



UNIVERSIDAD
D SEVILLA

Research and innovation actions

Structural mechanics

Research Group on Elasticity and Strength of Materials

School of Engineering

Universidad de Sevilla

E-mail: newfrac@us.es

Research Group



Universidad de Sevilla

- Established: 1505
- Students: 65k
- Faculty members: 4.3k
- 27 centers



Research Group on Elasticity and Strength of Materials

- 40-years experience on continuum mechanics.
- Expertise on structural mechanics for metal and composite structures.
- Computational and experimental techniques.
- 14 faculty members + 3 postdoc + 10 PhD students.
- Currently leading European (H2020 ITN, CleanSky),
- National and Regional Research projects.



School of Engineering – ETSI

- 6000 students and 400 faculty members
- Industrial Technology Engineering, Telecommunications Engineering Technology
- Chemical Engineering, Aerospace Engineering and Civil Engineering, Energy Engineering,
- Electronics, Robotics and Mechatronics Engineering and Industrial Organisation Engineering.
- The contact with the industrial sector has been a recurrent and productive target
- Technology transfer action → training of the students and the industrial development of the region.

Know-how and facilities

Computational



Solid Expertise on Finite Elements Analysis (FEA), user and developer level → reference research at national and international level

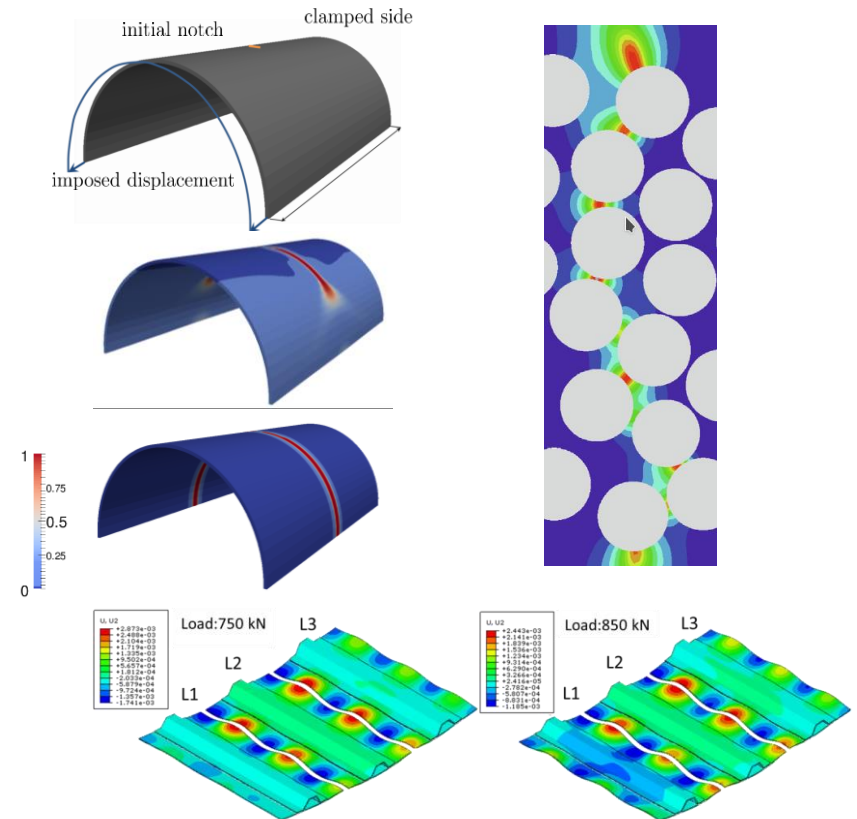
- Software: Abaqus, Patran/Nastran, Hyperworks, Ansys. Own licenses.
- Developing user subroutines for modeling innovative materials and/or new modelling techniques (UMAT, UEL).
 - Advanced shells, finite strains, postbuckling, advanced failure (cohesives, XFEM, phase field).
- Parametric and Machine-Learning analyses, using several programming languages: Python, Matlab, C++, Fortran.

25-years know-how on fundamental and industrial applications of FEA:

- Micro/meso and macro mechanical analysis of the failure in metal and composite structures.
- Analysis of singular problems in aeronautical industry, e.g. run-out

A network for massive computation:

- Own cluster optimized for finite element analysis of structures.
- Access to supercomputing facilities: MareNostrum 4 (BSC), Galileo (CINECA). Own codes already tested on these supercomputers.



Know-how and facilities

Computational - Details



Computational capacities:

Simulation of metal, concrete and composite structural elements. Linear analysis. Software: Abaqus, Patran/Nastran, Hyperworks, Ansys, Alya, FEAP.

Inclusion of nonlinearities: Nonlinear material behavior, geometric nonlinearities (e.g. buckling), fracture, fatigue.

