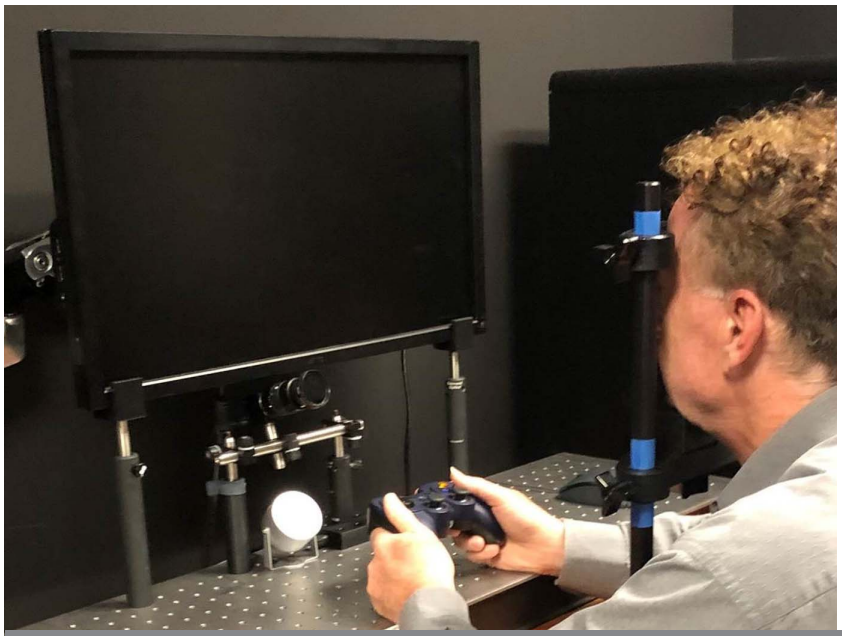


National Aeronautics and Space Administration

TECHNOLOGY SOLUTION

Health, Medicine and Biotechnology

Oculometric Testing for Detecting/Characterizing Mild Neural Impairment

Comprehensive Oculomotor Behavioral Response Assessment (COBRA)

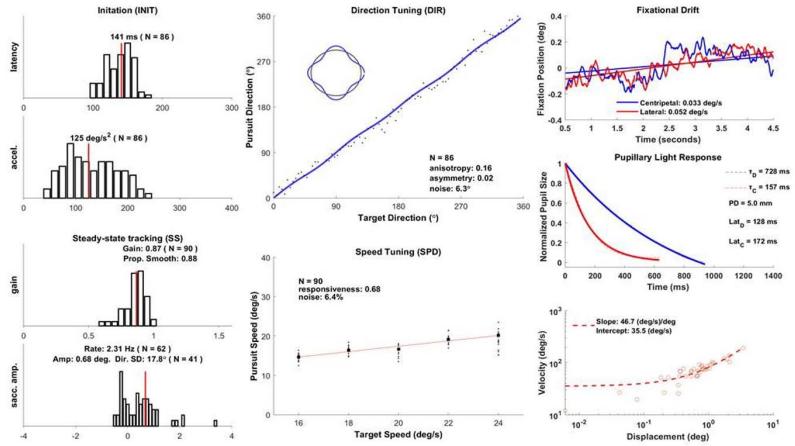
This novel technology is a screening tool to screen for neurological disorders or injury detecting oculomotor signatures. The tool can be used to measure/monitor the severity and nature of such symptoms. Eye movements are the most frequent, shortest-latency, and biomechanically simplest voluntary motor behavior, and thus provide a model system to assess perceptual and sensory processing disturbances arising from trauma, fatigue, aging, environmental exposures, or disease states. Scientists at NASA have developed and validated a rapid, non-invasive, eye-movement-based testing system to evaluate neural health across a range of brain regions. The technology applies a 5-minute behavioral tracking task consisting of randomized step-ramp radial target motion to capture several aspects of neural responses to dynamic visual stimuli, including pursuit initiation, steady-state tracking, direction and speed tuning, pupillary responses, and eccentric gaze holding.

BENEFITS

- Fast: scans take ~5 minutes
- Portable: compact, deployable system
- Inexpensive compared to CT/MRI or other current clinical imaging systems
- Evaluates status of brain function, not structure, so has direct operational implications
- Does not expose patients to radiation
- Analysis routines are automated and compatible with disparate data collection methods
- Customized user defined setting in software

THE TECHNOLOGY

To assess various aspects of dynamic visual and visuomotor function including peripheral attention, spatial localization, perceptual motion processing, and oculomotor responsiveness, NASA developed a simple five-minute clinically relevant test that measures and computes more than a dozen largely independent eye-movement-based (oculometric) measures of human neural performance. This set of oculomotor metrics provide valid and reliable measures of dynamic visual performance and may prove to be a useful assessment tool for mild functional neural impairments across a wide range of etiologies and brain regions. The technology may be useful to clinicians to localize affected brain regions following trauma, degenerative disease, or aging, to characterize and quantify clinical deficits, to monitor recovery of function after injury, and to detect operationally-relevant altered or impaired visual performance at subclinical levels. This novel system can be used as a sensitive screening tool by comparing the oculometric measures of an individual to a normal baseline population, or from the same individual before and after exposure to a potentially harmful event (e.g., a boxing match, football game, combat tour, extended work schedule with sleep disruption, blast or toxic exposure, space mission), or on an ongoing basis to monitor performance for recovery to baseline. The technology provides set of largely independent metrics of visual and visuomotor function that are sensitive and reliable within and across observers, yielding a signature multidimensional impairment vector that can be used to characterize the nature of a mild deficit, not just simply detect it. Initial results from peer-reviewed studies of Traumatic Brain Injury, sleep deprivation with and without caffeine, and low-dose alcohol consumption have shown that this NASA technology can be used to assess subtle deficits in brain function before overt clinical symptoms become obvious, as well as the efficacy of countermeasures.



COBRA summary chart. This full set of oculometrics illustrates the wealth of data captured in 5 minutes. The pattern of effects across metrics is different depending on the cause of the neural impairment, thus potentially supporting future diagnostic and therapeutic decisions.

APPLICATIONS

The technology has several potential applications:

- Sports training and medicine
- Military and Aerospace readiness-to-perform
- Medicine
  - Hospitals (ER and Trauma Centers)
  - Ophthalmology clinics
  - Universities
  - Clinical research facilities

PUBLICATIONS

Patent No: 9,730,582; 10,463,249; 11,419,494; 10,420,465

https://doi.org/10.1113/JP277779 Distinct pattern of oculomotor impairment associated with acute sleep loss and circadian misalignment - Stone - 2019 - https://journals.lww.com/optvissci/Fulltext/2017/01000/Oculometric_Assessment_of_Sensorimotor_Impairment.9.aspx The Journal of Physiology - Wiley Online Library; Oculometric Assessment of Sensorimotor Impairment Associated with TBI - Optometry and Vision Science 94(1)

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NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

ARC-17386-1, ARC-17386-2, ARC-17386-3, ARC-17837-1, TOP2-268

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NP-2015-05-1848-HQ