

WG 8 (Aerospace Medicine)

PilotSense - Multimodal Physiologic Monitoring of Combat Pilots in Extreme Environment

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X-Trodes Company.

Background:

Combat pilots are subjected to quick altitude dynamics and high accelerations and manage complex systems in rapidly changing environments. These conditions might cause perilous physiological events, including spatial disorientation (SD), g-induced loss of consciousness (g-LOC) and hypoxia. The operational conditions might incur sleep deficiency, cognitive overload, and excessive time on task. Together, these physiological and mental factors account for the majority of military aviation safety incidents.

Purpose:

Electrophysiologic data can be useful in identifying physiological events and mental conditions. Electroencephalography (EEG), electrocardiography (ECG), electrooculography (EOG) and electromyography (EMG) have previously been demonstrated to support reliable indicators in research settings. However, their translation to operational environments has been challenged by their size and their wired nature. In this work, we evaluated a novel low-footprint wireless device optimized for extreme environments.

Methods and Preliminary Results:

PilotSense (X-trodes inc.) uses printed dry electrode arrays to provide EEG, ECG, EOG and EMG data using small wireless patches. Multiple sensing modalities are integrated into a single patch. The dry electrode technology enables stable signal quality with sweat and movement. The wireless nature and small size enable standalone use in the combat aircraft environment.

Performance in high-acceleration environments has been initially evaluated in centrifuge and motorsport settings. In centrifuge settings, early results demonstrated reduced delta and theta activity related to a g-LOC event. In motorsport settings, Event Related Spectral Perturbation (ERSP) analysis demonstrated increased alpha and beta activity before sharp turns. Usability has been assessed in training combat flights.

Discussion:

PilotSense is a novel solution enabling electrophysiologic measurements in extreme environments. The patches are soft, thin and self-applicable. They are FDA approved to provide data quality equivalent to traditional systems. They are compatible with standard protective gear, communication devices and life support systems. PilotSense is currently being evaluated in debriefing use. Next steps will include integration with flight monitoring systems to support real time monitoring and alerts.

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Relationship Between Eye Examination and Timing Among Aircrew Candidates

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Background:

Vision plays a crucial role in daily life and is especially critical in aviation. In this study, we examine how the timing of eye exams influences their results for candidates applying to the Israeli Air Force Flight Academy. Since 2024, eye exams have been scheduled after candidates undergo a 4–5-hour computer-based test. The aim of the study is to assess whether the timing of the eye exam affects test outcomes.

Methods:

The study included candidates who failed their eye exams between 2019 and 2024. The cohort consisted of healthy young adults with no known ocular conditions, all highly motivated to perform well in vision tests. Each candidate underwent a thorough eye exam conducted by trained military optometrists and ophthalmologists. The study tracked disqualification reasons and categorized them accordingly. The eye exams involved tests for visual acuity (near and far), color vision, keratoconus, and a comprehensive binocular evaluation.

Results & Conclusions:

There was a significant increase in strabismus cases, with 140 recorded in 2024, compared to 85 in 2023 and 52 in 2022. This trend raises concerns about the impact of the timing of eye exams. The exams, scheduled after lengthy computer sessions, may contribute to visual fatigue, potentially affecting binocular function and increasing disqualification rates. The study suggests that the timing of vision assessments should be reconsidered to ensure accurate results and reduce unnecessary disqualifications. Further research is needed to explore how digital strain affects vision testing protocols in aviation.