

UNITED STATES ARMY AEROMEDICAL RESEARCH LABORATORY



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## **Evaluating Eye Tracking in Simulated Aviation Environments for U.S. Army Operator State Monitoring**

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13. Supplementary Notes (continued)

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# Evaluating Eye Tracking in Simulated Aviation Environments for U.S. Army Operator State Monitoring

Aura, C.<sup>1</sup>, Vogl, J.<sup>1,2</sup>, McAtee, A.<sup>1,2</sup>, Feltman, K.<sup>1</sup>, Temme, L.<sup>1</sup>, St. Onge, P.<sup>1</sup>

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## Background

- Developments in eye tracking technology have enabled researchers' better access to gaze and pupillary behavior in a wider range of settings.
- Changes in gaze patterns and eye movement dynamics, allow the assessment of cognitive workload, fatigue, and situational awareness in military operational environments, including within the aircraft.
- Changes in pupil diameter reflect the tone of the autonomic nervous system, also potentially revealing changes in cognitive workload, arousal, and stress.
- Eye Tracking can provide unique insights into operator state and physiological condition through passive, non-invasive measurement, and may be an important instrument in the operator state monitoring toolkit of tomorrow's military aviation needs.
- Head-mounted systems may be better suited to operational research

## Methods



6-Axis 2b-38 UH-60R Research Simulator  
 USAARL Flight Systems Branch.



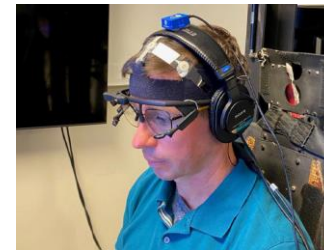
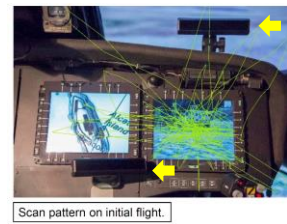
Pupil Core Binocular System  
 Pupil Labs (Berlin, Germany).



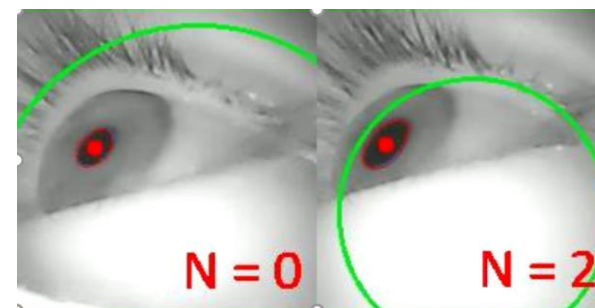
## Results

Initial efforts with dash mounted system resulted in >60% data loss.

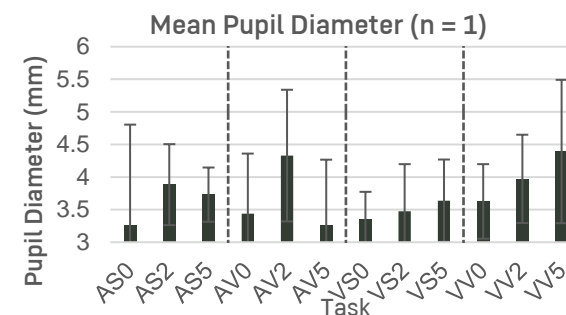
We saw changes in gaze behavior as the participants learned the new cuing display.



- Initial efforts with head-mounted system has resulted in <20% data loss.



- Thorough data analysis is underway, but initial reports look very promising.



## Discussion

### Head-Mounted Eye Tracking in UH-60M Flight Simulators Impressions

#### Pros:

1. Less data loss
2. Simple calibration
3. Mostly impervious to head movements
4. Vibration dampening of neck
5. Closer view of the eye improves potential pupil resolution

#### Cons:

1. More complex to register gaze to environment
2. Potential to add weight to head
3. Elements near eyes poses risk for some operational settings
4. Slippage

## Future Directions

- 6 Simulator-based studies starting in fiscal year 2023 at the U.S. Army Aeromedical Research Laboratory are using eye-tracking
- Developing designs to improve and expand mounting solutions for small eye cameras:
  - Improve Comfort and Reduce Slippage
  - Helmet/night vision goggle Mounts
- Data quality vs. mounting configuration on UH-60M cockpit study.
  - Desktop-mounted Single Camera (GP3HD, Gazepoint, Vancouver, Canada)
  - Desktop-mounted Multi-camera Arrays (ProDX, Smart Eye, Gothenberg, Sweden)
  - Head-mounted Cameras (Pupil Core Binocular, Pupil Labs, Berlin, Germany)
- Data synchronization with USAARL's UH-60M simulators and operator state monitoring systems using Lab Streaming Layer
- USAARL's simulators are now networked together.

## References

Hayes, A., Feltman, K., & Aura, C. (2020). Pupillometric workload measurement in the 360 degree integrated cueing environment. Proceedings of the Vertical Flight Society Annual Forum.

Feltman, K.A., McAtee, A., St. Onge, P., Aura, C., Stewart, J., Hartnett, G., Hicks, J., Durbin, D., Godfrey-Cooper, M., & Miller, J. (2020). Pilot cueing for 360° obstacle awareness during DVE mission. (USAARL Report No. USAARL-TECH-FR-2020-26). U.S. Army Aeromedical Research Laboratory.





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