

Axient Capability Highlight: Autonomous Intelligent Flight Management System (AIFMS)

Accelerating Possible

Purpose

Axient's AIFMS software tool provides situational awareness and autonomous response to ensure safe UAS operations. AIFMS consists of modular software executed in real time to provide flight safety functions that guard the UAS against internal anomalies, such as vehicle malfunctions, and external threats posed by other vehicles and terrain features. Our software tool can be adapted to customer requirements and includes:

- Customizable AI-based autonomy
- ML-based anomaly detection
- Real-time resolution of faults
- Collision avoidance of cooperative and noncooperative dynamic obstacles
- Collision avoidance of stationary terrain features
- Detection and resolution of command and control (C2) signal loss
- Ground Control Station UAS monitoring
- Automated selection of emergency landing sites
- Path planning to reachable locations
- Actionable intelligence in near-real time through cloud-based analytics support
- Customizable flyability assessment

Breakthrough Solution for UAS

Axient's AIFMS software tool provides UAS operations with minimum-hazard feasible response to critical flight events that can result in loss of life or property. AIFMS delivers greatly enhanced flight safety for people and places under the UAS flight path.

PROGRAM HIGHLIGHTS

Axient performed flight test validation of the AIFMS system on our Swallow UAS aircraft and its ground support equipment. The Axient UAS team successfully traveled and executed flight demonstrations of AIFMS flight management and safety capabilities onboard a Swallow UAS at the U.S. Army sponsored "Maneuver Support, Sustainment, and Protection Integration eXperiments 2020" (MSSPIX20), which took place at Ft. Leonard Wood, Mo. in December, 2020.

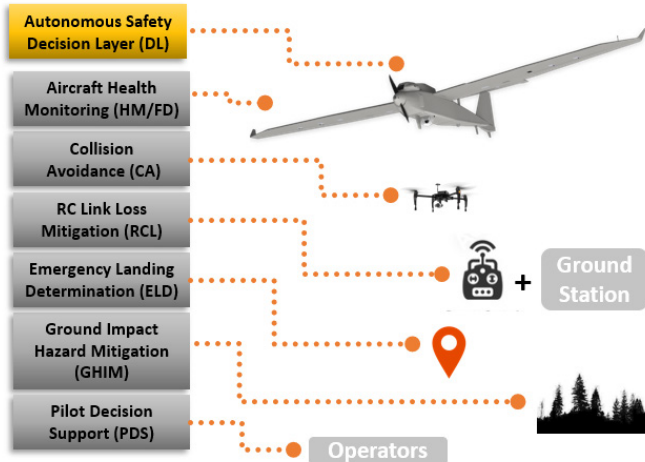
Even experienced pilots are often unable to respond to UAS component failures and other flight anomalies quickly enough to prevent uncontrolled descent to crash at unpredictable and hazardous locations. The autonomous response of AIFMS to such anomalies is realized in a few seconds, including flyability assessment with selection of mission termination (e.g., via parachute), or pilot advisories for decision support.



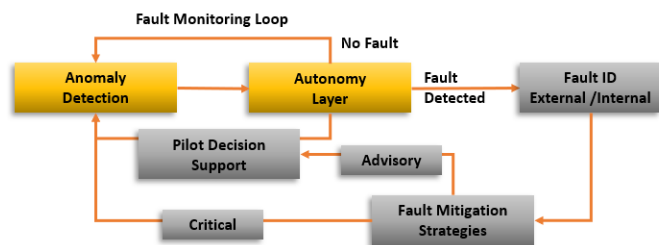


AIFMS: A System for Unmanned Aviation Flight Safety

Axient leverages iterative model-based development consisting of high-fidelity simulations, hardware in the loop (HWIL) testbed, embedded software platforms and flight testing hardware, for development, rapid fielding and deployment of AIFMS software. Rapid algorithm development of safety functions is based on initial system requirements specification, followed by rapid software-prototyping, using autocode generation tools to embed and simulate autonomy-based functions. Axient's highly integrated environment between models, simulations, flight hardware and embedded code greatly reduces development time and improves reliability and repeatability of results.



AIFMS System - Autonomous Safety



AIFMS System - Anomaly Detection and Mitigation

AIFMS Safety System

6-DOF Aircraft Simulation

Axient has a tailorable aircraft simulation to model UAS that is based on geometries and reference flight conditions to produce linearized models as well as nonlinear models. The model uses different path planners in selection of routes that depend on critical level of faults and available feasible emergency landing locations. Axient's holistic simulation includes estimation, filters, state estimators, high level controllers, modeling of control surface and power outages, and sensor failures. Hazard mitigation functions are also tailorable to customer specifications and environment conditions.

