Human Sciences Campaign Overview

Dr. Laurel Allender
Human Sciences Campaign Lead

Human Sciences Campaign

Human Sciences is focused on identifying, creating, and transitioning the underlying scientific discoveries and technological innovations that are critical to the U.S. Army's future technological superiority

HUMAN BEHAVIOR
HUMAN CAPABILITY ENHANCEMENT
INTEGRATION of HUMANS and SYSTEMS

ARL ESSENTIAL RESEARCH AREAS

Human Agent Teaming
AI and Machine Learning
Cyber and Electromagnetic Technologies for Complex Environments
Distributed and Cooperative Engagement in Contested Environments
Tactical Unit Energy Independence
Manipulating Physics of Failure for Robust Performance of Materials
Science of Manufacturing at the Point of Need
Accelerated Learning for a Ready and Responsive Force
Discovery

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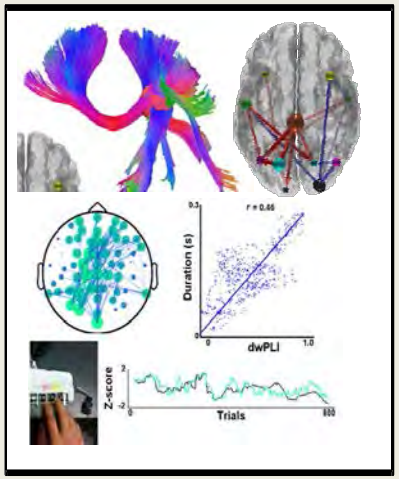
Human Sciences - Human Behavior

HUMAN BEHAVIOR: basic and applied research to discover, understand, and predict human perceptual, cognitive, affective, physical, and social behaviors in settings ranging from individuals and teams to organizations and societies.

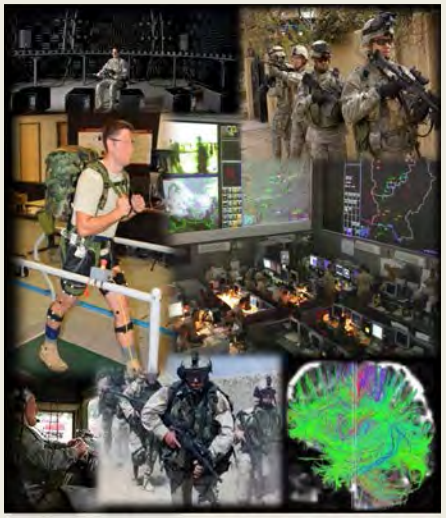
Human Variability



*Passaro, et.al. (2015) (*DCS, ARL, and Collaborators*)*

Understanding and predicting the variability in capabilities and intentions of individuals

Real World Behavior



Multi-aspect approaches to understanding and assessing human behavior within dynamic, complex, natural, military relevant real world contexts

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Human Variability

Continuous Multi-faceted Soldier Characterization for Adaptive Technologies (CMSCAT)

- Initiated at Open Campus Open House 2014
- Joint development and testing of a system for collection and real-time analysis of multiple simultaneous streams of information from body-worn and environmental sensors
- Provides computational infrastructure for future studies at ARL (CMSCAT) and at UMass-Amherst (NIH funded MD2K Center)

