2026 NIST-University Research Summit

July 1, 2026

Speaker Schedule & Presentation Details

Schedule of speakers and presentation information for each session.
15 min. talk, 5 min Q&A.

Day: July 01, 2026 (University Staff Presentations During Sessions)	
10:30 AM - 12:00 PM	**Session 1** Biotechnologies Building 101, Portrait Room
Jin Ryoun Kim, Ph.D. New York University Tandon School of Engineering, Department of Chemical and Biomedical Engineering	**Title: Machine Learning Frameworks for Predicting Enzyme Functional Landscapes Across Sequence, Temperature, and Molecular Interaction Spaces** Enzyme activity emerges from complex functional landscapes shaped by protein sequence, temperature, enzyme - substrate interactions, and enzyme - product interactions. Quantitatively modeling these multidimensional relationships remains a major challenge in enzyme engineering and discovery. Here, we developed machine learning (ML) frameworks to predict β-glucosidase (BGL) activity across multiple biochemical dimensions using amino acid sequence and assay-condition information. First, we developed a three-module ML framework that predicts temperature-dependent kcat/Km values from protein sequence and temperature. Each module captures distinct aspects of the sequence-temperature-activity relationship, and together they map the functional landscape associated with BGL catalytic efficiency. The modular architecture reduced overfitting and prediction variability while achieving strong generalization to unseen sequences. regression approaches to capture both distinct glucose-response classes and full activity–glucose concentration profiles, including monotonic and non-monotonic behaviors. Across validation studies, EPIC substantially outperformed sequence-identity-based baselines and generalized to unseen and ancestral enzyme sequences.Together, these studies establish scalable ML frameworks for quantitatively predicting enzyme functional landscapes across sequence, temperature, and molecular interaction spaces.

<u>Jacqueline Smith, PhD</u> Associate Professor of Chemistry College of Arts & Science Howard University	**Title: Development of a Fluorescence Based Assay to Evaluate Transport through LAT1** The Large Neutral Amino Acid Transporter (LAT1) facilitates the transport of large branched and aromatic amino acids and nutrients into cells. LAT1 is ubiquitously expressed throughout the body, with abundant expression in immune cells and at the blood-brain barrier. Due to the high metabolic needs of cancer cells for nutrients as they rapidly proliferate, LAT1 is upregulated in several cancer cells. Silencing or inhibiting LAT1 is lethal to cancer cells, ighlighting its promise as a drug target. Despite its significance as a target for cancer therapy, there are relatively few LAT1 inhibitors being investigated clinically. This is likely due to a lack of accessible tools to measure LAT1 transport. Traditional assays rely heavily on radiolabeled substrates, which restrict experimental throughput and accessibility. We report a cell-based fluorescent assay to measure LAT1 uptake using a tryptophan analog, 6-azatryptophan. This assay measured the transport of 6-azatryptophan in several cancer cell lines, which was dependent on the levels of LAT1 expression. We show that 6-azatryptophan transport was mediated through LAT1 by using LAT1-specific chemical and genetic inhibitors. Future work involves using this assay to identify potential inhibitors of LAT1 as therapeutic agents.
<u>Briana L. Simms, Ph.D.</u> Assistant Professor, Department of Chemistry University of Cincinnati	**Title: PAMAM-Acyl structurally tunable synthetic lipid nanoparticles for applications in therapeutic delivery** Lipid nanoparticles (LNPs) have emerged as a promising vehicle for therapeutic delivery finding significant use during the COVID-19 pandemic. While effective drug delivery vehicles, current lipid nanoparticles are formulated from a heterogenous mixture of naturally occurring lipids that play a critical role in determining the stability, circulation time, and cellular uptake of the nanoparticles in vivo. Identifying lipid compositions and formulations that result in LNPs with the desired properties often requires high-throughput experimentation and complicated formulation methods. Yet, even the more precise LNP formulations form micropopulations of nanoparticle with differing properties within the same formulation. This is caused by differences in phase separating properties of the lipid components within the LNP formulation. Nanoparticle characterization techniques (I.e. light scattering) average these differences into distributions that are not easily resolved; however, the human body is much more sensitive to the formation of these micro populations. Our work focuses on the development of single-component LNP formulations comprised of highly modular synthetic lipids. These amphiphilic hybrid macromolecules are synthesized by coupling a poly (amidoamine) (PAMAM) dendron to hydrocarbon acyl tail(s). These synthetic lipids aggregate in aqueous media to form single-component LNPs with tunable nanoparticle properties such as size, morphology, and internal organization structure. We evaluated these characteristics using light scattering, electron microscopy, and thermal analyses techniques to begin identifying trends in nanoparticle properties as a function of synthetic lipid structure. In this work, we explicitly focus on differences in PAMAM dendron generation, acyl tail length (number of carbons), and acyl tail saturation. We aim to develop design principles for this class of synthetic lipids to standardized LNP formulations.

