Workshop Session on Transformative S&T for the Department of Defense: Non-Linguistic Artificial Intelligence Models

NAS Lecture Room, 2101 Constitution Ave. NW, Washington, DC
AUGUST 20, 2025

Purpose

The National Academies' Standing Committee on Transformative Science and Technology for the Department of Defense, sponsored by OUSD(R&E), is organizing a series of workshop sessions each of which explores potentially transformative science and technology topics of relevance to the Department of Defense.

This workshop will explore the rapidly evolving landscape of artificial intelligence models beyond large language models (LLMs), with a focus on the importance of model selection and design in the context of national security. Participants will engage with emerging approaches such as diffusion models for generative tasks, embodied AI for physical and autonomous systems, and AI techniques tailored for non-tokenizable data types including images, signals, and multidimensional sensor inputs.

The session will also examine challenge of data sparsity, the role of simulated and synthetic data in accelerating development when real-world data is limited or classified, and the importance of selecting, training, and validating models appropriately for defense-relevant contexts. In doing so, the workshop will identify key areas where collaboration between academia, industry, and the Department of Defense can accelerate innovation.

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About the Workshop

This public, on-the-record workshop session is part of an ongoing series highlighting emerging trends in science and technology that could transform how the Department of Defense approaches research and engineering, and is aimed at a non-expert audience. An online proceedings-in-brief will feature video highlights and summarize insights from the discussions.

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AGENDA

WEDNESDAY, AUGUST 20, 2025

OPEN SESSION

12:30 PM	LUNCH
1:20 PM	**Workshop Session Introduction** • Bill Dally, Laura McNamara, and Amina Qutub, *session organizers*
1:30 PM	**AI Modelling Frame Setting Talks** (20 minute presentations followed by speaker Q&A) • Carey Priebe, Professor and Director of Mathematical Institute for Data Science, John's Hopkins University • Mengdi Wang, Professor of Electrical and Computer Engineering and the Center for Statistics and Machine Learning, Princeton University (virtual) • Michael Girard, Senior Data Scientist, Pacific Northwest National Laboratory
3:00 PM	BREAK
3:15 PM	**Addressing of Data Sparsity in AI Training and Modelling: Use of Simulated vs Measured, Synthetic vs Real Data** (20 minute remarks followed by panel discussion) • Uttam Majumder, Senior Staff Scientist, Radar Division, National Geospatial-Intelligence Agency Research and Development • Ralph Etienne-Cummings, Julian S. Smith Professor of Electrical & Computer Engineering, Johns Hopkins University
4:15 PM	Wrap-up Session
4:45 PM	ADJOURN MEETING

SPEAKER BIOGRAPHIES

Ralph Etienne-Cummings, an IEEE, AIMBE and ASI Fellow, received his B. Sc. in physics, 1988, from Lincoln University, Pennsylvania. He completed his M.S.E.E ('91). and Ph.D. ('94) in electrical engineering at the University of Pennsylvania. Dr. Etienne-Cummings was the Vice-Provost for Faculty Affairs (7/1/22 – 7/1/2025), Chairman of Department of Electrical and Computer Engineering (7/2014 – 7/2020), and is the Julian S. Smith Professor of Electrical Engineering at Johns Hopkins University (JHU). He was the founding Director of the Institute of Neuromorphic Engineering. He has served as Chairman of various IEEE Circuits and Systems (CAS) Technical Committees and was elected as a member of CAS Board of Governors. He also serves on numerous editorial boards and was the Deputy Editor in Chief for the IEEE Transactions on Biomedical Circuits and Systems. He is the recipient of the NSF's Career and Office of Naval Research Young Investigator Program Awards, among many other recognitions. He was a Visiting African Fellow at U. Cape Town, Fulbright Fellowship Grantee, Eminent Visiting Scholar at U. Western Sydney and has also won numerous publication and research awards. He was also recognized as a "ScienceMaker", an African American history archive and for the "Indispensable Roles of African Americans at JHU" exhibit. He has authored over 440 peer reviewed articles, books/chapters and patents/applications on his work.

Michael Girard is a senior data scientist in the Artificial Intelligence and Data Analytics Division within the National Security Directorate at Pacific Northwest National Laboratory. He holds a PhD. in theoretical physics from the University of California, Berkeley as well as a master's degree in electrical engineering from Purdue University. Prior to PNNL he worked at the University of California-San Francisco Medical Center where he collaborated with radiology, trauma, and cardiology departments, to create AI tools for medical data processing and human decision support. Since joining Pacific Northwest National Laboratory, Michael has led several efforts applying AI methods across the radio frequency domain. His work encompasses digital communication, signals intelligence, and radar technologies. Currently, he focuses on applying AI to communications and signals exploitation missions to increase the effectiveness of the US Warfighter as the technical lead for the Lab's Department of Defense Advanced Communications Portfolio.

Uttam Majumder is a R&D Scientist and Radar automation and artificial intelligence (A2I) lead for U.S. Department of Defense. He was a senior electronics engineer at Air Force Research Laboratory (AFRL). His research interests include AI/ML for Radar Target Recognition, Radar Waveforms Design, SAR Signal and image processing, High Performance Computing, and SAR algorithms development for surveillance applications. He was a technical lead for several DARPA programs including RFMLS (Radio Frequency Machine Learning Systems), TRACE (Target Recognition and Adaption for Contested Environments), and HIVE (Hierarchical Identify, Verify, and Exploit). He led numerous in-house and external funded radar signal processing and machine learning programs. Dr. Majumder received several awards from AFRL including AFOSR STAR Team Research Award, Distinguished Research Achievement Award, and SPIE Rising Researchers Award.

