PURDUE UNIVERSITY

School of Nuclear Engineering

NUCLEAR ENGINEERING NEWSLETTER

TRAILBLAZING THE FUTURE OF NUCLEAR INNOVATION

Fall 2024 | Issue 6

PURDUE UNIVERSITY

Leads three SMR studies in 2024
in collaboration with

U.S. DOE

IOED

DUKE ENERGY

MESSAGE FROM THE HEAD

The brilliant colors of changing leaves in West Lafayette serve as a backdrop to a semester marked by remarkable progress and collective achievements. With the 150th celebration of Purdue Engineering, find ourselves reflecting on how far we have come as a community, both in spirit and in our contributions to the world of nuclear engineering.

Our faculty continue to advance the frontiers of research innovations, tackling critical areas such as advanced reactor technologies, sustainable energy, cybersecurity, and the future of the nuclear engineering workforce. Ongoing projects led by our dedicated researchers, from advanced materials science to machine learning applications in energy systems, have gained national recognition and attracted new collaborations with both industry leaders and academic peers across the globe.

Equally inspiring are our students, who continue to push boundaries in both academics and research. In May 2024, 35 students graduated from the School of Nuclear Engineering, marking an important milestone, including our first online Master of Nuclear Engineering graduate. Interests toward nuclear energy as a feasible solution for the sustainable future has grown significantly and is well reflected by the continuing increase in student enrollment. As of Fall 2024, we have 139 undergraduate and 60 graduate students. Many of our students have earned prestigious awards, scholarships, and fellowships that will further fuel their passion for discovery and innovation.

This year, Purdue is leading a $6M DOE-sponsored research effort on small modular reactor and advanced reactor technologies, positioning our School of Nuclear Engineering as a key player in the nation's energy future. Purdue has also been chosen by the Indiana Office of Energy Development to lead the Indiana Focused SMR Study, further solidifying our leadership in energy innovation. In addition, our school continues to provide support to Purdue University and Duke Energy in exploring the feasibility of using advanced nuclear energy to meet the West Lafayette campus community's long-term energy needs. With the launch of the newest Purdue Engineering Initiative—Leading Energy-Transition Advances and Pathways to Sustainability (LEAPS)—our school is at the forefront of leading the energy transition, empowering future engineers and entrepreneurs to drive sustainability and create solutions for a changing world.

As we look ahead, we are excited to celebrate the milestones and achievements that make us proud to be part of this community. I wish you and your families a wonderful holiday season, and I look forward to continuing our journey of innovation and excellence together.

Seungjin Kim
Capt. James F. McCarthy, Jr. and Cheryl E. McCarthy Head of the School of Nuclear Engineering

150 YEARS OF PURDUE ENGINEERING

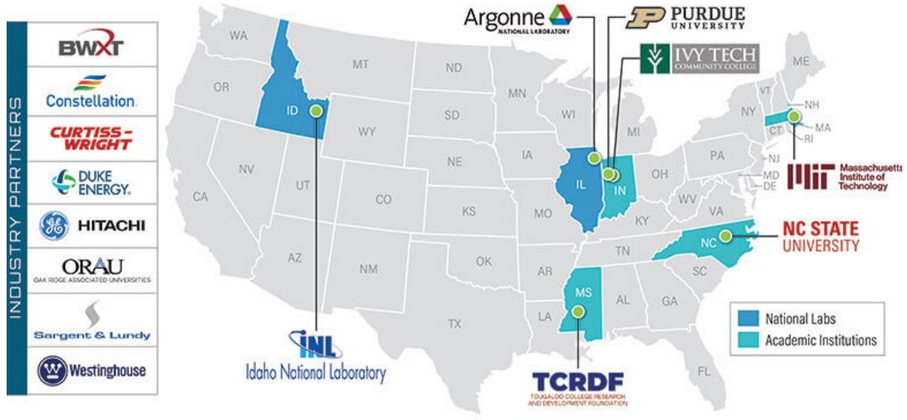
TABLE OF CONTENTS

PURDUE AWARDED $6M DOE GRANT

PURDUE AWARDED $6M TO LEAD DOE-SPONSORED RESEARCH FOR SMALL MODULAR REACTOR AND ADVANCED REACTOR TECHNOLOGIES

Purdue University has received a $6 million grant from the U.S. Department of Energy (DOE) to lead a consortium aimed at revitalizing nuclear research facilities and expanding university-led research into small modular reactor (SMR) and advanced reactor (AR) technologies. The consortium, led by Seungjin Kim, head of Purdue's School of Nuclear Engineering, includes MIT, North Carolina State University, and two national labs. Their goal is to upgrade four existing nuclear research facilities and create educational programs to train the future nuclear workforce.

The project will establish new cyber-physical capabilities for SMR and AR technologies, including a user facility that connects four cyber-physical facilities with cutting-edge digital instrumentation. This facility will serve as a regional center for research, education, and training, enabling collaboration between universities, national labs, industry, and other institutions. Argonne National Laboratory and Idaho National Laboratory will guide infrastructure design, while eight major nuclear industry partners will provide internship opportunities for students.



Purdue will lead the consortium consisting of five academic institutions and two national labs, supported by eight major nuclear industries.

This initiative builds on Purdue's leadership in nuclear energy research, including its partnership with Duke Energy to explore using SMRs to power Purdue's campus. The grant also supports the upgrade of Purdue's multidimensional integral test assembly (PUMA) and the enhancement of its research reactor (PUR-1), both of which will be equipped with advanced digital-twin systems for real-time simulation and analysis.

Kim emphasized the importance of SMR and AR technologies, noting their advanced design features, safety systems, and flexibility. He highlighted their potential to contribute to a carbon-free energy ecosystem, capable of hybridizing with renewables like solar and wind and producing hydrogen without carbon emissions.

"One of the exciting things about SMR and AR technologies is that they allow for load-following and hybrid with other renewables like solar and wind," Kim said. "You can also generate hydrogen without any carbon generation. Additionally, by being smaller and flexible, the electricity generated by SMR and AR can be used toward charging electric vehicles, for example. Nuclear energy can actually be used to create a 100% carbon-free energy ecosystem that would not be possible without it."

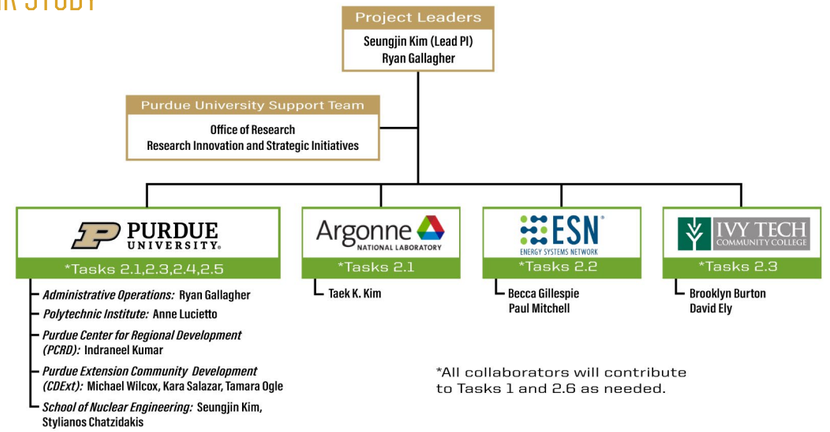
In addition to Kim, Purdue faculty members Stylianos Chatzidakis, Mamoru Ishii, Shripad Revankar, and Lefteri Tsoukalas will also play key roles in this transformative project.///

Learn more at https://bit.ly/Purdue6MGrant

PUR-1 & PUMA Facilities

PURDUE - IOED SPONSORED SMR STUDY

PURDUE UNIVERSITY SELECTED BY INDIANA OFFICE OF ENERGY DEVELOPMENT FOR INDIANA FOCUSED SMR STUDY



In collaboration with the IOED, the extensive study's main objectives are to analyze SMR technology's current status, the state and local economic impact, workforce development and employment, safety and environmental impact, the responsible handling of nuclear waste and site considerations, and community engagement needs and best practices.

This partnership aims to further IOED's mission of providing comprehensive energy planning and policy development for Indiana that is affordable, stable, reliable, and inclusive of a diverse and balanced generation mix.

Seungjin Kim, the Capt. James F. McCarthy, Jr. and Cheryl E. McCarthy Head of the School of Nuclear Engineering, and Ryan Gallagher, Associate Vice President of Purdue's Facilities Operations and Environmental Health and Safety, are leading the study with IOED in collaboration with experts from various institutions, including Argonne National Laboratory and Ivy Tech Community College.

Kim mentioned that this is the first state-sponsored study of its kind, which has attracted federal attention to their ongoing work and future findings.

"It is not only logical, but also in a way, in my opinion, is essential to consider nuclear for the state if we are serious about moving forward to a carbon-free environment," said Kim.

Purdue's history of research and development of new energy that benefits Indiana is a longstanding commitment.