Andy S. McCallion, Ph.D. Professo,r Co-Director, PhD Training Program in Human Genetics and Genomics, McKusick-Nathans Department of Genetic Medicine, Johns Hopkins University School of Medicine	**Title: Training future leaders in biomedical research today.** I started by PhD 30 years ago, so I am officially OLD. However, my excitement for the contributions that are being and will be made by the emerging generation of scientists remains high. My lab has been built by young, curious and enthusiastic scientists who progressively wanted to do more that I thought possible. My responsibility is to guide, course-correct, encourage, provide resources, and occasionally to dredge up anecdotes about how we did things before the genome was complete, in order to set some context. In 2026, we are privileged to work at the breaking dawn of a new era of science. The technological sun is rising and shedding progressively more light on the complexity of genome biology. I will share a little of where my research employs that rising sunlight and how trainees in Human Genetics and Genomics will be equipped to contribute across the horizon of emerging opportunity.
10:30 AM - 12:00 PM	Communication and Networking Technologies Building 101, Heritage Room
Minhee Jun, Ph.D. Assistant Professor, Electrical and Computer Engineering Computer Science (Affiliated) The Catholic University of America Director, GREENS Laboratory Vice Director, CAIR (Center for Artificial Intelligence Research)	**Title: Toward Physical AI: A Privacy-Aware Task Capture, Digital Twin, and Evaluation Platform** Physical AI systems require large-scale task demonstrations and realistic environments for efficient training, evaluation, and deployment. However, collecting representative task data and developing scalable training environments remain significant challenges. This presentation introduces a research vision for a privacy-aware platform that leverages smart-glasses recordings and existing video repositories to capture human task demonstrations and construct digital twins for Physical AI development. The proposed framework incorporates privacy-preserving processing and information masking techniques to protect sensitive information while maintaining the utility of collected data for AI training and evaluation. By transforming human task demonstrations into simulation-ready digital twins, the platform enables task-oriented Physical AI training without relying solely on costly real-world experimentation. In addition, the framework supports Test, Evaluation, Verification, and Validation (TEVV) through reproducible datasets, benchmark generation, and performance assessment methodologies. Potential collaboration opportunities with NIST in digital twin technologies, evaluation science, benchmarking, and standards development for trustworthy Physical AI systems will also be discussed.

<u>Hao Xu, Ph.D.</u> Ralph E. Hoeper Associate Professor Director of Autonomous & Intelligent Mobile Systems (AIMs) Lab Department of Electrical & Biomedical Engineering University of Nevada, Reno	**Title:** **<u>Intelligent RIS-Enhanced Industrial Wireless Networks for Advanced Manufacturing Using AI-Driven Optimization and Learning.</u>** Next-generation smart manufacturing systems require highly reliable, low-latency, and scalable wireless communication to support large numbers of distributed sensors, robots, and autonomous machines. This presentation introduces a novel Reconfigurable Intelligent Surface (RIS)-enhanced industrial wireless networking framework that integrates cross-layer optimization, reinforcement learning, federated learning, and hardware-aware wireless system design. The developed approach leverages RIS technology to dynamically manipulate wireless propagation environments, improving spectrum efficiency, communication reliability, and network security for both stationary and mobile users in advanced manufacturing environments. In addition, hybrid reinforcement learning and federated spectrum learning techniques are developed to enable real-time, distributed, and computation-efficient optimization under uncertain and dynamic conditions. Experimental RIS hardware development and wireless testbed validation are also discussed, highlighting the potential of intelligent RIS-assisted wireless systems for future Industry 4.0 and beyond.
<u>Aditya Varna Muppala, Ph.D.</u> Assistant Professor, University of California Berkeley	**Title:** **<u>Next-Generation Spherical Near-Field Measurement Systems for Rapid Phased Array Calibration</u>** Accurate measurement of antenna gain and radiation pattern is central to electromagnetic metrology, and spherical near-field (SNF) measurements remain the most accurate technique available. With the rise of large microwave and mm-wave phased arrays for 6G communications, automotive radar, and wireless power transfer, there is a growing need for SNF systems that can rapidly calibrate these arrays over the air. Existing solutions face a fundamental cost-speed trade-off. Traditional gantry based SNF systems are low cost, but too slow. State of the art multi-port array systems are fast but expensive, band-limited, and suffer from mutual coupling and AUT loading. In this talk, I will present a new SNF measurement system based on the concept of affine.virtual.arrays. The proposed system uses a single dual-polarized probe, a rotating ellipsoidal sub-reflector, and two fixed elliptic toroidal main reflectors to translate the phase center of the probe to any point on a measurement sphere surrounding the antenna under test. Rotating the sub-reflector synthesizes a virtual probe array over elevation, while rotating the AUT covers azimuth. The result is a non-invasive, low-cost, broadband, reconfigurable SNF system with no mutual coupling, low AUT loading, and sub-reflector rotation speeds up to 600 rpm — delivering the speed of multi-port systems at the cost of single-port systems. I will present the design of the proposed affine virtual array based SNF system followed by new ideas to extend this system into next generation rapid Compact Antenna Test Ranges (CATR).

