in-situ detection and quantifying PFASs in treated water. It will be extended to detection in field samples in the future. The sensor platform's key benefits that lead to high sensitivity and selectivity are due to shear force enhancement from the chip architecture to eliminate matrix interferences and high sensitivity from an automated and operator-independent electrochemical platform. Further data analysis integrated with Deep Learning (DL)/machine learning (ML) using the electrochemical data generated by the capture of PFASs by PFAS-specific capture probes immobilized on the platform will lead to significantly enhanced selectivity. Thus, the platform will act as a point-of-use device to measure PFAS concentration directly. In this proposal, the sensor will be used to measure the three most important PFAS identified by EPA. They are perfluorooctanoic acid (PFOA), perfluorooctane sulfonic acid (PFOS), and perfluorobutane sulfonic acid (PFBS).

The efforts for translating the device include the development of a new version of our current chip and integration with the ESSENCE platform for high chip-to-chip reliability, high sensitivity, and selectivity that meets the latest federal limits. PFOS, PFOA, and PFBS calibration curves will be generated. Data analysis with artificial intelligence/machine learning will allow for selective quantification of PFOS, PFOA, and PFBS in a mixed sample. The final aim is continuous in-situ monitoring and fast prescreening of all major PFAS compounds. Based on a NSF-Icorps customer discovery conducted by the PIs through interviewing 100 potential customers, the first line of potential customers would be water treatment plants like municipal corporations like the Jersey City Municipal Utilities Authority (JCMUA), as the water matrix is cleaner and more straightforward with significantly less interference. This would allow us to develop a more robust chip architecture (significantly more R&D) for future detection of PFAS in the field.

7

Title of the Technology: Climate-Smart Electrocatalytic Membrane Technology Transforms Nitrate Pollution into Enhanced Ammonium Salt Fertilizer

Proposers and Affiliations: Wen Zhang, Ph.D., P.E., BCEE, Professor, Department of Civil and Environmental Engineering, New Jersey Institute of Technology and Jianan Gao, Ph.D. candidate, Department of Civil and Environmental Engineering, New Jersey Institute of Technology

Partnership Team: Ed Weinberg, P.E. President ESSRE Consulting, Inc.

Executive Summary:

Exposure to excessive nitrate (NO_3^-) could lead to negative health impacts such as methemoglobinemia and other diseases. To minimize the adverse health impacts of nitrate, the World Health Organization has set a recommended maximum contaminant level (MCL) of 45 mg L^{-1} NO_3^- (10 mg·L^{-1} as nitrate nitrogen) in drinking water. Currently, over 40 million people in the US still do not have access to municipally-treated water, instead relying mostly on private groundwater wells. Even in public water systems, nitrate is among the most commonly reported water quality violations in the US. Thus, there is a need for efficient nitrate removal suitable to protect public health.

The global wastewater treatment market, currently valued at USD 295 billion, is expected to reach USD 572 billion by 2032, growing at a CAGR of 6.9%. This growth highlights the increasing demand for effective nitrate removal, particularly in municipal and agricultural sectors. The agricultural wastewater treatment market alone is projected to grow from USD 2.18 billion in 2021 to USD 3.13 billion by 2030. Besides, huge potential markets exist for treatment of diverse wastewater such as ion exchange brine (global discharge: >50 billion ton per year), landfill leachate (U.S. discharge: >60 million ton per year), mining wastewater (U.S. discharge: >200 million ton per year). Technology development for nitrate removal and ammonia recovery will have both positive environmental and financial impacts. Particularly, electrocatalytic membrane technology, with its unique value propositions (e.g., potentially driven by renewable energy and minimum use of hazardous chemicals), stands poised to capture a significant portion of this market and offer both environmental benefits and lucrative business opportunities.