Hardware in the Loop (HWIL) Simulation & Testing

The rapid HWIL approach allows Axient to simulate flight hardware and software, assess autonomous safety functions, and test interfaces for agile flight testing deployment. HWIL includes virtual flight framework, autopilot and on-board computing solution.

Detect and Avoid

Axient's detect-and-avoid algorithms allow for fast processing of detected vehicles with potential of a mid-air collision with UAS carrying DAA sensing technology. Algorithms issue avoidance maneuvers autonomously to avert projected collision.

Ground Risk Mitigation Tool

Axient's risk mitigation algorithms use a diverse set of databases to predict the best locations for a UAS to land or crash depending on criticality of fault and vehicle health..

Fault Injection System

Axient developed a system for physical injection of different types of faults on fixed-wing and rotary aircraft. It allows for customer-specific airframes to be tested under specific fault conditions, and to provide appropriate software mitigations via AIFMS software tools, which includes training of ML algorithms.

AIFMS UAS RADAR SYSTEM



UAS Radar Design

Axient has designed our AIFMS Radar System to integrate with U.S. Army small-UAS or commercial UAS to detect, track, and avoid other UAS or manned aircraft. Our UAS radar solution can be integrated with AIFMS on-board existing small-UAS platforms, including those in Groups 1-3, to provide collision avoidance capabilities. The UAS radar unit is projected to weigh approximately .5 pounds or less in prototype form, and we are estimating its unit cost for QTY 20 to be about \$2,000 per unit, far less than other radar systems being marketed for UAS sense-and-avoid. Our UAS radar is designed to detect fast low-altitude military helicopters, approach-altitude piloted aircraft, and all groups of UAS including small multi-propeller VTOL drones.

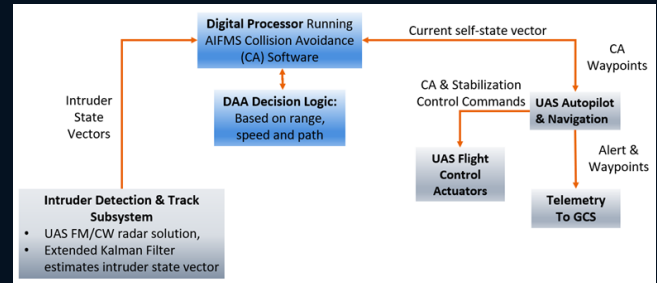
AIFMS ACAS with UAS Radar

Axient's ACAS algorithms can use inputs from portable radar solution to issue avoidance maneuvers based on:

- Detected intruder vehicle distance, speed and path
- Calculated risk for mid-air collision
- Number of intruders
- Reactive or calculated response, as required by customer
- Tailorable autonomous response and collision avoidance behaviors

About Axient

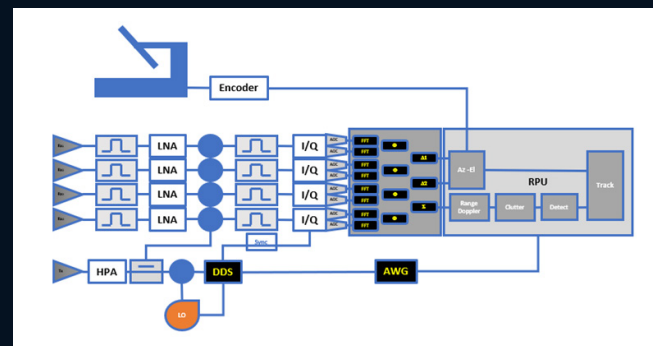
With over 2,200 employees, Axient is headquartered in Huntsville, Alabama and has provided premier services and solutions to the Federal Government for more than three decades. Axient's customers include the U.S. Army, U.S. Navy, Missile Defense Agency, U.S. Air Force, U.S. Space Force, and NASA. Axient is certified in the following: ISO 9001:2015, AS9100 Rev D, CMMIDEV Maturity Level 3, and has a DCMA Purchasing System, DCMA Property System, and DCAA Accounting System.



AIFMS DAA System

SAS-Optimized Radar parameters related to collision avoidance include:

- 360 deg- Scanning Pulse-Doppler Radar
- Frequency - 35.0 GHz
- Max weight - 5 lbs (+ Fairing)
- Tx Beamwidth - 30.0 by 43.7 deg
- Rx Beamwidth - 15.0 by 21.8 deg
- Detection Range (@10 dbsm mean RCS = 2.9 km (Combat Helicopter, small Airplane)
- Detection Range (@-15 dbsm means RCS) = .07 km (Quadcopter Drone)
- Range for Accurate Tracking (@10 dbsm mean RCS) = 2.2 km
- Track Angular Resolution = 2-3 deg



FMCW Compact Surveillance Rotating Reflector