Image credit: NASA

technology solution

Aeronautics

Reliable Geo-Limitation System for Unmanned Aircraft

An Assured Safety Net Technology for UAS

NASA Langley Research Center has developed a breakthrough technology called Safeguard that can alleviate hazards with unmanned aircraft (UA) flying beyond their authorized perimeters and into no-fly zones. Safeguard works by continuously detecting a UAs proximity to virtual perimeters established around no-fly-zones (i.e., stay-out or stay-in regions and altitude limits), and taking action to guarantee the perimeters are not breached. The key to the design is streamlined functionality that has been formally verified to guarantee detection of possible perimeter violations. Safeguard is applicable to both rotary- and fixed-wing systems and substantially outperforms embedded geo-fences in terms of reliably and dependably stopping excursions into no-fly zones. Safeguard has the potential to provide a means to comply with pending regulatory directives for geo-limitation for a burgeoning UAS industry.

BENEFITS

- Designed with a safety-driven focus to provide an aviation-grade system practical for UAS that are not built with safety and reliability in mind

- Distinguishing features such as independence, formally verified algorithms, alternative positioning sources, and simplistic mechanization support compliance with aerospace standards for safety critical-systems

- Can function as an assured safety net for UAS that are built without safety-grade components, keeping them from exceeding their geo-limitations during practically all unmanned aircraft operations

THE TECHNOLOGY

Safeguard is an independent avionics system that can be easily ported to virtually any UA. The current prototype weighs approximately 1 lb (without hardware optimization). The invention innovations include formally verified algorithms to monitor and predict impending boundary violations through flight termination trajectory estimation, and a system architecture that facilitates performance certification. The system can be configured without sole reliance on the global positioning system to avoid known problems with GPS inaccuracies and unavailability. It is independent of the UA and any on-board components, such as the autopilot, for physical and logical separation from non-aviation-grade systems. The perimeter boundaries are described using polygons, which can approximate almost any shape, and there are practically no limits to the number of shapes and boundaries. The algorithms for establishing the validity of a boundary and for detecting proximity to all defined boundaries are based on rigorous mathematical models that have been formally verified.
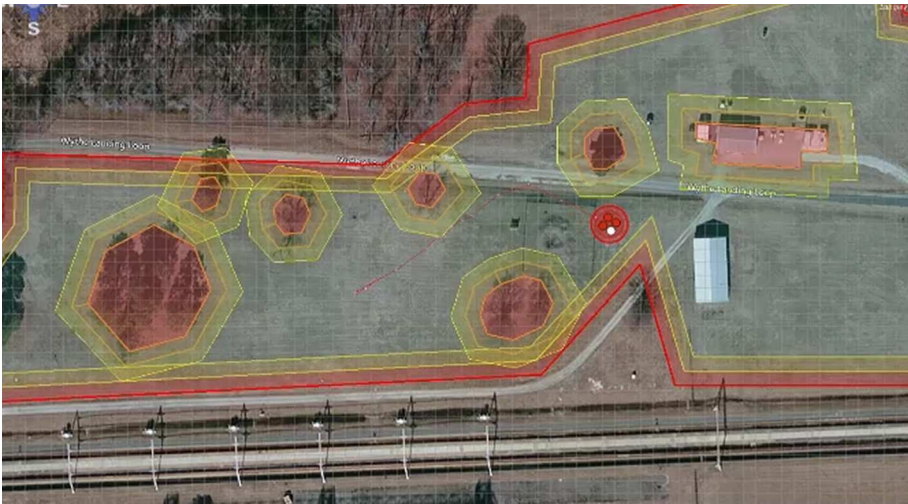
Ground station display of containment system boundaries during flight. Image source: NASA

APPLICATIONS

The technology has several potential applications:

- Private, commercial, and public sector operations in which range containment or prevention of entering no-fly zones is desirable
- Infrastructure inspection
- Cargo delivery
- Surveillance and monitoring
- Agriculture

PUBLICATIONS

Patent No:

More Information