Dr. Wen Zhang's group at NJIT plans to develop novel flow-through electrocatalytic membrane systems to recover nutrients such as nitrate or ammonia (NH_3). This cutting-edge electrocatalytic membrane technology has proven effective for NO_3^- conversion into NH_3 with concurrent NH_3 recovery as valuable products such as ammonia salt fertilizers. This innovative electrocatalytic membrane and cell system will use a reactive gas-permeable cathodic membrane to efficiently convert NO_3^- in the influent flow through feed stream to NH_3, and subsequently trap the NH_3 via an acid solution generated by the anode, which results in the generation of ammonium salt solution fertilizer. Compared to conventional methods like ion exchange, air stripping and biological nitrification/denitrification, electrocatalytic membrane technology provides nitrogen removal from water or wastewater and nitrogen upcycling via nitrogen nutrient recovery and reuse. This system is electrochemically driven, which eliminates secondary pollution or the addition of external carbon or chemicals. This electrocatalytic membrane design selects a copper-based material, which is not on the DOE's Critical Mineral list, unlike other similar technologies that may employ Critical Minerals content (e.g., platinum and palladium) for the catalytic component. Broader impacts, beyond these environmental and sustainability benefits, exhibited by our bench-top results indicate a lower carbon intensity than industrial NH_3 gas synthesis via the Haber-Bosch process, which may provide a transformative pathway to "green" ammonia and industrial decarbonization.

Collaborative Early Research Translation (CERT) Seed Grant Awards Program

To accelerate NJIT's trajectory towards increased collaborative research and innovation funding for higher faculty and student success, a new strategic initiative, Collaborative Early Research Translation (CERT) Seed Grants supported by the U.S. National Science Foundation Accelerating Research Translation (ART) program was launched in 2023 to invest in translational research of high potential impact. These CERT seed grants will initiate early translation of research and innovation, working collaboratively with an external partner, towards developing proof-of-feasibility and potential intellectual property to build foundation to submit competitive proposals for external research translation acceleration funding opportunities, or internal NJIT TITA (Technology Innovation Translation Acceleration) seed grants for further advancement in translational research and market validation.

NJIT's internal seed funding opportunities including FSG, CERT and TITA seed grants are critical components of the strategic Research, Innovation and Technology Entrepreneurship (RITE) ecosystem as outlined in the 2030 Strategic Plan. Each CERT Seed Grant is awarded $25,000 with which is funded by the NSF Accelerating Research Translation (ART) grant and NJIT Collaborative Research and Innovation Strategic Partnership (CRISP) investment plan through the NJIT Center for Translational Research.

Collaborative Early Research Translation (CERT) Seed Grant Awards FY2026 (July 2025 - June 2026)

8

Title of the Technology: DermaMech: Kirigami-Inspired Skin Grafts that Enhance Graft Success and Reduce Donor Site Morbidity

Proposers and Affiliations: NJIT Principal Investigator: Farid Alisafaei, Mechanical Engineering

Partnership Team: Guy Genin, Professor, Washington University St. Louis

Executive Summary:

Split-thickness skin grafting is vital for treating severe wounds affecting 8.2 million Americans annually, yet failure rates remain unacceptably high (7-66%) and are currently unpredictable. Our laboratory has identified the biomechanical mechanism underlying these failures: uneven distribution of mechanical stress within meshed grafts activates fibroblast cells, inducing a persistent "mechanical memory" effect that drives excessive contraction and graft failure. We have invented a technology for reengineering the meshing pattern to control this stress distribution and prevent adverse outcomes.

9

Title of the Technology: An Intelligent Unmanned Aerial Vehicle (UAV) Drone Robotic System Featuring Dynamic Sensor Reorientation Apparatus, Multimodal Sensor Fusion, and Artificial Intelligence (AI) for Smart and Automated Infrastructure Asset Management

Proposers and Affiliations: NJIT Principal Investigator: Rayan Hassane Assaad, Civil and Environmental Engineering

Partnership Team: Wei Wang, CEO and founder Operating Officer, UrbanTech Consulting Engineering

Executive Summary:

