NASA PHOTO

Astronaut Joseph Tanner, STS-115 mission specialist, performs work on the Boeing-built P3/P4 truss on the International Space Station last month. Boeing is working on a technology called augmented reality that could support NASA's training efforts for space-based endeavors.

Now see this

Boeing's working on augmented reality, which could change space training, ops

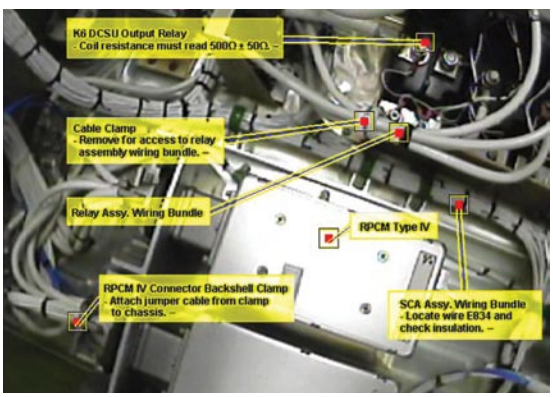
By Ed Memi

When NASA begins the six-month trek to Mars someday, astronauts will face the daunting task of operating and maintaining numerous systems that might unexpectedly break, or maybe having to perform life-saving surgery. Because of time delays of more than 15 minutes, communications back to earth can be a problem. And it's difficult for a crew member to remember every detail of every system.

That's where "augmented reality" can help reduce training requirements and communicate complicated technical instructions. Augmented reality is a machine vision and computer-graphics technology that overlays graphic additions on views of the real world. The hallmark of AR is that the graphics are spatially registered; that is, they are positioned in the viewed scene relative to the positions of actual objects.

Former astronaut Rich Clifford is leading Boeing efforts to create an AR demonstration project on the International Space Station and hopes to show NASA the value of AR in terms of savings over traditional training methods. Boeing Phantom Works is providing the research and development for this demonstration project.

Anthony Majoros, a Phantom Works product engineer in Human Systems Integration and a Technical Fellow, said AR operates by determining a viewer's direction of gaze and merging graphics into the viewer's perspective. The resulting composite view is displayed on a conventional monitor or on a head-mounted display screen.



BOEING PHOTO

In this single frame from an augmented reality session, graphic additions are positioned relative to features in a scene. As the viewpoint changes, the graphics change positions as if attached to the features. Boeing hopes to create an augmented reality demonstration project on the International Space Station.

"AR adds information to observed scenes, eliminates the need to search for information, and eliminates the time it takes to mentally associate information with objects," Majoros said. For example, the AR "view" when performing tasks such as the removal and replacement of a printed circuit board could include graphic text boxes with instructions and leader lines "attached" to features (e.g., fasteners) that are important in the task sequence.

"AR could revolutionize human spaceflight by replacing time-consuming task-based instruction with skills-based training," Clifford said. "Astronauts can be taught the basics of making repairs and then can reference AR for more detailed procedures to accomplish needed repairs."

Majoros said learning is easier when information about objects and devices is embedded in viewed scenes. Added Paul Jackson, advanced design systems engineer for Phantom Works: "AR can be difficult to visualize without seeing examples, but single frames captured from AR sessions help."

Properties of AR such as spatial registration, feature tracking and rapid authoring produce methods that are adaptable to human space flight requirements. That adaptability is central to Clifford's vision. For example, detailed procedural instructions to complement skill-based training can be generated with AR overlays based on video documentation; and downlinked video from spaceflight crews can be rapidly annotated and then uplinked to help crewmembers resolve anomalies.

Clifford said skill-based training is a key transformation needed to reduce the cost of space travel, and AR is an enabling media form for skill-based training. "With AR, we could eliminate repetitive task instruction, and crews could access an AR library that can be updated by ground crews," Clifford said. He added that AR could allow astronauts to go through the refresher steps of performing critical space tasks. In addition, AR can save money by reducing paper procedures while significantly decreasing training, operations and logistics requirements. ■

edmund.g.memi@boeing.com