NATIONAL ACADEMIES Sciences Engineering Medicine

Division on Engineering and Physical Sciences
Army Research Laboratory Technical Assessment Board

Panel on Assessment of Humans in Complex Systems (HCxS) Meeting
HCxS Competency Compound, Aberdeen Proving Ground, Maryland

November 2– 4, 2022

Agenda

Wednesday, 2 November 2022

DATA GATHERING SESSION: OPEN TO THE PUBLIC
Location: Building 459, Auditorium, Aberdeen Proving Ground, Tel: 410-278-5801

9:15 - 9:30 Welcome: Administrative Remarks and Introductions, **Dr. William B. Rouse, Panel Chair**, and **Dr. Gaston & Dr. Gregory, ARL HCxS Competency Co-Leads**

9:30 - 9:45 ARL Overview and Question and Answer Session, **Dr. Patrick J. Baker**, **ARL Director**

9:45 - 10:15 ARL HCxS Overview, **Dr. Gaston & Dr. Gregory, ARL HCxS Competency Co-Leads**

10:15 - 11:25 Neuroscience and Neurotechnologies Core Competency: Talks

- 10:15-10:25 Introduction, **Dr. Fred Gregory, ARL**
- 10:25-10:45 The Elastic Brain in Complex Ecosystems, **Dr. Javier Garcia, ARL**
- 10:45-11:05 Brain Dynamics: Avalanches and Chimeras, **Dr. Kanika Bansal, ARL**
- 11:05-11:25 Brain-body Measurements Augment Human-Agent Teaming **Dr. Paul Sajda, University of Columbia**

11:25 - 11:40 *Break* - Obtain Lunch

11:45 - 12:30 *Working Lunch* - Neuroscience and Neurotechnologies Core Competency: Talks Continued

- 11:40-11:50 ARL as part of a Neuroscientist's Early Career, **Dr. Nuttida Rungratsameetaweemana, Salk Institute (EC)**
- 11:50-12:10 Training a Spiking Neural Network via Reinforcement, **Dr. Sam Neymotin, Nathan Kline Institute**
- 12:10-12:30 Spatial Reasoning Manifolds and Simplicial Complexes, **Dr. Vasileos Maroulas, University of Tennessee Knoxville**

12:30 - 12:45 *Break* - Transition

Location: Building 459, Collaboration Commons, Aberdeen Proving Ground, Tel: 410-278-5801

12:45 - 13:45 Neuroscience and Neurotechnologies Core Competency: Interactive A

1. Physiological Correlates on Complex Decisions in Teams (Demo), **Ms. Xiaojue Zhou, UC Irvine (EC) / Mr. Paul Groves, DCS Corp**
2. Augmenting the Brain via Subcortical Stimulation (Demo,) **Mr. Shane Nguyen, UC Irvine (EC) / Dr. Javier Garcia, ARL**
3. Investigating Probabilistic Learning Across Species and Spatiotemporal Scales (Poster), **Ms. Shruti Kumar, Columbia University (EC)**
4. Improving Working Memory in Recurrent Neural Networks via Optimal Noise Control (Poster), **Dr. Nuttida Rungratsameetaweemana, Salk Institute (EC)**
5. Changes in Brain Network States While Switching Tasks after Abrupt Awakening (Poster), **Dr. Luis Jimenez, ARL (EC)**
6. Behavioral and Neural Underpinnings for Heterogenous Human-Autonomy Teams (Poster), **Ms. Alexa Harris, Northwestern University (EC)**
7. Automating Dynamic Community Detection Via Scale-Free Behavior (Poster), **Dr. Italo Pinto, ARL**

Location: Building* 520*, INFORMS Dismounted Operations Lab, Aberdeen Proving Ground, Tel: 410-278-5801

12:45 - 13:45 Neuroscience and Neurotechnologies Core Competency: Interactive B

1. In-Ear EEG and Phanton Head (Demo), **Dr. Dave Hairston, ARL**
2. Complexity Synchronization: Implications for Rehabilitation, Training, and Decision Support (Poster), **Dr. Scott Kerick, ARL**
3. Deep Simplicial Manifold Learning for Neural Spike Train (Poster), **Mr. Eddie Cameron, University of Tennessee Knoxville (EC)**
4. Bayesian Topological Signal Processing (Poster), **Ms. Brittany Story, University of Tennessee Knoxville (EC)**
5. Impact of Simulated Asymmetric Interregional Cortical Connectivity on the Local Field Potential (Poster), **Dr. David Boothe, ARL**
6. Manifold Discovery in the Spatial Reasoning System (Poster), **Mr. Patrick Gillespie, University of Tennessee Knoxville (EC)**
7. Enabling Large-Scale Simulations with the GENESIS Neuronal Simulator (Poster), **Mr. Josh Crone, ARL (EC)**

13:45 - 14:00 *Break* – Transition to Building 520

Location: Building 520, Conference Room, Aberdeen Proving Ground, Tel: 410-278-5801

