

S&T Campaign: Human Sciences
Human Behavior
Real-World Behavior

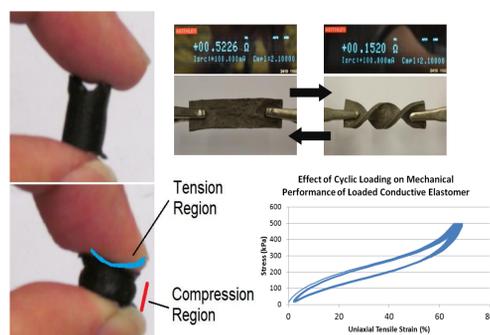
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Research Objective

- Understanding brain dynamics as they occur is true-to-life, real-world scenarios and outside of traditional restricted laboratory paradigms
- Develop novel technologies and approaches enabling neuroimaging research under real-world, less-than-ideal scenarios



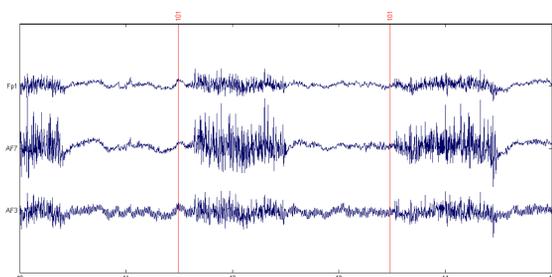
Understanding brain and behavioral dynamics during driving



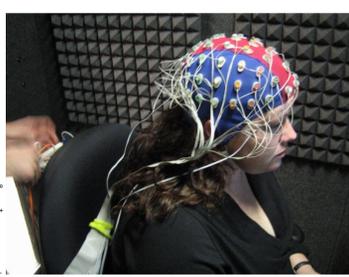
Developing novel nonmetallic materials for comfortable biosensing

Challenges

- To date, very little neuroscience research has been conducted outside of confined laboratory or medical settings and restricted paradigms, leaving a limited perspective of how well principles actually translate into real-world contexts
- This challenge arises primarily from a lack of:
 - (1) robust methods and paradigms for extracting meaningful response features within poorly controlled or scientifically “noisy” scenarios, and
 - (2) tools (hardware and algorithms) for acquiring data in a low-impact, robust manner that are sufficient for non-restricted scenarios (e.g. high motion, long recordings).



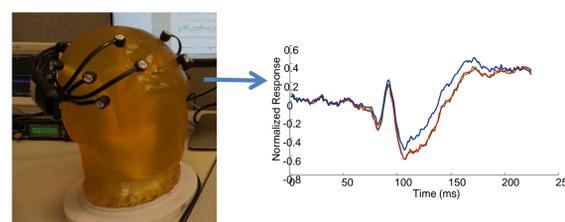
Motion artifacts create challenges for interpreting real-world data



Modern acquisition techniques are intrusive

ARL Facilities and Capabilities Available to Support Collaborative Research

- Unique laboratory facilities (at APG, MD):
 - Mission Impact for Neurotechnology Design (MIND) Laboratory
 - Brain Imaging and Experimental Research Suite (BIERS)
 - Labs for fabrication and quantification of flexible, pliable, and novel conductive materials
- Unique expertise:
 - Access to unique, military relevant, and often one-of-a-kind data and data collection opportunities
 - Knowledge of translating basic science research to applied settings, including technology development
 - Multi-disciplinary teams across neuroscience, cognitive psychology, BME, and materials science
- Unique experimental datasets and approaches:
 - Database (N>600) of participants performing real-world tasks, including driving, target detection, etc.
 - Ability to fabricate and test novel materials and circuits for new data collection methods
 - Ability to simulate realistic brain activity using “phantom” devices based on realistic conductance



Simulate realistic brain activity



Multiple novel recording environments



Complementary Expertise / Facilities / Capabilities Sought in Collaboration

- Innovative methods for state detection from physiological measurements
- Techniques for EEG data acquisition in non-ideal scenarios
- Advanced computational and statistical analysis approaches for removing artifacts and inferring causality in high-noise datasets