

# Multimodal Neurodiagnostic Tool for Exploration Missions

## *For detecting stress markers and providing actionable feedback*

Linea Research Corporation has developed a neurodiagnostic tool that detects behavioral stress markers for astronauts on long-duration space missions. Lightweight and compact, the device is unobtrusive and requires minimal time and effort for the crew to use. The system provides a real-time functional imaging of cortical activity during normal activities.

In Phase I of the project, Linea Research successfully monitored cortical activity using multiparameter sensor modules. Using electroencephalography (EEG) and functional near-infrared spectroscopy signals, the company obtained photoplethysmography and electrooculography signals to compute the heart rate and frequency of eye movement. The company also demonstrated the functionality of an algorithm that automatically classifies the varying degrees of cognitive loading based on physiological parameters.

In Phase II, Linea Research developed the flight-capable neurodiagnostic device. Worn unobtrusively on the head, the device detects and classifies neurophysiological markers associated with decrements in behavior state and cognition. An automated algorithm identifies key decrements and provides meaningful and actionable feedback to the crew and ground-based medical staff.

## Applications

### NASA

- ▶ Monitoring behavioral health of astronaut crew during long-duration space missions
- ▶ Training for the psychological challenges of extended space missions

### Commercial

- ▶ Diagnoses and treatment of various neurologic diseases:
  - Multiple sclerosis
  - Epilepsy
  - Tumors
  - Brain abscesses
- ▶ Sleep monitoring
- ▶ Head injury and post-surgery evaluations
- ▶ Psychiatric illness evaluations
- ▶ Ambulatory, multimodality functional imaging of cortical activity



## Phase II Objectives

- ▶ Design and fabricate an unobtrusive, flight-capable device that can be deployed for neurodiagnostic monitoring
- ▶ Develop algorithms that use the multimodality measurements to automatically classify neurophysiological markers associated with decrements in behavior
- ▶ Demonstrate and verify that the system provides feedback and automatically recommends countermeasures based on the neurophysiological data

## Benefits

- ▶ Monitors behavioral health of astronaut crew during space missions
- ▶ Facilitates training for the challenges of extended space deployments
- ▶ Diagnoses various neurological diseases and psychiatric illnesses
- ▶ Permits autonomous operation
- ▶ Is unobtrusive and automated

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