Unmanned Aerial Vehicles (UAVs) or drones are pivotal in the field of infrastructure inspection and monitoring, offering multiple operational benefits such as improved accessibility, enhanced efficiency, and increased safety. Despite the growing adoption of UAVs in infrastructure asset management applications, current systems often face challenges related to limited sensor adaptability and data collection/coverage capabilities, payload limitations, and inefficient power consumption ultimately reducing inspection fidelity and mission endurance. Therefore, there is a pressing need to enhance the adaptability, intelligence, and sensing capabilities of UAV-based robotic inspection platforms. This project proposes a novel UAV robotics system, designed with a rotating sensor belt mechanism – a Dynamic Sensor Reorientation Apparatus (DSRA) – to advance the monitoring setup by allowing sensors to move 360-degrees across the body of the drone, thus increasing its fidelity. This mechanism addresses key limitations associated with the multi sensor payload distribution by reducing the weight, optimizing energy usage and allowing full frame coverage of the targets without the need of extensive UAV maneuvering in complex tasks (i.e., inspection). In addition to the reorientation system, the proposed method integrates several emerging states of the art technologies such as multi model sensor fusion with AI algorithms (i.e., attention-based region proposal deep learning segmentation architecture) for accurate defect identification and proper quantification. This novel robotic system introduces new frontiers in both aerial hardware and software integration by combining RGB and thermal cameras with rangefinders for accurate quantification and an AI-driven two-stage deep learning architecture that first identifies critical inspection regions and then detects and quantifies defects with high accuracy. The research team will leverage the 3D printing and fabrication facilities in the NJIT Makerspace to develop the proposed platform. This innovation intersects with two clusters within the NJIT research enterprise: robotics and machine intelligence, and data science and management.

10

Title of the Technology: Toward the Development of an Interactive Virtual Environment for Motor Activity Deficits Assessment and Rehabilitation in Children with ADHD

Proposers and Affiliations: NJIT Principal Investigator: Xiaobo Li, Biomedical Engineering

Partnership Team: Qinyin Qiu, Assistant Professor, School of Health Professions, Rutgers University

Executive Summary:

Motor activity deficit is one of the key deficits in ADHD that manifests in tasks requiring sequential movements and fine-motor skills. The routine stimulant approach for ADHD symptom management has been widely concerned about its severe side-effects, high cost, and inefficiency in addressing the motor activity deficit in ADHD. Exergame-based intervention for motor activity deficit in ADHD, which is personalized, affordable, easily accessible, and with minimal side-effect, has not yet been sufficiently investigated. To address this press need in the field, the overall goal of this research program is to develop and disseminate a virtual reality (VR)- based exergame intervention platform, the Sequential Movement Assessment and Rehabilitation Toolkit (SMART), targeting the behavioral impairments and neurobiological substrates associated with motor activity deficit in ADHD. The short-term objectives of this pilot research focus on the development of SMART and testing its feasibility and reliability in healthy children. Based on the critical pilot results generated from this pilot research, we will apply for large-scale grants from federal agencies to conduct longitudinal and trail-based studies in sizable samples, to solidly validate the behavioral and neurobiological improvements associated with this innovative intervention approach in

ADHD. The market need of our proposed product is pressing and sizable. The ADHD apps market is projected to grow significantly, with a global value of \$1.7 billion in 2024, expected to reach \$4.9 billion by 2033. This internal funding is needed for our collaborative research program from NJIT and Rutgers NJMS to address the high impact scientific and societal needs of ADHD, which is one of the major general-public health concerns.

11

Title of the Technology: Bonepihist: new biomarkers for osteoporosis prediction and prognosis

Proposers and Affiliations: NJIT Principal Investigator: Sara Casado Zapico, Chemistry and Environmental Science

Partnership Team: Victoria Dominguez, Assistant Professor, Lehman College-CUNY

Executive Summary:

The goal of this proposal is to address one of the fundamental problems in the elderly: the correct diagnosis and prognosis of osteoporosis to improve quality of life in a vulnerable population. This will be approached by the identification of novel biomarkers through the simultaneous assessment of epigenetic and histological changes in bone tissues during the adult lifespan. The significance and market need of this proposal relies on the current medical costs associated with osteoporosis treatment and moreover the post-fracture hospitalization and recovery, which not only is an economic burden, also increases disability and reduces lifespan, significantly hampering healthy aging. The identification of novel biomarkers could lead to the development of preventive strategies and/or more targeted and less expensive treatments. The expected outcome of this proposal is that a two-way assessment of methylome-bone architecture, in combination with machine learning approaches, will identify specific bone aging biomarkers to address and potentially overcome the effects of OP. These outcomes are based on trial data generated by the PIs and the proven effectiveness of both techniques individually to evaluate bone aging. Our future plans will include the development of the first epigenetic clock for bone tissue, filing a patent with the newly discovered biomarkers, and applying for NIH, NSF and NIJ grants to target both clinical and anthropological questions of interest, based on the broader impacts of the findings of this project. Our justification for internal funding is to develop enough robust preliminary data to be able to apply for external federal funding.

