



Wednesday, October 25

0700 – 0830	Registration and Breakfast
0830 – 0900	Welcome and Program Overview (Touryan, Lee)
0900 – 1030	<p>Science Area Updates:</p> <p>Broad overview of ongoing research efforts within the three CaN CTA science areas. The following presentations will highlight significant progress and identify near-term research objectives in each area. The goal of this session will be to broaden awareness of research across the CTA, to identify areas of potential collaboration, and to facilitate proposal development for the final biennial program plan.</p> <p>Advanced Computational Approaches (Sajda)</p> <p>Brain-Computer Interaction (Jung)</p> <p>Real-World Neuroimaging (Ferris)</p>
1030 – 1100	Break
1100 – 1200	<p>Successes (and Failures!) that are Shaping our Research Vision - an ARL Perspective (Vettel, Hairston, Waytowich)</p> <p>In this session, we will discuss some of our planned research directions at ARL that extend beyond this CTA (2020+). We will highlight how some of the accomplishments (and failures) of our past work has reshaped our viewpoints. Our goal is to spark a discussion about potential collaborations that will extend and transition CTA research into new domains and programs.</p>
1200 – 1330	<p>Lunch (<i>provided</i>)</p> <p>CMC Meeting (Lee - <i>Azalea</i>)</p>
1330 – 1400	<p>Big EEG(1): Standardized Annotated Neurophysiology Data Repository (Johnson, Kellihan)</p> <p>ARL and the CaN CTA have conducted numerous neurophysiological research studies over the past 10 years to support a broad spectrum of analytical objectives. These datasets have now been collected into a single repository that utilizes a standardized preprocessing pipeline and common event-level reference schema, among a number of other features. The Standardized Annotated Neurophysiological Data Repository (SANDR) is positioned to become a unique resources for large-scale EEG analysis, both within and beyond the CTA. In this presentation, we will review the database content, architecture, and user-friendly system interface.</p>
1400 – 1500	<p>Big EEG(2): Large-Scale EEG Analysis and Validation of Hierarchical Event Descriptors (Bigdely-Shamlo, Robbins)</p> <p>The CaN CTA has invested years of effort in building a standardized data repository (SANDR) containing over twenty studies and millions of annotated events, along with a plethora of tools for curation and processing. This unique resource has the potential to transform interpretation of neural signals by teasing out the manifold aspects of events and states. In this talk, we present results and insights from large-scale investigations of EEG patterns across different studies (mega-analysis) modeled hierarchically using HED tags, with and without temporal regression. Such large-scale investigations provide a more comprehensive context for interpreting details of models associated with different types of neural processes. Our results</p>

also shed light on the spatial and frequency variabilities in channel and dipole EEG activity across recordings and studies.

1500 – 1800

Demo and Poster Session (POC: Hairston – *Prefunction Area*)

1630 – 1800

Big EEG(3): Software Tools for Experimentation, Synchronization, Recording, and Visualization (Jaswa, Walker – *Hawthorne*)

The Lab Streaming Layer (LSL) is a CaN CTA supported, open-source software suite for recording and accessing synchronized data streams from multiple devices in near real-time. Since its initial development, it has seen use in many projects within the CaN CTA and is beginning to see significant adoption within industry. In this session, we provide a brief overview of LSL and associated resources, industry adoption, and some current projects that make use of the technology. We'll end the session with a discussion about experiences integrating LSL, impediments to adoption, and future directions.

1630 – 1800

Efficient Embedded Systems Approaches enabling Long-term and On-line Neuroimaging (Mohsenin, Hairston)

Conventional approaches to EEG processing are infeasible for on-line long-term, continuous monitoring due to bulky equipment, real-time constraints and high power consumption of devices. Most techniques are highly computationally intensive and need to process data offline due in large part to the highly volatile, nonstationary nature of the data, especially in natural, noise-ridden conditions. In this session we will explore the challenges posed and opportunities enabled by robust and low-power embedded processing for EEG data, and how it might be useful for future CTA efforts. For example, efficient processing on a small embedded hardware removes the need to transmit data, significantly reduces power consumption, enables ambulatory BCI systems to work in real-time, and is ergonomically feasible due to reduced battery requirements. In this session we will discuss issues related to generalization of techniques for real-world applications, efficient on-line learning for adaptive systems, use cases enabled by embedded processing, in situ application of machine learning models to EEG data, and the feasibility of embedded on-line artifact removal.