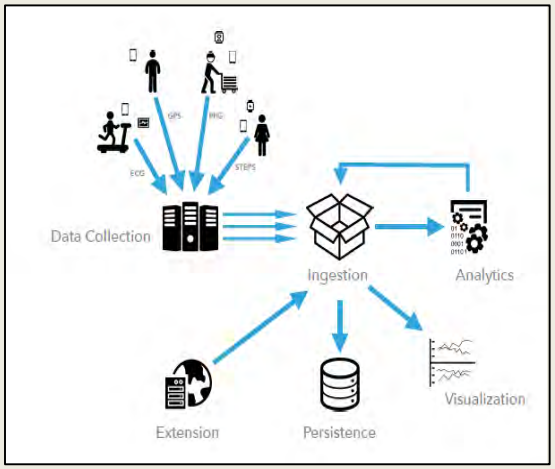


Diagram of computational infrastructure currently under development

UMass Amherst
The Commonwealth's Flagship Campus

Exemplar components of wearable sensors

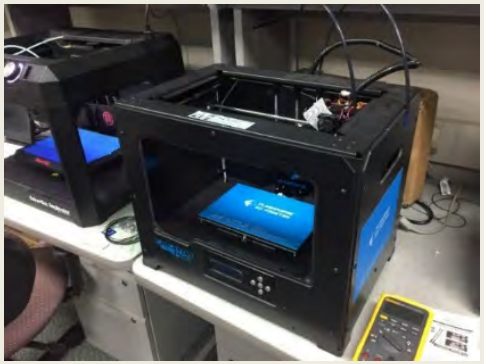
Open Campus Partnership with UMBC

Real World Behavior

(Above) ARL researchers meet with professors and students to discuss analytic approaches to EEG data streams

Novel Adaptive Systems

- ARL provides
  - the research challenge, technical equipment, & expertise
- UMBC provides
  - 24/7 access to open lab space & large research participant pool
  - Student research projects and support
- Together – new multidisciplinary synergies created
  - Generating a potential patent, collaborative proposals, and joint publications



(Left and above) UMBC provides expertise in developing novel, flexible hardware and software components that will enable near real-time assessment of human state.

(Above) Virtual and Augmented Reality system developed at UMBC will support the examination of physiological and neural adaption to stress in a realistic shooting task. Also pictured is a part of the laboratory space provided by UMBC to ARL Researchers.

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Human Sciences - Human Capability Enhancement

HUMAN CAPABILITY ENHANCEMENT: basic research, applied research, and advanced technology development effort to discover, innovate, and develop technologies that directly and indirectly enhance human perceptual, cognitive, physical, and social capabilities ranging from individuals and teams to organizations and societies.

Augmentation

Technological approaches to augmenting fundamental human capabilities applicable across wide ranging scenarios

taken by Paul Fetters for Science Magazine

Training

Enhancing the effectiveness of training and training simulation technologies

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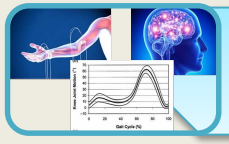
Open Campus Partnerships

Augmentation



Adaptive Controls
Individual variability and task complexity
Response to perturbations

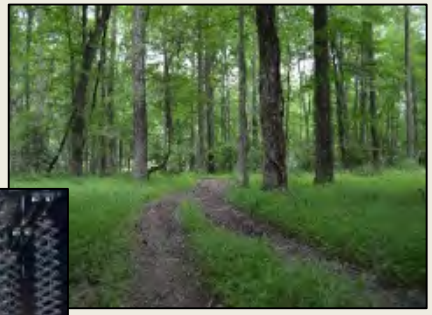
System Design/Optimization
Where, when and how to provide augmentation
Effects of magnitude and timing of assistance

Short & Long Term Adaptation
Initial training/motor learning process
Long-term effects and prevention of mal-adaptation

Fit and Comfort
Accommodation of anthropometric differences
Application of forces to & through body

Physical Augmentation

- ARL unique facilities used for exoskeleton evaluations
- Development of metrics and methods
- Research to inform system design
- Led to multiple potential partnerships with government, academia and industry



Soldier Performance and Equipment Advanced Research (SPEAR) Facility

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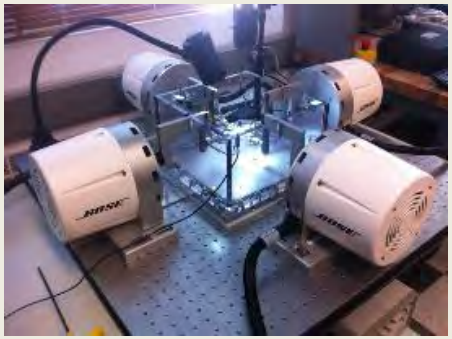
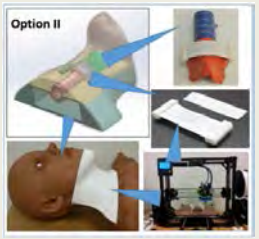
Open Campus Partnership