Mallesham Dasari, Ph.D. Assistant Professor, Electrical and Computer Engineering, Northeastern University	**Title: Open4D: A Foundational 4D Geometry Data Platform for Spatial Computing Systems** Spatial computing systems such as XR, Robotics, and AI increasingly rely on real-time understanding and interaction with dynamic 3D environments. However, today's computing and networking stacks remain built for 2D images and video, creating a fundamental gap in how time-evolving geometry, i.e., 4D data, is represented, compressed, and transmitted. This talk introduces Open4D, an open ecosystem for real-time 4D dynamic geometry. Open4D rethinks 4D data as a first-class systems primitive, enabling unified handling of meshes, point clouds, and other spatial representations across the pipeline. I will present key algorithmic and systems advances, including time-varying geometry compression, object-aware streaming, and cross-layer adaptation strategies that optimize latency, bandwidth, and spatial fidelity. I will highlight new challenges and trade-offs in delivering 4D data over commodity networks, and discuss emerging metrics that go beyond bitrate to capture spatial quality and user experience.
12:00 PM-1:00 PM	Lunch- Boxed lunch, Dining Room A
1:00 PM-2:30 PM	Session 2 Quantum Technologies Building 101, Portrait Room
Brian Sawyer, Ph.D. Chief Engineer, Quantum Systems Division CIPHER Lab|Georgia Tech Research Institute	**Title: Quantum Information and Sensing at Georgia Tech Research Institute** Over the last fifteen years, the Quantum Systems Division within the Georgia Tech Research Institute (GTRI) has focused on development of quantum technologies for information processing, timing, and sensing. Recent research efforts include demonstration of compact Penning ion traps for quantum simulation, computation, and precision measurement using Ca^+ and Be^+ as well as radiofrequency electrometers based on vapor cells of neutral Rb atoms. We will highlight recent technical results and future directions.
Chong Zu, Ph.D. Assistant Professor Department of Physics, Washington University in St. Louis	**Title: Quantum Sensing at Washington University** Washington University in St. Louis is developing a university-wide quantum ecosystem through the Center for Quantum Leaps, with a strong emphasis on quantum sensing, measurement science, and interdisciplinary applications. In this presentation, we will highlight WashU's efforts to build quantum sensing capabilities that can serve broad communities in materials science, biology, medicine, geoscience, and engineering. We will discuss our recent work using solid-state quantum sensors, including diamond and two-dimensional material platforms, for live-cell imaging, mineral characterization, and studies of superconducting materials. We will also describe how AI-enabled data analysis and instrument control workflow can make quantum sensing platforms more robust, automated, and accessible to non-specialist users. Finally, we will highlight WashU's NSF NRT LinQ graduate training program in quantum sensing, which trains students across quantum science, engineering, and application domains and helps build the workforce needed for future quantum-enabled measurement infrastructure.

