# Guidance Navigation & Control Laboratory - Integrated Simulation Facility (ISF)

Type of Infrastructure
Real-time hardware/man-in-the-loop simulation of Avionic technologies and ATM procedures

Main technical features
- Supports all phases of the Technology and Procedure Development Process:
    - Preliminary Design (High Level Requirements assessment);
    - Detailed Design (Low-Level Requirements Validation);
    - Prototype Development and Test (Rapid-Prototyping)
    - Integration, Validation and Verification
- Integrated Simulation Facility (ISF):
    - Real time simulation facility with interaction of one or more pilot-in-the-loop flight simulators of manned/unmanned vehicles in a realistic and complex ATM & multi-agent scenario (including shared traffic, weather, GNSS satellites configuration, etc.)
    - internet based voice communication for simulating pilots-controllers radio communications, audio-video recording, private mass storage archive.
    - Distributed Simulation with possibility to connect with other (geographically distributed) simulation facilities by means of standard protocols (like High-Level Architecture -HLA- standard) or proprietary protocol (UDP overt internet, MQTT, etc…).
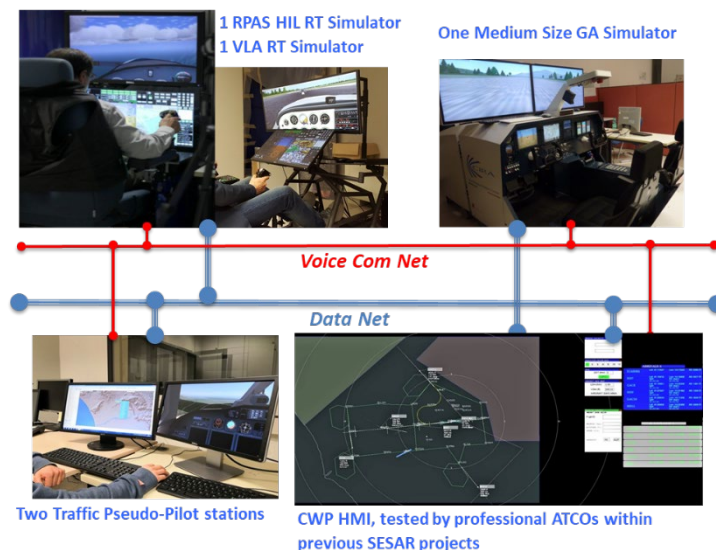
Integrated Simulation Facility

Application Domains
- Sensor fusion algorithms for navigation
- Synthesis techniques and advanced flight control algorithms
- Failure Detection, Isolation and Reconfiguration for GN&C
- Algorithms for the online trajectory planning both in 3D and in 4D and in the presence of obstacles or areas to avoid
- Autonomous Decision Making Algorithms

- Advanced methods of development and validation of digital GN&C prototypes (Real-time Systems & Rapid Prototyping)
- RPAS integration in Civil Airspace
- ATM Procedures Testing & Validation

Main measuring instruments/techniques

They are essentially divided into three categories:

- HW/SW instruments for laboratory validation
  - 5 Real-Time Simulation Machines, with high modularity, reconfigurability and expandability
  - Stewart platform for attitude simulation (hexapod with 6 degrees of freedom starting maximum 100 kg)
- HW/SW platforms for the development of prototypes of GN&C systems
  - Automatic Code generation by using Matlab/Simulink environment
  - DSPACE Control Systems Prototype Development Environment
  - Control system prototype development environment for PC-104 like systems
- ISF Simulators
  - **HIL RPAS reconfigurable flight simulator (FLARE)**: It reproduces a high-fidelity dynamic behaviour of an RPAS (both Tactical and MALE), with a full-size reproduction of the remote pilot station, for complete piloting of the RPAS flight simulators. It is used for the evaluation of the functionalities and performances of SW prototypes for Unmanned Guidance, Navigation and Control (including Detect & Avoid systems), and RP human performances assessment
  - **General Aviation piloted simulator**: It is a facility that allow a pilot to maneuver a simulated aircraft through a representative cockpit of a GA aircraft (CS-VLA/CS-23). The facility has been built reproducing faithfully a real General Aviation cockpit with related out-of-window view, real instrumentation and a glass cockpit.
  - **VLA piloted simulator**: It reproduces the dynamic piloted behaviour of small manned air vehicle (both fixed and rotary wing) or that can be configured as a second remotely piloted of the unmanned aircraft in addition to the above one
  - **Scenario Simulator**: It includes all the elements for the realization of a complex simulation scenario. Specifically: traffic generation with different categories and performances of aircraft simulation, GPS satellite constellation simulator, Segregated Areas and No-Flight zones, Navigation Aids systems, weather hazards areas (differentiable for type and severity), other services and control of all other simulators, including terrain and data log recording
  - **Two Pseudo-Pilot stations**: These are dedicated substation(s) that let a single operator to act as an on-board pilot of several aircraft (pseudo-pilot), so that the air traffic can follow the directives of the controllers.
  - **Controller Working Position emulator for Air Traffic Controllers**: this station implements current requirements of typical controller workstation, for both En-route and TMA operation, in all airspace classes A-G.

Operational Status

Fully operational