RPAS-ATM Integration Demonstration

Real-Time Simulations results: test scenarios DAA system

RAID 1st Workshop - Rome, Palazzo dell’Aeronautica, December 10th 2015
The DAA system implements **enhanced situational awareness**, **tactical traffic avoidance** (i.e. separation assurance) and **emergency collision avoidance** functionalities.

The DAA system main features are:

- **ADS-B based** surveillance;
- **customized** HMI integrated in the RPAS Operator (RPO) Cockpit (CDTI, PFD, MFD);
- **tactical self-separation** (i.e. traffic avoidance) management, by providing *indication* about the separation manoeuvre to be implemented by the RPO or by providing *automatic* manoeuvre implementation;
- **automatic emergency collision avoidance management**;
- **flexibility** in terms of possibility to modify both the separation volume and the collision volume implemented by the system.
The system uses ADS-B In inputs to assess the situation in the surrounding airspace. The ADS-B data are processed in order to:

→ **Assess risk of future separation breach with the surrounding aircraft** → **Traffic Avoidance (TrA)**

If a **loss of separation** is predicted, the system alerts the RPO and automatically proposes a separation recovery manoeuvre; the RPO is then in charge of evaluating the feasibility of the proposed manoeuvre in order to implement it manually or automatically.

→ **Assess risk of imminent collision with the surrounding aircraft** → **Collision Avoidance (CA)**

If a **risk of collision** is predicted, the system alerts the RPO and automatically elaborates a collision avoidance manoeuvre with respect to the most priority aircraft; the manoeuvre, due to its emergency nature, is automatically implemented but the RPO can abort it and take the direct control of the vehicle, at any moment.

The system provides **enhanced overall situational awareness** to the RPO, by performing classification of the surrounding traffic and feeding the dedicated HMI with related info for graphical representation.
The Traffic Avoidance functionality can be defined as the tactical capability of keeping the RPAS vehicle away from other airborne aircraft by at least the separation minima defined by EUROCONTROL:

**Specification RPA11:** “Where an RPA pilot is responsible for separation, he should, except for aerodrome operations, maintain a minimum distance of 0.5 NM horizontally or 500 ft vertically between his RPA and other airspace users [...]”.

**TrA Volume**
Cylindrical volume of airspace, centered on the traffic aircraft, with a horizontal radius of 0.5 NM and a vertical height of 500 ft.

Additional extra-size depending on the closure rate between the conflicting aircraft, due to uncertainties affecting sensor measurements and aircraft maneuvering.
The Collision Avoidance functionality can be defined as the capability of avoiding a Near Mid Air Collision (NMAC) with a conflicting aircraft, if Traffic Avoidance has failed.

**NMAC [EUROCONTROL]:** “An encounter in which the aircraft are simultaneously within 500 ft of each other horizontally and 100 ft of each other vertically”.

**NMAC [FAA]:** “An incident associated with the operation of an aircraft in which a possibility of a collision occurs as a result of proximity of less than 500 feet to another aircraft [...]”.

**CA Volume**
Spherical volume of airspace, centered on the traffic aircraft, with a radius of 500 ft.

Additional *extra-size* depending on the closure rate between the ownship and the threat aircraft, due to uncertainties affecting sensor measurements and aircraft maneuvering.
Real-Time Simulation tests results

**Briefing:**
- CIRA → 1 intruder creating a head-on conflict condition with the RPAS flying to WP1
- MATS → no traffic
- DAA → TrA manoeuvre proposal to RPO
- RPO → proposal evaluation and approval
- DAA → TrA manoeuvre activation
- ATC0 → monitoring

**Debriefing:**
- The expected Loss of Separation is detected by DAA
- The conflict is correctly managed by the DAA system suggesting the TrA manoeuvre to RPO and, after approval, manoeuvring the RPAS
DAA HMI integrated within the RPO Cockpit

- Loss of separation alert visualization on PFD
- Conflicting aircraft visualization on CDTI and MFD
- TrA manoeuvre acceptance input
- TrA manoeuvre references visualization on CDTI and MFD
Real time Simulations videos