Mingzhong Wu, Ph.D. Professor in the Department of Physics and the Department of Electrical and Computer Engineering, Northeastern University, Boston	**Title: Quantum Oscillations of Nonlinear Electrical Transport in a Topological Dirac Semimetal** Quantum oscillations in electrical transport have long served as a powerful probe of fundamental Fermi surface physics. To date, however, such studies have been restricted to linear electrical transport. This talk presents the experimental observation of quantum oscillations in nonlinear electrical transport and, more importantly, demonstrates their ability to uncover key features of the Fermi surface that lie beyond the reach of linear-transport quantum-oscillation techniques [1]. Using α-Sn, a topological Dirac semimetal known to support both linear and nonlinear transport, this study shows that quantum oscillations of nonlinear resistance are highly sensitive to both the geometry and spin texture of the Fermi contour—features to which linear counterparts are insensitive. Further, nonlinear-transport oscillations exhibit markedly distinct dependencies on magnetic field and temperature compared to their linear analogs. These findings establish nonlinear-transport quantum oscillations as a transformative tool for exploring Fermi surface physics, opening new avenues for revealing hidden Fermi surface properties in known materials and discovering new exotic electronic states and phases. Reference: [1] Physical Review Letters 136, 096603 (2026).
Yichao Zhang, Ph.D. Assistant Professor, Materials Science and Engineering Maryland Energy Innovation Institute	**Title: Unveiling Hidden Structural Dynamics in 2D Quantum Materials** Controlling the performance of emerging semiconducting and quantum materials requires a deep understanding of how atoms move, reorganize, and respond to external stimuli. In 2D systems, these structural dynamics are shaped by defects, phonons, and moiré interactions and play a central role in determining electronic transport, coherence, and long term stability. In this talk, I will highlight recent findings that reveal how these hidden structural degrees of freedom influence the functional limits of 2D materials. We uncover how defect mediated reorganization affects uniformity in twisted bilayers, how soft vibrational modes in moiré systems shape thermal behavior, and how strain driven responses govern energy flow in heat transport. Together, these insights point to new opportunities to engineer 2D materials through their dynamic behavior, enabling more reliable, tunable, and high performance platforms for next generation semiconductor and quantum technologies.
1:00 PM-2:30 PM	Robotics Building 101, Heritage Room

<u>Nilanjan Chakraborty, Ph.D.</u> Associate Professor, Department of Mechanical Engineering Stony Brook University	**Title:** **<u>Experimental Characterization of Fingertip Trajectory Following for a 3-DoF Series-Parallel Hybrid Robotic Finger</u>** Task-space control of robotic fingers is a critical enabler of dexterous manipulation, as manipulation objectives are most naturally specified in terms of fingertip motions and applied forces rather than individual joint angles. While task-space planning and control have been extensively studied for larger, arm-scale manipulators, demonstrations of precise task-space trajectory tracking in compact, multi-DoF robotic fingers remain scarce. In this paper, we present the physical prototyping and experimental characterization of a three-degree-of-freedom, linkage-driven, series–parallel robotic finger with analytic forward kinematics and a closed-form Jacobian. A resolved motion rate control (RMRC) scheme is implemented to achieve closed-loop task-space trajectory tracking. We experimentally evaluate the fingertip tracking performance across a variety of trajectories, including straight lines, circles, and more complex curves. Across all paths we report millimeter level deviations, with sub-millimeter level repeatability. To the best of our knowledge, this work provides one of the first systematic experimental demonstrations of precise task-space trajectory tracking in robotic fingers, thereby establishing a benchmark for future designs aimed at dexterous in-hand manipulation.
<u>Tan Le, Ph.D.</u> Assistant Professor, Electrical and Computer Engineering Hampton University	**Title:** **<u>Quantum-Enhanced Encoding and Trustworthy Digital Twins for Secure Autonomous Robotics</u>** This presentation introduces a unified research framework for building trustworthy, secure, and adaptive autonomous robotic systems through quantum-enhanced encoding, digital-twin modeling, and resilient AI. A central contribution is a quantum-inspired encoder that expands classical sensor inputs into expressive multi-qubit feature spaces, improving robustness to noise, corruption, and adversarial perturbations in navigation and perception tasks. The framework integrates quantum-enhanced sensing with digital-twin-based state estimation, predictive forecasting, and anomaly detection. Additional components include privacy-preserving attack detection for multi-robot networks, TinyML-based cybersecurity for embedded platforms, semantic signal recognition for NextG/ORAN spectrum-aware autonomy, RF-based environmental health prediction, and physics-guided ML for pKA-induced material behavior. Together, these results form a cross-domain architecture that advances reliable, interpretable, and secure autonomy, aligning with NIST priorities in robotics measurement science, AI assurance, and cyber-physical resilience.