12

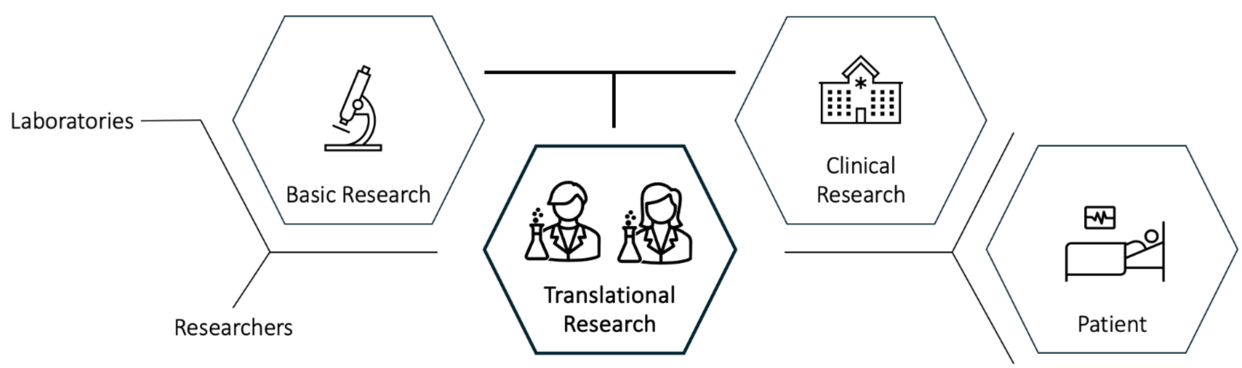
Title of the Technology: AgriTech in the era of AI: Vertical Farming Innovation and Implications

Proposers and Affiliations: NJIT Principal Investigator: Jae-Hyuck Park, MTSM
NJIT Co-Principal Investigators: Jim Shi, MTSM

Partnership Team: Bryan Santos, Director of Corporate Development at Aerofarms, AeroFarms

Executive Summary:

In the era of AI, Agricultural Technology (AgriTech) is rapidly advancing. Vertical farming (VF), an innovative form of AgriTech, has been widely implemented to meet the growing population's needs by cultivating crops in vertically stacked layers within controlled environments using advanced agricultural techniques, such as IoT, Machine Learning, AI-driven tools. One close business example is AeroFarms, located in Newark, NJ. This project aims to investigate the operational innovativations, market dynamics and economic benefits of VF. The merit of this project lies in its potential to address the urgent need for sustainable transformation in AgriTech via leveraging AI. VF o!ers substantial advantages, including increased efficiency, yield stability, and reduced energy consumption. VF also strengthens coordination between farmers and retailers, promoting more resilient and sustainable agricultural supply chains. We will begin by quantifying VF's gains in economic efficiency and reliability. Building on this analysis, we will develop a game-theoretical model to explore the dynamics of collaboration-competition among firms. The project will also deliver actionable insights and best practices for agribusinesses to adopt VF more electively. Partnering with AreoFarms, we aim to translate findings into AI-oriented solutions and data-driven business models tailored to the VF industry. Support from this internal funding is essential to translate this study into practical VF. This in turn will provide a basis for future external funding opportunities. This work can contribute significantly to the field of entrepreneurship, sustainable operations and supply chain management and pave the way for the broader adoption of advanced AgriTech.