> "Purdue began seriously researching the practical application of small modular nuclear technology with duke energy in 2022 when we kicked off our joint feasibility study," Gallagher explained.
>
> "Since then, we have continued to expand our knowledge on topics including technology development, approval and implementation timelines, siting considerations, and other factors that position us well to help the state evaluate the potential benefits SMRs could bring to Indiana."
>
> RYAN GALLAGHER

Currently, coal supplies the largest share of Indiana's total in-state utility-scale electricity generation. SMRs are capable of generating up to 300 megawatts of power per unit, approximately one-third of the capacity of traditional reactors.

According to Kim, SMRs will be manufactured in factories, potentially making them more affordable and versatile, including the capability to generate hydrogen. SMRs feature passive safety systems and advanced nuclear fuel, which reduce safety risks and the chance of fuel melt. They can provide a stable energy baseload and integrate other renewable sources like wind and solar.

The study began in March 2024 and is predicted to conclude in October 2024.///

PURDUE & DUKE ENERGY JOINT SMR FEASIBILITY STUDY

(Left to Right) Seungjin Kim, Head, Purdue School of Nuclear Engineering; Stan Pinegar, President Duke Energy Indiana; Ryan Gallagher, Associate Vice President, Facilities Operations and Environmental Health and Safety; Lee Grzeck, Licensing Manager, New Nuclear Generation, Duke Energy; Michael B. Cline, Purdue, Senior Vice President, Administrative Operations; President Mung Chiang, Purdue University; Timothy Hanley, Senior Vice President and Chief Operating Officer Constellation Nuclear; Chris Nolan, Vice President, New Nuclear Generation Strategy and Regulatory Engagement, Duke Energy; Ahmed Tokpinar, Principal Vice President and General Manager of Nuclear, Bechtel Power; Luis Reyes, Former Executive Director for Operations, U.S. Nuclear Regulatory Commission; Kelley Karn, Duke Energy of Indiana, Vice President, Regulatory Affairs & Policy; Norman Kunkel, Duke Energy, Engineering Manager, New Nuclear Generation; Brad Runda, Purdue, Former Director of Energy and Utilities

In May of 2023, Purdue University and Duke Energy released an interim report outlining the feasibility of small modular reactors (SMRs) as a promising solution to meet future energy needs. The report emphasizes the potential of SMRs to provide carbon-free, continuous power and their compatibility with renewable energy sources.

The interim report reveals that SMRs have emerged as a front-runner in supplying carbon-free energy. Their adaptability to fluctuating power demands makes them a valuable complement to renewables. Additionally, SMRs boast advanced safety features and a simplified design compared to traditional nuclear plants. This simplification potentially allows for faster, more affordable construction, making them an attractive possibility. The deployment of SMRs is expected to bring substantial economic advantages, including generating tax revenue, creating jobs, and attracting businesses to Indiana.

Federal and state governments have an essential role to play in supporting advanced nuclear development. Recommendations include advocating for policies such as insurance options, workforce development programs, tax credits, and support for initial planning and development activities.

While the report highlights the potential of SMRs, it also acknowledges various challenges. These challenges include public acceptance, regulatory conditions, cost competitiveness, technology development, used fuel management, and workforce availability. To address these challenges, the report suggests advocating for federal and state policies that support advanced nuclear development, including insurance options, workforce development programs, and fuel availability programs. Additionally, building on successful engagement efforts, Purdue University and Duke Energy aim to continue dialogue at regional and national levels to ensure a broad understanding of the benefits and challenges of new nuclear development. Monitoring the progress of first-of-a-kind projects, and conducting economic studies, site evaluations, and technology assessments will be vital to determine the path forward. Should Purdue University and Duke Energy decide to pursue SMRs in the future, public and stakeholder input will be a crucial part of the process.///

Learn more at https://bit.ly/Purdue-DukeSMRstudy

LEADING ENERGY-TRANSITION WITH LEAPS

PURDUE'S NEXT GIANT LEAP: ENERGY TRANSITION, EMPOWERING FUTURE ENGINEERS AND ENTREPRENEURS TO CREATE SUSTAINABILITY

Purdue University's spirit of innovation continues to propel its College of Engineering forward. In response to the global challenge of generating sustainable, affordable, and reliable energy, Purdue has launched the Purdue Engineering Initiative—Leading Energy-Transition Advances and Pathways to Sustainability (LEAPS). This initiative aims to drive research and education innovation across disciplines, linking expertise and empowering future engineers and entrepreneurs to create sustainable energy solutions.

Fabio Ribeiro and Lefteri Tsoukalas

LEAPS focuses on key areas relevant to Indiana and the Midwest, such as transforming the manufacturing sector to meet the growing demand for sustainable power, products, and processes. Indiana is poised to play a major role in the hydrogen economy, nuclear energy, renewables, and energy grids—sectors where LEAPS will help forge partnerships between Purdue, the state, and industry.

Co-chaired by Lefteri Tsoukalas, professor of nuclear engineering and leader of Purdue's Center for Intelligent Energy Systems, and Fabio Ribeiro, William Nicholas and Elizabeth Holstein Delgass Distinguished Professor of Chemical Engineering and director of engineering research center, CISTAR, LEAPS is dedicated to empowering faculty, facilitating curriculum development, attracting large-scale funding, building industry connections, and developing scalable energy technologies.

"In the spirit of Neil Armstrong's famous words, humanity is taking a giant leap forward in the energy transition space and Purdue Engineering will be there to help," Tsoukalas said. "LEAPS will provide a panoply of excellent tools for the energy transition.

Together, we can craft a legacy of stewardship for our planet."

Lefteri Tsoukalas / Professor of Nuclear Engineering

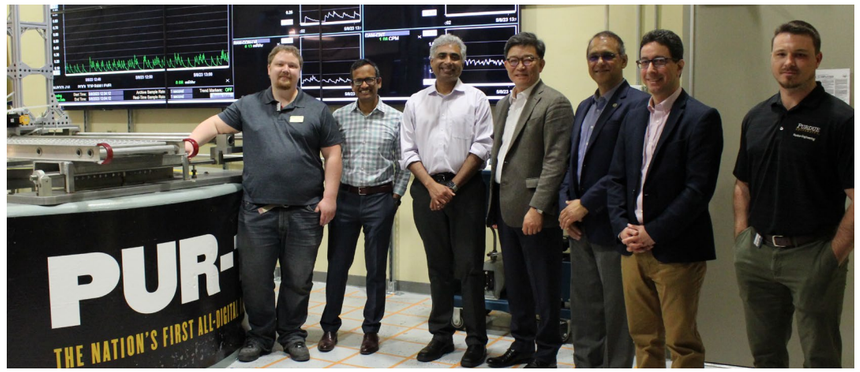
"In the spirit of Neil Armstrong's famous words, humanity is taking a giant leap forward in the energy transition space, and Purdue Engineering will be there to help," Tsoukalas said. "LEAPS will provide a panoply of excellent tools for the energy transition. Together, we can craft a legacy of stewardship for our planet."

"Through LEAPS and other leading initiatives at Purdue, we will spark innovations that create scalable technologies for the energy transition," said Arvind Raman, John A. Edwardson Dean of the College of Engineering.///

Learn more at https://bit.ly/PurdueLEAPS

ENGINEERS DEVELOP FASTER, MORE ACCURATE AI ALGORITHM FOR IMPROVING NUCLEAR REACTOR PERFORMANCE

PURDUE UNIVERSITY RESEARCH REACTOR SERVES AS TEST BED FOR OPTIMIZING PERFORMANCE OF SMALL MODULAR REACTORS



Dean Arvind Raman visits Purdue University Reactor Number One (PUR-1)

A study conducted by Purdue University and the U.S. Department of Energy's Argonne National Laboratory has made strides in using artificial intelligence (AI) to improve the monitoring and control of small modular reactors (SMRs). SMRs, designed to be more cost-effective and quicker to build than traditional reactors, are seen as a promising solution to expand nuclear power availability.

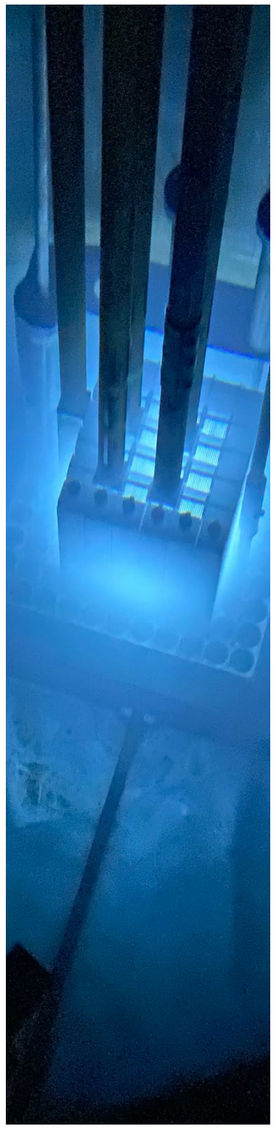
The research, published in *Nature's Scientific Reports*, demonstrates how a machine learning algorithm can predict reactor performance with 99% accuracy by quickly learning the physics behind power production. This AI method requires significantly less training compared to other models, potentially reducing operational and maintenance costs for SMRs, making them more economically viable.