Raymond Sheh, Ph.D. Associate Research Scientist, Whiting School of Engineering Johns Hopkins University	**Title: Systemic Governance and Risk Management for Intelligent Robotics in Critical Infrastructure** Deploying intelligent robotics in critical applications requires the integration of cutting-edge engineering with informed forward-thinking policy. Research continues to drive breakthroughs in solving complex problems that enable transformative real-world applications. This presentation provides a high-level overview of key NIST initiatives for establishing robust risk management and governance of these intelligent systems. The presentation will highlight the development of the NIST AI Risk Management Framework (AI RMF) Profile for Trustworthy AI in Critical Infrastructure, examining its operational technology and robotics implications across sectors such as public health and safety, transportation, and energy. It also surveys complementary NIST efforts, including standard test methods for response robots, autonomous vehicles, adversarial machine learning, and cybersecurity. Our goal is to demonstrate how deep technical insights can translate into actionable governance artifacts and identifies clear opportunities to bridge the technical and governance fields.
Manocha Dinesh, Ph.D. Professor, Paul Chrisman Iribe Professor of Computer Science and Electrical and Computer Engineering, Distinguished University Professor	**Title: Challenges in developing autonomous robotic systems** While the last few decades have seen significant robotics success stories, they have largely been confined to structured or controlled settings, leaving a major open challenge in developing truly autonomous systems that can safely adapt to unpredictable, unstructured public spaces, homes, complex outdoor terrains, or hospitals. This talk provides an overview of our ongoing work to bridge this gap by addressing the core technical hurdles of autonomy, including perception failures in unstructured environments, the scarcity of real-world training data, the complexities of human-agent teaming, and the critical need for photorealistic simulation to overcome the sim-to-real gap. We present new methods that utilize multimodal observations from RGB cameras, 3D LiDAR, or robot odometry—alongside deep reinforcement learning or visual language models—to compute dynamically feasible, spatially aware actions. We highlight the performance of these systems across different applications: navigation in indoor scenes with dense crowds; long-range navigation on outdoor terrain for off-road autonomy; and the development of an automatic medicine return system for hospital pharmacies. We also address the limitations of current hardware (e.g., humanoids) and machine learning and foundation models used for robotics.
2:30 PM- 2:45 PM	Afternoon Break
2:45 PM- 4:15 PM	Session 3 Semiconductors and Microelectronics Building 101, Portrait Room

<u>Weidong Zhou, Ph.D. (Virtual)</u> Janet and Mike Greene Professor Director, UTA Photonics Center Professor of Electrical Engineering Nanophotonics Lab (NPLAB) University of Texas at Arlington (UTA)	**Title:** **<u>Semiconductor laser revolution: PCSEL promises and challenges</u>** Photonics will play a critical role in the advancement of AI, data centers, communications, sensing, and future chips. We will introduce the principles, promises, and challenges of the third-generation semiconductor laser technology, namely, photonic crystal surface-emitting lasers (PCSELs). The capabilities of mode engineering for power scaling and high speed operation, as well potentially of beam control and manipulation make PCSEL a very powerful new laser architecture for a wide range of applications. However, challenges remain as well from fundamental cavity design to fabrication and packaging.
<u>Ahmed A. Busnaina, Ph.D.</u> William Lincoln Smith Professor, Distinguished University Professor and Director The Advanced Nanomanufacturing Cluster for Smart Sensors and Materials CSSM, the NSF Nanoscale Science and Engineering Center for High-rate Nanomanufacturing Northeastern University	**Title:** **<u>High-throughput and Scalable Directed Assembly-based Manufacturing of Nano and Microelectronics</u>** It is essential to have secure and resilient access to micro and nanoelectronics manufacturing, yet conventional offshore fabs are ill-suited for the using new and emerging materials as well as prototyping, low-volume, and rapidly adaptable fabrication. The high-throughput and scalable directed assembly-based manufacturing by using directed assembly-based liquid based, additive processes at ambient temperature and pressure to overcome these limitations. It eliminates etching, vacuum deposition, and toxic chemistries by assembling nanomaterials—metals, semiconductors, and dielectrics. This enables rapid fabrication of transistors, logic gates, interconnects, and multilayer circuit boards down to 25 nm feature sizes. Entire circuits can be designed digitally and produced within hours. The technology will enable the fabrication of nanoelectronics and electronic components while reducing the cost by 10-100x. The nano and microscale printing platform enables the heterogeneous integration of interconnected circuit layers of electronics and sensors on rigid or flexible substrates. Applications such as transistors, inverters, diodes, logic gates, NEMs switches, display, and sensors at the micro and nanoscale have been demonstrated using inorganic and organic materials. A high throughput fully automated additive manufacturing platform (Fab in a Box) for manufacturing micro and nanoelectronics will be presented.

