Human Factors research for PAVs

Max Planck Institute for Biological Cybernetics

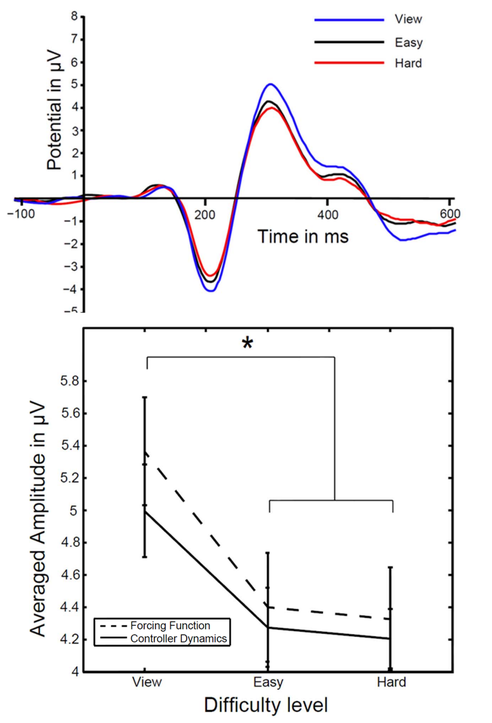
Max-Planck-Institut
für biologische Kybernetik

Psychophysiological Evaluation of Operational Workload

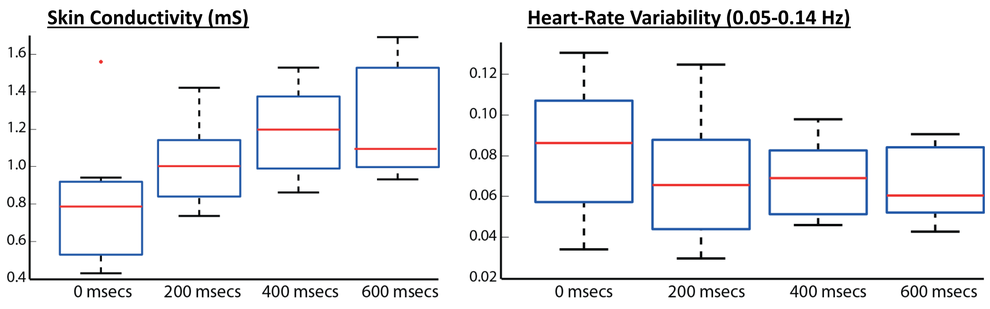
A pilot can be continuously monitored for his operational state (e.g., attention, workload, anxiety levels) with the use of gaze-trackers and physiological sensors.

By measuring the amplitude of EEG signals to task-irrelevant stimuli, we can infer the level of demand that the primary control task places on the operator. **High frequency turbulence and controller complexity can induce workload in pilots and reduce situational awareness.**

EEG response to environmental sounds



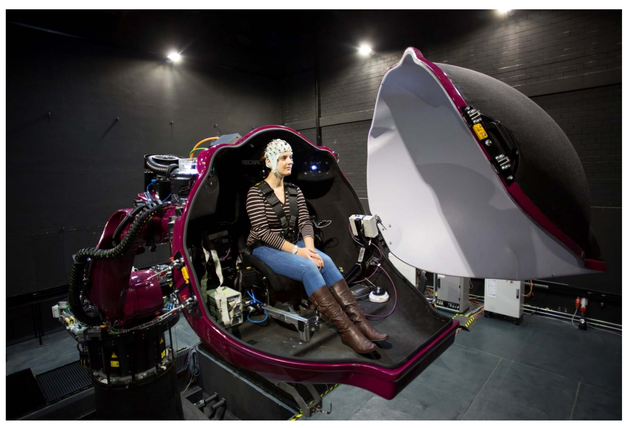
Latencies in PAV models can induce stress in pilots.



Experimental Setup

Gaze-trackers and mobile bio-sensors are easily configurable & deployable across different flight simulators.

Camera systems track eye-movements to indicate regions of interest across instruments and world.



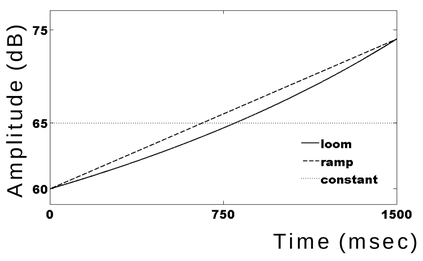
EEG signals from skin electrodes indicate the operational levels of attention and workload.

