



# Air Force Research Laboratory | AFRL

*Science and Technology for Tomorrow's Air and Space Force*



## Success Story

### SENSORS DIRECTORATE DEVELOPS MODEL FOR SEE-AND-AVOID SYSTEM



The Federal Aviation Administration (FAA) see-and-avoid requirement is qualitative and provides no clear success criterion. FAA Directive 7610.4J states that unmanned air vehicles (UAVs) must provide an “equivalent level of safety, comparable to see-and-avoid requirements for manned aircraft” to operate in the national air space.

The Sensors Directorate’s Electro-Optic Threat and Target Detection Technology Branch, in conjunction with Defense Research Associates, through a Small Business Innovation Research program, developed a model that quantifies “the equivalent level of safety” requirement. This model has successfully compared capabilities of manned and unmanned aircraft.



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## **Accomplishment**

Directorate engineers developed a model in MATLAB® for calculating the detection range required to avoid a collision for both manned and unmanned aircraft. The model allows variation in sensor and target velocities; initial separation and look angle; latencies associated with communications, decisions, and maneuvers; a safety factor (final miss distance); and specific UAV maneuvering capabilities (flight speeds, climb rates, and turn rates as a function of altitude). Directorate engineers applied this model to the Global Hawk and Predator UAVs to determine the detection requirements for a see-and-avoid system placed on each of these platforms.

After completing the requirements definition phase and flight demonstration of an aircraft detection system, directorate engineers compared the results of both. The UAV air traffic detection system performance exceeded that of a trained human pilot.

## **Background**

The FAA defines “equivalent level of safety” detection range requirement with a single constraint: a see-and-avoid system must detect and avoid air traffic with at least the same capability as a human pilot. To determine the “equivalent level of safety” detection range requirements for the Global Hawk and Predator UAVs, directorate engineers performed an analysis as if a human pilot was onboard, using human response inputs from the Human Factors Directorate, Aeronautical System Center’s Global Hawk and Predator System Program Offices, and studies by the FAA.

In addition, directorate engineers used the Optical Encounter model to determine the range at which a trained pilot would detect an F-16 from co-altitude, nose-on perspective under various atmospheric conditions and sun positions. Directorate engineers developed a prototype system that went beyond this constraint. The system can detect approaching aircraft at a sufficient range to allow a maneuver that avoids a collision.

Sensors  
Emerging Technologies

## **Additional information**

To receive more information about this or other activities in the Air Force Research Laboratory, contact TECH CONNECT, AFRL/XPTC, (800) 203-6451 and you will be directed to the appropriate laboratory expert. (03-SN-10)