Donald Yeung, Ph.D. Professor, ECE Department University of Maryland at College Park	**Title: Monolithically Integrated Accelerator-Main Memory Chips.** Certain non-volatile memories, such as resistive RAM, or ReRAM, are compatible with standard CMOS logic processes and can be integrated directly into compute chips, like GPUs or accelerators. Moreover, ReRAMs implemented using 1TnR arrays can be fabricated in 3D across multiple metal layers, resulting in extremely high densities. We envision a device with 100+ GBs of memory integrated with an accelerator all on the same die. Such a device could provide high performance via extremely parallel connectivity between compute units and the memory. It would also enable very high efficiency since the physical proximity of the memory and compute units would largely eliminate data movement. One significant hurdle is the limited write endurance of ReRAM. However, we envision a significant opportunity to support machine learning inference which is highly dominated by reads. In addition to studying the performance and efficiency potential of this technology, we are also motivated to build hardware prototypes that can prove the technological concept. We are working with IBM Research which has a ReRAM fabrication capability to develop the memory technology; we are also working with GlobalFoundries who can potentially commercialize the technology and offer it in one of their existing process nodes; and finally, we are working with Northrop Grumman who deploys military systems that perform ML inference under significant SWAP constraints.
Yoichi Miyahara, Ph. D. Department of Physics Materials Science, Engineering and Commercialization program Texas State University	**Title: Nanoscale Electrometry with a Scanning Single-Electron Box Probe** Spatially resolved electrometry at the nanometer scale is a critical capability for characterizing and engineering quantum devices. Random dopant potentials, defect-induced disorder, and fluctuating offset charges are leading sources of qubit decoherence in semiconductor quantum dot platforms — yet they remain difficult to probe non-invasively with the required sensitivity and spatial resolution. In this talk, I introduce Scanning Single-Electron Box (SSEB) Electrometry, a new scanning probe technique that achieves single-electron charge sensitivity without the fabrication complexity of conventional scanning Single-Electron Transistor (SET) probes. The SSEB integrates a single-electron box with an Atomic Force Microscopy (AFM) cantilever, detecting discrete electron tunneling events through changes in cantilever resonance frequency and mechanical damping. Crucially, because no DC current path through the tip is required, the SSEB eliminates the need for multiple nanoscale electrodes patterned on a sharp apex — a process that severely limits SET probe yield and reproducibility. Instead, standard commercial AFM probes can be adapted into functional SSEB probes, making the technique immediately compatible with existing cryogenic AFM platforms. I will present the probe design and fabrication strategy, show preliminary experimental results demonstrating nanometer-scale charge and potential imaging, and discuss the prospects for deploying SSEB electrometry to characterize quantum dot arrays, semiconductor spin qubit devices, and other systems where local electrostatic disorder directly impacts performance. This technique offers a practical, low-barrier path to ultrasensitive electrometric imaging for the quantum device community.