NJIT Collaborative Early Research Translation (CERT) Seed Grant Awards

CERT FY 2024-2025 Seed Grants

13

Title of the Technology: Bone Allograft Composite Inks for 3D Printing of Bone Grafts

Proposers and Affiliations: NJIT Principal Investigator: Murat Guvendiren, Chemical and Material Engineering

Partnership Team: Dave Washburn, Chief Operating Officer, Acuitive Technologies

Executive Summary:

Osteoporosis is the most common bone disease affecting over 10 million people in the United States according to the CDC. Osteoporosis is associated with loss of bone tissue, structure, and strength. It is considered the leading cause of bone defects. Additionally, 40 million people are currently at high risk as they have low bone density. In addition to osteoporosis, critical size bone defects caused by traumatic injury, infection, tumor removal, and birth defects are difficult to treat as the size of the defect is beyond the intrinsic capacity of the self-regeneration of the bone. In the United States, the annual cost of bone defect treatments is ~$5 billion. Autograft bone – bone tissue from a patient's own body – is the gold standard for bone grafting to treat large bone defects. Complications in the bone harvesting site as well as availability of large enough tissue have led to a search for alternative grafting options. Bone allografts – bone from donors, and synthetic bone graft substitutes are commonly explored alternatives with some success. This highly transformative proposed project addresses the unmet need for restorative treatments of large bone defects by developing novel bone allograft composite ink formulations to 3D print bone grafts designed from patient's medical images. We hypothesize that our unique platform will help us to develop much-needed human bone grafts that could potentially revolutionize the currently utilized treatment approaches. We aim to demonstrate the utility of this platform in vitro by studying the bone formation utilizing human adult stem cells.

14

Title of the Technology: Empowering Grid Innovation: Collaborative Research and Industry Partnership in Power Systems Engineering

Proposers and Affiliations: NJIT Principal Investigator: Philip Pong, Electrical and Computer Engineering
NJIT Co-Principal Investigators: Mohsen Azizi, School of Applied Engineering and Technology; Marcos Netto, Electrical and Computer Engineering; SangWoo Park, Mechanical and Industrial Engineering, Joshua Taylor, Electrical and Computer Engineering

Partnership Team: Andrew Chad Watson, Renewables Development Manager, PSEG; Rafael Wilches, Senior Development Manager, PSEG; Jason Kalwa, Offshore Wind Department Director, PSEG; Sid Parmar, Senior Manager, Invenergy; Wesley Jacobs, Senior Project Director, Invenergy; Michael Porto, Senior Director (External Engagement), Invenergy; Mahdiyeh Khodaparastan, Senior Interconnection Engineer, TotalEnergies; Favio Geran, Community Engagement Manager, TotalEnergies; Doug Copeland, Business Development & Strategic Partnerships Manager, Atlantic Shores Offshore Wind, David Wang, O&M Engineer – Offshore Projects Delivery, Atlantic Shores Offshore Wind; Tony Appleton, Offshore Wind Director, Burns & McDonnell

Executive Summary:

Our project aims to advance grid enhancement technologies for utility and offshore wind integration through collaborative research and industry partnership. The project's goals include developing novel solutions to improve system reliability, enhance operational efficiency, and enable seamless integration of offshore wind resources. These advancements are crucial to meet the increasing demand for renewable energy and ensure grid stability in the face of evolving energy landscapes. By leveraging the expertise of our multidisciplinary team and partnering with industry leaders, we seek to address critical challenges facing the power systems sector. Through this project, we aim to lay the foundation for future external funding, particularly the NSF Industry-University Cooperative Research Centers (IUCRC) Program. The funding provided by the CERT seed grant will facilitate the preparation phase of the NSF IUCRC proposal, including engaging industry partners, conducting preliminary research, and establishing necessary infrastructure. Our anticipated outcomes include innovative technologies, industry collaborations, and a pathway to secure external funding for sustained research efforts in power systems engineering.