Training



Tissue Simulation for Medical Training

- Material science
- Tissue behavior sensors
- Training efficacy



Agreement with University of Minnesota and University of Central Florida on common test procedures for human and synthetic tissue characterization

Host Mechanical Engineering biomedical students in unique tissue laboratory

Support proposed UCF Biomedical Engineering Master Degree program

University of Minnesota Driven to Discover℠

University of Central Florida

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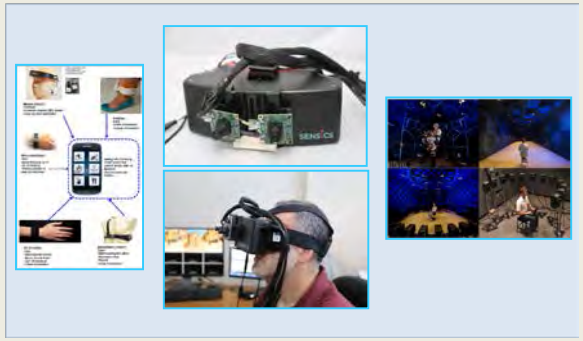
Human Sciences - Integration of Humans and Systems

INTEGRATION OF HUMANS AND SYSTEMS: basic and applied research that aims to discover, understand, exploit, and apply fundamental principles of human-system integration across domains, including but not limited to complex information systems, human-agent teams, cybersecurity, and organizational and social networks.

Integration Technologies

Discover and innovate, principles and mechanisms for the integrating of humans and systems



Humans in Multi-Agent Systems

Approaches to jointly consider multiple heterogeneous agents across networks

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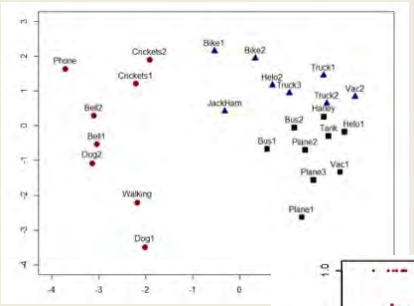
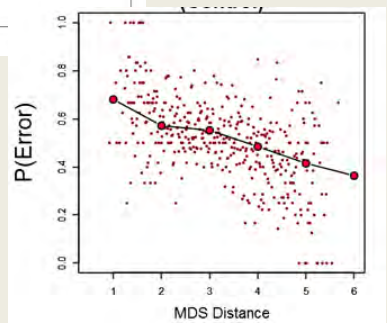
Open Campus Partnership with SUNY-Binghamton

Integration Technologies

Environment for Auditory Research





Integration Technologies

- Shared protocols
- Shared student resources
- Together – Long-term collaborative relationship
  - Metrics and data collections methods to support stimulus norming and characterization work for integration technologies and real world neuroimaging
  - To date: Four peer-reviewed publications, one technical report, and several presentations
- Demonstrated link between subjectively defined similarity and performance extends to localization and detection performance

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Open Campus Partnership with Bowie State University

Humans in Multi-Agent Systems

Understanding Socio-cultural Influences within Dense Urban Environments (DUEs)

Developing virtual reality visualizations for commander decision-making to support shared situational awareness.

Bowie State University researchers in collaboration with ARL to develop the requirements for a virtual reality environment.

ARL provides:

- Knowledge of Army visualization and decision-making needs
- Specific human domain challenges of DUEs
- Expertise in Human Systems Integration for military operational environments

Bowie State provides:

- Thurgood Marshall Faculty Appointee – Dr. Sharad Sharma
- Expertise in crowd evacuation and emergency response behavior models and simulations
- Virtual reality and visualization methodologies and capabilities

Collaboration:

- Development of a virtual reality environment for emergency response, training, and decision-making
- Adaptation of a crowd evacuation model to examine sociocultural behaviors
- Research to expand the virtual visualization of the common operational picture (COP)

BSU provides expertise in developing virtual tools for evacuation models, training, and experimentation for dense urban environment scenarios.

