INEGI PROJECTS

SOME OF OUR PROJECTS IN AERONAUTICS, SPACE AND DEFENSE

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<table>
<thead>
<tr>
<th>Key Numbers</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>People</td>
<td>271</td>
</tr>
<tr>
<td>Clients</td>
<td>591</td>
</tr>
<tr>
<td>Turnover</td>
<td>11.1 M EUR</td>
</tr>
<tr>
<td>Innovation Projects with Industry</td>
<td>123</td>
</tr>
<tr>
<td>Spin-offs in the market</td>
<td>6</td>
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<tr>
<td>Internacional Partners</td>
<td>222</td>
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<tr>
<td>PhDs</td>
<td>113</td>
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<tr>
<td>PhD Thesis per Researcher</td>
<td>1.3</td>
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<td>ISI Articles per Researcher</td>
<td>2.8</td>
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<tr>
<td>Patents</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>5 granted</td>
</tr>
<tr>
<td>Facilities - Porto</td>
<td>8.272 m²</td>
</tr>
</tbody>
</table>

| Invoicing | 47% |
| Projects with industry | 70% |
| International | 21% |
Solutions for the interior of aircrafts to become more eco-efficient, lighter and more comfortable


The project aimed to create skills for design, development and industrialization of technical and functional solutions for the interior of aircrafts to become more **eco-efficient, lighter, more comfortable** in an integrated way and with an innovative design.

- Study of advanced structures, structural design and mold design
- Manufacturing of some components in composite materials
- System integration
New solutions for civil aviation contemplating eco-efficiency and integrated design


- Creation of new aircraft concepts
- Development and analysis of solutions in terms of materials, structures and processes for composites that enable the concepts developed
- Construction of a scale prototype of a fuselage with isogrid reinforcements
Aerostructures for civil unmanned aerial vehicles
Project: X AERO STRUCTURES [2016-2019]

- New methods for development, testing and validation for unmanned vehicles
- Development of national technologies for the aeronautics field
- Development of new concepts of operation, new methods of production processes and new manufacturing materials
New aircraft concept based on modularity

Project: FLEXCRAFT – Flexible Aircraft [2016 - 2019]

Validation of previous concept of NewFace project: Utility – a aircraft with a cabin capable of reconfiguring itself for the transport of people or merchandise, or for civil protection missions.

Mechanical characterization of different carbon composites certified for aerospace use and comparison of manufacturing processes to select the material and process to be used in the demonstrator component.

Development of new process and integration with new materials: resin transfer molding (RTM), which guarantees the out-of-autoclave production in a single phase (one-shot process), which results in a reduction of costs, fulfilling the same quality parameters.
Design of multifunctional structures using intelligent technologies
Project: PASSARO – Capabilities for innovative structural and functional testing of aerostructures [2016-2020]

Production of more efficient aircraft in relation to cost and weight, using the incorporation of composite materials

Demonstration, through representative prototypes, of the applicability of technologies for design, manufacturing and ground testing, including full-scale physical demonstrators on the ground (a cockpit structure, external wing and aileron)

Development of new multifunctional materials and structural solutions in composite materials, with special focus on impact resistance and internal noise reduction
European Carbon Fibres and Pre-Impregnated Materials for Space Applications

Project: SpaceCarbon [2018-2021]

- Develop intermediate and high modus carbon fibres for launchers and satellite sub-components
- Develop pre-impregnation process for Space Qualified Prepregs
- Novel prepreg formulations for future Spacecraft structural composites
Thermally Conductive CFRP manufactured by Resin Transfer Moulding
Project: RTM E-BOX [2013-2015]

Development of a thermally conductive composite material for electronic box space applications

Demonstration of suitability of an out-of-autoclave manufacturing process (resin transfer moulding) for low-series production
Dual-Gridded Carbon Fibre Reinforced Plastic Reflector

Project: KuDGR [2011-2015]

- Improved accuracy in Space environments due to the use of CFRP materials
- Development of tailor-made materials (fibre/matrix) to meet applications requirements
- Development of manufacturing and assembly strategy to obtain the target dual-gridded structure
Flight qualification of non-explosive actuators for space applications

- Shape-Memory alloy release mechanism validation under Space-like environmental conditions
- Definition of the test plan and respective procedures to verify the mechanism requirements at operating conditions
- Adaption of testing equipment to achieve the representative operation conditions
- Test campaign: mechanical, vibration and shock resistance tests, correct operation at the operating conditions, measurement of the actuation and operation parameters, and measurement of the shock generated during actuation
Integrated Design of Re-Entry Vehicles

**Project: Diver [2013-2015]**

- Mission driven-design of **thermal protection systems** for re-entry vehicles
- Sensitivity analysis for TPS **abative materials** properties
- Evaluation of high-temperature CFRP interface structures for improved vehicle design
Non-conventional tubular composite material structures for space applications
Project: FILTUBE [2016-2019]

New lighter advanced structures, made of composite materials, able to withstand mechanical loads and different atmospheric pressures, to dissipate or isolate heat

Made by filament winding, a manufacturing process more automatic and therefore cheaper

Structures development; simulation, development and optimization of the filament winding process; demonstrators manufacturing and validation tests
Weldless Aluminium Liner for Xe storage COPV

Project: AluLiner [2016-2017]

- Development of **pressure vessels** for the aerospace industry reinforced with carbon fiber
- Definition of composite component geometries and materials
- Structural project of the laminate
- Definition and development of the manufacturing process including the carbon fiber winding process
- Experimental validation of the technology using correlation tests, burst tests and fatigue tests
- Pressure vessel with **lower weight and storage capacity of higher pressures**, due to the **cold forming process** which excuses the existence of structural welds
Composite elastic hinge for Antenna Deployment Structures
Project: COMETH [2017-2019]

Design and optimization process of a deployable, tubular and composite structure, which supports a telecommunication antenna to be installed on a satellite.

