

menus, sliders, text boxes, radio buttons, and check boxes. Task completion time is recorded.

In Task 8, a circular track is presented with a disc in it at the top. Track width and disc size are adjustable. The task is to move the disc with circular motion

within the path without touching the boundaries of the track. Time and errors are recorded.

Task 9 is a discrete task that allows evaluation of discrete cursor control devices that tab from target to target, such as a castle switch. The task is to follow a

predefined path and to click on the yellow targets along the path.

*This work was done by Kritina Holden, Aniko Sandor, John Pace, and Shelby Thompson of Lockheed Martin for Johnson Space Center. Further information is contained in a TSP (see page 1). MSC-25214-1*

## Functional Near-Infrared Spectroscopy Signals Measure Neuronal Activity in the Cortex

**This non-invasive monitoring method can be used to evaluate the mental state of people performing critical tasks.**

*John H. Glenn Research Center, Cleveland, Ohio*

Functional near infrared spectroscopy (fNIRS) is an emerging optical neuroimaging technology that indirectly measures neuronal activity in the cortex via neurovascular coupling. It quantifies hemoglobin concentration ([Hb]) and thus measures the same hemodynamic response as functional magnetic resonance imaging (fMRI), but is portable, non-confining, relatively inexpensive, and is appropriate for long-duration monitoring and use at the bedside. Like fMRI, it is noninvasive and safe for repeated measurements. Patterns of [Hb] changes are used to classify cognitive state. Thus, fNIRS technology offers much potential for application in operational contexts. For instance, the use of fNIRS to detect the mental state of commercial aircraft operators in near real time could allow intelligent flight decks of the future to optimally support human performance in the interest of safety by responding to hazardous mental states of the operator. However, many

opportunities remain for improving robustness and reliability. It is desirable to reduce the impact of motion and poor optical coupling of probes to the skin. Such artifacts degrade signal quality and thus cognitive state classification accuracy. Field application calls for further development of algorithms and filters for the automation of bad channel detection and dynamic artifact removal.

This work introduces a novel adaptive filter method for automated real-time fNIRS signal quality detection and improvement. The output signal (after filtering) will have had contributions from motion and poor coupling reduced or removed, thus leaving a signal more indicative of changes due to hemodynamic brain activations of interest. Cognitive state classifications based on these signals reflect brain activity more reliably. The filter has been tested successfully with both synthetic and real human subject data, and requires no auxiliary measurement.

This method could be implemented as a real-time filtering option or bad channel rejection feature of software used with frequency domain fNIRS instruments for signal acquisition and processing. Use of this method could improve the reliability of any operational or real-world application of fNIRS in which motion is an inherent part of the functional task of interest. Other optical diagnostic techniques (e.g., for NIR medical diagnosis) also may benefit from the reduction of probe motion artifact during any use in which motion avoidance would be impractical or limit usability.

*This work was done by Angela Harnivel and Tristan Hearn of Glenn Research Center. Further information is contained in a TSP (see page 1).*

*Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Glenn Research Center, Innovative Partnerships Office, Attn: Steven Fedor, Mail Stop 4-8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-18952-1.*

## ESD Test Apparatus for Soldering Irons

**Prior lengthy testing now takes less than a minute.**

*Goddard Space Flight Center, Greenbelt, Maryland*

ESDA (Electrostatic Discharge Association) ESD STM 13.1-2000 requires frequent testing of the voltage leakage from the tip of a soldering iron and the resistance from the tip of the soldering iron to the common point ground. Without this test apparatus, the process is time-consuming and requires several wires, alligator clips, or test probes, as well as additional equipment. Soldering iron tips must be tested for electrostatic

discharge risks frequently, and this typically takes a lot of time in setup and testing. This device enables the operator to execute the full test in one minute or less.

This innovation is a simple apparatus that plugs into a digital multimeter (DMM) and the Common Point Ground (CPG) reference. It enables the user to perform two of the electrostatic discharge tests required in ESD STM 13.1-2000.

The device consists of a small black box with two prongs sticking out of one end, two inputs on the opposite end (one of the inputs is used to connect the reference CPG to the DMM), and a metal tab on one side. Inside the box are wires, several washers of various materials, and assembly hardware (nuts and screws/bolts). The device is a passive electronic component that is plugged into a DMM. The operator sets