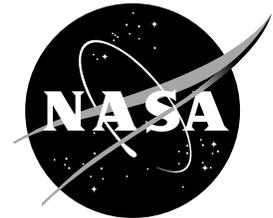


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Helping Pilots See Through the 'Soup'

Langley Concepts Will Help Reduce Terminal Delays



Future subsonic flight decks are likely to have "enhanced vision" for a "situation-at-a-glance" advantage during low-visibility operations. Head-up displays (HUDs) would display essential information during critical phases of flight on a transparent screen between the pilots and the forward cockpit window. In advanced subsonic transports, HUDs are likely to be accompanied by additional upgrades of the cockpit like the large-screen, flat-panel displays illustrated here.

NASA is studying advanced concepts that will allow airline pilots to fly and land safely in very low-visibility conditions, thereby increasing the number of flights in poor weather, reducing terminal delays, and cutting costs for the airline industry and the flying public.

An extension of the same technology may allow safe and efficient "windowless" cockpits for pilots of advanced U. S. supersonic transports after the turn of the century. Eliminating forward-looking windows and replacing them with "synthetic vision" could dramatically reduce operating costs.

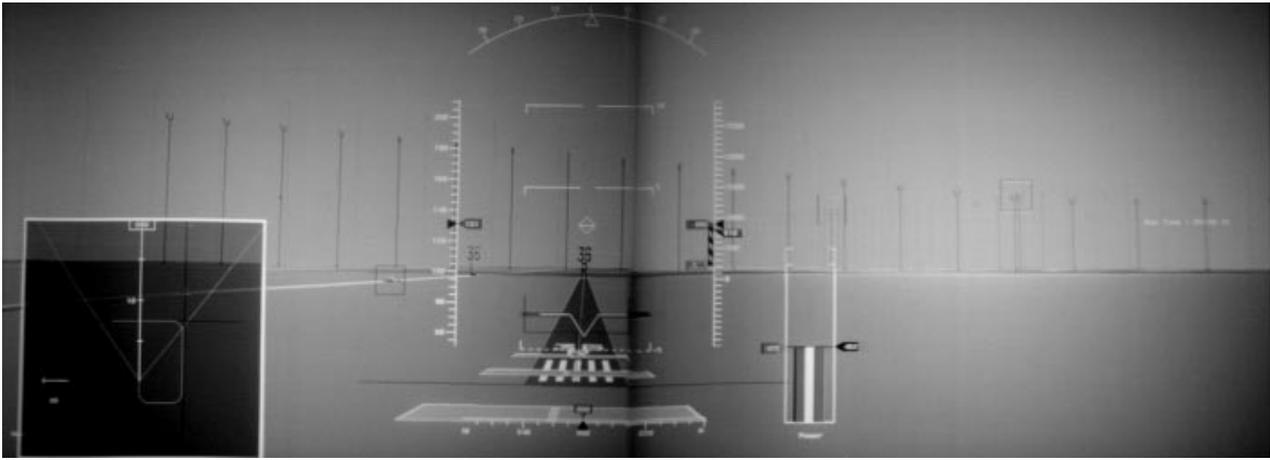
Both applications will make use of weather-penetrating sensors and innovative, pilot-friendly cockpit displays.

Program is government-industry effort

Candidate sensor/display concepts and requirements are being developed at NASA Langley Research Center, Hampton, Va. and NASA Ames Research Center, Mountain View,

Calif. in cooperation with the FAA and industry. Industry will be largely responsible for developing the technology to implement these concepts in response to airline needs.

Sensor concepts being examined now will allow pilots to see objects – including the runway and other aircraft – through fog, heavy rain, and snow, which are usually to blame for flight cancellations and airport closings. Sensor concepts include a forward-looking infrared system that would provide heat-related images from objects ahead of the airliner. This concept would be used primarily at night and under light fog and haze conditions. Another sensor concept would produce images using a passive camera or active radar operating at millimeter wave frequencies – frequencies which have demonstrated potential for penetrating heavy fog. Each concept has its advantages and disadvantages. The solution may be to electronically fuse the image data from several sensors for a piercing, yet realistic, view of the scene ahead.