The algorithm was tested using Purdue University's Reactor Number One (PUR-1), the only U.S. reactor with a fully digital instrumentation and control system. Unlike traditional analog reactors, SMRs and reactors like PUR-1, with digital systems, enable real-time AI-driven data collection and monitoring. PUR-1 also features a "digital twin," a virtual clone that allows researchers to simulate reactor operations without impacting the physical reactor.

Stylianos Chatzidakis, associate director of PUR-1, highlighted the potential of digital twins, stating they could allow future SMRs to predict reactor behavior in real-time, enabling more precise control. The study's algorithm accurately monitored neutron flux, the core reaction driving nuclear fission, with less than 1% error, signaling significant progress in AI-driven reactor management.

This research builds on Purdue and Argonne's ongoing collaboration and is supported by funding from DOE's Advanced Research Projects Agency-Energy and a donation from Goldman Sachs Gives to Purdue's AI Systems Lab.///

Learn more at https://bit.ly/ImprovingReactorPerformance



U.S. NRC PUBLISHES PURDUE NUCLEAR PROJECT REPORT

U.S. NRC PUBLISHES PURDUE NUCLEAR PROJECT REPORT, LED BY STYLIANOS CHATZIDAKIS, ON ADVANCING NUCLEAR CYBERSECURITY, AS AN OFFICIAL NRC TECHNICAL LETTER REPORT

The exploration of artificial intelligence and machine learning has become one of the many innovative strategies contributing to the advancement of cybersecurity and safety in the nuclear industry.

The applicability of AI/ML in this field offers significant benefits, including enhanced anomaly detection, failure prediction, and optimized maintenance schedules, all of which contribute to reducing accident risks and ensuring strict safety compliance. Assistant Professor and Associate PUR-1 Director Stylianos Chatzidakis and a team of researchers from the School of Nuclear Engineering conducted a project titled, Characterizing Nuclear Cybersecurity States Using Artificial Intelligence/ Machine Learning. Their final report, now published as an official NRC Technical Letter Report, evaluates the feasibility of AI/ML technologies to characterize cyber events within nuclear systems. The project focuses on how these tools can distinguish between normal, abnormal, and cybersecurity-related states in nuclear environments.

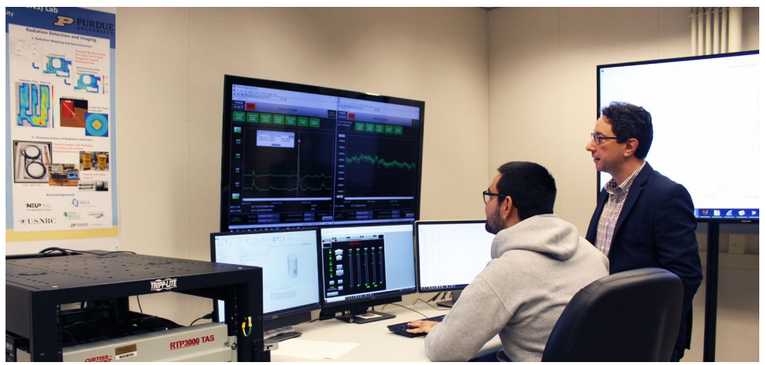
The research identified nine potential use cases, with one fully implemented using real-world data from Purdue University's PUR-1 digital reactor. Extensive operational technology (OT) and information technology (IT) data were collected to train AI/ML models, which were then assessed through a composite classifier architecture. This system demonstrated the ability to effectively identify different system states and detect cybersecurity events, offering critical insights into AI/ML's practical applications in nuclear safety and cybersecurity.

Stylianos Chatzidakis
Assistant Professor, Associate PUR-1 Director

Among the various algorithms tested, Random Forest models emerged as the most effective, showing superior performance and explainability compared to alternatives such as Super Vector Machines and Logistic Regression. This approach proved to be effective in differentiating between cyber-threat-related, normal, abnormal, and abnormal conditions in the nuclear environment.

The broader goal of this initiative is to leverage AI/ML technologies to predict system failures, detect anomalies, and enhance responses to cyber threats. By doing so, nuclear facilities can reduce the likelihood of accidents, improve maintenance practices, and strengthen operational safety. Integrating AI/ML into these systems will help contribute to the overarching objectives of strengthening critical infrastructure and representing the future of safer and more secure nuclear reactor operations.

This research project marks a milestone in nuclear cybersecurity and AI/ML research, being the first of its kind to use real-time reactor data. The Purdue team, led by Stylianos Chatzidakis, includes graduate research assistants Vasileios Theos, Konstantinos Gkouliaras, Zachery Dahm, William Richards, Kostas Vasili, and True Miller, Reactor Supervisor and Brian Jowers, Nuclear Electronics Technician, expects to publish several papers based on this groundbreaking work.///



Vasileios Theos and Stylianos Chatzidakis at the Digital Twin

PURDUE & SYNGENTA COLLABORATION

HOW PURDUE UNIVERSITY AND SYNGENTA ARE PIONEERING THE USE OF ELECTRICAL FIELDS TO MAKE SEED HYBRIDIZATION MORE SUSTAINABLE

Purdue University and Syngenta have joined forces to develop a groundbreaking method for making seed hybridization safer and more sustainable. Their innovative research focuses on replacing a traditional chemical process used in hybrid crop breeding with electrical fields, significantly reducing chemical waste and improving breeder safety.

Modern agriculture relies on hybrid seeds to produce higher yields, and the collaboration between Purdue and Syngenta targets a key step in this process: doubled-haploid breeding. Typically, chemical agents are employed to double the chromosomes of haploid seeds, a critical step for seed fertility that can stress plant cells. However, Purdue and Syngenta's approach disrupts chromosome movement electrically during cell division (mitosis) in a manner that mirrors the chemical method but without its negative side effects.

This collaboration, which began in 2016, was sparked when Syngenta reached out to Purdue's Professor Allen Garner, an expert in bioelectrics and membrane dynamics. Garner's team, in partnership with Syngenta's Principal Scientist Rachel Egger, adapted principles used in human brain tumor therapy to plant breeding, leading to the development of an electric field generator and custom equipment for plant cell experiments.

Despite challenges posed by the COVID-19 lockdowns, the teams optimized the system for use in tobacco and corn, achieving breakthroughs that could revolutionize hybrid seed production. Their novel method holds immense potential for widespread integration into crop breeding programs, offering a more sustainable and efficient way to meet the growing global demand for food.///

Learn more at https://bit.ly/PurdueSyngentaCollaboration

"A lot of what we do is theoretical or principles based. To be involved in something that could be commercialized, impacting agriculture so positively, was really exciting for us"

ALLEN GARNER

IAEA COLLABORATING CENTER AT PURDUE

THE INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA) NAMED PURDUE'S CENTER FOR SCIENCE OF INFORMATION (CSOI) ITS FIRST COLLABORATING CENTER ON USING ARTIFICIAL INTELLIGENCE FOR NUCLEAR POWER

"This Collaborating Center will help build confidence in AI applications for high-consequence systems, such as nuclear reactors," said Abdel-Khalik. "Without reliable quantification, the nuclear community's ability to realize the potential of AI will be diminished and this will negatively impact its ability to remain competitive in the energy market."

Hany Abdel-Khalik / Professor

The International Atomic Energy Agency (IAEA) has named Purdue's Center for Science of Information (CSOI) as its first IAEA Collaborating Center focused on using artificial intelligence for nuclear power. The four-year agreement begins immediately.

The genesis of the IAEA can be traced back to a 1953 address by President Dwight Eisenhower to the United Nations General Assembly. The agency oversees nearly 200 member states and manages research projects worldwide, supported by its collaborating centers, to help achieve the United Nations' nuclear development goals.

Hany Abdel-Khalik, a professor in the School of Nuclear Engineering, will oversee all IAEA Collaborating Center activities at Purdue, coordinating projects with other member states globally. Wojciech Szpankowski, the Saul Rosen Distinguished Professor of Computer Science in the College of Science, will serve as its director. The Collaborating Center at CSOI aims to advance new frontiers in nuclear technology through modeling and simulations, validating AI concepts for nuclear applications, and enhancing training and education.

Establishing the IAEA Collaborating Center at Purdue will elevate research visibility, positioning the university as a leader in AI advancements for the nuclear industry. It will facilitate international collaborations, enriching research with diverse perspectives on the value, applications, and opportunities for nuclear power worldwide.

Additionally, the center will help attract funding from government and industry, addressing key goals of nuclear technology in the 21st century, focusing on accelerating the deployment of advanced reactors and ensuring the optimal extension of the life of existing reactors. Students will benefit from hands-on experience, preparing them for careers in AI while fostering industry partnerships that offer internships and job opportunities.