14:00 - 15:00 Human-Guided System Adaptation Core Competency Talks

14:00-14:10	Introduction, **Dr. Kaleb McDowell, ARL**
14:10-14:30	Cycle-of-Learning, **Dr. Nick Waytowich, ARL**
14:30-14:45	Human-Guided Machine Learning for Future Human-Machine Teams, **Dr. Christopher MacLellan, Georgia Institute of Technology**
14:45-15:00	Closing the Performance Gap: Understanding How to Prompt Foundational Models, **Dr. Laurel Orr, Stanford University (EC)**

15:00 Quick Transition to Building 520, INFORMS Computation Lab

Location: Building 520, INFORMS Computation Lab, Aberdeen Proving Ground, Tel: 410-278-5801

15:00 - 16:00 Human-Guided System Adaptation Core Competency Posters A

1. 2021 and 2022 MineRL Competition (Multimedia), **Dr. Ellen Novoseller, ARL (EC)**
2. Army Vision Versus Human-Artificial Intelligence Experimentation. (Poster), **Dr. Kaleb McDowell, ARL**
3. Experimental Platform Workshop (Poster), **Dr. Christopher MacLellan, Georgia Institute of Technology**
4. Co-Evolution of Human-Artificial Intelligence Adaptation (Poster), **Dr. Ying Choon Wu, University of California – San Diego**
5. ARL/U. Columbia Human-Guided System Adaptation (HSA) Science Challenge and Hackathon Week (Multimedia), **Dr. Paul Sajda, Columbia University**
    i. Super-Mega Tetris (Demo), **Mr. Bryce Bartlett, DCS Corp**
6. Meerkat: Intelligent and Interactive Data Structures for Complex Data Types (Demo), **Mr. Sabri Eyuboglu, Stanford University (EC)**
7. A Continuously Adaptive Human-in-the-Loop Exoboot (Poster), **Dr. Courtney Bradford, ARL**
8. Human-guided Hierarchical Reinforcement Learning for Partially Observed Environments (Futures Poster), **Mr. David Slayback, ARL (EC)**

Location: Building 518, KAIROS Lab, Aberdeen Proving Ground, Tel: 410-278-5801

15:00 - 16:00 Human-Guided System Adaptation Core Competency Posters B

1. Cycle-of-Learning Drone Control (Demo), **Mr. Joshua Miller, ARL (EC) & Dr. Nick Waytowich, ARL**
2. Hardware Accelerator for Language-Guided Reinforcement Learning (Poster), **Mr. Aidin Shiri, University of Maryland - Baltimore County (EC)**
3. Improving Autonomous Navigation with Imitation Learning (Poster), **Mr. Brian Cèsar-Tondreau, ARL (EC)**
4. Combining Human Demo and Interventions (Poster), **Dr. Nick Waytowich, ARL**
5. Beyond Preferences; Learning from Human Feedback Using Ratings (Poster), **Mr. Devin White, University of Texas – San Antonio**
6. Achieving Sim2Real Transfer with Large Scale foundation Models and Behavior (Poster), **Mr. Nazmus Sunbeam, Texas A&M University (EC)**
7. Curriculum Learning from Human Demo (Poster), **Dr. Zack Hare, ARL**
8. Human-Guided Multi-Agent Reinforcement Learning (Futures Poster), **Dr. Ellen Novoseller, ARL (EC)**

DATA GATHERING SESSION: OPEN TO THE PUBLIC

Location: Vandiver Inn, 301 South Union Avenue, Havre de Grace, MD, Tel: 202-263-9844

18:00 *Joint Working Dinner*: Panel and ARL Engage in Discussion/Question and Answer Session

20:00 Adjourn

Thursday, 3 November 2022

DATA GATHERING SESSION: OPEN TO THE PUBLIC

Location: Building 520, Conference Room, Aberdeen Proving Ground, Tel: 410-278-5801

08:30 - 08:45 Day 1 Feedback Session: Neuroscience and Neurotechnologies and Human-Guided System Adaptation Core Competencies

08:45 - 10:15 Human-System Team Interactions Core Competency: Talks

- 08:45 - 08:55 Introduction, **Dr. Katherine Cox, ARL**
- 08:55 – 09:15 Trust: From Dyadic Interactions to Multi-Human, Multi-Agent Teams, **Dr. Andrea Krausman, ARL**
- 09:15 – 09:35 Cohesion Metrics for Human Autonomy Teaming, **Dr. Shan Lakhmani, ARL (EC)**
- 09:35 – 09:55 Adaptation for Human Agent Teams, **Dr. Katia Sycara, Carnegie Mellon University**
- 09:55 – 10:15 Neurophysiology and Human-Agent Teams: From Measurement of Emergent Team States to Neuro-inspired AI, **Dr. Leanne Hirshfield, University of Colorado - Boulder**

DATA GATHERING SESSION: OPEN TO THE PUBLIC

12:15 - 13:15 Bi-Directional Human-System Communication Core Competencies: Talks

- 12:15 - 12:20 Introduction, **Dr. Jonathan Touryan, ARL**
- 12:20 - 12:40 Multisensory Neural Information Processing for Direct Brain-Computer Communications, **Dr. Maryam Shanechi, University of Southern California (virtual)**
- 12:40 - 13:00 Psycho-Social Dynamics of Human Agent Teaming, **Dr. Noshir Contractor, Northwestern University**
- 13:00 - 13:15 Aided Target Recognition Approaches that Complement Rather than Conflict with Human Visual Processing, **Dr. Chloe Callahan-Flintoft, ARL (EC)**

