

## GRASP Visual Displays for Review

The GRASP experiment is designed to probe for changes in eye-hand coordination on orbit. Subjects (astronauts) perform a video game-like task using virtual reality that consists of shooting a projectile out of a hand-held tool toward a target. The target and the projectiles are presented as a line of sphere that can have different orientations in space. Since the line of targets and projectiles are long and narrow, the tool must be placed at the same orientation as the target to achieve success.

GRASP studies the mental representation of the target's orientation by having subjects shoot the projectile to the *remembered* target orientation. The target is presented only briefly, then disappears. The subject then triggers the projectiles after a waiting period of about 5 seconds.

GRASP goes further to study how the brain represents objects in extra-corporal space. On most trials, the subject is required to move the head between the time that the target is present and the moment of the response. The subject must take into account that the object would no longer be at the same orientation with respect to the eyes when producing the response.

Trials vary in terms of what can be seen and felt during the execution of the task, organized into three different experimental paradigms:

- In the main task (Visual-Manual) the subject can see the target but must trigger the projectiles without being able to see the orientation of the hand.
- In one variant (Visual-Visual) the subject can see both the target and the hand.
- In a second variant (Manual-Manual) the subject is not presented with an oriented visual target. Instead, he or she is guided by color cues to place the hand at the desired target orientation. The subject must memorize this orientation, lower the hand, wait for 5 seconds, and then reproduce the remembered orientation.

In practical terms, subjects perform repeated trials of one of these paradigms during each of three sub-sessions.

The subject also performs the experiment in two different postural conditions:

- On orbit, subjects are either strapped in an upright, seated position with respect to the ISS module, or for other trials, are maintained in a state of quasi-freefloating with no

contact with the floor, walls or ceiling of the ISS module.

- On the ground subjects perform the experiment seated securely in a chair that may be upright or may be tilted with respect to gravity.

The details of the experiment design can be found elsewhere (e.g. the ESR). In this document we present the different visual displays that subjects and operators will see when performing the GRASP experiment. The document is organized as follows:

- This Introduction
- Graphical User Interface that controls the experiment on the Perspectives laptop computer.
- Instructions presented to the operator during hardware preparation.
- Screens for the Visual-Visual Task
  - Instructions (presented in the GUI)
  - VR Scenes (presented in the Virtual Reality Helmet)
- Screens for the Manual-Manual Task
  - Instructions (presented in the GUI)
  - VR Scenes (presented in the Virtual Reality Helmet)
- Screens for the Visual-Manual Task
  - Instructions (presented in the GUI)
  - VR Scenes (presented in the Virtual Reality Helmet)
- Additional messages that the subject may see inside the VR display.