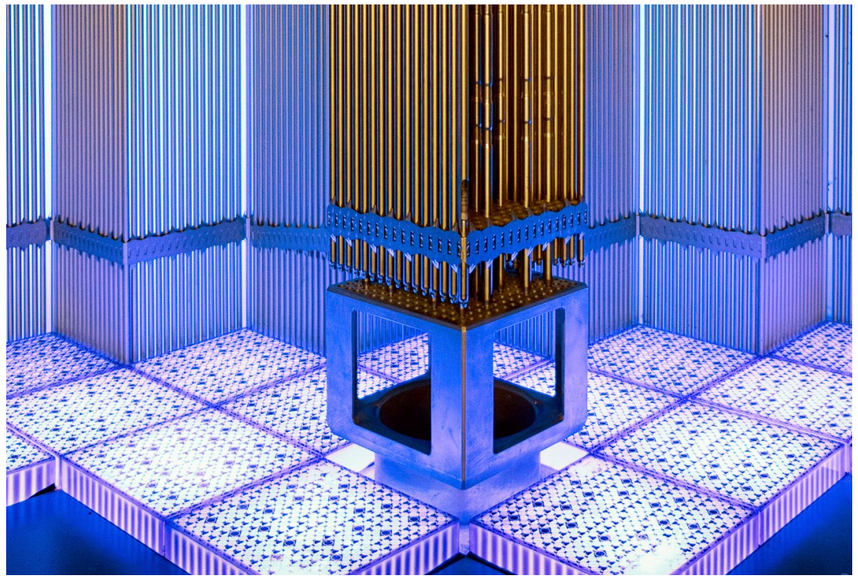
Overall, the center promises to enhance academic prominence, set trends in AI nuclear research, and contribute significantly to both theoretical advancements and real-world impact in the nuclear sector.///

Learn more at https://bit.ly/IAEAPurdueCollabCenter

DESIGNING SAFER, MORE ECONOMICAL NUCLEAR REACTORS

RESEARCHERS HAVE IDENTIFIED NEW NUCLEAR REACTOR CORE DESIGNS FOR AN EMERGING CLASS OF REACTORS

Hitesh Bindra and associated researchers at Purdue University have developed an improved nuclear reactor core design for Generation IV high-temperature gas-cooled reactors (HTGRs), significantly enhancing safety and operational efficiency. This new design optimizes core heat dissipation, allowing reactors to operate more safely during crises while maintaining efficiency under normal conditions. A major advancement is that this design can be constructed using additive manufacturing (3D printing), making it more economically viable compared to traditional methods.



Problem

Nuclear power generation is an environmentally friendly way to produce electricity without emitting carbon, thus helping to protect air quality. However, concerns about nuclear power's safety persist, with the public often perceiving it as risky or unstable. Additionally, the high costs associated with building nuclear plants—often amounting to billions of dollars—have hindered its widespread adoption.

Solution

Purdue researchers have developed a safer and more efficient nuclear reactor core design that leverages additive manufacturing. This innovative approach improves economic viability while addressing safety concerns. Their design has been validated through both experimental testing and numerical analysis, demonstrating its potential to enhance reactor safety and operational economics.///

The researchers have identified new nuclear reactor core designs for an emerging class of reactors, high-temperature gas-cooled reactors, which offer efficiency advantages and reduce water use.

- Jacob Brejcha
Licensing Associate

STYLIANOS CHATZIDAKIS IN MEDIUM BLOG

DIGITAL TWINS CAN STRENGTHEN CASE FOR NUCLEAR ENERGY

Public acceptance of nuclear energy is essential for its role in clean and sustainable energy production. Digital twins (DTs) enhance this acceptance by providing continuous updates on lifecycle and maintenance requirements, ultimately improving the performance, efficiency, and safety of nuclear power plants. These virtual representations of physical systems offer valuable insights through real-time data exchange, making them instrumental in optimizing reactor operations.

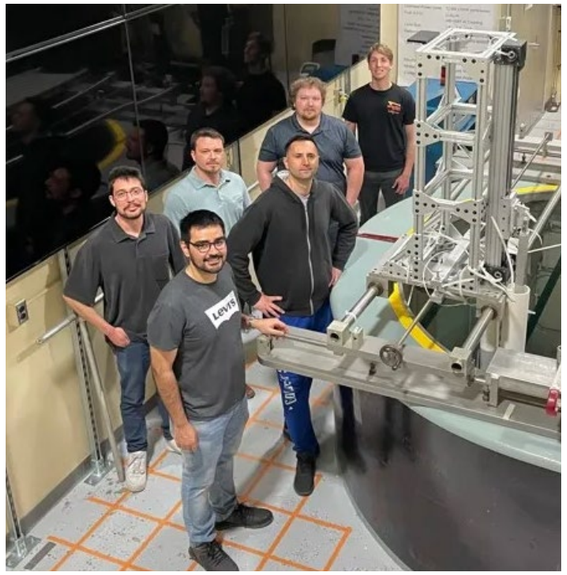
Problem

Despite the environmental benefits of nuclear energy, public skepticism regarding its safety and operational reliability poses significant challenges. Concerns about potential failures and the high costs associated with constructing and maintaining nuclear power plants have deterred both public and industry interest. Additionally, the lack of real-time data integration and communication between nuclear reactors and their digital counterparts limits the effectiveness of operational improvements.

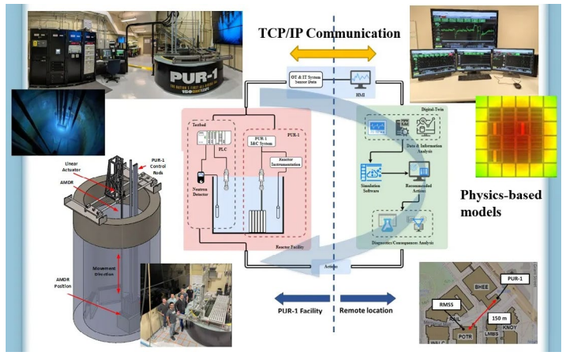
Solution

Stylianos Chatzidakis and the RADIaNS Lab Group at Purdue University are tackling these challenges by developing a new cyber-physical testbed at Purdue University Reactor Number One (PUR-1). This innovative setup allows for experimentation without disrupting actual reactor operations, leveraging digital twin technology to provide real-time data for predictive maintenance, operational optimization, and enhanced safety measures. By employing physics-based models and AI/ML algorithms, this approach not only improves reactor performance but also enhances cybersecurity, ultimately fostering greater public acceptance of nuclear energy and supporting the transition to clean energy.///

Read full Medium blog at https://bit.ly/ChatzidakisMediumBlog



PUR-1 with the cyber-physical testbed installed. (Purdue University photo/RADIaNS Lab



PUR-1 digital twin: main components and processes. (Purdue University image/ RADIaNS Lab)

Stylianos Chatzidakis
Assistant Professor, Associate PUR-1 Director

CONGRATULATIONS CLASS OF 2024

THE SCHOOL OF NUCLEAR ENGINEERING PARTICIPATED IN THE PURDUE UNIVERSITY GRADUATION CEREMONY HELD SATURDAY, MAY 11TH. 26 BSNES, 5 MSNES, 1 MNE, AND 3 PHDS WERE CONFERRED.

BACHELOR OF SCIENCE

Alexander Baker
Jennah Bari
Robert Beatty
Trent Bloor
Jackson Cowan
Jacob Davis
Zachary Fleming
Evan Frishholz
Joshua Furtek
Christopher Gaston
Andres Gomez
Adam Hermann
Susan Huster
Trevor Hylen
Tejas Kedlaya
Dylan Kohler
Allison Komrska
Jake Marr
Colin McGee
Joseph Powell
Andrew Romes
Donovan Simonton
Yash Singh
Dylan Sumski
Lucas Ugolini San Martin
Chloe Yoder

MASTER OF SCIENCE

Zachery Dahm
Kelly Herman
T-Ying Lin
Yusuke Ota
Broderick Sieh

DOCTOR OF PHILOSOPHY

N.R. Sree Harsha
Joeun Lee
Molly Ross

MASTER OF NUCLEAR ENGINEERING

Tetyana Martin

TETYANA MARTIN FIRST ONLINE MNE GRADUATE

MARTIN BECOMES PURDUE SCHOOL OF NUCLEAR ENGINEERING'S FIRST ONLINE MASTER OF NUCLEAR ENGINEERING GRADUATE

Tetyana Martin recently became the first graduate of Purdue University's online Master of Nuclear Engineering program. This milestone marks a significant step forward in her growing career within the nuclear industry.

Born in Ukraine, Martin grew up in a "reactor town" near a nuclear power plant where both of her parents worked. Her interest in nuclear technology began early, and she initially worked as a technical English teacher for engineers at the plant. After earning a master's degree in education in Ukraine, she moved to Atlanta, Georgia, with her husband, Tim, an American nuclear engineer, to pursue opportunities in the nuclear field.