Dr. Uttam K. Majumder earned his Ph.D. in Electrical Engineering from Purdue University, West Lafayette, Indiana on the topic “Nearly Orthogonal Waveforms Design for MIMO Radar Applications”. He published two textbooks “Deep Learning for Radar and Communications Automatic Target Recognition” and "Essential Principles of Signals Collection and Analysis. Dr. Majumder submitted two patents. In 2024, Dr. Majumder selected as Science and Technology Fellow for the Department of Defense. He is a senior member of IEEE and SPIE and a Distinguished Lecturer of IEEE AESS.

Carey Priebe is a professor in the Department of Applied Mathematics and Statistics, with research interests primarily concerned with computational statistics, kernel and mixture estimates, statistical pattern recognition, statistical image analysis, dimensionality reduction, model selection, and statistical inference for high-dimensional and graph data. He is also a member of the Data Science and AI Institute. Priebe received a BS degree in mathematics from Purdue University in 1984, an MS degree in computer science from San Diego State University in 1988, and a Ph.D. in information technology (computational statistics) from George Mason University in 1993. He has been a professor at the Whiting School of Engineering since 1994. He is a senior member of IEEE, a lifetime member of the International Statistical Institute, and a Fellow of the American Statistical Association and the Institute for Mathematical Statistics. Priebe has received many awards and honors, including the 2010 American Statistical Association Distinguished Achievement Award, the 2011 McDonald Award for Excellence in Mentoring and Advising, and in 2008 he was named one of six inaugural Vannevar Bush National Security Science and Engineering Faculty Fellows.

Mengdi Wang is an Associate professor at the Department of Electrical and Computer Engineering and Center for Statistics and Machine Learning at Princeton University. She is also affiliated with the Department of Computer Science, Princeton’s ML Theory Group. She was a visiting research scientist at DeepMind, IAS and Simons Institute on Theoretical Computer Science. Her research focuses on machine learning, reinforcement learning, generative AI, AI for science and intelligence system applications. Mengdi received her PhD in Electrical Engineering and Computer Science from Massachusetts Institute of Technology in 2013, where she was affiliated with the Laboratory for Information and Decision Systems and advised by Dimitri P. Bertsekas. Before that, she got her bachelor degree from the Department of Automation, Tsinghua University. Mengdi received the Young Researcher Prize in Continuous Optimization of the Mathematical Optimization Society in 2016 (awarded once every three years), the Princeton SEAS Innovation Award in 2016, the NSF Career Award in 2017, the Google Faculty Award in 2017, and the MIT Tech Review 35-Under-35 Innovation Award (China region) in 2018, WAIC YunFan Award 2022, AACC’s Donald Eckman Award 2024. She serves as a Program Chair for ICLR 2023 and Senior AC for Neurips, ICML, COLT, associate editor for Harvard Data Science Review, Operations Research. Research supported by NSF, AFOSR, NIH, ONR, Google, Microsoft C3.ai, FinUP, RVAC Medicines. Mengdi’s research group studies machine learning theory, reinforcement learning, generative artificial intelligence, AI for science and intelligence system applications.

TRANSFORMATIVE S&T STANDING COMMITTEE

The Standing Committee on Transformative Science and Technology for the Department of Defense (DoD) will organize a seminar series, designed for a non-expert audience, on emerging trends in science and technology (S&T) that could transform the Department's approach to research and engineering (R&E). The seminar series will aim to (1) foster scientific awareness within the DoD leadership of emerging trends in S&T; (2) generate robust discussion on the applications of these most recent scientific discoveries; and (3) explore opportunities to transform and disrupt traditional R&E strategies and adopt innovative solutions that enable the United States to maintain a scientific and military advantage.

Members

Richard M. Murray, NAE
Chair
Thomas E. and Doris Everhart Professor, Control and Dynamical Systems and Bioengineering
Caltech

Darlene Solomon, NAE
Vice Chair
Former CTO and Senior Vice President
Agilent Technologies

Samuel Achilefu, NAM
Inagural Chair and Professor, Biomedical Engineering
University of Texas Southwestern

Cecilia Bitz
Professor, Atmospheric Sciences
University of Washington

Nadya T. Bliss
Executive Director, Global Security Initiative
Arizona State University

Robert Braun, NAE
Head, Space Exploration Sector
Johns Hopkins Applied Physics Laboratory

William J. Dally, NAE
Chief Scientist
NVIDIA

Deepakraj M Divan, NAE
John E. Pippin Chair Professor, Georgia Research Alliance Eminent Scholar
Georgia Institute of Technology

Markita P. Landry
Assistant Professor, Chemical and Biomolecular Engineering
University of California, Berkeley

Robert H. Latiff
Private Consultant

Ivett A. Leyva
Department Head and Arthur McFarland Professor, Aerospace Engineering
Texas A&M University

Laura A. McNamara
Research and Development Manager
Sandia National Laboratory

Jill C. Pipher
Vice President for Research and Elisha Benjamin Andrews Professor, Mathematics
Brown University

Amina A. Qutub
Burzik Professor, Engineering Design
University of Texas at San Antonio

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