Workshop on Mathematically Formalized Assurance for National Security (MFANS) Workshop

Monday, April 29, 2024

Organizers

Greg Shannon (Host)
Idaho National Laboratory (INL)

Noah Evans
Sandia National Laboratory (SNL)

Dan Trujillo
Air Force Research Laboratory (ARFL)

Christopher Harrison
Sandia and Department of Homeland Security (DHS)

Yakoub Nemouchi
National Renewable Energy Laboratory (NREL)

Purpose

The workshop focuses on the use of formal methods to improve the assurance of security, safety, and functionality in complex systems. Organizers will solicit one-page white papers from registrants in April in order to enrich the workshop's discussions.

Goals

- Bolster a nascent technical community in the federal R&D ecosystem.
- Discuss with stakeholders the successes, needs, challenges, and opportunities for applying mathematically formalized assurance capabilities to national security systems.
- Highlight current applications, technical capabilities, and challenges.

Host: Greg Shannon
Coordinator: Catie Holschuh

Revised Date: 03/25/2024

Monday, April 29, 2024

Collaborative Computing Center (C3), 955 MK Simpson Boulevard, Idaho Falls, ID 83415

Auditorium 1131

***Attire**: Business casual.*

8:00	Gathering	
8:30	Workshop Framing and Goals	
9:00	Session 1 – Technical Capabilities	
10:00	Break	
10:30	Session 2 – Applications	
12:00	Lunch and Keynote – TBD	
1:30	Session 3 – Challenges	
3:30	Break	
4:30	Session 4 – Closing with Observations and next steps	
6:00	No-host Workshop Dinner – TBD	

https://art.inl.gov/Meetings/GCR%20Program%20Review%20July%202020/INL_C3_Directions.pdf

Digital Engineering Conference 2024

April 30 - May 1, 2024

Attire: Business casual

Idaho National Laboratory, Idaho Falls, Idaho

775 MK Simpson Blvd, Idaho Falls, ID 83401

Host: Christopher Ritter
Protocol Officer: Kimberly Whitehouse

Date agenda revised: 4.16.24

Tuesday, April 30, 2024

INL Meeting Center, 775 MK Simpson Blvd., Idaho Falls

7:30 Registration and badging ..... INL Tour Ambassadors

8:15 Welcome and announcements ..... Christopher Ritter
Director of Digital Innovation Center of Excellence (DICE) and Digital Engineering Manager, Idaho National Laboratory

8:30 National Laboratory Leadership Panel .....

Erin Searcy
Deputy Laboratory Director (acting); Chief Research Officer; Idaho National Laboratory

Jonathan Menard
Deputy Director for Research and Chief Research Officer; Princeton Plasma Physics Laboratory

Laura McGill
Deputy Laboratories Director for Nuclear Deterrence and Chief Technology Officer, Sandia National Laboratory

Marianne Walck
Lab Director, National Energy Technology Laboratory

9:15 Opening keynote ..... Harlan Bowers
President, X-Energy

10:00 Break.....

10:30 Breakout sessions.....

Session Topics

Digital Twin Applications	Moderator: Lauren French	Room: A102
Model Based System Engineering	Moderator: Lee Linville	Room: A112-113
Artificial Intelligence and Machine Learning	Moderator: JJ Langford	Room: A110

12:30 Lunch .....

1:30 Breakout sessions.....

Session Topics

Digital Thread and Computing	Moderator: Haoyu Wang	Room: A102
Instrumentation, Controls, and Cyber Resilience	Moderator: Casey Noll	Room: A110
Decision Science and Visualization	Moderator: Gregory Chavez	Room: A112-113

3:30 Break.....

4:00 Afternoon keynote ..... Candice Ling
Vice President of Strategic Missions and Technologies, Microsoft Federal

5:00 Close.....