15

Title of the Technology: Developing an Intelligent Multi-Modal, IoT-enabled, AI-integrated, Sensor Fusion-based Wearable Device for Improving Human-Robot Interaction

Proposers and Affiliations: NJIT Principal Investigator: Rayan H. Assaad, Civil and Environmental Engineering

Partnership Team: Gilles Albeaino, Director of the Construction Automation, Safety, and Education (CASE) Lab, Texas A&M University

Executive Summary:

Human-robot interaction (HRI) has been an extensive research area for over two decades, offering numerous workplace benefits such as increased task efficiency and accuracy. Despite the development of various devices for facilitating HRI, they often face challenges related to user privacy and safety concerns, reliability and robustness in complex and dynamic work environments, and adaptability across different applications. Therefore, there is a pressing need to enhance the reliability, safety, and adaptability of HRI systems while ensuring cost-effectiveness for accessibility across various industries. This project proposes a groundbreaking wearable device, designed in the form of an armband, to advance HRI by integrating several emerging and state-of-the-art technologies such as multi-modal sensing and fusion, Internet of Things (IoT), artificial intelligence (AI), and haptics. The transformative potential of this innovation lies in its game-changing ability to translate results from basic research on multi-modal sensing and HRI into practical benefits for humans, enabling more revolutionized, intuitive and natural interactions with robots in complex work environments. This novel technology will lead to radical changes in HRI by introducing new frontiers in both hardware and software. The proposed wearable device integrates various sensors including surface electromyography (sEMG), inertial measurement unit (IMU), Ultra-wideband (UWB), and haptic sensors, along with integrated deep machine learning and adaptive algorithms. The research team will leverage the fabrication facilities in the NJIT Makerspace to develop the proposed device. This innovation intersects with two clusters within the NJIT research enterprise: robotics and machine intelligence, and data science and management.

16

Title of the Technology: Algorithm-guided Geotechnical Surveying using Wearable Miniaturized Sensors

Proposers and Affiliations: NJIT Principal Investigator: Petras Swissler, Mechanical and Industrial Engineering and Co-Principal Investigator: Oladoyin Kolawole, Civil and Environmental Engineering

Partnership Team: Nejm E. Jundi, Principal, JZN Engineering

Executive Summary:

We aim to develop a prototype for a hardware-algorithm system to revolutionize how engineers go about characterizing underground geohazards. The innovation combines inexpensive geotechnical sensors with a swarm exploration algorithm, enabling real-time, in-situ assessment of subsurface conditions. The project addresses a critical market need for rapid, cost-effective, and accurate geotechnical assessment, with potential applications across agriculture, environmental remediation, construction, and resource industries. Expected outcomes include the development of a prototype, understanding market needs, and integrating the system into existing workflows. Internal funding will support the development of sensing and algorithmic tools, student workers, and travel expenses for market research. Completion of deliverables, including the prototype and market validation, will lay the foundation for securing external funding from programs like NSF Cyber-Physical Systems, Future of Work, and the Convergence Accelerator. Without internal funding, the project's success and ability to secure external funding are uncertain, given the shift from the applicants' core research thrusts.

17

Title of the Technology: Development of a Novel Peptide Tracer for Tracing Potential Septic Pollution Sources

Proposers and Affiliations: NJIT Principal Investigator: Hao Chen, Chemistry and Environmental Sciences and NJIT Co- Principal Investigator: Zeyuan Qiu, Chemistry and Environmental Sciences

Partnership Team: Bob Averill, the Cupsaw Lake Improvement Association (CLIA); Maureen Jobrack, The Environmental Commission Chair, CLIA; Alan Fedeli, New Jersey Coalition of Lake Associations; Alan Fedeli, New Jersey Coalition of Lake Associations; Tom Conway, North America Lake Management Society

Executive Summary:

Lakes in New Jersey and beyond are increasingly experiencing harmful algae bloom (HAB) due to climate changes. Many lake communities rely on septic systems to treat onsite wastewater. One of the primary reasons for HAB is the discharge of nutrients, especially the limiting nutrient like phosphorus, from those septic systems to the lake. Effective lake management through septic system treatment invention requires the identification of those septic systems in the community that are primarily responsible for the discharge of phosphorus to lakes. We propose to develop a novel peptide tracer to be used for detecting and quantifying the relative contributions of the septic systems in lake communities to the nutrient loads to the lakes that lead to HAB and help prioritize the community efforts to improve nutrient treatments in those septic systems. We plan to apply this developed tracer for assessing the relative nutrient contributions of the septic systems that drains to the Cupsaw Lake, which is the direct intake to the Wanaque Reservoir, the drinking water source for nearly 3 million residents in North Jersey. If successful, this tracer can be marketed for identifying the contamination sources in many other lake communities in New Jersey and beyond. We expect our peptide tracer will be sensitive and powerful in terms of detecting and quantifying septic pollution sources. Currently no other fund is available for this project which is urgent in terms of protecting Cupsaw Lake from further contamination caused by septic systems.