Martin joined the Institute of Nuclear Power Operations and earned a senior reactor operator's certification. Later, she spent 18 months working at the Palo Verde Nuclear Generating Station in Arizona, where she developed a deep appreciation for the state. In 2018, she and her husband relocated to Phoenix, where she took on a project management role at Palo Verde. Although successful, Martin knew she needed to return to school to pursue further career advancement.

Martin had long desired to earn an engineering degree but faced financial and timing challenges throughout her life. In 2021, she finally enrolled in Purdue's online Master of Nuclear Engineering program, attracted by its rigor, flexibility, and focus on emerging technologies. The program enabled her to balance professional responsibilities with academic pursuits, all while working full-time.

While initially more interested in courses directly applicable to her work, Martin unexpectedly enjoyed learning about artificial intelligence (AI). Though skeptical at first, she took two AI courses and found them highly relevant to the future of nuclear engineering. "AI is here to stay," Martin said. "I really learned something new, and it's going to shape the industry."

The online program's flexibility and support—from professors to virtual office hours—were key in helping Martin manage her course load. She also built lasting connections with classmates from across the globe. "The nuclear world is small," Martin remarked. "You treasure those relationships."

Balancing work, school, and personal life was Martin's greatest challenge, but her ability to plan ahead and the support from her family played a critical role in her success.

At work, she recently joined a mentorship program to help her navigate the path to director-level positions within her company.

Martin appreciates her MNE degree and is excited to use her newfound expertise to drive innovation and contribute to the future of the nuclear industry. ///

Read More at https://bit.ly/PurdueMNEGrad

> "There is a fear of nuclear engineering," she explained. "But it's safe, reliable, and clean. Nuclear is the best technology we have, and it's here to stay."
>
> TETYANA MARTIN

ATOMS AT WORK SUMMER CAMP

THE SCHOOL OF NUCLEAR ENGINEERING HOSTED TWO COHORTS OF HIGH SCHOOL STUDENTS FOR THE 2024 ATOMS AT WORK SUMMER CAMP

During the Atoms at Work Summer Program, rising high school seniors undergo a crash course on all things nuclear. Each day of the one-week course is a combination of interactive lectures and hands on experiments at Purdue's Nuclear Engineering and Radiation Laboratory (NERL). Summer camp leaders demonstrate concepts ranging from radiation detection to reactor physics, where students are exposed to the topics and materials they will likely study in nuclear engineering in a fun and interactive manner. The experience culminates at the end of the week with a hands-on lab, where students get to use the PUR-1 reactor for their final experiment and tour of a commercial nuclear power plant.

In June 2024, Atoms at Work hosted two cohorts of students for one week. The camp was organized by Reactor Supervisor and Assistant (NERL) Director, True Miller together with Assistant Professor, Associate Reactor Director and Director of Nuclear Engineering Radiation Laboratory, Stylianos Chatzidakis; Electronics Technician, Brian Jowers; and Head of the School of Nuclear Engineering, Seungjin Kim. The camp was also supported by the Associate Administrative Assistant, Teresa Luse; Executive Assistant to the Head, Kellie Reece; and Associate Marketing and Communications Specialist, Jessica Johnson.

In collaboration with faculty guest lecturers, the summer camp was taught by Purdue nuclear engineering undergraduate and graduate leaders.

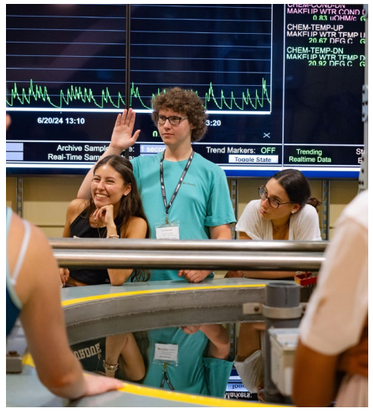
To mark the completion of the camp, students were presented with certificates that signified the fulfillment of the 2-credit fun-size course requirements. ///

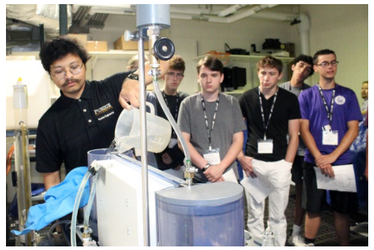
TOPICS

- Radiation
- Detectors & Shielding Neutron Activation, Sources, Gamma Spectroscopy Nuclear Fuel
- Laminar Flow
- Gamma Attenuation Fission & Fusion
- Reactor Physics
- Power Production
- Thermal Hydraulics
- SMR's and Advanced Reactors
- Nuclear Fuel Cycle

FACILITIES

- PUR-1 Nuclear Reactor
- Nuclear Energy Radiation Lab
- Thermal Hydraulics Research Facility Multiphase & Fuel Cell
- Research Laboratory Clinton Nuclear Power Plant (Illinois)





"I really enjoyed all of the labs; they were my favorite part."

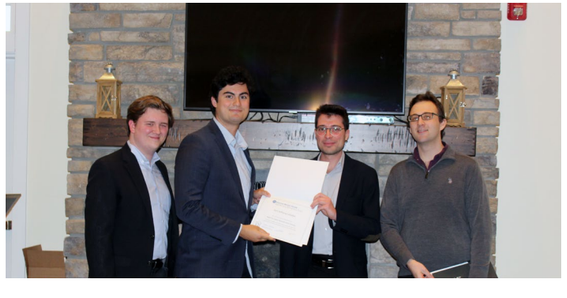
"Atoms at Work was very beneficial for my college career choices."

"This definitely helped push me to go into nuclear."

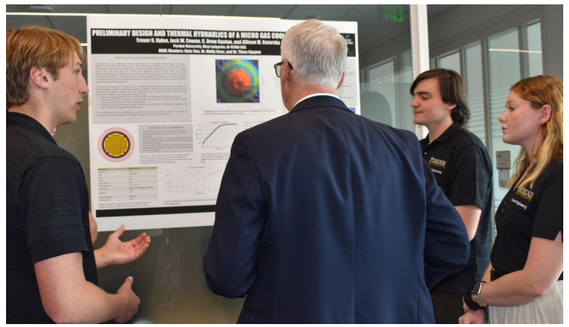
Atoms at Work Student Testimonials

SCHOOL OF NUCLEAR ENGINEERING

Fall 2024 Welcome Picnic

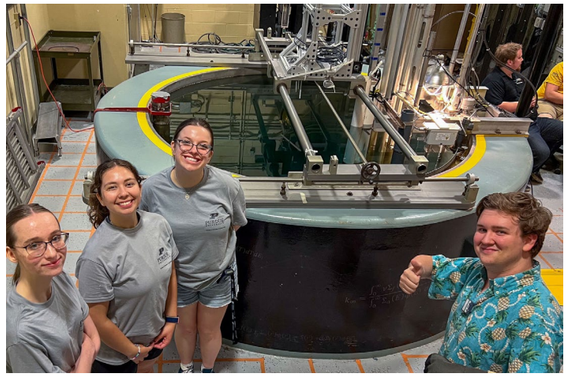


Spring 2023 Alpha Nu Sigma Induction



Spring 2023 Senior Design Project Poster Presentations

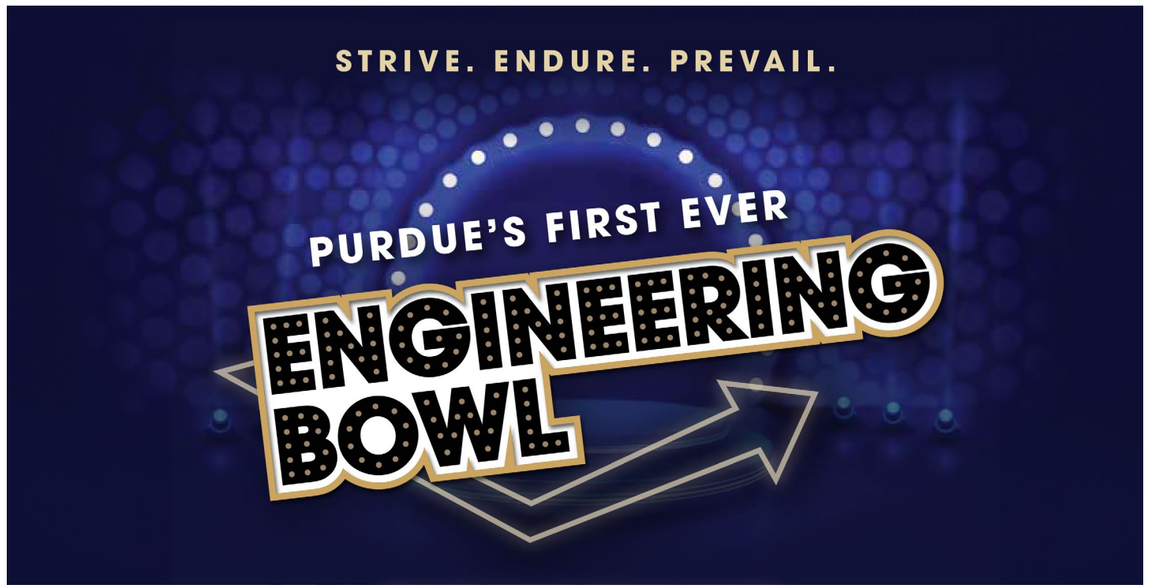
Spring 2023 Recognition Seminar



Summer 2024 Atoms at Work Student Leaders

PURDUE'S FIRST ENGINEERING BOWL

JONAH LAU, 2024 SCHOOL OF NUCLEAR ENGINEERING GRADUATE, ORGANIZED PURDUE'S FIRST ENGINEERING BOWL: A MULTIDISCIPLINARY ENGINEERING QUIZ GAME SHOW



On April 5th, during Engineering Week, Purdue University held its inaugural Engineering Bowl, a quiz game show-style event hosted by the Purdue Engineering Presidents' Council. This event aimed to unite the various engineering disciplines and showcase their brilliant students in a fun yet competitive environment.