Wednesday, May 1, 2024

INL Meeting Center, 775 MK Simpson Blvd., Idaho Falls

8:00 Arrival

8:30 Welcome and announcements — Christopher Ritter
Director of Digital Innovation Center of Excellence (DICE) and Digital Engineering Manager, Idaho National Laboratory

8:45 Break

9:00 Breakout sessions

Session Topics

Digital Twins Applications	Moderator: Jason St. John	Room: A102
Model Based System Engineering	Moderator: Anthony Matta	Room: A112-113
Artificial Intelligence and Machine Learning	Moderator: Michael Churchill	Room: A110
Digital Engineering Applications (OUO)	Moderator: Krystiane Otis	*C3 Auditorium*

11:00 Break

11:30 Mid-day keynote — Geraldine Richmond
Under Secretary for Science and Innovation, Department of Energy

12:30 Lunch

1:30 Breakout sessions

Session Topics

Digital Twins Tools	Moderator: Jaren Brownlee	Room: A102
Digital Thread and Computing	Moderator: Ryan Stewart	Room: A112-113
Decision Science and Visualization	Moderator: Ashley Shields	Room: A110
Digital Engineering Applications (OUO)	Moderator: Jeren Browning	*C3 Auditorium*

3:30 Break

4:00 Closing keynote — Daniel Hettema
Director of Digital Engineering; Modeling and Simulation, Office of the Under Secretary of Defense for Research & Engineering

5:00 Close

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Tuesday, April 30, 2024

10:30 Breakout sessions.....

Digital Twin Applications (Room: A102)

Speaker	Title	Time
Ryan Stewart	Idaho National Laboratory has demonstrated the capability to fully integrate a digital twin framework with operating research reactors	10:30-10:50
Haowen Xu	A Digital Twin Approach to Support Real-time Situational Awareness and Intelligent Cyber-physical Control in Energy Smart Buildings	10:50-11:10
Tom Conley	A Machine-Learning Pipeline for Digital Twins	11:10-11:30
Richard Vilim	Development and Maintenance of a Digital Twin over the Life Cycle of an Engineered System	11:30-11:50
Donna Guillen	Development of a Digital Twin for DLP-Printed Ceramics	11:50-12:10
Haoyu Wang	Real-time power dispatch optimization for Integrated Energy Systems	12:10-12:30

Model Based System Engineering (Room: A112-113)

Speaker	Title	Time
Joe Mahanes	Security Inclusive MBSE Tools for Nuclear Reactor Development	10:30-10:50
Mohammad Abdo	SparSensing	10:50-11:10
Thomas Bradley	A Model-Based Approach to Accrediting United States Government Information Technology Systems Following the Authorization to Operate Process	11:10-11:30
Ricardo Martinez	Harnessing MBSE for Unified System Architecture in Advanced Energy Systems	11:30-11:50
Casey Noll & Johan Valcarel	Model Based Systems Engineering (MBSE): Strategically Advancing the Maturity at Sandia National Labs	11:50-12:10
TBD	TBD	12:10-12:30

Artificial Intelligence and Machine Learning (Room: A110)

Speaker	Title	Time
Yidong Xia	Predicting the comminution of lignocellulosic biomass: Physical experiment, population balance model, and deep learning	10:30-10:50
Madison Wenzlick	Machine learning and artificial intelligence (AI/ML) for materials modeling	10:50-11:10
Hilary Egan	The utility of incorporating AI at a variety of stages in the material synthesis feedback loop, from data analysis to guiding experiment	11:10-11:30
Stephen DeWitt	Additive manufacturing (AM) techniques for metal alloys are revolutionizing product design and manufacturing	11:30-11:50
Patrick Emami	Accelerating Community Clean Energy Transitions with Generative AI	11:50-12:10
Kaylee Dalton	Applications of generative AI techniques to support high performance computing operations at Idaho National Laboratory	12:10-12:30

Tuesday, April 30, 2024

1:30 Breakout sessions.....