Development of subroutines for modelling of new materials, e.g. Printed metals and composites. Integration of these subroutines on commercial software.

Development of subroutines for modelling phenomena not implemented in commercial software yet. For instance: Fracture using phase field, Hydrogen embrittlement.

Supercomputation through own cluster, and access to public supercomputers.

Recourses:

Own codes in Abaqus for:

- Phase field modelling of fracture, critical load and crack pattern, including yielding, brittle fracture, ductile fracture, fatigue.
- Hydrogen-induced cracking, including micro (inter- and trans-granular cracking) and macro-micro coupling for structural analysis.
- Advanced modelling of shells, including finite strains, large displacements, and all the previous fracture and damage analyses.
- Advanced failure criteria for composite laminates.

Own cluster with 9 nodes, 104 processors, 4TB RAM.

Access to external supercomputers as Mare Nostrum 4, Galileo.

Know-how and facilities

Experimental



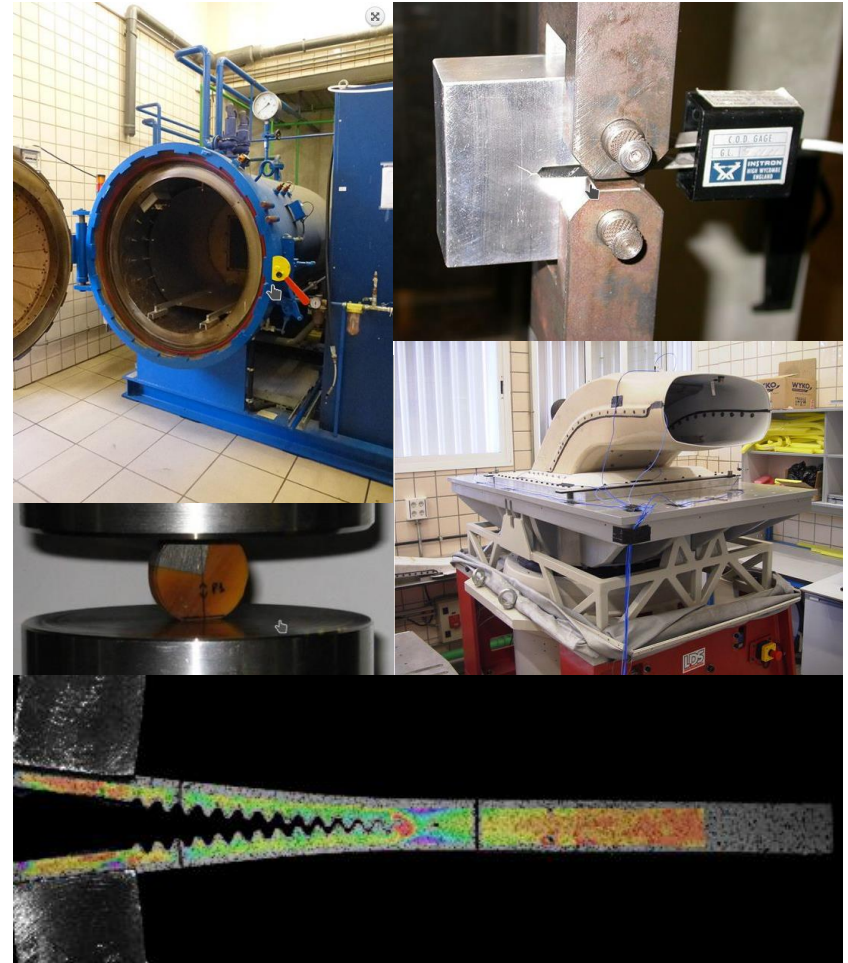
Top-level laboratory for mechanical testing of material and structures. ISO 9100, UNE-EN17025.

Among many others:

- Dynamic and static tensile testing machines (5-500 kN)
- Necessary equipment for the whole process of fabricating composite structures using standard procedures in aeronautical and space industries, and 3D composite printers.
- Advanced observation techniques: DIC, Very high speed cameras (up to 1 Mfps), Computed Tomography (voxel down to 0.5 μm).

35-years of know-how on testing from fundamental research to industrial applications.

- Thousands of tests carried out for the industry, in particular for the aeronautical industry. Experience on every test procedure for material characterization.
- Long experience on the design of singular tests for full-scale structures: Airbus A380 Belly Fairing, Airbus A350 S19.



Know-how and facilities

Experimental - Details



Testing capacities:

Design of singular tests on structural elements.

Design and fabrication of tool for singular experiments.

Experiment monitoring, Setting.

Standard Metallic material testing: Tensile tests, Rockwell, Fracture toughness, R-Curve, S-N Curve, Paris law, Residual stresses. Mass spectrometry, Corrosion tests in artificial atmospheres (e.g. salt spray), Intergranular corrosion,, Electrical and thermal conductivity.

