AUGMENTED REALITY FOR SPACE FLIGHT

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Augmented Reality for Space Flight is an investigation of crew task guidance with video imagery augmented with computer graphics. With augmented reality (AR), graphic elements are registered to specific features in video scenes, such as a descriptive text banner appearing in the videorecord that is continuously linked to the locking mechanism of a hatch during operation of the hatch. Empirical evidence suggests that annotations registered to features in real-world scenes present a substantial advantage for communicating task details, and implies that a new method for guiding human performance could be developed with this technology.

In this project, we examined requirements for guiding crew tasks with AR, and determined that the existing ISS communication infrastructure, and likely future Mars mission communication, would support this approach. We developed an AR tracking and authoring system to enable authoring, that is, to review a videorecord, design an annotation plan according to the task guidance needed by a crew member, and add and link graphics to selected features appearing in the video. Tests with this tracking and authoring interface allowed us to discover opportunities for interface improvements, including preview modes and text banner expansion.

The core component of the AR authoring system is an image feature tracking technology we developed. The technique is unique in its integrated usage of region tracking and point tracking that integrates three motion analysis modules - feature selection, tracking, and verification, in a closed-loop cooperative manner to adaptively cope with complex and dynamic imaging conditions. The system also has an interactive interface that allows users to easily acquire, track, edit, and author the video stream as frames in a time-line. The interface provides an integrated working environment, a variety of extendable function buttons, time-line edit functions, and task control. Operational modes include (1) Video acquisition; (2) Video pre-processing; (3) Database management including text labels, 2D/3D objects, and URL web-links; (4) Video feature tracking with support for both automatic and manual operations, bi-directional tracking, and multi-pass tracking for verification and refinement; (5) Annotation authoring for attaching 2D or 3D annotations; (6) Media playback for viewing and controlling annotated video; and (7) Web link*:* link annotations providing web data in neighboring browser windows. In this framework, we emphasized the factors of human performance that provide a convenient and flexible authoring environment.

From recent advancements to the software, more efficient authoring brought about a refined definition of the objectives of annotations on motion imagery; that is, what crew performance needs (behavioral and cognitive) could be supported within the context of a task demand. These included an aid to interpreting the action in imagery, clarifying obscured views, communicating the dynamics of complex motion, and others. We

designed a pilot study to determine the constraints inherent in use of the software, focusing, in the study, on an informal examination of the effects of annotations on attention to features of a workpiece shown in a video. Only minor evidence was found that annotations diminish attention to workpiece features. With the pilot study completed, a simple comparison of authoring speed with and without tracking capabilities is now underway. Following this comparison, we intend to examine task guidance in two segments: the first segment will be an investigation of the effect of augmented scenes on recall for features shown in a video, the second segment will be an investigation of effectiveness of task guidance where the baseline is non-annotated video.