Events in **bold** are designated all-hands session, attendance is requested.

All scheduled presentations will be held in the *Century Ballroom A* unless otherwise indicated.

Thursday, October 26

0700 – 0830	Breakfast
0830 – 0900	ARL's Essential Research Areas (Metcalf, Franaszczuk) <p>ARL has recently created a set of Essential Research Areas for the purpose of focusing science and technology efforts within the organization towards spaces of greatest potential effect. Two of these areas are particularly relevant to the problems that have been examined within the CAN CTA over its lifetime. The areas include "Accelerated Learning for a Ready and Responsive Force" and "Human Agent Teaming". This presentation will describe each of these areas, how they relate to one another and with broader elements of ARL's strategic vision for addressing critical future Army needs.</p>
0900 – 1030	Recent Developments in Noninvasive Human Brain Imaging (Prof. Mingzhou Ding) <p>In this talk I will describe three ongoing projects that are broadly related to the three programmatic areas of the CaN CTA. The first project examines the technique of recording EEG and fMRI simultaneously. Examples from affective neuroscience and visual attention will be used to illustrate our current approach to integrate complex data from different imaging modalities. The second project examines neural responses to cognitive fatigue resulting from prolonged performance of a cognitively demanding task. We demonstrate that the brain copes with the fatigue-induced impairment of the task-related network by recruiting additional neural resources to maintain performance and that such compensation mechanisms eventually fail as cognitive fatigue further worsens. The third project examines recent efforts at taking neuroscience into the real world. Wireless EEG were recorded simultaneously from all the students in a high school biology class over 11 class periods in the span of one semester. Brain-to-brain synchrony was evaluated and shown to be associated with social and educational assessments.</p>
1030 – 1100	Break
1100 – 1200	Addressing Nonstationary Processes in Neuroimaging Data (Moderators: Lin, Wu) <p>In this session several CTA researchers will briefly introduce their work on handling nonstationarity elements of neuroimaging data:</p> <ul style="list-style-type: none">• Tim Mullen (Qusp): Bayesian state-space modeling of nonstationary brain source activity, connectivity and behavior• Shawn Hsu (UCSD): Detecting brain states by modeling source nonstationarity• C-T Lin (UTS): Detection of brain nonstationarity for adaptive BCI• Dongrui Wu (DataNova): Brain state change detection using unsupervised ensemble regression, piecewise constant approximation, and hypothesis testing
1100 – 1200	New Approaches to Parameterizing Human Performance (Moderator: Verstynen - <i>Hawthorne</i>) <p>Identifying and quantifying the algorithmic properties of human performance remains a fundamental challenge for neuroscience. It is nearly impossible to track neural signatures of underlying cognitive states without knowing precisely what those states are. This session will present novel approaches to parameterizing behavior during naturalistic tasks by incorporating the use of multivariate approaches and applying neurobiological constraints to model designs.</p>
1200 – 1330	Lunch (<i>provided</i>)
1330 – 1430	Using Deep Models to Bridge the Gap Between the Laboratory and Real-World for EEG Analysis (Lawhern, Solon) <p>Although optimizing BCI performance by fitting to a single subject and task is often ideal, in many scenarios it is simply not possible. Today, I will discuss our work in creating generalized P300 detection BCI models. Our motivation is twofold: to create general, calibration-free systems that generalize to unseen scenarios, and to lay the ground work for big data modeling</p>

across many disparate EEG datasets. First, I will give a brief update on recent developments in the field of EEG-based Deep Learning (DL), including an update to our EEGNet algorithm, EEGNet2. In the second part, I will elaborate on our current and future goals in building generalizable DL systems for multi-dataset learning across subjects and tasks. For example, transfer from RSVP to free-viewing experiments as opposed to within RSVP paradigm transfer. I will give initial results of this concept using a subset of the CaN CTA database, where we train our models across RSVP, free-viewing, and guided fixation datasets.

1430 – 1500

Proposal Submission and Selection Process (Touryan)

1500 – 1730

Integrated Research Project Review and Planning (Moderators: Ferris, Sajda)

Q&A review of integrated project ideas and discussion of capstone technology demonstrations. Selected project ideas include:

1. Accelerated Learning via a Hybrid Immersive / Pervasive Training System
2. Closed-Loop Neurofeedback-based Human-Agent Teaming System

1730 – 1800

Feedback, Wrap-up and Adjourn

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Notes: