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 Harrivel 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 the DMM to read voltage. The operator places the heated tip of the soldering iron onto the metal tab with a small amount of solder to ensure a complete connection. The voltage is read and recorded. The operator switches the DMM to read resistance. The operator places the heated tip of the soldering iron onto the metal tab with a small amount of solder to ensure a complete connection. The resistance is recorded. If the recorded voltage and resistance are below a number stated in ESDA ESD STM 13.1-2000, the test is considered to pass.

The device includes all the necessary wiring internal to its body so the operator does not need to do any independent wiring, except for grounding. It uses a stack of high-thermal-resistance washers to minimize the heat transfer from the soldering iron to the wiring used to measure the resistance and voltages. This minimizes thermal error.

The device allows very rapid execution of a test that is performed frequently.

This work was done by José Sancho and Robert Esser of Goddard Space Flight Center. Further information is contained in a TSP (see page 1). GSC-16611-1

FPGA-Based X-Ray Detection and Measurement for an X-Ray Polarimeter

Goddard Space Flight Center, Greenbelt, Maryland

This technology enables detection and measurement of x-rays in an x-ray polarimeter using a field-programmable gate array (FPGA). The technology was developed for the Gravitational and Extreme Magnetism Small Explorer (GEMS) mission. It performs precision energy and timing measurements, as well as rejection of non-x-ray events. It enables the GEMS polarimeter to detect precisely when an event has taken place so that additional measurements can be made. The technology also enables this function to be performed in an FPGA using limited resources so that mass and power can be minimized while reliability for a space application is maximized and precise real-time operation is achieved.

This design requires a low-noise, charge-sensitive preamplifier; a high-speed analog to digital converter (ADC); and an x-ray detector with a cathode terminal. It functions by computing a sum of differences for time-samples whose difference exceeds a programmable threshold. A state machine advances through states as a programmable number of consecutive samples exceeds or fails to exceed this threshold. The pulse height is recorded as the accumulated sum. The track length is also measured based on the time from the start to the end of accumulation. For track lengths longer than a certain length, the algorithm estimates the barycenter of charge deposit by comparing the accumulator value at the midpoint to the final accumulator value. The design also employs a number of techniques for rejecting background events.

This innovation enables the function to be performed in space where it can operate autonomously with a rapid response time. This implementation combines advantages of computing system-based approaches with those of pure analog approaches. The result is an implementation that is highly reliable, performs in real-time, rejects background events, and consumes minimal power.

This work was done by Kyle Gregory, Joanne Hill, and Kevin Black of Goddard Space Flight Center, and Wayne Baumgartner of the University of Maryland. For further information, contact the Goddard Innovative Partnerships Office at (301) 286-5810. GSC-16367-1

Sequential Probability Ratio Test for Spacecraft Collision Avoidance Maneuver Decisions

Goddard Space Flight Center, Greenbelt, Maryland

A document discusses sequential probability ratio tests that explicitly allow decision-makers to incorporate false alarm and missed detection risks, and are potentially less sensitive to modeling errors than a procedure that relies solely on a probability of collision threshold. Recent work on constrained Kalman filtering has suggested an approach to formulating such a test for collision avoidance maneuver decisions: a filter bank with two norm-inequality-constrained epoch-state extended Kalman filters. One filter models the null hypotheses that the miss distance is inside the combined hard body radius at the predicted time of closest approach, and one filter models the alternative hypothesis. The epoch-state filter developed for this method explicitly accounts for any process noise present in the system. The method appears to work well using a realistic example based on an upcoming, highly elliptical orbit formation flying mission.

This work was done by J. Russell Carpenter and F. Landis Markley of Goddard Space Flight Center. For further information, contact the Goddard Innovative Partnerships Office at (301) 286-5810. GSC-16333-1.