Crowd evacuation models are being studied to account for sociocultural behavior modifiers.

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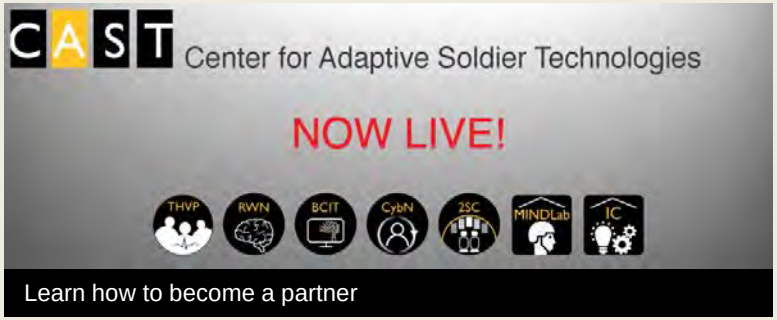
Center for Adaptive Soldier Technologies

CAST | LIMIT NO ONE



- The Human Variability Project
- Real World Neuroimaging
- Brain Computer Interface Technologies
- Cybernetics
- 2 Soldier Crew
- The MIND Lab
- Innovation Commons

- **Understanding fundamental principles of when and how to adapt technologies to individuals**
- **Instantiating those principles in demos**
- **Bringing together expertise in multiple fields through topical discussions and news**
- **Partnering to further human-centric design for adaptive and autonomy capable technologies**
- **Exchange centered on mutual investment**
  - **Ideas**
  - **Researchers**
  - **Open use of laboratories and technologies**

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Human Sciences Personnel

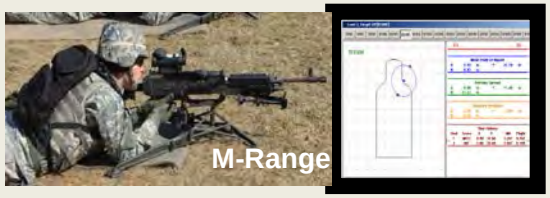
Expertise in:

- Research & Engineering Psychology
- Training & Learning Science
- Human Factors Engineering
- Cognitive Science
- Neuroscience
- Biomechanics & Kinesiology
- Computer Science
- Modeling & Simulation
- Virtual Environments
- Research Audiology
- Industrial/Mechanical/Electronics Engineering

Human Sciences Laboratories – APG, MD

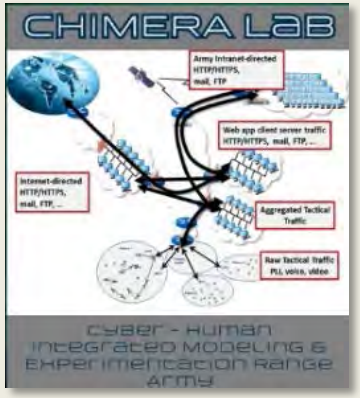
open campus

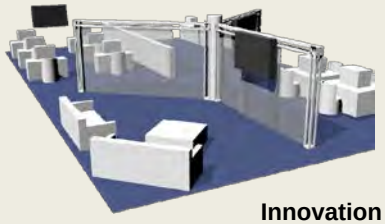
Existing Research Facilities



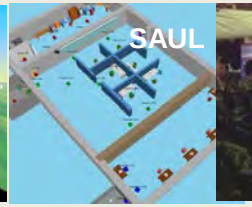
- Soldier Performance and Equipment Advanced Research (SPEAR)
- Shooter Performance Facility (M Range)
- Mission Impact through Neuro-inspired Design (MIND) Laboratory
- Environment for Auditory Research (EAR)
- Tactical Environment Simulation Facility (TESF)
- System Assessment & Usability Lab (SAUL)
- Cognitive Assessment, Simulation, & Engineering Laboratory (CASEL)
- Cyber-Human Integrated Modeling & Experimentation Range Army (CHIMERA)
- Innovation Commons

