**Study Aim & Method:**
Develop methodologies for improving, and metrics for measuring, mission effectiveness of human-machine teams.

**Teleoperation**
- Removes soldiers from danger to reduce risks for the operator and reduces cost
- **Challenges:**
  - Operators' cognitive performance may limit mission effectiveness.
  - Factors impacting cognitive performance: fatigue, multi-tasking, switching from the civilian to the war-fighting setting, uncertainty about environment

**Project Research Questions:**

1. How to **automatically recognise** human cognitive performance during teleoperation?
   - Examples of sensors include: Kinect, EEG, ECG, physiological, speech, and IMUs.
2. What is an appropriate set of indicators for humans, and the task, to load-balance the distribution of sub-tasks among human and non-human actors?
3. What is an appropriate methodology for **real-time load balancing**?
4. How to assure **trustworthiness** in a team made of humans and autonomous systems during teleoperation?
## Hypotheses

1. Real-time human and autonomy indicators $\rightarrow$ are appropriate to adapt distribution of tasks
2. Adapting the distribution of tasks $\rightarrow$ will balance load on humans and autonomy
3. Balancing load on humans and autonomy $\rightarrow$ improve effectiveness and efficiency of mission
4. Improving effectiveness and efficiency of missions $\rightarrow$ improve commander’s trust in autonomy

## Deliverables

2. Activity Recognition Software
3. Cognitive Load Software
4. Closed Loop System
5. Trust-aware Closed Loop System
6. Fully-integrated Closed Loop System

## Timelines

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Progress, challenges, lessons learnt, opportunities, insights

Research Products
(1) A **methodology** for assessing the trustworthiness of a human-autonomy team
(2) A **prototype** load balancing system for ensuring a manageable load on humans and a trustworthy human-autonomy team

Payoff
Improved understanding of the potential of AI to enhance human-autonomy teaming
Refinement and development of a dynamic multi-modal approach for assessing trustworthiness

Progress
1) Distributed Simulation Facility in the TA lab at UNSW
2) Data Capture System from VBS
3) Data Collection and Synchronisation from human
4) Comprehensive review of the literature of cognitive workload modelling techniques with focus on multi-modal approaches
5) One academic paper published, one paper submitted, and one close to submission
6) Approved Ethics Clearance Application

Challenges
Delays in recruitment
VBS

Opportunities
New Fully Distributed Simulation Facility at UNSW-Canberra for Human Autonomy Teaming, VBS, and Cognitive Performance
Tele-operator Interface
Human-Autonomy Interaction

- Collect Human Data
- Process Signals
- Extract Features
- Map Features into Mental States

- Collect Task Data
- Process Signals
- Extract Features
- Map Features into Environmental States
"Quantifying and Predicting Human Performance for Effective Human-Autonomy Teaming", Ma-Wyatt, Anna and Fidock, Justin and Abbass, Hussein A
**Trusted Closed-Loop Human-Autonomy Interaction**

- Collect Human Data
  - Process Signals
  - Extract Features
  - Map Features into Mental States

- Collect Task Data
  - Process Signals
  - Extract Features
  - Map Features into Environmental States

**Adaptive Allocation Logic**
Learn + Optimise + Trust
List of Publications


- “Workload and Situational Awareness in Ground-Aerial Interaction Under Information Latency and Dropout Scenarios”, Essam Debie, Raul Fernandez Rojas, Justin Fidock, Michael Barlow, Kathryn Kasmarik, Sreenatha Anavatti, Matthew Garratt, and Hussein Abbass (In Preparation).
Thank You for Your Attention

Questions?