18

Title of the Technology: XCopilot: Private Code Generation with Large Language Models

Proposers and Affiliations: NJIT Principal Investigator: Hai Phan, Data Science and NJIT Co- Principal Investigators: Cristian Borcea, Computer Science; Abdallah Khreishah, Electrical and Computer Engineering

Partnership Team: Ruoming Jin, Professor, Computer Science, Kent State University; Jonathan Maletic, Professor, Computer Science, Kent State University; Yelong Shen, Principal Research Manager, Microsoft

Executive Summary:

Project Goals: The project aims to develop XCopilot, the first privacy-preserving system that protects users' prompts and generated software codes from being observed by AI code generation service providers (e.g., ChatGPT, Microsoft Copilot). XCopilot is secure, costeffective, and deployable in industrial settings. As a result, it will revolutionize existing AI copilot systems by addressing their security and intellectual property (IP) leaking risks.
Significance and Market Need: The demand from both individuals and enterprises for integrating commercial-grade AI-powered (software) code generation tools into their software development pipelines have significantly increased. This emergent market is projected to reach $94.75 billion by 2028 across a wide range of industry sectors, i.e., healthcare, retail, education, manufacturing, etc. However, many individuals and enterprises are afraid to use these tools due to potential security and privacy risks (i.e., OpenAI or Microsoft learn the IP of third-party companies that use their AI copilots).
Expected Outcomes and Future Plans: Expected outcomes include: (1) Privacypreserving code generation system design and models tailored to comply with data privacy, security, and IP regulations with rigorous guarantees; (2) The optimization of the trade-offs among system performance, model utility and data privacy loss; and (3) The integration between XCopilot in industrial settings, including varieties of (publicly) available copilot platforms (e.g., GPT4 with Microsoft Copilot). Our future plan is to create a startup company following the pathway of TITA, NSF SBIR, and external funding, including submission of multiple federal grant proposals such as NSF SaTC and NSF Safe Learning-Enabled Systems, and industry funding from Microsoft and OpenAI.
Justification of Internal Funding: This effort will help us to do preliminary work for strong grant proposals in emerging and translational research, allowing us to apply for external funding, patents, and ultimately commercialized products. Our related pilot studies along this direction have been submitted to NJIT (invention disclosure) while approved and filed for a US provisional patent by QCRI [6] and won the AAAI'23 Distinguished Paper Award [7] (AAAI is the leading AI conference). XCopilot significantly advances these pilot studies.

19

Title of the Technology: Deep Learning and Large Language Models for Personalized Cancer Vaccine Design

Proposers and Affiliations: NJIT Principal Investigator: Zhi Wei, Computer Science

Partnership Team: Dr. Hakon Hakonarson, Director of CAG, The Center of Applied Genomics (CAG), the Children's Hospital of Philadelphia

