



## Aeronautics

# Sense-and-Avoid System with ADS-B Avionics for Unmanned Aerial Systems

Improving safety and efficiency in military,  
reconnaissance, and research applications

Innovators at NASA's Armstrong Flight Research Center have developed an integrated command-and-control and communications system that utilizes automatic dependent surveillance broadcast (ADS-B) avionics. The primary objective of this system is to address the safety concerns relating to unmanned aerial systems (UAS) sharing airspace with traditional aircraft. This state-of-the-art system is capable of real-time traffic and weather updates in three dimensional (3-D) trajectories and can be reengineered for specific missions and applications, giving the user a customized experience. The technology's ability to integrate each component for enhanced communications, command-and-control operations, and efficient sense-and-avoid capabilities addresses many of the technical barriers related to the safety and operation of unmanned aircraft systems in the National Airspace System (NAS).

## BENEFITS

- ➔ **Safer:** Enhances sense-and-avoid capabilities for UAS, increasing safety for other aircraft as well as persons and property on the ground
- ➔ **Economical:** Utilizes existing global positioning system (GPS) hardware and software
- ➔ **Effective:** Provides critical command-and-control elements for operation of UAS in the NAS
- ➔ **Easy to Implement:** Avoids substantial disruption of other aircraft avionics
- ➔ **Regulation Ready:** Satisfies mandated federal requirements for ADS-B Out to be installed on all aircraft (manned and unmanned) by 2020
- ➔ **Efficient:** Provides and improves crucial operational capabilities, such as environmental situational awareness (weather and terrain), conflict detection and alerts, and precise navigation

technology solution



# NASA Technology Transfer Program

Bringing NASA Technology Down to Earth

## THE TECHNOLOGY

### How It Works

Armstrong's system is built around a standard Garmin GDL 90™ Universal Access Transceiver (UAT), which is independent of other aircraft avionics and requires only a power feed from the aircraft. The system is also compatible with the RANGR™ XVR system, model FDL-978-XVR, from FreeFlight® Systems™. The software interface uses the standard ADS-B message protocol, such that the software does not have to be rewritten. The system architecture is designed with a lightweight tablet display for general aviation use, specifically the air-to-air ADS-B Out traffic. Tablets will soon be universal in general aviation cockpits for navigation using ADS-B situation displays and digital maps. The system is compatible at both 978 and 1,090 MHz and projects real-time satellite 3-D and 4-D imagery using Internet network links. In addition, because of the technology's unique ADS-B capabilities, other aircraft (manned or unmanned) can send information to the unmanned aerial vehicles (UAV), which allows for unique situational awareness compared to other systems. The system architecture is easily re-engineered for specific missions and applications.

### Why It Is Better

Currently, commercial use of the UAS is constrained by regulatory issues based on multiple safety concerns. In order to meet these challenges and in response to increasing demand for civilian operations of UAVs in the NAS, the Federal Aviation Administration (FAA) is currently developing new policies, procedures, and approval processes. Of major concern is the ability to provide sense-and-avoid capabilities. The FAA has determined that ADS-B is a critical component in meeting the next-generation air traffic control requirements and will replace radar as the FAA's primary surveillance method.

Armstrong innovators have leveraged this regulatory change to create an integrated command-and-control and communications system that is superior to currently available offerings. The Armstrong technology is designed to ultimately meet the functional requirements for operation in the NAS, such as separation assurance from other air traffic and communications with air traffic control. By integrating ADS-B surveillance technology with improved communications and sophisticated display options, they have created a combined hardware and software package that improves safety for both UAVs and other aircraft, enhances command and control, and addresses regulatory requirements. This novel system also offers improved operational capabilities such as traffic situational awareness, conflict detection and alerts, and navigation.

The FAA participated in four successful open-loop flight demonstrations that validated the ability to transmit and receive ADS-B data and an enhanced situational display with multiple targets. The last two tests demonstrated the system as a whole, ADS-B Out and ADS-B In. These tests indicate that this system will integrate into the NAS efficiently.

## APPLICATIONS

The technology has several potential applications:

- ➔ Military missions and training
- ➔ Law enforcement
- ➔ Scientific research
- ➔ Public safety surveillance and reconnaissance, such as forest fire management or search and rescue
- ➔ Crop data collection
- ➔ Meteorological data collection
- ➔ Aerial photography and mapping
- ➔ Traffic monitoring
- ➔ Freight transportation
- ➔ Communication and broadcasting
- ➔ Civilian general aviation

## PUBLICATIONS

Patent No: 9,405,005

*Garmin and Garmin GDL 90 are trademarks of Garmin Ltd. or its subsidiaries, registered in the USA and other countries.*

*RANGR is a trademark and Freeflight is a registered trademark of Freeflight Systems and its subsidiaries, registered in the USA and other countries.*

National Aeronautics and Space Administration

Technology Transfer Office

Armstrong Flight Research Center

PO Box 273, M/S 1100  
Edwards, CA 93523-0273  
661-276-3368  
DFRC-TTO@mail.nasa.gov

<http://technology.nasa.gov/>

[www.nasa.gov](http://www.nasa.gov)

NP-2012-11-10-AFRC

NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

DRC-011-012