Led by Chemical Engineering Professor Joseph Pekny, teams faced multidisciplinary questions derived from 100- and 200-level engineering courses. Students had the opportunity to demonstrate their engineering knowledge by quickly answering questions correctly before their rivals.

Five teams representing the Schools of Nuclear Engineering, Materials Engineering, Construction and Engineering Management, Mechanical Engineering, and Biomedical Engineering competed in the event. At the end of the game, Vishnu Srinivas and Caden Lee Jarausch from the School of Mechanical Engineering emerged victorious, becoming the first winners of Purdue's Engineering Bowl.///

"We thought it'd be a great idea to bring all schools respective to your discipline together and showcase discipline-based pride," said nuclear engineering student and event organizer Jonah Lau. We have geniuses all around Purdue, and they don't get showcased enough. I think this is the right platform for that."

Jonah Lau / 2024 BSNE Graduate

NE STUDENT HOSTED A GEN IV INTERNATIONAL FORUM WEBINAR

JONAH LAU HOSTED GEN IV INTERNATIONAL FORUM WEBINAR ON REVOLUTIONIZING NUCLEAR ENGINEERING EDUCATION

Jonah Lau, an undergraduate student at the School of Nuclear Engineering, hosted the GEN IV International Forum webinar titled, *Revolutionizing Nuclear Engineering Education: Developing Virtual Laboratories (Virtual Labs) for Neutron Detection, Geiger Counter, and Reactor Experiments*, on January 31, 2024.

During the webinar, Jonah outlined the mechanisms behind each Virtual Lab and explained how they worked together to bridge technological fluencies and generational gaps in nuclear engineering education.

"Our Virtual Labs were created to produce undergraduate nuclear radiation detection and reactor operations laboratories in a more immersive, standardized, and gradual manner," Jonah commented. "Virtual Labs will eventually be used to provide nuclear and radiological education to middle and high-school students, as well as lower-division undergraduate students who do not have access to high-class nuclear engineering facilities."

The ultimate goal was for Virtual Labs to be used as an open-source and publicly available educational tool worldwide, aiding in the mission of securing a clean energy future using nuclear power.

The Virtual Labs research project was developed by six undergraduate students—Robert Beatty, Zenen Enriquez, Shea Ruthe, Trent Bloor, Julian Triveri, and Jonah Lau—under the supervision of Professor Stylianos Chatzidakis.///

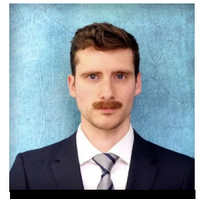
ANS PRESENTS THE ENERGY UNPACKED SUMMIT

PURDUE'S AMERICAN NUCLEAR SOCIETY HOSTED A NUCLEAR ENERGY SUMMIT

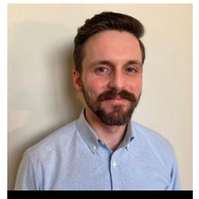
Energy Unpack was a day-long showcase of what the Purdue School of Nuclear Engineering offers potential stakeholders whose impact extends to the state of Indiana and on the global stage. This day-long event took place on February 27th and aimed to facilitate intellectual discourse between student organizations and experts. ///

SPEAKERS

Hitesh Bindra
Associate Professor of Nuclear Engineering



Mark Nelson
Founder and Managing Partner of Radiant Energy Group



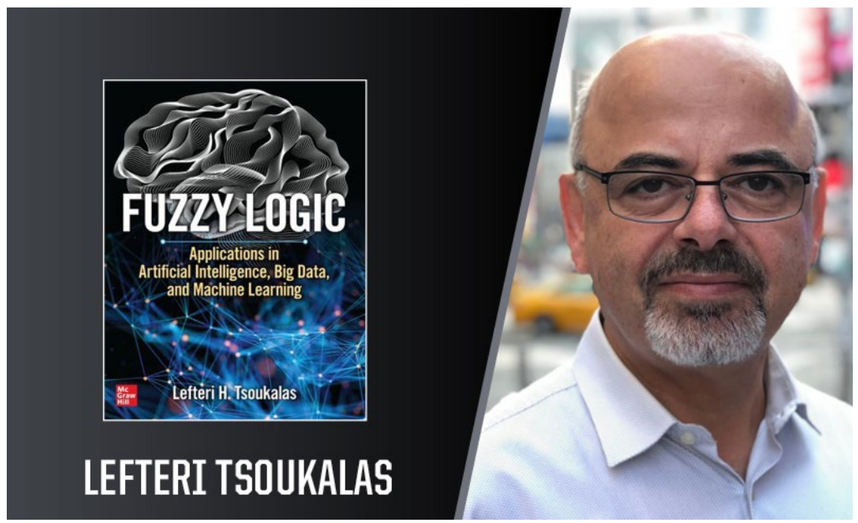
Randall Reames
Independent Commercial Nuclear Project Development Consultant

Lefteri Tsoukalas
Professor of Nuclear Engineering

Learn more at https://bit.ly/EnergyUnpackedSummit

LEFTERI TSOUKALAS PUBLISHES NEW BOOK

LEFTERI TSOUKALAS PUBLISHED FUZZY LOGIC: APPLICATIONS IN ARTIFICIAL INTELLIGENCE, BIG DATA, AND MACHINE LEARNING



About the Book

This hands-on guide offers clear explanations of fuzzy logic along with practical applications and real-world examples. Written by an award-winning engineer, "Fuzzy Logic: Applications in Artificial Intelligence, Big Data, and Machine Learning" is aimed at improving competence and motivation in students and professionals alike.///

Learn more about the book at https://bit.ly/FuzzyLogicBook

37TH AFRICAN UNION SUMMIT IN ADDIS ABABA, ETHIOPIA

AFRICA'S EMERGING NUCLEAR ENERGY SECTOR CAN HELP TO BUILD SUSTAINABLE ECONOMIC DEVELOPMENT

Seungjin Kim recently participated in a discussion on capacity building in nuclear energy-related skills, businesses, and policies at the 37th African Union Summit in Addis Ababa, Ethiopia. This event was jointly organized by the Nuclear Energy Agency (NEA), the OECD Development Centre, and the African Commission on Nuclear Energy (AFCONE). ///

Learn more about this event at https://bit.ly/NuclearRoundtable

PURDUE NE STARTUP WINS TOP TECH PRIZE

COVERT DEFENSES GARNERED THE TOP PRIZE OF $10,000 IN THE DIGITAL TECH CATEGORY AT THE 2024 INNOVATION SHOWCASE PITCH COMPETITION HOSTED BY THE VENTURE CLUB OF INDIANA

Arvind Sundaram

In July 2024, Purdue-based startup Covert Defenses won the top prize of $10,000 in the digital tech category at the 2024 Innovation Showcase pitch competition, hosted by the Venture Club of Indiana. Co-founder Arvind Sundaram, a Purdue alum (BSNE '19, PhD NE '22), presented the patented self-healing Covert Cognizance platform to an audience of investors and aspiring entrepreneurs in Indiana's thriving startup ecosystem.

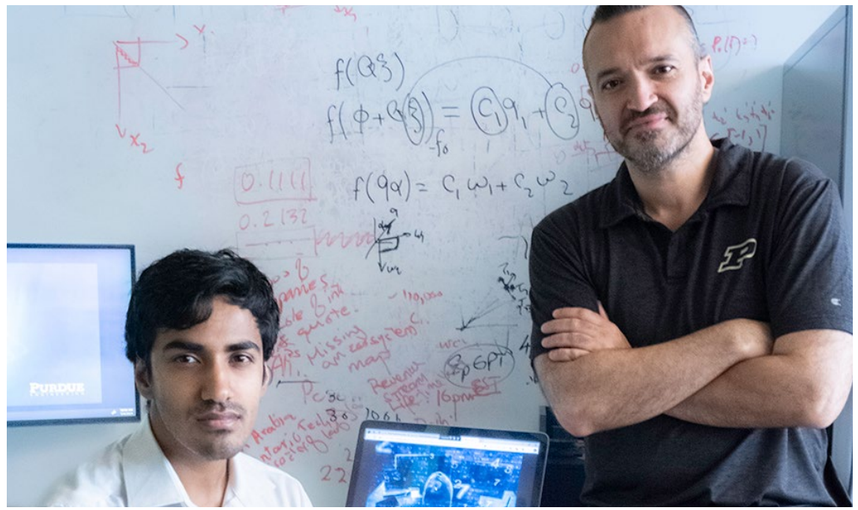
Covert Cognizance is designed to ensure zero-downtime operation of control systems, even if they are compromised, thanks to its unique self-healing capability. Sundaram noted that a core challenge in combating ransomware and data spoofing attacks today is that it often costs far more to take systems offline than to simply pay the ransom—a "lose-lose" situation.

