

Adaptive Structures Laboratory (LASA)

Type of Infrastructure

Mock-ups and systems for testing

- adaptive wing structures (such as adaptive leading and trailing edges, adaptive winglet and adaptive rotor blades),
- integrated structural sensor systems (for Structural Health Monitoring, Hard Landing detection, and so on)
- integrated vibration and acoustic radiation control systems (for comfort increase, payload protection, and so on)

Main technical features

- Design and Testing full-scale integrated adaptive structures and component;
- Development of FE models and numerical-experimental correlation;
- Integrated sensor networks design and implementation;
- Integrated actuator networks design and implementation;
- Smart materials and structures.

Application Domains

The application domains refer to the ACARE standards referred to in document NLR-CR-2002-688 and in detail:

- Sensor networks development (piezoelectric devices, optical fibres);
- Integration of sensors;
- Active Piezoelectric materials;
- Electrostrictive materials;
- Single crystals;
- Magnetostrictive materials;
- Magnetorheological, Electrorheological Fluids (MRF, ERF);
- Shape Memory Alloys (SMA);
- General Actuators and Actuator Networks;
- Micro-motors;
- Control strategies;
- Multi-functional materials;
- Structural Health Monitoring System;
- Structural Dynamics Monitoring
- Ultra sound Ice protection systems
- Control of vibration and noise;
- Shape Control;
- Active flow Control;
- UAV, mini UAV

More in detail, with reference to the experience and know-how accumulated in the field of the discipline over the years, the main activities of the laboratory are divided into:

- Design and implementation of morphing wing systems;
- Design and implementation of integrated sensor networks;
- Design and implementation of integrated actuator networks;
- Design and implementation of integrated damping systems;
- Design and implementation of structural control systems;
- Design and implementation of SHM systems;
- Design and implementation of ultrasound ice protection systems;
- Design and integration of Structural Dynamics Monitoring systems.

The fields of investigation range from static (e.g., shape control) to dynamic systems (e.g. dynamic response control) and employ sensors systems both classical (e.g., strain gauges, accelerometers) and innovative (e.g. piezoelectric, FBG), as well as actuator systems both classical (e.g., linear motors, rotary motors) and innovative (e.g., piezo-electrics, shape memory alloys), configured according to compact and minimally intrusive architectures.

Main measuring instruments/techniques

At the laboratory there is a wide portfolio of instruments for the generation and amplification of signals and the acquisition of deformations, displacements, stress, temperature, force and wavelengths for various advanced functional materials (PZT, SMA, FO, etc.), for standard sensors (strain gauges, load cells, thermocouples, accelerometers), etc. In detail:

- Optical table with mechanical test rig for testing structural systems integrated with sensor networks;
- Facility for training torsional Shape Memory Alloys actuator systems;
- High voltage, high power amplifiers for piezoelectric ceramics (PZT);
- Power Suppliers for Shape Memory Alloys (SMA);
- CRONOS acquisition system for strain gauges, thermocouples, etc.
- Optical Spectrum Analyzer (OSA);
- Micron Optics sm130 Optical Interrogator;
- Micron Optics sm125 Optical Interrogator;
- LUNA ODISI-b Optical Interrogator;
- AEROGATOR Optical Interrogator;
- Smart Fibres SMARTSCAN 2;
- Smart Fibres AEROMINI;
- DSP for multi-channel structural control;
- NI Labview multipurpose acquisition system
- 3D printer for rapid manufacture of prototypes of adaptive structural elements and related washing machine plus muffle furnace for SMA elements
- SCADAS LMS acquisition system for dynamic and static structural experimental characterization tests.

- Climatic room for de-icing laboratory tests down to -40°C

Further facilities being designed and on development are:

- Iron bird for structural morphing systems;
- Virtual environment for adaptive structures design.

Operational Status

The Laboratory of Adaptive Structures (LASA) is fully operational.