New Facilities





Innovation Commons



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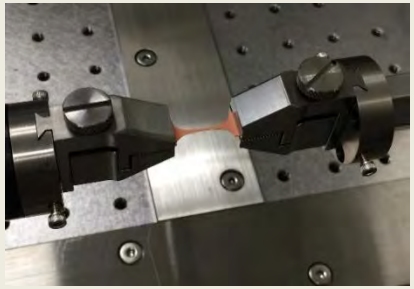
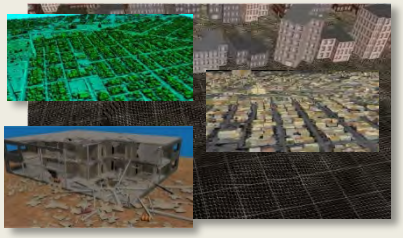
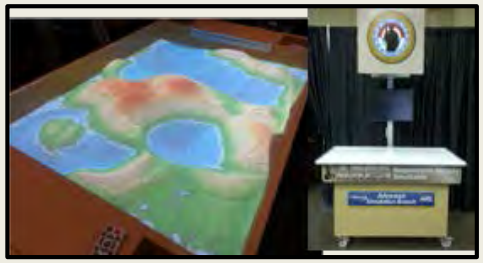
Human Sciences Facilities- Orlando, FL and Playa Vista, CA



SFC Paul Ray Smith Center

- Adaptive Tutoring Lab
- Virtual/Augmented Reality Lab
- Gaming Lab
- Visualization Testbed
- Medical Research/Tissue Lab
- Open Campus Laboratories at UCF Institute for Simulation and Training
- Army UARC - Institute for Creative Technologies at USC





ARL West & ICT

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ARL Open Campus Collaboration Opportunities

Human Behavior	
Continuous Multi-faceted Soldier Characterization for Adaptive Technologies	Dr. Amar Marthe
Individual Differences in Human Variability for Translational Neuroscience	Dr. Justin Brooks
Social Psychophysiology of Immersion	Dr. Justin Brooks
Novel Approaches for Real-World Neuroimaging	Dr. Jason Metcalfe
Interaction of Physical and Cognitive Performance	Dr. James Head
Real-Time Assessment of Group Dynamics	Dr. Arwen DeCostanza
Measuring Team Behaviors Under Stress	Dr. Thomas Price
Neurotechnology for Rapid Capability Enhancement	Dr. Alfred Yu
Human Capability Enhancement	
Field Assessment of Dismounted Soldier Performance	Ms. Maria Tararico
Biomechanics for a Dismounted Warrior	Dr. Michael LaFiandra
Control Systems for Physical Augmentation	Mr. Andrew Tweedell
Human Performance Augmentation for Improved Lethality	Mr. Frank Morelli
Cloud GIFT –Virtual Open Campus	Mr. Michael Boyce
Distributed Soldier Representation	Dr. Joe McDonnell
Cyber Battlefield Operating System Simulation Tools for Live-Virtual-Constructive (LVC) Simulations	Dr. Henry Marshall
Virtual World Research	Dr. Douglas Maxwell
Live Training Technologies	Ms. Eifert and Mr. Hillyer
Integration of Humans and Systems	
Real-World Perceptual Augmentation	Dr. Jeremy Gaston
Similarity Metrics for Multimodal Cueing	Dr. Kelly Dickerson
Human-Robot Interaction	Dr. A. William Evans
Manned and Unmanned Collaborative Systems Integration	Mr. Jared Sapp
Human-Robot Interaction & Human-Agent Teaming	Dr. Jessie Chen
Performance Assessment of Multiple Cybersecurity Teams in a Cyber Exercise Event	Dr. Blaine Hoffman
Understanding Sociocultural Influences	Dr. David Scribner

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