



Human-Centered Systems Lab



**HCSL Flight Deck
Surface Operations Simulator**



**HCSL ATC
Surface Operations Simulator**

The Human-Centered Systems Lab (HCSL) at NASA Ames Research Center brings together multiple computing platforms and a variety of applications to support both a medium-fidelity pilot-oriented simulation and an ATC simulation capability currently under development. Shown above left, is the **HCSL Flight Deck Surface Operations Simulation** facility, in which more than 150 pilots have participated in controlled surface operations experiments since 1996. Shown above right, is the **HCSL ATC Surface Operations Simulation** facility, under development, designed to simulate a ground controller environment and will be used to research automation, intelligent tools and display concepts. The HCSL is located in the Human Factors Research & Technology Division (ARC/Code TH), and consists of two large rooms with a combined area of 840 square feet, separated into development and work areas, subject test areas and experimenter control areas. There are also several offices with networked computers for HCSL staff.

Both environments perform distributed computational and simulation tasks. The HCSL Flight Deck Surface Operations Simulation facility includes four simulation computers, a medium-fidelity LCD large-screen forward-view projection, serial-box flight controls, an eye-tracking system with eye/head integration, an electronic moving map, a HUD display, video editing and playback, video capture and data capture with time-code registration, and an experimenter's workstation for planning, simulation control, data analysis, and simulation playback. The facility, representing approximately 15 person-years of development, currently consists of:

- ∞ Four workstations for the simulation;
- ∞ One PC and eye-tracker for data collection and scene recording;
- ∞ Two DVD recorders for eye camera and pilot test-area recording;
- ∞ One PC for geometric-model building, data analysis and documentation;
- ∞ Three out-the-window (OTW) displays (1 forward, 2 side) for a pilot subject;
- ∞ An electronic moving map display for the subject;
- ∞ Repeater displays (OTW and moving map) for the experimenter;
- ∞ An experimenter's workstation for scenario development, simulation control and post-experiment data analysis;

- ∞ A sound system for aircraft, engine, and external sounds;
- ∞ Two video displays for monitoring the subject's activities in the simulator;
- ∞ A workstation for code development, system backups and maintenance, data analysis and documentation;
- ∞ A visualization system that is to be included in the next generation of flight deck automation development;
- ∞ Advanced scenario development and implementation software for the controlled simulation of surface operations events (datalink, traffic control, etc.); and,
- ∞ Customized data analysis software for the analysis of scenario events, pilot performance data, and eye-tracking data.

The HCSL ATC Surface Operations Simulation facility includes the following equipment, under system integration and applications software development:

- ∞ A visualization system capable of supporting as many as eight displays and three or four experimental workstations – for example, a ground controller station with four displays, an experimenter workstation, and a pseudo-controller or pseudo-pilot confederate workstation;
- ∞ Three 36-inch LCD displays for OTW visualization system as part of the ground controller system;
- ∞ A PC for a surface operations automation tool (GO-SAFE from Optimal Synthesis Inc.) that optimizes ground traffic flow and can be used to generate routes;
- ∞ A sound-attenuation subject testing booth;
- ∞ A PC for documentation, image scanning and image editing; and,
- ∞ A video editing and playback station.

The two simulation environments are to be used not only separately, but for combined simulations in which the pilot's aircraft in the HCSL flight deck simulator will also appear on the displays in the ATC simulation. The PC-based surface operations automation tool currently simulates and solves traffic management problems defined in its own database, but it is to be networked to the ATC simulation to provide guidance for other aircraft and to optimize traffic flow on the simulation's airfield.

The HCSL is a heterogeneous collection of systems that will be integrated in a manner that allows research questions to be addressed on one component or another, or on the environment as a whole. It will be capable of combining automated control with pilot and controller input, and will provide the appropriate instruments, applications and systems with which the researcher can address different problems, or different components of a larger problem. Operator (pilot and controller) system requirements and interface design issues will continue to be determined in both simulation facilities to evaluate how different levels of automation affect the multi-operator, multi-computer, ground-control environment.

The Human-Centered Systems Lab (HCSL) is directed by David C. Foyle, Ph.D., Senior Research Scientist in the Human Systems Integration Division (ARC/Code TH).

E-mail: David.C.Foyle@nasa.gov

URLs -- <http://human-factors.arc.nasa.gov/groups/hcsl/>

<http://human-factors.arc.nasa.gov/groups/hcsl/publications.html>