Improving the HUMAN-MACHINE INTERFACE for Helo Pilots

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Helicopters operate at low altitude—within 500 feet of ground level. As helicopters evolve and become faster and more agile, their pilots will continue to navigate in this restricted environment at high speeds. By better understanding human-machine interactions, we can increase the safety of our rotary-wing aviators through improved training programs and cockpits. A project with the aim of reaching this goal is under way at the Modeling, Virtual Environments and Simulation (MOVES) Institute at the Naval Postgraduate School (NPS) in Monterey, Calif.

During the summer of 2011, I worked with Dr. Quinn Kennedy of the NPS operations research department and Dr. Ji Hyun Yang of MOVES on a collaborative effort between the university and the Navy that investigated human-machine interaction and helicopter pilots.

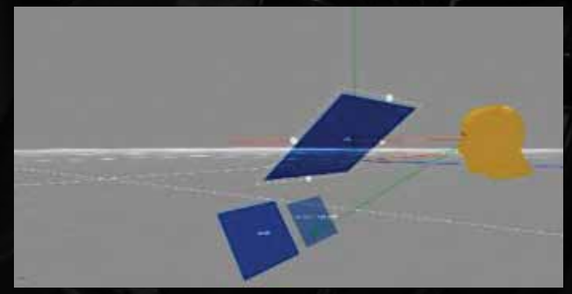
The project analyzed the visual scan patterns of pilots using a system called FaceLab, while the pilots flew in environments specifically encountered by helicopters. A scan pattern is defined as a series of head and eye movements that give insight as to how a pilot gains information about the aircraft and the environment. FaceLab collects face/head/eye data using infrared light. For this experiment, FaceLab used two pairs of fixed (as opposed to head-mounted) stereo cameras, two infrared light emitters, and two laptop computers. (Infrared emitters were needed to produce the level of infrared light necessary for the fixed stereo cameras to capture head and eye motion.)

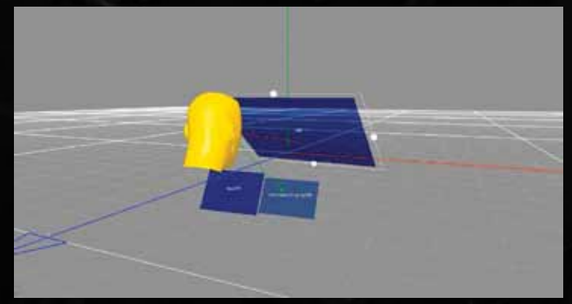
The system in use at NPS was merely a mock-up of a helicopter cockpit (chair, desk, and a large computer screen) created in the MOVES Institute's lab rather than an actual helicopter simulator. Despite these limitations, I approached Kennedy and Yang with the idea of taking FaceLab on the road for use in a simulator that represented a helicopter in service with the fleet. They agreed that getting FaceLab to the fleet was an important goal, and we were on our way to understanding better how helicopter pilots scan.

The amount of coordination necessary to obtain a simulator and pilots to support the project was staggering. After many phone calls, e-mails, and drives to NAS North Island, I obtained the permission and support required from Helicopter Sea Combat Wing Pacific, three North Island-based squadrons (the HSC-3 Merlins, HS/HSC-4 Black Knights, and HSC-21 Blackjacks), and NPS. In November 2011, we were ready to start our project in a working helicopter simulator. A research assistant from NPS accompanied me to the Tactical Operational Flight Trainer (TOFT) 2 at North Island, and we began our work.

Left: Pilots from three North Island-based squadrons recently participated in a Navy study on human-machine interaction—using flight simulations that mimicked the actual terrain they're used to flying around San Diego. (Photo by PM2 Daniel R. Mennuto)

TOFT-2 is a non-motion simulator used for training and evaluation of pilots flying the Navy's MH-60S. The simulator represented a Seahawk cockpit of the MH-60S and produced video quality that was more than sufficient to meet the needs of the study. Using charts donated by the squadrons and my experience as a naval helicopter pilot familiar with the San Diego air space, I was able to construct a low-level route the pilots would fly in the simulated airspace around the local area. The video quality of the simulator had everything I needed, from mountains to the occasional "widow maker" (a telephone pole or radio tower) on the route to keep the pilots busy. With the simulator, the FaceLab equipment, and the route of flight ready to go, all I needed were the pilots.





The experiment used systems that followed the eye movements of pilots as they looked from their instruments to outside the cockpit. (Photo from Naval Postgraduate School)

From the three squadrons, I was able to recruit 17 subjects for the trials. They were all Navy helicopter pilots from carrier-based (HS) and expeditionary helicopter (HSC) communities. In the preflight demographic surveys, the eight pilots from the HS squadron described themselves as primarily maritime operators. The nine pilots from the HSC squadrons described themselves as overland operators. All of the pilots except one were current in the MH-60S. Of the 17 participants, 14 were men. The most experienced pilot was a female maritime pilot with 3,400 total flight hours. The least experienced pilot was a man with only 350 flight hours who was recently certified to fly the MH-60S.