Space researchers developing tool to help disoriented pilots

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Not knowing which way is up can have deadly consequences for pilots. This confusion of the senses, called spatial disorientation, is responsible for up to 10 percent of general aviation accidents in the United States, with 90 percent of these being fatal, according to the Federal Aviation Administration.

Although there have been no spatial disorientation accidents in space, it is a major concern for astronaut pilots. A National Space Biomedical Research Institute (NSBRI) study is tackling the issue by developing a tool that will assist pilots in real-time to overcome spatial disorientation.

Project leader Ron Small said the first step is to understand the factors leading to spatial disorientation, which tends to occur in poor visibility conditions. The root cause, though, is physiology.

"Humans are notoriously bad at figuring out their orientation when flying because we did not evolve in a flight environment, in contrast with birds," said Small, a member of NSBRI's Sensorimotor Adaptation Team. "It is worse in a spacecraft because the vehicle can move side to side, up and down, and rotate in all directions."

The project involves specially designed software that monitors the flight of the vehicle – speed, heading, pitch and altitude – and the actions of the pilot. The system will use audio and visual cues to alert pilots of problems before things get out of hand. The group is also looking at the option of testing a vest with pager-like vibrators distributed throughout

that vibrate in a sequence to alert the pilot when an orientation correction is needed.

"It is really important that the system alert pilots in real-time," said Small, a principal system engineer at Alion Science and Technology Corp., in Boulder, Colo. "We're not doing the pilot any good if we can only give advice after the fact."

Small is working closely with co-investigator Dr. Charles Oman, who is NSBRI's Sensorimotor Adaptation Team Leader and director of the Man Vehicle Laboratory at Massachusetts Institute of Technology. To better understand the problems facing astronauts, the group is building on information from Small's previous studies of spatial disorientation for the U.S. military and analyzing data from aircraft accidents and space missions. The group has consulted with experts such as former astronaut Dr. Thomas Jones.

"As we go forward with deep space exploration and return to the moon, it's important to provide the latest tools in the cockpit to help pilots from being misled by spatial disorientation," said Jones, a former U.S. Air Force pilot and veteran of four space shuttle flights. "Spatial disorientation mistakes in space are very rare, but because of mission costs and the potential for loss of life, you want to do everything possible to preclude them."

The group has tested the software's ability to detect spatial disorientation incidents. They are now working to better understand the differences in craft movement in the atmosphere and in space and how the human inner ear functions in both environments. The inner ear helps control the sense of orientation.

The researchers are putting emphasis on lunar landings due to the challenges of reduced gravity and the unfamiliar, dusty terrain. Data

collected from helicopters will play a large role in the research since the rotary-propelled aircrafts' movements are most like a spacecraft touching down on the moon. Low-gravity flight experiments and lunar lander simulations are slated to begin next year.

The project team members believe the onboard aids developed for spaceflight will be an essential tool for pilots of medical emergency helicopters, who often respond to auto accidents on dark, rainy nights when it is easy to become disoriented. Military and civilian pilots are also likely to benefit from the research.

"Pilots of small planes often have less training in spatial disorientation and how to respond to an incident," Jones said. "Their lives can be saved by having this extra help in the cockpit."

The NSBRI Sensorimotor Adaptation Team is developing pre-flight and in-flight training countermeasures so that astronauts can adjust more rapidly to weightlessness, to other gravitational environments, and upon return to Earth's gravity. The team is also developing training tools for telerobotic arm operation.

Source: National Space Biomedical Research Institute