2:45 PM- 4:15 PM	Artificial Intelligence and Machine Learning Building 101, Heritage Room
Joseph (Yossi) Cohen, Ph.D. Assistant Professor, Department of Mechanical and Aerospace Engineering Rutgers University	**Title: Multimodal and Explainable AI for Cyber Risk Resilience in Smart Manufacturing Systems** Advancements in AI/ML and smart manufacturing are converging towards multimodal systems in which heterogeneous data sources are essential for planning, production, health monitoring, and maintenance strategies. Although AI/ML models are maturing into critical assets in the manufacturing landscape, they introduce new attack surfaces and vulnerabilities that can have devastating consequences on decision-making if compromised. A new measurement science and model explanation metrology framework is necessary for trustworthy, secure, and certifiable multimodal AI in manufacturing. This presentation highlights our recent efforts at Rutgers University in developing explainable AI techniques to identify and quantify cyber risks by assessing model explanations rather than relying on prediction outputs alone. Furthermore, we introduce cross-modal modeling via a masked multimodal autoencoder approach with the capability to reconstruct missing or degraded modalities, leading to new frontiers in interpretable anomaly detection and resilience in manufacturing systems.
Cheryl Xu, Ph.D. Distinguished Professor, Mechanical Engineering, University Professor, Department Head, and RJ Reynolds Professor NC State University	**Title: AI-Enabled Smart Manufacturing: Connecting NC State Research Strengths with NIST Priorities** AI-enabled smart manufacturing is emerging as a critical pathway to accelerate materials and qualification, improve manufacturing quality and repeatability, enable automation, and support scalable production of advanced technologies. However, broader adoption of AI in manufacturing requires trusted measurement methods, interoperable data frameworks, validated digital models, and standards-informed pathways for translating research advances into industrial practice. This presentation will discuss opportunities for NIST–university collaboration in AI-enabled smart manufacturing, using NC State University as an example of a research-intensive university with relevant capabilities. NC State brings strengths in advanced manufacturing, materials science, microelectronics, robotics, data-driven modeling, and industry-engaged research infrastructure. These strengths are supported by research infrastructure and programs, including the Center for Additive Manufacturing and Logistics (CAMAL), the Analytical Instrumentation Facility (AIF), the PULSTAR Reactor, and related university initiatives in materials, manufacturing, and national security-relevant research. These capabilities align with potential NIST partnership areas, including materials and process qualification, digital twins, advanced sensing, uncertainty quantification, benchmark datasets, and standards-based validation. The presentation will also highlight practical pathways for engagement, including shared testbeds, benchmark datasets, university-NIST working groups, graduate student and postdoctoral exchanges, standards-development partnerships, coordinated industry pilot projects, and future exploration of joint-appointment or visiting-researcher mechanisms. More broadly, I will discuss how universities can identify distinctive institutional assets and align them with NIST priorities to accelerate trusted, scalable, and industry-adopted manufacturing innovation.

Johnny Wei, Ph.D. Computer Science, University of Southern California	**Title: Advanced model metrology with spiking** To properly measure LLMs, we must go beyond observational analysis. I will trace the theme of spiking (inserting certain data into training at known rates) in my own work, and show how spiking enables principled statistical inference on LLMs. First, I will review the role of randomization in making exact inferences about model properties. Some inferences are possible with the natural randomization in training (e.g. random order of training examples), but many more inferences can be made if developers spike their training data and insert additional randomness. I will then present my recent work on adjusting test set contamination with spiking. By spiking a small number of test examples or natural texts, these texts can be used to calibrate predictors of model memorization and statistically correct inflated benchmark scores. I'll outline the statistical intuitions here, and end with a call for more study on spiking based measurement.
Osamah Dehwah, Ph.D. Postdoctoral Fellow Johns Hopkins University PREP Associate – National Institute of Standards and Technology (NIST)	**Title: AI-Based Segmentation of Concrete Microstructure for SEM Image Analysis** Concrete is a composite material containing aggregates, sand, cement paste, the interfacial transition zone (ITZ), and voids. In certain concrete structures, cracks may develop due to factors such as pyrrhotite oxidation or internal sulfate attack. Imaging using optical, electron, and X-ray methods plays an important role in forensic investigations of failure modes. The resulting images and elemental maps are qualitatively assessed to examine microstructural details and phase relationships, which can be further enhanced using image processing techniques to separate constituents into discrete groupings, enabling quantitative analysis. However, these methods vary in the level of user involvement required and in their suitability for different tasks. Scanning electron microscopy (SEM) is widely used to study these features due to its high resolution, which enables detailed observation of phases, interfaces, and microcrack morphology. Despite these advantages, SEM image analysis remains largely dependent on manual interpretation, grayscale thresholding, and operator-guided measurements. These approaches are time-consuming, require significant expertise, and often produce subjective and inconsistent results. Advanced machine learning and AI techniques are investigated to reduce user intervention and improve consistency across varying imaging conditions. The focus is on applying phase segmentation and crack detection methods to SEM images to support validation of crack formation models developed at NIST.