

General Aviation

Sponsor Organization: AFS

TCRG Lead: Phil Potter

Title: Lowering GA Accidents in Low Visibility: UAV See-and-Avoid Requirements

Description of Requirements:

This research will compile and review the characteristics and performance of existing optical systems that could be used to enhance the human UAV operator's ability to see-and-avoid potential conflicts with other manned and unmanned aircraft. Data will be collected for those sensor systems that are currently being used in Commercial UAV operations (e.g., surveillance, search-and-rescue, law enforcement, etc.) to determine their ability to be used to detect and avoid conflicting aircraft. The types of systems (cameras) will be characterized by their performance characteristics: field-of-view, field-of-regard, modulation transfer function, focal point, and lens quality. This comparison will be used to determine the ability of these systems to detect static images of differing sizes, at a range of distances in, variety of visibility conditions, i.e., sense-and-avoid. Existing optical models will be used to analyze the performance of these systems for detecting when the optics are integrated with a processor and data link system to determine the effects of bandwidth, image compression, and latency on see-and-avoid performance for large and small conflicting aircraft operating at a range of speeds with both vertical and horizontal path variations leading to the conflict. Finally, the utilization of these systems will be evaluated considering the performance of the human operator's eyes in the role of see-and-avoid (human-in-the-loop).

Background:

Current UAV operations can require approximately four team members to operate safely in the NAS. This system uses some combination of Human Operator, Payload Operator, chase planes, radar, and a Ground Observers to perform the desired mission. The commercial use of UAVs and their integration into the NAS make this operational "team" see-and-avoid" concept impractical. What is needed is a virtual see-and-avoid capability that enables a single ground-based operator to safely and cost effectively to perform the see-and-avoid task within the same FAR requirements applied to manned aircraft. The proposed research will investigate the current technological capabilities to "sense" potential aircraft-to-UAV conflicts, provide the sensed information to the operator, and allow the operator to perform the "avoid" function using computer generated display information from the airborne sensor system. The

objectives of this research are:

- To determine the characteristics of an optical system that could be used by Commercial UAVs flying in the NAS to satisfy Part 91 See-and-Avoid requirements.
- To analyze the capabilities of existing optical systems and evaluate the suitability for UAV operations.
- To assess the capabilities of a single human operator to use existing optical systems to See-and-Avoid opposing aircraft of various sizes and performance capabilities

Output:

This research will determine specific optics and optical system characteristics required to enable UAV operator see-and-avoid capabilities and limitations in current operating conditions. In addition, a minimum set of baseline optical system requirements necessary to achieve the desired FAR Part 91 requirements will be specified. Finally, the minimum specification for a UAV see-and-avoid system required to achieve the regulatory objectives will be developed. This specification will include the optics, the data rate and processing requirements, the data link requirements and the human operator visual processing capabilities.

Regulatory Link:

- FAA Flight Plan 2004-2008:
<http://www.faa.gov/avr/FlightPlan/toc.cfm>
- Regulation & Certification
<http://www.faa.gov/aboutfaa/BusinessPlans/AVR.pdf>
- AFS Business Plan Website <http://www.faa.gov/avr/afs/2001.pdf>
- UAV Special Orders - 8700.25
- UAV - Enhanced COA