Digital Thread and Computing (Room: A102)

Speaker	Title	Time
Evan Richardson	Integrating Sandia's Digital Thread into the larger Enterprise	1:30-1:50
James Roche	The Promise and Reality of the Digital Thread Insights from Industry Research	1:50-2:10
Peter Chandler	Data Integration: What's the right tool for my use case?	2:10-2:30
Adam Fagan	Developing an Engineering Digital Thread using DeepLynx	2:30-2:50
Sunil Acharya	Digital Beam Forming System: From Requirements to Mission Verification	2:50-3:10
Justin Rey	Integrating simulation within a PLM-based digital thread	3:10-3:30

Instrumentation, Controls, and Cyber Resilience (Room: A110)

Speaker	Title	Time
Nageswara Rao	Virtual infrastructure twin of scanning transmission electron microscopes and computing platforms at different facilities at Oak Ridge National Laboratory	1:30-1:50
Daniel Cole	Current challenges and potential solutions for the formal verification of cyber-physical systems	1:50-2:10
Mauricio Gutierrez	Systems-Theoretic Process Analysis	2:10-2:30
Sin Ming Loo	Cyber-Informed Engineering: Integrating Cybersecurity into Digital Engineering	2:30-2:50
TBD	TBD	2:50-3:10
Richard Vilim	Toward Unattended Operation of a Semi-Scale Electrically Heated Reactor Test Facility	3:10-3:30

Decision Science and Visualization (Room: A112-113)

Speaker	Title	Time
Nathan Woodruff	Digital Engineering strategies to achieve net-zero carbon emissions for buildings, vehicles, operations, and vendors by 2031	1:30-1:50
John Ploschnitznig	Leveraging the high-fidelity 3D visualization environment to exploit complex wideband radar imagery (OMEGA Project)	1:50-2:10
Andrew Clark	Integrating Probabilistic Risk Assessment Models with the Digital Engineering Ecosystem	2:10-2:30
Maria Eduarda Montezzo Coelho	Demonstration Platform for Control Method Evaluation	2:30-2:50
Jake Swinford	Department of Energy's Project Alexandria: A Digital Library	2:50-3:10
John Thompson	Digital Acquisition - Digital Prototypes and Executable Models for Proposal Evaluation	3:10-3:30

Wednesday, May 1, 2024

9:00 Breakout sessions

Digital Twins Applications (Room: A102)

Speaker	Title	Time
Vaibhav Yadav	Technical approaches are critical towards adoption and implementation of digital twins enabling technologies in currently operating and future reactors	9:00-9:20
James Nutaro	The Tactical Emulation for Software-in-the-Loop Assessment (TESLA)	9:20-9:40
Jaden Palmer	Idaho State University's 5-W AGN-201 reactor	9:40-10:00
Kalyan Chakravarthy Sharma	A platform with a complementary suite of technologies to enable Hybrid Digital Twins	10:00-10:20
Maria Eduarda Montezzo Coelho	A digital-twin enabled operation framework for integrated energy systems	10:20-10:40
Kaleb Houck	Digital twin and extended reality capabilities for the Beartooth testbed	10:40-11:00

Model Based System Engineering (Room: A112-113)

Speaker	Title	Time
Clyde Huibregtse	Oklo's approach of holistic simulation of nuclear systems	9:00-9:20
Walter Schwarz	Model-Based System Engineering for Parametric and Performance Analyses of an Aircraft Engine	9:20-9:40
William Epting	A convolutional neural network model was then developed to predict microstructural properties from low-resolution microstructural data	9:40-10:00
Hannah Ekblad	Supporting Test Series with Digital Engineering	10:00-10:20
Svetlana Lawrence	MBSE principles and tools to support decisions in energy systems	10:20-10:40
Diego Mandelli	From machine learning to machine reasoning: a model-based system engineering perspective	10:40-11:00

Artificial Intelligence and Machine Learning (Room: A110)

Speaker	Title	Time
Tom Conley	Understanding Deep Learning	9:00-9:20
Yeni Li	A first-of-a-kind condition monitoring framework for complex systems	9:20-9:40
Brandon Biggs	The field of machine learning operations (MLOps)	9:40-10:00
Adam Giammarese	An alternative, machine learning (ML)-based method for state space exploration	10:00-10:20
Rachael Hill	Opportunities to incorporate automated technologies into the nuclear industry	10:20-10:40
Randall Reese	YOLO: A state-of-the-art deep learning model renowned for its real-time object detection	10:40-11:00

Wednesday, May 1, 2024

1:30 Breakout sessions.....