Covert Cognizance represents a paradigm shift in cybersecurity, distinguished by its deterministic approach to intrusion detection and its proactive recovery methods.

"We work in an environment where we cannot afford false positives. We need to be sure of a cyber attack and recover stealthily without alerting our adversaries despite the compromise."

Arvind Sundaram / Co-founder & Purdue Alumnus

The platform serves as a "last line of defense" for both commercial and military applications, protecting manufacturing plants and oil and gas pipelines from ransomware attacks, and enabling drone swarm operations in cyber-contested environments. The Covert Defenses team also envisions offensive applications, including deception, covert communication, and reconnaissance.



Arvind Sundaram and Hany Abdel-Khalik

Covert Defenses has strong ties to Purdue University and was founded by Hany Abdel-Khalik, professor of nuclear engineering. The technology was disclosed and patented through the Purdue Innovates Office of Technology Commercialization (USP 10,942,500). The team believes that participating in the pitch competition will raise awareness of the platform's capabilities among industrial control system vendors and defense stakeholders, with the goal of identifying pilot partners and transitioning the technology into these industry verticals.///

BILL JEFFERSON RETURNS TO CAMPUS TO INSPIRE STUDENTS

JEFFERSON, AMONG THE FIRST AFRICAN-AMERICAN GRADUATES OF THE SCHOOL OF NUCLEAR ENGINEERING, RETURNS TO CAMPUS TO ENGAGE WITH STUDENTS

William (Bill) Jefferson (BSNE 1985) among the first African-American graduates at the School of Nuclear Engineering, recently returned to campus to inspire and give back to the engineering community. Born in Paducah, Kentucky, and raised in Liberty, Indiana, Bill's passion for nuclear science began in high school after reading about particle accelerators.

Once enrolled at Purdue, Jefferson excelled with the support of faculty and peers, securing internships and earning respect for his dedication. He graduated in 1985 with 13 job offers, and joined Peach Bottom Atomic Power Station. Later Jefferson held leadership roles at companies such as Exelon, Duke Energy, and STP Nuclear Operating Company.

Currently, Jefferson is the executive vice president of operations and chief safety officer at NiSource, a natural gas and electric utility company involved in power generation from coal, gas, solar, and wind. In this role, he oversees emergency response, engineering, environmental health and safety, field operations, major projects, and more.

On Jan. 11, Bill returned to Purdue to share his story with the Minority Engineering Program (MEP) and contribute to NiSource's efforts in engaging and recruiting talented engineers from Purdue. His visit aligned with MEP's mission to foster corporate diversity and NiSource's commitment to recruiting talented engineers. Together, MEP and a team from NiSource held a recruiting event with over many students in attendance.

Reflecting on the growth of diversity in engineering, Jefferson described it as "very satisfying and exciting." He encouraged students to stay open to new opportunities, learn from experienced colleagues, and remain flexible in their careers.///

Read full story at https://bit.ly/PurdueNEJefferson

Bill Jefferson, executive vice president of operations and chief safety officer at NiSource, and Seungjin Kim, Capt. James F. McCarthy, Jr. and Cheryl E. McCarthy Head of the School of Nuclear Engineering at PUR-1.

"Purdue prepares you for anything you want to do." Jefferson said, emphasizing how the university enabled him to seamlessly transition into various roles and make a significant difference at many companies that impact the world.

BILL JEFFERSON

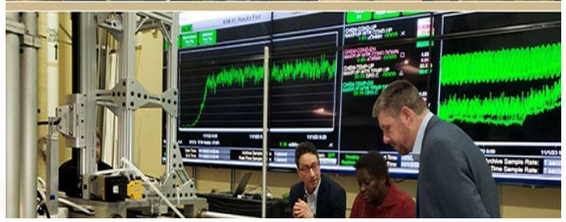
SCHOOL OF NUCLEAR ENGINEERING VISITS

DOE UNDERSECRETARY RICHMOND VISITS PURDUE NUCLEAR ENGINEERING

Geri Richmond, the Undersecretary for Science and Innovation at the U.S. Department of Energy, visited Purdue University to observe demonstrations of various projects aimed at shaping the future of energy consumption. During her tour, she visited Purdue University Reactor Number One and the Maha Fluid Power Research Center, where she witnessed a demonstration of a new DOE-funded electro-hydraulic actuation system. This innovative system is a compact, energy-efficient fluid power solution currently being used to power a compact loader. Richmond also held discussions with President Mung Chiang, Executive Vice President for Research Karen Plaut, and other campus leaders.///

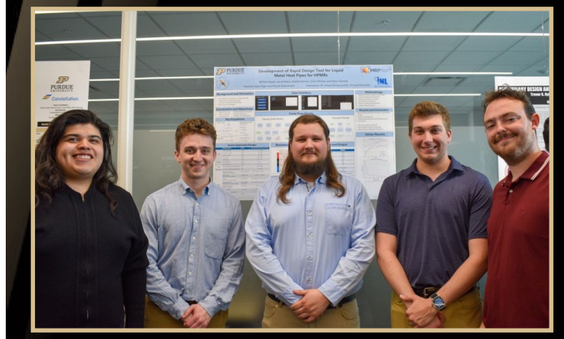
U.S. NRC VISITS PUR-1 AND ITS DIGITAL-TWIN

The U.S. Nuclear Regulatory Commission (NRC) made a visit to Purdue University to meet with Professor Stylianos Chatzidakis and his research team. In their Instagram caption, the U.S. NRC shared, "We recently visited Purdue University to meet with Nuclear Engineering Professor Stylianos Chatzidakis and several graduate students, to discuss the school's all-digital research reactor – the first in the nation – and a related research project. Purdue students used artificial intelligence and machine learning tools to keep an eye on the reactor's status and search for any unusual activity, including identifying cybersecurity intrusions or abnormal reactor conditions."///



SCHOOL OF NUCLEAR ENGINEERING AWARDS & RECOGNITIONS

CONGRATULATIONS TO THE MANY STUDENTS ACKNOWLEDGED DURING THE 2023-2024 SCHOOL OF NUCLEAR ENGINEERING RECOGNITION SEMINAR!



Academic Achievement Award
Best Design Poster
Team INL-HPMR: William Appel, Jacob Davis, Andres Gomez, Colin McGee, Dylan Sumski

Outstanding Senior Award
Christopher Gaston

Outstanding Leadership Award
Cole Baker, Noraa Silver, Madeline Burton, Preston Kilzer, Jonah Lau, Jennah Bari, Jake Marr, Adam Dix

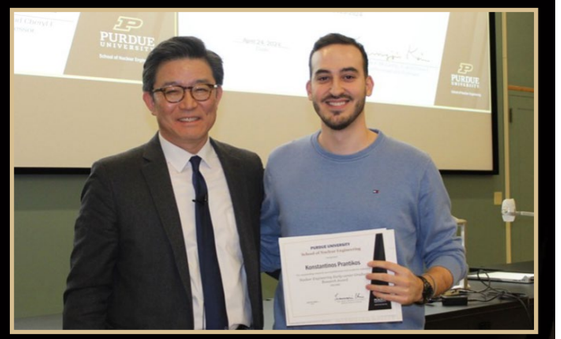
First Female NRC Licensed Reactor Operator
Chloe Yoder

Advocacy and Outreach for PUR-1 Award
Trevor Hylen

Undergraduate Research Scholarships
Allison Komrska
Peter Suarez

Graduate Research Recognition Seminar Award
Sree Harsha Naropanth Ramamurthy

Graduate Research Award
Molly Ross



Early-Career Graduate Research Award
Konstantinos Prantikos

2024-2025 Ambassadors
Front Row: Preston Kilzer, Stella Betts, Jessica Williams
Back Row: Ethan Gersos, Niels Eysturlid, Peter Bradshaw

Alpha Nu Sigma Honor Society New Members
Undergraduate Students: Alicja Stoppel, Sam LoGalbo, John Jackson, Qi Heng Law, Shea Ruthe, Madeline Burton, Preston Kilzer, Christopher Gaston II, Evan Frishholz, Andres Gomez

Graduate Students: Shashank Shekhar, Konstantinos Vasili, Broderick M. Sieh, John Matulis, John Snitzer, Seda Yilmaz