Standard Composite material testing: Tensile, compression, interlaminar shear, Double Cantilever Beam, 3-point bending, 4-point bending, interlaminar fracture toughness, mechanical joints in composite panels. Resin contents, viscosity, Density, thermal expansion.

Standard testing of Adhesive joints: Drum peel, Single-lap shear, Double-lap shear. Tensile strength composite sandwich, foam tube shear.

Equipment:

Tensile Testing Machines: Instron 2 electromechanical and 4 hydraulic tensile testing machines (Instron) with load cells ranging from 5kN to 500kN.

Temperature chambers for the tensile testing machines (-70°C a 350°)

Environmental chambers, humidity, salt spray, temperature.

Diverse equipment for strain/stress/damage measurement: Wheatstone bridges, acquisition equipment, DIC, Photoelasticity, Equipment for ultrasound testing, High Speed Cameras (up to 1MHz), optical emission spectrometer, equipment for hole-drilling strain gage method, Moiré interferometry, optic microscope. Other equipment from US research central services: Electronic microscope, Computed tomography.

Basic machining and metal fabrication tools.

Full equipment for fabrication of composite laminates and structural elements: Clean room for aerospace-grade composites, Autoclave, Hot-press plate, Composite 3D printer. Tools for machining cured composite elements.

An international network



AIRBUS



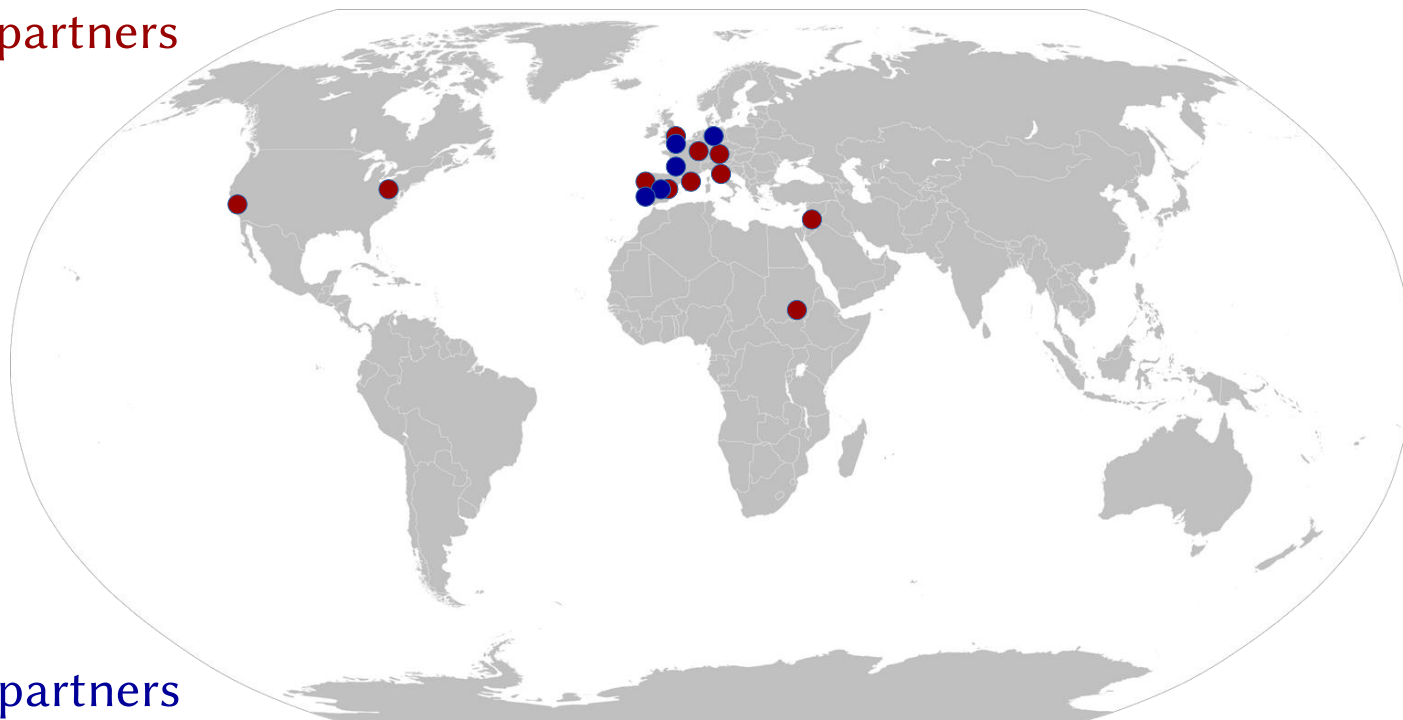
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Industrial partners



Academic partners



POLITÉCNICA

