The goal of the Information Presentation Directed Research Project (DRP) is to address design questions related to the presentation of information to the crew on flight vehicles, surface landers and habitats, and during extra-vehicular activities (EVA). Designers of displays and controls for exploration missions must be prepared to select the text formats, label styles, alarms, electronic procedure designs, and cursor control devices that provide for optimal crew performance on exploration tasks. The major areas of work, or subtasks, within the Information Presentation DRP are: 1) Controls, 2) Displays, 3) Procedures, and 4) EVA Operations.

## CONTROLS – Cursor Control

The unique environmental conditions encountered by crewmembers on space missions (vibration, varied gravity, vacuum requiring pressurized suits) translate into specific design requirements for crew interaction with information presented on computer displays. Cursor control devices (CCDs) must be specially designed to function under the variable, harsh conditions of space.

### Partnerships and Collaborations

The cursor control device work described below has fed and supplemented concurrent work on Orion cursor control device validation. Results of these studies have led Orion device down selection, and software development for the effort being used for Orion cursor control device evaluations.

### Text Battery

One of the first goals of the DRP project was to develop a comprehensive text battery that could be used to evaluate a number of different types of cursor control devices. The text battery provides a standardized methodology for measurement, and will be in use by any researcher interested in evaluating cursor control devices.

A collection of 70 tasks consisting of CZT, dragging and dropping, and interaction with standard interface components.

### Cursor Movement Study

In addition to investigating cursor control device hardware, the behavior of the cursor on the computer screen is an area of investigation as well. An upcoming study will experimentally compare task performance with a cursor in the following modes: continuous, discrete, gravity well. Later studies will examine advantages and disadvantages of type of cursor movement under different environmental conditions: vibration, microgravity. These studies will provide recommendations for cursor movement under different environmental conditions.

### Pressurized Gloved Cursor Control Study

A study was performed in collaboration with the Orion Concept Working Group using EVA gloves to gain a better understanding of the controls required for EVA tasks. Additional conclusions were developed to feed forward into the design of a cursor control device for Orion.

### Procedures

- At Electronic Procedure Viewer (EPV) is one of the most operationally critical interfaces for next-generation crewed space vehicles, particularly for real-time fault isolation and recovery operations.
- We recently completed a human-in-the-loop evaluation of two fault management concepts, one (BESI) where the EPV is functionally integrated with an Advanced Caution and Warning (CAW) System, and another less advanced concept (ELSIE) with no functional connections between the EPV viewer and the CAW system.

### Displays - Label Orientation

#### Results: Text Orientation

This confirms that horizontal alignment is the preferred type for display of labels.

Next Steps: Additional studies need to be done to further evaluate vertical text styles, incorporating more complex displays, additional practice, and time pressure.

### Displays - Label Alignment

#### Results: Label Alignment

Vehicle displays are often made up of many columns of labeled data values. Design direction on alignment of these columns of data varies in the literature. The goal of this study was to experimentally compare various types of alignment.

Next Steps: Additional studies need to be done to further evaluate label alignment, incorporating more complex display, additional practice, and time pressure.

### Displays - Auditory Alarms

#### Results: Auditory Alarms

Within each task there was one hidden reference representing the existing alarm used on current space vehicles for each condition, and five alternative alarms based on results from a previous study of alarms by the same authors.

Next Steps & Impact: Crew participants are currently being used in the study. A validation study will be done to confirm the results before recommendations are made. Results will be submitted to Orion and Constellation standards documents.

### DISPLAYS - Orientation

#### Results: Text Orientation

The cursor control device work described below has fed and supplemented concurrent work on Orion cursor control device validation. Results of these studies have led Orion device down selection, and software development for the effort being used for Orion cursor control device evaluations.

A collection of 70 tasks consisting of CZT, dragging and dropping, and interaction with standard interface components.

### DISPLAYS - Controls

#### Results: Text Battery

The text battery provides a standardized methodology for measurement, and will be in use by any researcher interested in evaluating cursor control devices.

### DISPLAYS - Procedures

#### Results: BESI Fault Management Display

- **ELSI Fault Management Display** at the outset of procedure
- **EPV Fault Management Display** at the outset of Procedure
- **Advanced Caution and Warning System**
- **BESI Fault Management Display** at the outset of Procedure
- **Magenta box highlights system component associated with root cause list**
- **Fault management display shows the point where participant has diagnosed malfunction and is starting to work procedures through the EPV**
- **Blue (Current Focus) line is one of many cues to help operator navigate through the steps in the procedure checklist**

### EVA OPERATIONS

Working in space or extravehicular activities presents great challenges in terms of displays, controls, and crew information, especially in the harsh lunar environment. This is a new adaptation for FY19.

Work will be completed in the areas of:

- **EVA displays**
- **Video feed back and fine-motion control during EVA operations**
- **Near-eye and auditory displays**

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