Current technology: deployment arms by articulation of one or multiple limbs through mechanical hinges.

Objective: develop an ultra-light and low-cost composite arm for deployable antennas based on elastic hinges.
Articulated Booms - Large Ultrastable Deployable Structures

Project: ABDS [2016-2019]

- Design and manufacturing of the MGSE (Mechanical Ground Support Equipment) for full arm deployment
- Design of the MGSE for Thermo-Vacuum Chamber tests at DLR facilities
- Full deployment and TED (Thermo-Elastic Distortion) testing
Large Stable Deployable Structures for future science missions

Project: LADS [2015 - ongoing]

- Design and simulation analysis of spherical joints of the mast
- Design and manufacture of the Deployment Mechanism used for prototype mast system testing (BreadBorad and EQM - Engineering Qualification Model)
- Tests on various elements and materials used in the different subsystems, including the composite components and the spherical joints
- Monitoring and support of the Deployment tests
Large European Antenna
Project: LEA [2017-ongoing]

Design and manufacturing of:
• 0g device for reflector surface accuracy and RF test
• Reflector Deployment GSE
• Arm deployment and 0g compensation device
• Arm TED test GSE
• Vibration test adapter for arm and reflector
• TVAC (Thermo-Vacuum) test adapter for arm and reflector

Definition of TED Test and input to test plan
Large Deployable Reflector for Earth Observation
Project: LEOB [2019- ongoing]

Design and manufacturing of:
• 0g device for reflector surface accuracy
• 0g device for Thermal Vacuum Cycling & Partial Deployment at TCOLD test
Large Deployable Reflector with Advanced Surface Technology
Project: RAST [2020 – ongoing]

Design and manufacturing of:
• Deployment Test gravity compensation system for a 3.5m reflector demonstrator deployment

Assembly and verification of the 0-g devices and verifications of the overall performance of the GSE (Ground Support Equipment)
Copernicus Imaging Microwave Radiometer High Priority Candidate Mission
Project: CIMR [2020 – ongoing]

Arm activities:
- Project management and PA activities regarding the Arm test MGSE
- Perform engineering and design activities regarding the 0-g Arm and TED test MGSE
- Support to the arm deployment and TED Test Plan and support test campaigns
- Planning of Arm 0-g and TED Test MGSE Manufacturing, Assembling and Integration activities
- Manufacturing, integration and verification of the Arm test MGSE

Reflector activities:
- Project management and PA activities regarding the Reflector Deployment Test GSE
- Perform engineering and design activities regarding the device for Reflector Deployment Test 0-g
- Plan all Reflector Deployment Test 0-g Device Manufacturing, Assembling and Integration activities
- Manufacturing, integration and verification of the Arm test MGSE

Sub-System (Reflector and Arm) activities:
- Coordinate and manage the activities related with the TVAC S/S MGSE
- Plan all TVAC S/S MGSE Manufacturing, Assembling and Integration activities
- Manufacturing, integration and verification of all TVAC S/S MGSE
Damage Tolerance of Cryogenic Pressure Vessels

Laboratory service: DATOL [2013-2014]

Life assessment of composite reinforced pressure vessel (COPV) tank for hydrogen storage

Definition, manufacture and preparation of the COPV interfaces

Characterization of the structural behavior under cycling pressure, leakage detection and thermographic inspection

COFUNDING

INEGI’s preparation of experimental test set-up
Determination of strain rate dependent material behaviour for typical structural aircraft seat and crash absorber materials

Mechanical characterization of metallic, fiber reinforced polymer composites and foam at wide range of strain rates, ranging from quasi-static loading up to high strain rate tests

Project: EXPRO - ESA Express Procurement [2015 - ongoing]

- Identification of materials for launchers structural and propulsion systems manufacturing
- LSP and residual stress characterization
- Mechanical characterization: fatigue, fatigue crack propagation and corrosion of pristine and welded materials, un-processed and after LSP
DEFENSE PROJECTS
Materials & Structures Strategic Research Agenda

Project: SRA [2017-2018]

Development and update of the document that outlines the R&D strategy - Strategic Research Agenda (SRA) - in the field of materials and structures, to be coordinated by the European Defence Agency (EDA)

Specialized contributions in the field of defense structural materials.

Identification of **key technological trends for European Defence materials and structures**

Development of the tool and methodology to support the identification and prioritization of technological domains in the scope of materials and structures
Lightweight and impact resistant civilian and military unmanned aerial vehicles

Project: ALIR - Advanced Lightweight Impact Resistant [2017-2019]

- Development of new materials with the capacity to **withstand the impact** of low, medium and high energy
- Development of numerical characterization models and manufacturing processes
- Integration of the developed materials, in order to guarantee easy implementation in an assembly line
Smart and multifunctional clothing for European armies

Project: STILE – Smart TextILEs in Defence [2019-2019]

Textile technology integration to enable the collection and transmission of useful information through wireless communications, and to make clothing more comfortable and capable of assisting in the soldiers’ protection

Technological roadmapping with the aim of obtaining a Multifunctional Smart Textile in European Defense that integrates several functionalities

Definition of the project implementation’ stages, through workshops with specialists, bibliographical survey and documentary analysis
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INSTITUTE OF SCIENCE AND INNOVATION IN MECHANICAL AND INDUSTRIAL ENGINEERING

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