PURDUE RECOGNITIONS

Magoon Excellence in Teaching Award
Hanna Pike

Outstanding Graduate Research
Molly Ross

Graduate School Summer Research Grant
Paul Stockett

EXTERNAL AWARDS

NRC Licensed Student Reactor Operators
Andrew Romes
Alex Baker
Adam Herman
Chloe Yoder
Trevor Hylen

DOE UNLP 2024 Scholarship
Stella Betts

Rickover Fellowship
John Matulis

ANS Lawrence E. Hochreiter Graduate Scholarship
Broderick Sieh

ANS Alan F. Henry/Paul A. Greebler Graduate Scholarship
Muhammad Oktavian

ANS Incoming Freshman Scholarship
Sydney Madezke

ANS Robert E. Uhrig Graduate Scholarship
Konstantinos Prantikos

ANS Graduate Scholarship
Konstantinos Vasili

OECD/NEA Global Rising Star Award
Molly Ross

Roy G. Post Foundation Scholarship
Konstantinos Gkouliaras

Gerondelis Foundation, Inc.
Konstantinos Vasili

IEEE Travel Grant and APS Travel Grant
Reshma Ughade

Greek Atomic Energy Agency Scholarship
Konstantinos Gkouliaras

FACULTY & STAFF RECOGNITIONS

Arden L. Bement, Jr. Early Faculty Development Award

Stylianos Chatzidakis

ANS Technical Achievement Award Thermal Hydraulics Division

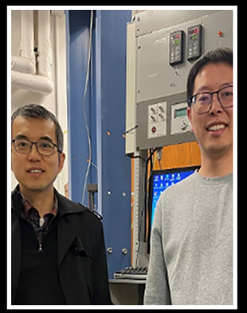
Chair of the Council of Advisors of the NEA Global Forum on Nuclear Education, Science, Technology and Policy

Seungjin Kim

Best Undergraduate Teacher Award

Outstanding Faculty Research Award

Allen Garner



Best Paper Award of 2023
Journal of Nuclear Materials

Xiaoyuan Lou
Jingfan Yang

Best Graduate Teacher Award

Lefteri Tsoukalas

Best Staff Award

Teresa Luse

ALUMNI RECOGNITION

PURDUE ENGINEERING 38 BY 38 AWARD TO RECOGNIZE 38 YOUNG ALUMNI WHO HAVE ROCKETED THROUGH THE RANKS AND LEFT THEIR MARK BY THE TIME THEY ARE 38 YEARS OLD.

Kiernan McCullough has a propensity for solving complex problems using simple solutions, a skillset he polished during his studies at Purdue and one that he still applies to his current work in radiation oncology. He is the chief of therapeutic medical physics at Colorado Associates in Medical Physics (CAMP), where he began his career in 2014 as an assistant physicist. On his way up the company ladder, where he is now part-owner, he has spearheaded hospital accreditations, created revolutionary radiation treatment techniques, and standardized radiation therapy across multiple facilities.

His position is unique, in that CAMP is not tied to a single hospital, enabling him to have a meaningful impact across the Rocky Mountain Region. He has practiced at some of the busiest hospitals in the area and provided care to remote destinations that otherwise would be at risk of providing sub-standard care. He has designed, tested and created products, including a novel device for small skin lesions that delivers optimal radiation treatments and can easily be employed in most facilities across the country. Since joining the practice, his leadership has grown CAMP from just two facilities in Colorado to 10 across Colorado, Wyoming, and New Mexico — including one veterinary oncology clinic.

Kiernan's influence is also evidenced in his service to the American Association of Physicists in Medicine, co-authoring the Medical Physics Practice Guideline for linear accelerator performance tests, serving as president of the Rocky Mountain Chapter, winning the Radiation Measurement of the Year Award, and most recently, sitting on the board of directors.

PURDUE FOR LIFE

THE PURDUE FOR LIFE FOUNDATION HELPS YOU AND EVERYONE WHO LOVES PURDUE STAY CONNECTED, GET INVOLVED, AND GIVE BACK

The School of Nuclear Engineering aims to increase our pace of transformational innovation by increasing our number of faculty, undergraduate and graduate students, and facility enhancements. Your support in three key areas – undergraduate student scholarships, graduate fellowships, and professorships – is critical in positioning Purdue at the forefront of advances in nuclear engineering.

Our goals are bold, but the possibilities are limitless.

https://purdue.university/4egZRlb

150TH ANNIVERSARY

COLLEGE OF ENGINEERING

Show off your Purdue Engineering pride with this beautiful commemorative lapel pin! Receive your pin with a gift of $50 or more to the College of Engineering 150th Fund, which will help us empower Boilermakers to influence the field of engineering on a global stage for another 150 years.

https://purdue.university/3XmqZsr

STAY CONNECTED

INTERNATIONAL ALUMNI CONTACT UPDATE FORM

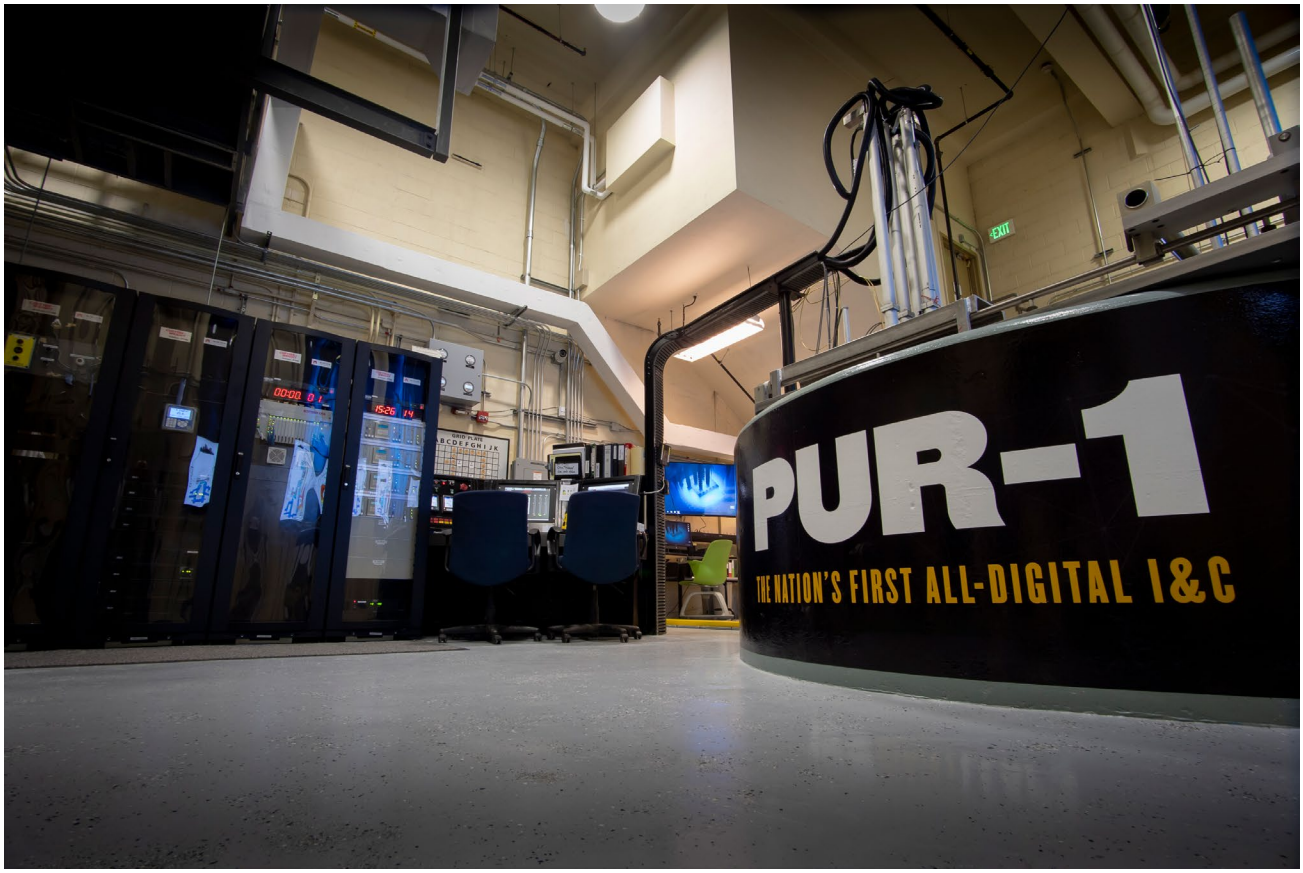
Purdue has International Networks which operate in nearly 100 cities outside the US. International Networks are led by International Alumni Ambassadors, volunteers who represent Purdue and plan activities for alumni and friends in their area. We support many alumni events that are hosted by traveling faculty/staff leading study abroad programs, research/institutional visits, or other travel on behalf of Purdue.

https://www.purdueforlife.org/international-networks/international-alumni-information-update/

PURDUE UNIVERSITY

School of Nuclear Engineering

150 YEARS OF PURDUE ENGINEERING



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