Virtual *Cockpit* *Becomes* Reality

by Roger Roberts and Joanne Hale

IMAGINE

what it would be like to fly an aircraft hundreds of miles an hour at low altitudes without the use of windows. Now imagine if scientists were able to replace each of the aircraft's windows with a real-time digital image of the aircraft's immediate surroundings. One group of JSC engineers has already taken the first steps in making that vision a reality.

NASA/Markowitz/Stafford JSC2004-00588

Members of the ACES team stand beside the ACES van as it prepares for testing at JSC's "Mars Yard."

The Advanced Cockpit Evaluation System (ACES) uses inexpensive desktop computers to produce live panoramic views of real-world environments. This synthetic view is created by using a combination of live video, advanced computer graphics and modern sensor technology.

On the outside, the ACES mobile command station appears standard in almost every respect. It resembles an average cargo van equipped with the most basic of options. But appearances can be deceiving.

"Sitting in the back of the van is like sitting in the cockpit of some sort of experimental aircraft," Jim Secor, ACES engineer, said. "Everything is there – a cockpit, controls and even windows. The only difference is our windows are actually monitors that look into a world where information is displayed across a continuous horizon."

ACES' view is achieved by blending live video with synthetic imagery sources such as satellite photos, heads-up displays and topographical imagery scans.

"If you depend solely on your eyes or video image to navigate, you will eventually find yourself in a situation where you are, in fact, flying blind," Jeff Fox, ACES team lead, said. "With ACES, if live video were to fail, then a synthetic virtual scene would be immediately available to maintain total situational awareness. Since ACES does not depend on line of sight to render its views, it can even be used in vehicles that have no windows at all."

ACES provides two ways to present the blend of video and synthetic imagery. The primary method allows images to be displayed on five flat-panel computer monitors. These monitors are located in the rear of the van and are arranged in a semicircle designed to mimic a forward field of view. The middle monitor displays live video while the remaining four monitors recreate the rest of the scene using computer graphics.

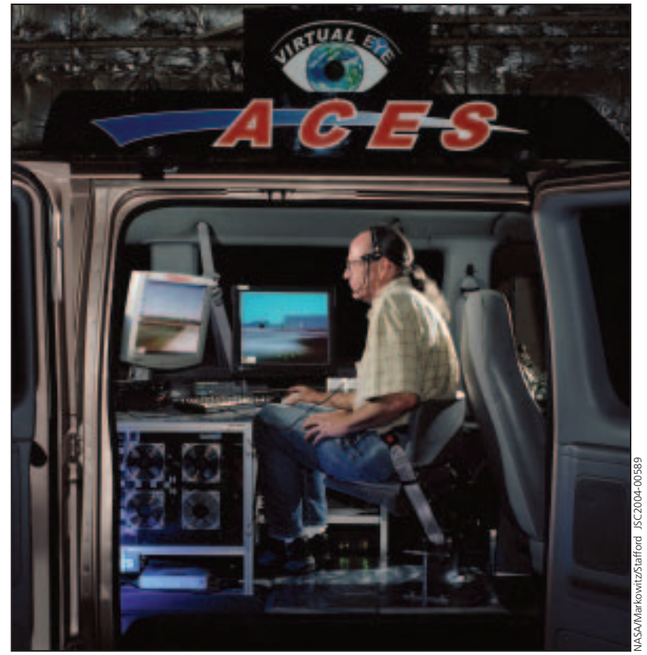
In addition to the monitor configuration, ACES also has a helmet-mounted display system that creates a digital view of reality.

"Inside the van there are seven state-of-the-art computers that work in parallel to process the sensor data to generate an immersive 3-D environment," Patrick Laport, ACES software integration engineer, said. "Basically, ACES makes you feel like you've stepped into the greatest video game of all time."

The capacity to present basic information such as speed and altitude on top of live video imagery is only the beginning of ACES' potential.

"We are currently working with the Federal Aviation Administration to design a system that will help pilots land both commercial and general aviation aircraft," Laport said. "Currently, pilots must use a combination of instrumentation and textual procedures to plan their final approach. With ACES, we can combine all necessary information into a single graphic interface that would give pilots a complete 3-D view of their current environment."

Recently, in the high deserts of Arizona, ACES' versatility proved useful in supporting the ongoing testing of NASA's prototype planetary rover, also known as the Science Crew Operations and Utility Testbed (SCOUT).



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Jim Secor, ACES engineer, oversees synthetic vision operations from inside the ACES van/mobile command station.

"Using the ACES mobile command station, our team was able to easily interface with and remotely control SCOUT in both day and nighttime operations," Fox said. "With only a few seconds' communication delay to the moon, the situational awareness provided by ACES may give future lunar rover pilots the vision necessary for enhanced real-time remote control from the Earth itself."

"Though it may be a while, the day is coming when ACES, and projects like it will become a part of everyday life," Coffman said. "In the future, cars, planes and spacecraft may all exist in a world where the options are limited only by our capacity to understand and create them. It's only a matter of time."

With the myriad of possibilities represented by the ACES project, Fox said he believes one attribute remains key in distinguishing it amongst its peers.

"ACES' main attribute lies in its relative affordability," Fox said. "While it's true other technologies currently emulate some of ACES' abilities, many of them are higher-priced systems. Since ACES is comprised almost entirely of off-the-shelf hardware, it maintains an adaptability factor that makes it ideal for exploring possibilities in a wide range of environments."

While Fox and his team continue to make advancements in ACES technology, the project remains in its infancy.

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ACES mobile command station remotely controls SCOUT in the Mars-like environment of the Arizona desert.