Selected Publications

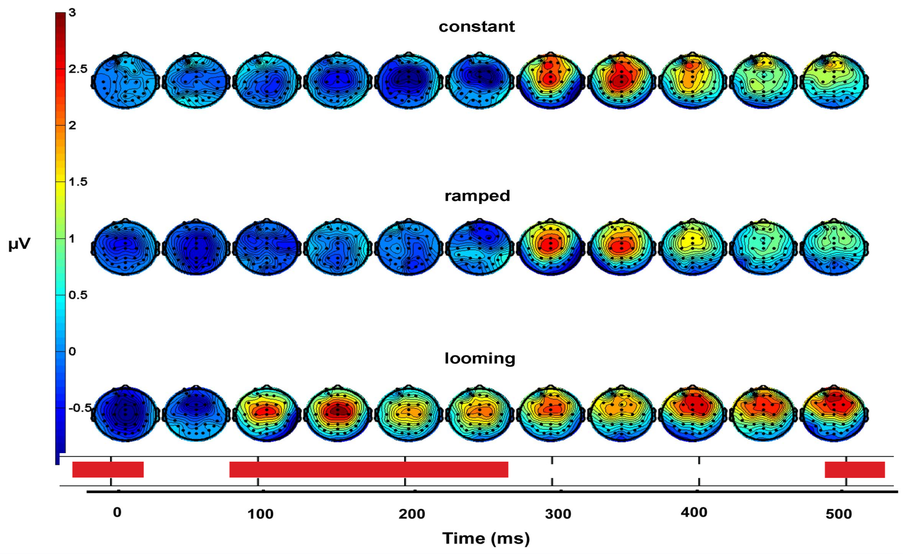
1. Scheer M., Bülthoff H. H. and Chuang L.L. (2014) **Is the novelty-P3 suitable for indexing mental workload in steering task?** *Cognitive Processing*, **15,** S135-S136.
2. Glatz C., Bülthoff H. H. and Chuang L.L. (2014) **Looming auditory warnings initiate earlier event-related potentials in a manual steering task.** *Cognitive Processing*, **15**, S38.
3. Flad N. , Nieuwenhuizen F.M. , Bülthoff H.H. and Chuang L.L. (2014) **System Delay in Flight Simulators Impairs Performance and Increases Physiological Workload.** In: *Engineering Psychology and Cognitive Ergonomics, Lecture Notes in Artificial Intelligence*, **8532**, 3-11.
4. Chuang L.L., Nieuwenhuizen, F.M. and Bülthoff H.H. (2013) **A fixed-base flight simulator study: The Interdependence of Flight Control Performance and Gaze Efficiency.** In: *Engineering Psychology and Cognitive Ergonomics, Lecture Notes in Computer Science*, **8020**, 95-104.
5. Bieg H-J., Bresciani J-P, Bülthoff H.H. and Chuang L.L. (2013) **Saccade reaction time asymmetries during task-switching in pursuit tracking.** *Experimental Brain Research*, **230**, 271-281.

Evaluating Assistive Technology

Novel technologies can be evaluated for how humans respond to them at the physiological level.



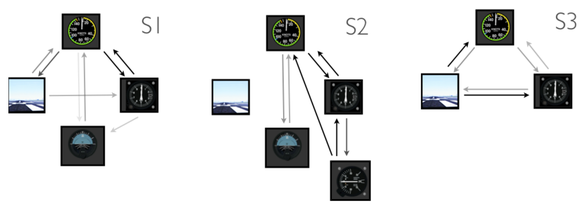
Auditory warnings can incorporate ecologically intuitive cues, such as time-to-contact properties, to facilitate saliency. This results in earlier detection and deeper processing of warning cues in the brain.

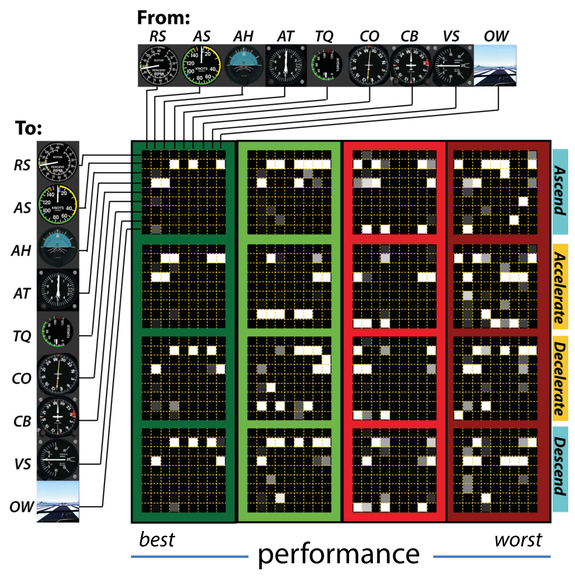


Eye-movements and Information Visualization

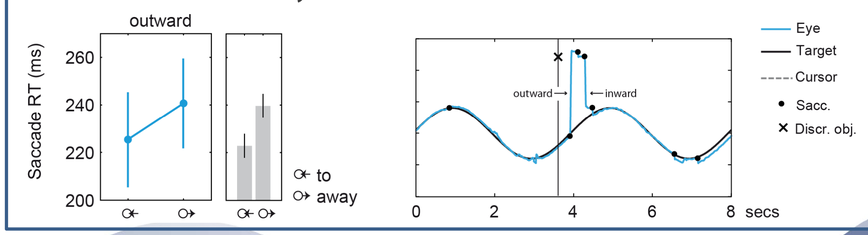
Flight control performance is strongly influenced by eye-movement planning. Individuals with less predictable eye-movements tend to generate inferior flight control performance.

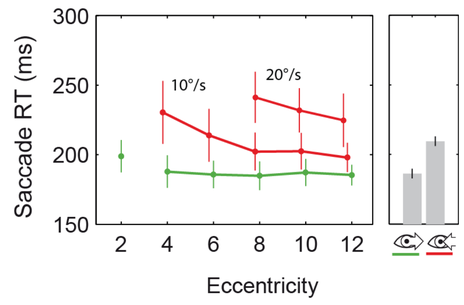
Ideal instrument scanning patterns treat one instrument as the central reference node, External world is not ideal for error estimation as it can introduce reference bias.





Eye-movements during steering include fast saccades to new targets and slow pursuit of one's trajectory or other moving vehicles. A moving target's position and velocity determines how likely and how fast we are to look at it.





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