



FEDERAL AVIATION ADMINISTRATION  
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From: General Aviation Human Factors Program Manager, AAR-100  
To: General Aviation Human Factors TCRG, (POC: Anne Graham, AIR-130)  
Subj: Low Visibility and Visual Detection: Design and Development of a Visibility Analysis Tool  
Ref: (a) General Aviation TCRG February 21, 2002 meeting minutes  
(b) Communication between Ms. Graham and Dr. Krebs, 07/23/02  
(c) General Aviation requirement entitled "Low Visibility and Visual Detection"

- 1) Per references (a) and (b), the General Aviation TCRG considered the "Low Visibility and Visual Detection" (ref: c) an important requirement for Flight Standards. The requirement's objective is to "develop research and educational materials that will help reduce accidents caused by 4 related problems: 1) continued flight into reduced visibility, 2) failure to detect targets, 3) failure to utilize resources, 4) need for improved education and training for problems 1-3."
- 2) Background: The Federal Aviation Administration (FAA) is presently engaged in research to 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.

In order to facilitate this research, the FAA has proposed the development of a See-and-Avoid Detection and Recognition Visibility Analysis Tool. The plan is to develop this tool by leveraging from, and expanding the functionality of, an enhanced version of the recently-developed Air Traffic Control Tower Visibility Analysis Tool (FAA Vis). The proposed work will provide the FAA with a user-friendly computer software tool, which will allow for effective decision-making in this important area.

- 3) Project's Objective and Technical Approach: to provide the FAA with a user-friendly software tool that provides quantitative information on the available time that a UAV operator has to respond to a potential conflict with other manned and unmanned aircraft. The tool will include drop-down windows for user input as well as text boxes and graphical charts for results output. The primary output of this tool will be the maximum available time that a UAV operator has to respond to a potential conflict, for the sensor/visibility scenario modeled. Other outputs will include probability-of- discrimination (detection, recognition, and identification) curves as a function of observation range. The technical approach that ARL SEDD will utilize is to team with the U.S. Army's Night Vision Laboratory (NVL) to develop an interface between NVL's Solid-State Camera (SSCAM) and Night Vision Thermal Imaging Systems (NVTherm) performance models, and the FAA's See-and-Avoid Detection and Recognition Visibility Analysis tool. The NVL models will be used to generate all camera- and display-related performance parameters, while the FAA See-and-Avoid tool will account for all atmospheric- and target-related performance effects. The FAA See-and-Avoid tool will combine all of the performance parameters to generate overall results. The majority of the algorithms and routines used in the See-and-Avoid tool will be identical to those used in the recently-developed Air Traffic Control Tower Visibility Analysis Tool (FAA Vis). As before, overall validation of the proposed analysis tool will require establishment of the proper detection and recognition discrimination criteria.
- 4) Deliverables and Schedule:
  - i. Develop an interface/mechanism to import relevant camera- and display-related performance parameters from NVL's Solid-State Camera (SSCAM) and Night Vision Thermal Imaging Systems (NVTherm) performance models into the FAA's See-and-Avoid Detection and Recognition Visibility Analysis tool. NVL has agreed to perform this task under the present FAA/ARL Inter-Agency Agreement. (June '05).
  - ii. Incorporate the camera- and display-related performance parameters into the See-and-Avoid tool performance calculations (August '05).
  - iii. Develop graphical user input (GUI) elements and calculation routines into the See-and-Avoid tool for additional scenario inputs and outputs (Sept '05).
  - iv. Quarterly (December, March, June, September) research progress status reports: Informal e-mail reports from the program manager aviation maintenance human factors to General Aviation Human Factors TCRG.
  - v. Annual five page report.
  - vi. Program Review: Grantee will participate in the annual program review.

- 5) AFS-800 Responsibility
  - i. Make available personnel and resources to investigator

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