Digital Twins Tools (Room: A102)

Speaker	Title	Time
Tony Davenport	Digital Engineering is more than just tools – A tool vendor's perspective	1:30-1:50
Erica Dretzka	BOMs, knitting them into the next phase of the data mesh ecosystem, anticipating the need for well-defined DevSecOps environmental control components	1:50-2:10
Conrad Grant and Irene Qualters	National Academies Report on Digital Twins	2:10-2:30
Aaron Comis	NASA Goddard Space Flight Center (GSFC) is home to the largest organization of scientists, engineers, and technologists across NASA	2:30-2:50
Walter Schwarz	Digital Engineering for Electric Vehicle Development	2:50-3:10
Takanori Kajihara	Optimization of Real-Time Capacity Allocation (ORCA)	3:10-3:30

Digital Thread and Computing (Room: A112-113)

Speaker	Title	Time
Christopher Benson	Software-Defined-Digital-Threads: Are digital threads just python scripts?	1:30-1:50
El Mehdi Azzouzi	The principles of a Virtual Twin through a high-temperature gas-cooled reactor (HTGR) project	1:50-2:10
Sunil Acharya	A Digital Twin for optimization and asset management of a solar farm.	2:10-2:30
Jon Parish	The transformative NNSA program, PRIDE (Product Realization Integrated Digital Enterprise)	2:30-2:50
Samuel Bayham	An in-depth understanding of dynamic issues related to the integration is critical to design, demonstration, and deployment of hybrid energy systems	2:50-3:10
Lance Joneckis	Extension of SysML using Category Theory for Structured Analysis	3:10-3:30

Decision Science and Visualization (Room: A110)

Speaker	Title	Time
Robin Bloomfield	A hypothetical reactor protection system that higher assurance at lower cost in less time	1:30-1:50
Maria Eduarda Montezzo Coelho	Design, Construction and Operation of Advanced Infrastructure Systems: A Digital Engineering Approach	1:50-2:10
Tony Davenport	Leveraging Advanced Concepts and Digital Transformation for Enhanced Efficiency	2:10-2:30
Prashant Jain	Opportunities for Digital Twins to Define the Future of Nuclear Energy Systems	2:30-2:50
Fan Zhang	As nuclear energy expands its capacity and operational scope to meet evolving energy needs and combat climate change	2:50-3:10
Ronald Boring	The Human Unimodel for Nuclear Technology to Enhance Reliability (HUNTER)	3:10-3:30

Wednesday, May 1, 2024

9:00 Breakout sessions (OUO) .....

Digital Engineering Applications (Collaborative Computing Center: Auditorium)

Speaker	Title	Time
Jacquelyn Rambo	The NSE has declared an intent to stand up a Digital Thread by October 10th, 2025	9:00-9:20
TBD	TBD	9:20-9:40
Jeren Browning	The NA22 office within NNSA has recently started a new venture project called Osiris	9:40-10:00
Curtis Taylor	The Cybersecurity Manufacturing Innovation Institute (CyManII)	10:00-10:20
Tony Jones	Sandia National Laboratory is investigating avenues to develop capabilities that will transcend multiple decades, generations, nuclear security sites	10:20-10:40
John Chilleri	Sandia's pursuit of a real-time, digital twin-informed calibration framework for a physics-based model of the conductive and radiative pathways of an electrical network	10:40-11:00

1:30 Breakout sessions (OUO) .....

Digital Engineering Applications (Collaborative Computing Center: Auditorium)

Speaker	Title	Time
Vaughn Halford & Karen Blaha	A Systems Model for the World's Largest Pulsed Power Machine Using Model Based Systems Engineering (MBSE) Tools	1:30-1:50
Michael Mitchell & Ken Street	Sandia has transformed the qualification of requirements process using digital engineering	1:50-2:10
Gregory Chavez	Decision application exemplars are provided to demonstrate case study using an established digital thread to rapidly respond to DoD and NNSA inquiries and requests.	2:10-2:30
Samantha Thueson & Ashley Shields	Examines a case study focused on developing a graphical user interface (GUI) and an accompanying 3D visualization for a chemical separation process	2:30-2:50
Ryan Shaw	Digital Engineering methods utilized within APT	2:50-3:10
Jonathan Edelen	RadiaSoft has emerged as the lead industry player for particle accelerator complexes	3:10-3:30