COLLINS SYNTHETIC VISION INFORMATION SYSTEM (SVIS)

Rockwell Collins

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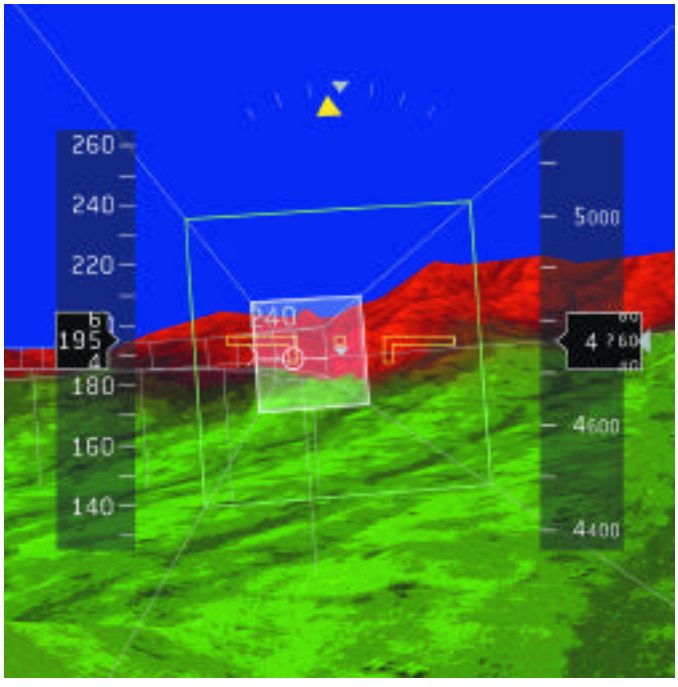
SYNTHETIC VISION INFORMATION SYSTEM (SVIS)

Controlled Flight Into Terrain (CFIT) has been identified as the cause for more than half of all commercial aviation fatalities over the past two decades. The most common contributing factor to CFIT accidents is a lack of situational awareness in conditions of reduced visibility. Conventional flight management system (FMS) displays require pilots to assimilate large amounts of textual data to properly interpret the current and anticipated aircraft situation. To help reduce the number of accidents associated with CFIT, Rockwell Collins is leading a NASA program focused on increasing crew situational awareness through advanced synthetic vision technology. The effort is focused on providing flight crews with better vertical information and more intuitive guidance cues and terrain displays than is possible with current navigation displays or ground proximity warning systems.

As a part of NASA's Langley Research Center Aviation Safety Program, the SVIS program brings together the resources of several world-class organizations, including Rockwell Collins, Delft University of Technology (Netherlands), Jeppesen Sanderson, Embry-Riddle Aeronautical University, American Airlines and Boeing. The team's goal is to develop a synthetic vision system solution that does not require enhanced vision sensors. The resulting Synthetic Vision Information System (SVIS) will help flight crews avoid CFIT by making them continuously aware of terrain at all times, without an increase in pilot workload. It will also help reduce the number of loss of control (LOC) accidents and will enhance airport surface guidance by identifying an aircraft's location on the airport, the assigned route and clearances and the location of other aircraft.



Display of pathway and terrain provides instant situational awareness.

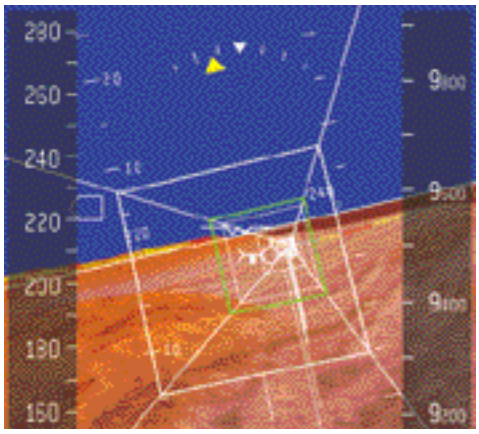
HUMAN-CENTERED DESIGN

The SVIS incorporates three types of displays to help increase pilot situational awareness. The head-up display includes terrain cues and helps keep the crew aware of the situation outside of the aircraft. The primary flight display (PFD) integrates all tactical information including flight path, pathway and terrain to augment the crew's decision-making capability. The multifunction display (MFD) provides key strategic information, improving crew awareness of terrain, obstacles, traffic and weather.