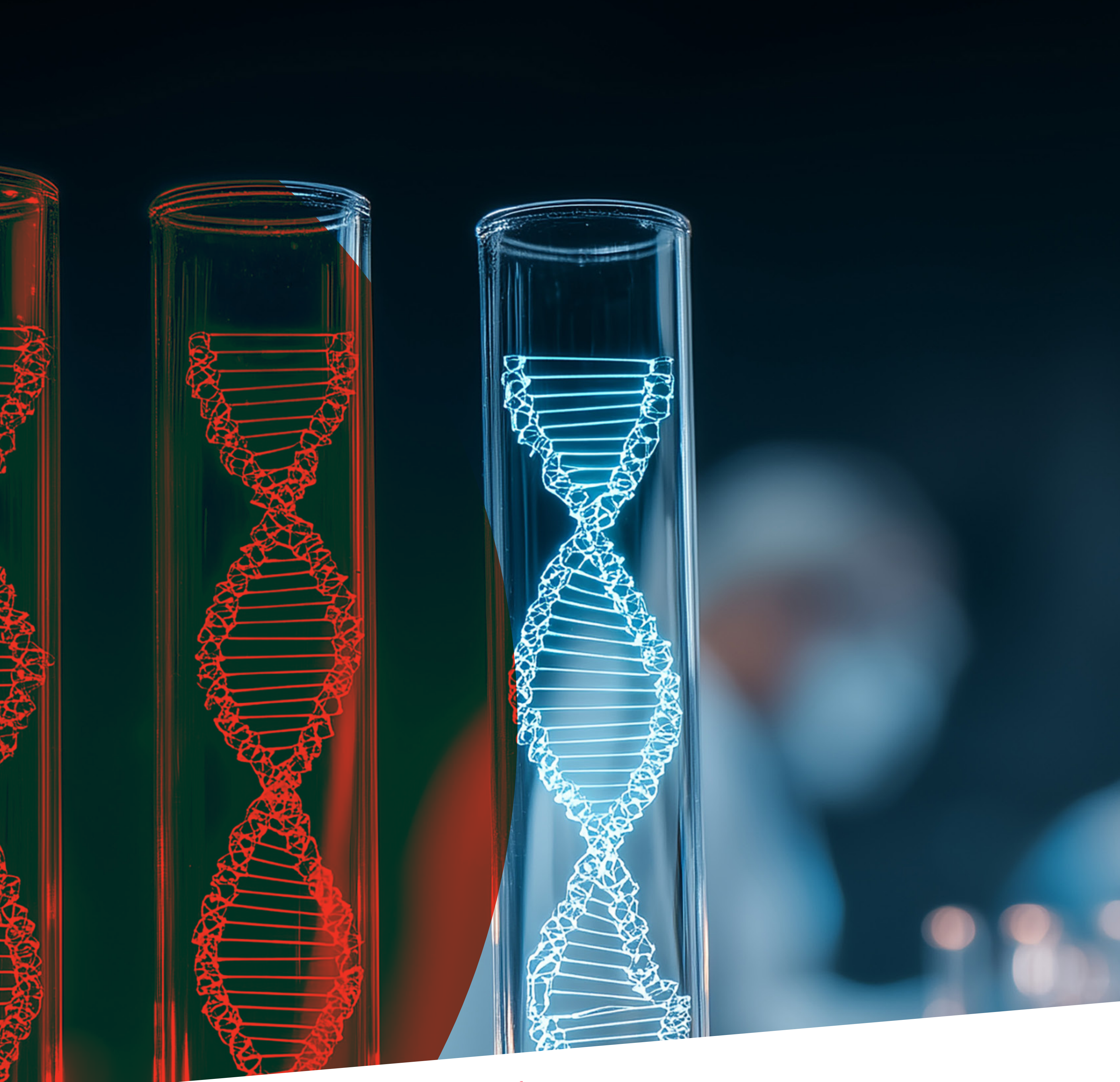
Executive Summary:

This project aims to develop a novel personalized cancer vaccine design technology by leveraging deep learning and large language models to integrate multi-omics data, identify patient-specific neoantigens, and generate optimized peptide sequences for improved immunogenicity and manufacturability. The significance of this project lies in addressing the pressing need for more effective and personalized cancer therapies, as cancer remains a leading cause of mortality worldwide. The global cancer vaccines market is expected to witness substantial growth, reaching a size of USD 4.3 billion by 2028, with the personalized cancer vaccine segment poised for significant expansion due to increasing demand for precision medicine.

The expected outcomes of this project include the development of a comprehensive deep learning framework, optimized peptide sequence generation, and validation of the designed cancer vaccines' efficacy through preclinical studies. Future plans involve establishing partnerships with pharmaceutical companies and healthcare providers to translate the technology into clinical practice. The successful completion of this project will lay the foundation for securing external funding from various sources, including NIH grants, SBIR/STTR grants, and partnerships with industry and investors.

Internal funding is justified as no other funds are directly available for this project. The requested budget allocation will support the hiring of a dedicated graduate student for model development, as well as travel to conferences, translation activities with industry partners and collaborators, and visits to funding agencies. This internal funding will be crucial in advancing the project and positioning it for future external funding opportunities.

Notes



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