Technological innovation on Solid Mechanics at transportation and civilian security industries

Solid mechanics studies the behaviour of solid materials, especially their motion and deformation under the action of forces, temperature changes, phase changes, and other external or internal agents. It is fundamental for civil, aerospace, nuclear, biomedical and mechanical engineering, for geology, and for many branches of physics such as materials science.

Structural elements employed in the aforementioned industrial sectors are often subject to a wide variety of unusually severe thermo-mechanical solicitations. It is obvious that this kind of structure (e.g. components for satellites) must be designed to sustain extreme temperatures, which may vary hundred degrees in short periods of time, and extreme mechanical loads such as hypervelocity impacts.

New specific structural solutions need to be developed to fulfil such requirements, which place these industrial sectors at the forefront of the technological innovation.

New results towards technological innovation on solid mechanics

This is precisely the gap that the three EC-funded projects are filling with ground-breaking fundamental science in response to industrial needs: OUTCOME, QUANTIFY & PURPOSE. Their focus is to analyse and model the mechanical damage and failure in engineering structures used in transportation (automotive, shipping, aircraft, aerospace, etc) and civilian security industries subject to extreme loading conditions.

The effort of these three projects breakthroughs the solid mechanics field, by developing novel solutions for the analysis and design of structures subjected to the action of external forces that compromise efficiency and security of equipment.

Analytical & numerical models and software

- Development of analytical and numerical models to predict the behaviour of the engineering materials studied in the project.
- Development of routines to implement constitutive models describing the behaviour of structural materials in commercial finite element codes.
- Mechanical characterization of the engineering materials studied to identify their behaviour under a wide variety of loading conditions.
- Demonstration on optical system to measure damage in aerospace structures functioning under lab conditions.

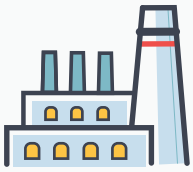
Common Dissemination Booster

These projects have received support from the European Commission's Common Dissemination Booster

The impact on Solid Mechanics

- New lightweight metals fabricated for automobiles, ships, aircrafts and civil infrastructures, all sectors of crucial importance for the European economy and society
- Novel solutions for the analysis and design of aerospace and defence structures subjected to extreme loading conditions
- Comprehensive experimental, analytical and numerical methodology to address canonical fragmentation problems
- New knowledge about the effect of anisotropy in the dynamic mechanical failure of lightweight metallic materials used in the transportation and civilian-security industries
- Bring down the entry barriers that the 3D-printing technology has found in energy absorption applications
- Elucidate whether at sufficiently high strain rates there may be a transition in the fragmentation mechanisms from defects–controlled to inertia–controlled
- New framework which incorporates a deterministic component within the fragmentation mechanisms
- An international network of experts addressing the challenges of Solid Mechanics

Who benefits?



Industry:
Aerospace engineering, automotive engineering, civilian security.

Governments/public agencies:
National agencies in EU countries funding research in the same field, as well as infrastructure and public works ministries.

General Public:
General public potentially on a global scale.

The EU cluster of research projects tackling the mechanical damage and failure in engineering structures used in transportation and civilian security industries

outcome
Marie Skłodowska-Curie Innovative Training Network

Train early-stage researchers in what is referred to as an outstanding mechanics: developing novel solutions for the analysis and design of aerospace and defense structures subjected to extreme loading conditions.

QUANTIFY

Form an international network in the field of Solid Mechanics, to exchange/share skills and knowledge with the view to understand and model the effect of anisotropy in the dynamic mechanical failure of lightweight metallic materials used in the transportation and civilian-security industries.

PURPOSE

Develop a comprehensive experimental, analytical and numerical methodology to address 4 canonical fragmentation problems from solid mechanics which respond to distinct geometric and loading conditions which make easily identifiable from a mechanical standpoint.

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