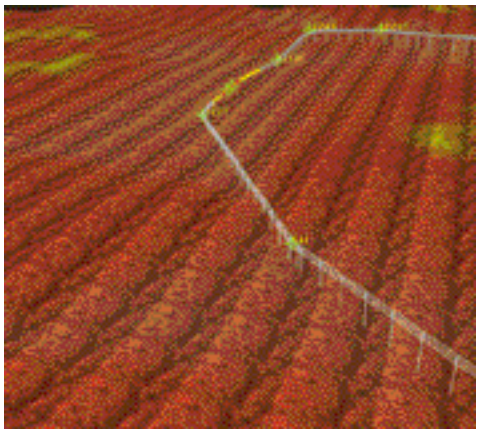
On the PFD, a tunnel represents the desired flight path and trajectory. A number of spatial awareness aids have been integrated, including a semi-transparent window that shows a cross-section of the tunnel and the predicted position five seconds ahead of the current position.

A 3-D map presented on the MFD graphically depicts the flight plan and predicted vertical trajectory of the aircraft in the context of surrounding terrain and presents navigation data in an easy-to-understand format. The map features digitally rendered terrain from an on-board digital elevation model database and is synchronized to the aircraft's position using GPS. Close coupling with the FMS allows route planning with terrain clearance protection.

The 3-D map also has an adjustable orientation that allows the pilot to customize the desired viewing angle. In addition to the traditional map controls of range and map center, angle-of-view controls allow rotation of the map around two axes. The lateral viewing angle of the 3-D map can be adjusted to any value ranging from 0° to 360°. The vertical viewing angle is adjustable independently from the lateral viewing angle and can be varied from 0° to 90°. The 3-D map also provides predicted flight path views that are referenced from the ground, from directly above map center or referenced from an intermediate point in between.



Primary Flight Display provides visualization of flight hazards.



Multifunction Display integrates route and terrain information in 3-D.

ENHANCED OPERATIONS

The improvement in situational awareness resulting from synthetic vision will produce significant enhancements in airline operations, including increased safety, simplified planning and reduced pilot workload in all phases of flight. It will also help operators reduce costs by decreasing the number of flights cancelled, delayed or rerouted due to adverse weather conditions. With the addition of curved path guidance for arrivals, departures and missed approach guidance, the SVIS will improve bad-weather operations and enable lower takeoff and arrival minimums.

SVIS PROTOTYPE TESTING

Operational demonstrations of the SVIS are being conducted to validate navigation, terrain and pathway display concepts. The displays being used in the flight tests include avionics-quality liquid crystal flight displays and the Rockwell Collins Flight Dynamics Head-up Guidance System (HGS). NASA Langley's Flight System Integration Laboratory is being used for integration and preflight validation of key hardware and software systems. Flight tests will use NASA's Boeing 757-200 Airborne Research Integrated Experiments System (ARIES) flying laboratory, used to conduct research for increasing aircraft safety, operating efficiency and compatibility with future air traffic control systems. Evaluations are scheduled for late 2000 at Dallas-Ft. Worth (DFW) and Eagle County Regional Airport (EGE) in Colorado.

EXPECTED BENEFITS OF THE ROCKWELL COLLINS SYNTHETIC VISION INFORMATION SYSTEM

Improved Situational Awareness	• Terrain and obstacle (manmade and natural) awareness • Aircraft energy awareness and approach path stability • Position and traffic awareness in the air and on the ground • Weather awareness including real-time weather reporting • Special Use Airspace status indications
Improved Real-Time Guidance	• Conflict resolution guidance for terrain conflicts, traffic and obstacles (on the ground and in the air) • Vertical guidance for approaches at all airfields • Real-time surface guidance capability
Improved Predictive Alerting	• Predictive alerting of landing short • Predictive aircraft energy decay alerting
Improved Crew Decision Making	• Improved go-around decision making • Emergency procedures support
Improved Flight Planning (Pre-flight and in-flight)	• Operational adaptability due to weather • Airport and approach familiarization tools • Terrain proximity check for all FMS planned routes • Electronic charts incorporating terrain and obstacle data
Rehearsal Capability	• For use with complex/unfamiliar procedures • Used during low workload times, such as preflight and en route
Enhanced Operational Efficiency	• Lower takeoff and approach minimums • Approach path flexibility (curved, segmented, etc.) • Improved missed approach guidance

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523-0780588-00111R 3M-BC-CS-9/00

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