Human Factors Issues in Using Micro-Uninhabited Vehicles in Urban Disasters

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Technical advances in remotely operated vehicles (eg. drones, ground robots) have seen an increase in their use in a variety of work settings , including remote searches and damage assessment. In the case of disaster response and management, **uninhabited aerial vehicles (UAVs)** and **uninhabited ground vehicles (UGVs)** could be extremely useful. For example in floods UAVs could be used to search for people trapped on roofs or floating on debris, in bushfires they could be used to improve the view of the fire and provide response managers with improved situational awareness, in marine environments UAVs could be used to search for lost people, and finally, in earthquakes UAVs/UGVs could be used, if small enough, to search within buildings for damage assessment and searches. In the later case, this has already been attempted in response to the Christchurch February 22nd earthquakes, in which a Parrot A.R. quadrocopter drone (commercial off-the-shelf drone) was flown into the Christchurch Cathedral in order to assess for damage. This **significantly reduces the risk to search and damage assessment personnel,** and can potentially be much **cheaper** too. However, operating unmanned vehicles (UVs) presents potential **challenges in these kinds of environments.**

operator **Challenges**

Limited sensory information due to teleoperation
- 2-D camera image instead of naturalistic scene
- No tactile or vestibular cues regarding the UV's orientation
- No auditory cues regarding drone's engine

Constrained environments
- Tight spacing, turbulence

Functional near infrared spectroscopy (fNIRS) is a relatively hassle-free and non-invasive physiological measure of cognitive load, via measurement of blood oxygenation in the brain's prefrontal cortex.
Having users fitted with this during operation allows cognitive workload to be measured objectively.

current **Research**

Investigating the **cognitive load** (mental effort) of UV operators
- How can fNIRS help us?
- Dual tasking: the nature of teleoperation is such that dual tasking (eg. communicating with a team member while operating UV) is even more difficult, so what effect will this have on operators? See fig.3.

Investigating **team performance** – efficiency, communication, situation awareness, team cohesion, and team workload.

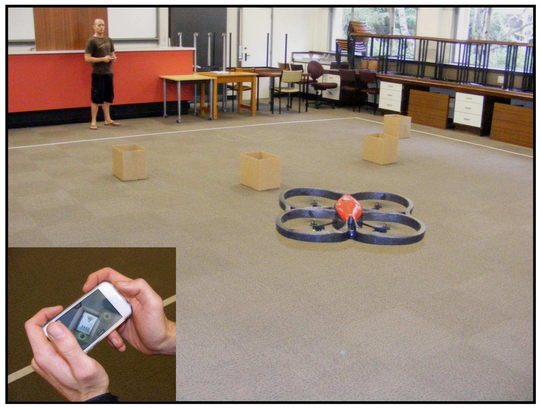

Figure 1: Team drone flying experiment. Boxes simulate ships, which contain symbols representing information such as hazards and passenger numbers.

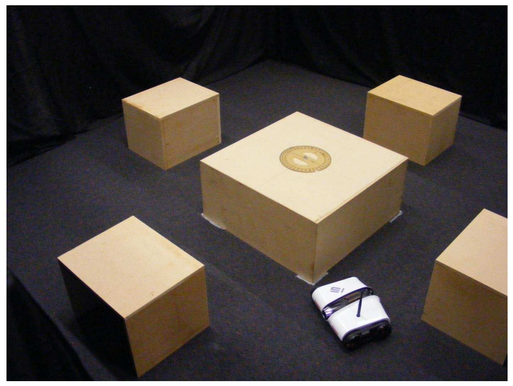

Figure 2: Ground robot (Rover tank) experimentation.

UGV operation being investigated
- How does driving performance change when an operator utilises a **first-person versus third-person view**?
- What changes in cognitive load and driving manoeuvrability will occur?

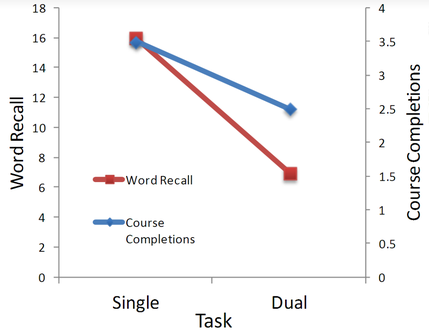

Figure 3: Flying & Memory Performance on a Single & Dual Task

where to?

- Develop **models** for operators through testing & validation with experienced users
  - Models should allow managers to hand-pick operators for tasks of particular natures and select teams using knowledge of teammate compatibility
  - fNIRS should enable objective and on-the-go measurement of operators' mental workload
- **Obstacle negotiation** testing
  - How do operators cope when navigating through apertures of various sizes and around corners of different angles, e.g. in buildings, mine shafts.
- Comparison of **interface types**
  - E.g. Smartphone vs. PC + joystick
- **Application of knowledge to various domains such as natural hazards and disaster situations**