13:15 - 13:25 *Break* - Transition to INFORMS Computation Lab

Location: Building 520, INFORMS Computation Lab, Aberdeen Proving Ground, Tel: 410-278-5801

13:25 - 14:10 Bi-Directional Human-System Communication Core Competencies: Interactive

1. Opportunistic Sensing to Improve Aided Target Recognition Algorithms (Poster-Demo), **Dr. Courtney Haynes, ARL**
2. Dynamic Information Representation in Complex Environments (Poster-Demo), **Dr. Laura Marusich-Cooper, ARL**
3. Interpreting Gaze Behavior in Open-World Virtual Environment (Poster-Demo), **Dr. Leah Enders, DCS Corp, Ms. Heather Roy, ARL**

14:10 - 14:25 *Break* - Transition to Building 459, Auditorium

Location: Building 459, Auditorium, Aberdeen Proving Ground, Tel: 410-278-5801

14:25 - 15:25 Estimating and Predicting Humans in Complex Systems: Talks

14:25-14:35	Introduction, **Dr. Virginia Pasour, ARL**
14:35-14:55	Leveraging Individual Differences and Big Data to Inform Psychological Theory, **Dr. Stephen Mitroff, The George Washington University**
14:55-15:15	Modeling Collision Avoidance Decisions by a Simulated Human-AI Team with Inverse Reinforcement Learning, **Dr. Evan Carter, ARL (virtual)**
15:15-15:25	Mind-Body-Community Connections: Multiscale Integration of Neural, Social, and Network Theory, **Dr. Emily Falk, University of Pennsylvania**

15:25 Quick Transition to Collaboration Commons/Mind Lab

15:25 - 16:10 Estimating and Predicting Humans in Complex Systems: Interactive A

1. Highly Repeated Sampling for Characterizing Human-AI Collaboration Over Time and Between People (Demo), **Mx. Torin Adamson and Mr. Mohammad Rashid Yousefi, University of New Mexico (EC)**
2. Decoding Neural Activity to Assess Individual Latent State in Ecologically Valid Context (Poster), **Dr. Stephen Gordon, DCS Corp**
3. Visual Search for Beyond-Field-of-View Targets: Effects of Cue Modality, Eccentricity, and Distractor Presence on Speed and Precision (Poster), **Dr. Anthony Ries, ARL**
4. Predicting Rapid Shifts in Cognitive Resource Allocation (Multimedia), **Dr. Justin Brooks, D-Prime and Mr. Jonroy Canady, ARL**
5. Apps and Computational Tools for Understanding Cognitive Fatigue (Demo), **Dr. Daniel Forger, University of Michigan**

Location: Building 459, MIND Lab, Aberdeen Proving Ground, Tel: 410-278-5801

15:25 - 16:10 Estimating and Predicting Humans in Complex Systems: Interactive B

1. Developing an Approach to Human-Centered Big Data (Linked Posters and Demo)
    i. On the Utility and Use of "Bigger Data" in the Human Sciences, **Dr. Kelvin Oie, ARL**
    ii. Leveraging Bigger Data to Predict Rare Outcomes in User Engagement, **Dr. Sean Fitzhugh**, **ARL**
    iii. Leveraging Big Data to Disentangle Effects of Distractor Interference and Improve Prediction of Visual Search Performance, **Dr. Chloe Callahan-Flintoff, ARL (EC)**
2. Leveraging Dynamic Tasking Networks to Estimate Team Performance (Poster), **Dr. Sean Fitzhugh, ARL**
3. Technically Savvy Soldiers (Futures Poster), **Dr. Catherine Neubauer, ARL**

16:10 Quick Transition to Auditorium

Location: Building 459, Auditorium, Aberdeen Proving Ground, Tel: 410-278-5801

16:10 - 16:40 Hybrid Human-Technology Intelligence: Futures Talks

16:10-16:30 Scientific Background and Initial Hybrid Thinking Plans, **Dr. Javier Garcia, ARL**

16:30-16:40 Hybrid Intelligence and Command and Control in the Army's Projected Future Operating Environment, **Dr. Kaleb McDowell, ARL**

Friday, 4 November 2022

DATA GATHERING SESSION:OPEN TO THE WORKFORCE

Location: Building 459, Auditorium, Aberdeen Proving Ground, Tel: 410-278-5801

12:30 - 13:30 Panel Feedback Session with HCxS

***EC - Early Career presenter.**

Note: The data gathering sessions of this meeting to be held on November 3, 2022 from 10:15 am, EDT - 11:15 am, EDT, and 11:30 am – 12:15pm, EDT, and on November 4, 2022, from 12:30pm – 1:30 pm, EDT, and 1:30 pm – 2:30 pm, EDT will not be open to the public under Subsection 15(b)(3) of the Federal Advisory Committee Act, 5 U.S.C. App. The Academy has determined that to open these sessions to the public would disclose information described in 5 U.S.C. 552(b).