Computer-painted scenes may help pilots fly “blind.” This synthetic vision display presents a high-fidelity, color, 3-D pictorial image overlaid with helpful symbols.

Innovative, pilot-friendly cockpit displays

Future display concepts under test at Langley include integrated, pictorial displays with “real-world” formats — possibly with stereo vision — presented on large panoramic screens. For example, one “real-world” display format being studied at Langley presents guidance information in the form of a “pathway-in-the-sky” (see above). These features contribute to giving a pilot a “situation at a glance” advantage.

‘Enhanced vision’ for subsonic commercial transports

For the nearer-term application, called “enhanced vision,” airline pilots will likely have a “head-up” display (HUD), through which they will view a sensor-derived scene complete with superimposed aiding symbology (see p. 1). Together, they will give the pilot precise landing guidance.

The HUD would supplement the head-down primary displays by providing the pilot with essential information during critical phases of flight (particularly, landing and takeoff) on a transparent screen between himself and the forward cockpit window. This concept would allow the pilot to see through the window at the same time. Enhanced vision technology could be available for retrofit on today’s airliners before the end of the decade.

In the application of enhanced vision to new subsonic transports, the HUD is likely to be accompanied by additional upgrades of the cockpit. Here, large-screen flat-panel display technology may enable the new pictorial display concepts to be

employed for head-down displays as well. Flat-panel displays promise to extend the advantages of existing computer-driven cathode ray tube (CRT) displays by being lighter, more reliable, and providing the larger screen sizes required by pictorial display concepts — without incurring the bulk, weight, and depth-behind-panel penalties that the use of large CRTs would entail.

‘Synthetic vision’ would allow windowless supersonic transports

For the farther-term supersonic transport application, pilots will likely have full-time “synthetic vision” with no forward windows at all. And, of course, without forward windows, they will not have head-up displays. As presently envisioned, computers will paint a synthetic picture, derived from sensors and stored geographic data bases, on two head-down or “virtual window” panoramic displays that will serve both pilot and copilot — or each pilot might wear a lightweight helmet-mounted display that senses which direction the pilot is looking to provide a wider field-of-view.

In a synthetic vision experiment at Langley, 14 commercial airline pilots “flew” a one-person cockpit simulator to help evaluate the benefits of these new concepts and technologies. On the simulator’s 15-inch high by 40-inch (38 by 102 cm) wide screen was displayed a color, pictorial scene representing a 70 degree field of view. Overlaid were “pathway-in-the-sky” symbols to help guide the pilots over curved, descending flight paths for precise approach and landings. The pilots’ demanding flight task was representative of future

requirements for precision approach to closely-spaced parallel runways, while remaining aware of other traffic in the terminal area. The pilots judged the pictorial display concepts easier to fly than the flight system they are flying today and that the pictorial concepts provided better situation awareness (see right).

Synthetic vision and windowless cockpits are at early stages of evaluation by NASA and industry for a possible next generation High-Speed Civil Transport (HSCT). Synthetic vision capability would save weight by avoiding the droop nose of the British-French Concorde and by reducing fuel reserves. The Concorde's nose swings down at takeoff and landing for pilot visibility. Fuel reserves could be significantly less in an aircraft with all-weather, all-site takeoff and landing capability.

Studies indicate that a fixed-nose design would trim up to 1,500 - 2,500 pounds (675 - 1,125 kg) from the structural weight of a supersonic transport and eliminate several times that weight in additional fuel required for the droop-nose mechanism. Further, a fixed-nose design (with synthetic vision) would allow for a longer nose with reduced drag. In total, an all-weather, all-site supersonic transport with fixed nose and synthetic vision could trim up to 40,000 pounds (18,000 kg) of reserve fuel, resulting in a significant savings in operating costs.



A NASA research technician operates a rapidly reconfigurable flight display simulator. Known as the Visual Imaging Simulator Transport Aircraft Systems (VISTAS), the simulator allows researchers to compare conventional flight displays with wide field-of-view, integrated, pictorial display concepts.

Technology being developed by NASA and others to help pilots see through fog and heavy rain may be extended to do away with forward cockpit windows altogether on the country's first supersonic transport.

