



# PhD in INGEGNERIA STRUTTURALE, SISMICA, GEOTECNICA / STRUCTURAL SEISMIC AND GEOTECHNICAL ENGINEERING - 38th cycle

**PNRR\_352 Research Field: DEVELOPMENT OF INNOVATIVE NUMERICAL METHODS FOR  
THE SIMULATION OF FLUID-STRUCTURE INTERACTION PROBLEMS IN THE FORMING  
PROCESSES OF FOOD CARTON PACKAGES**

**Monthly net income of PhDscholarship (max 36 months)**

**€ 1400.0**

In case of a change of the welfare rates during the three-year period, the amount could be modified.

## **Context of the research activity**

**Motivation and objectives of the research  
in this field**

The proposed project aims at developing innovative numerical methods for the simulation of fluid interaction with thin shell structures in mechanical apparati where different geometrical scales are present and where the 3D nature of the problem is not reducible. This type of problems is of paramount importance in the food carton packaging industry, and cannot be tackled with the currently available commercial software. A reliable numerical simulation tool could play a crucial role for the design of safe and healthy food containers, biologically compatible, employing new, non-conventional and eco-compatible materials, opening new perspectives towards a green transition in food packaging. This will allow to implement a smart and sustainable production chain, improving the management of waste, simplifying the waste sorting and enhancing the circular economy, in accordance with the purposes of the PNRR M2C1 objective.

The project is supported and will be carried out in strict collaboration with Tetra Pak Packaging solutions. Tetra Pak is a worldwide leading Company in food packaging, at the frontline in the research and development of new packaging technologies and materials. Tetra Pak will play a key role in providing real data and information on the production needs and standards.



<b>Methods and techniques that will be developed and used to carry out the research</b>	The research consists mainly in the theoretical development and implementation of innovative numerical simulation tools, involving advancements in existing computational methodologies such as FEM, Virtual Element Method (VEM), particle-FEM (PFEM), Lagrangian-Eulerian approaches and explicit dynamics, applied to various challenging and present-day engineering problems.
<b>Educational objectives</b>	The project involves multiphysics and multidisciplinary competences. The Ph.D. student is expected to become prepared to tackle complex problems and to develop effective problem-tailored innovative solution procedures, also gaining culture and consciousness on environmental themes and challenges, according to the 3.3 investment of the MC21 PNRR objective.
<b>Job opportunities</b>	There is a growing need for post-docs with specific expertise in computational mechanics and in the modeling of complex, multiphysics engineering problems, employing new, non-conventional materials, such as those typical of the green transition, requiring a specific training in research and in the development of innovative solutions.
<b>Composition of the research group</b>	1 Full Professors 2 Associated Professors 0 Assistant Professors 0 PhD Students
<b>Name of the research directors</b>	Umberto Perego, Massimiliano Cremonesi

<b>Contacts</b>	
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<b>Additional support - Financial aid per PhD student per year (gross amount)</b>	
<b>Housing - Foreign Students</b>	--



<b>Housing - Out-of-town residents (more than 80Km out of Milano)</b>	--
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<b>Scholarship Increase for a period abroad</b>	
<b>Amount monthly</b>	700.0 €
<b>By number of months</b>	6

<b>National Operational Program for Research and Innovation</b>	
<b>Company where the candidate will attend the stage (name and brief description)</b>	Tetra Pak Packaging Solutions - <a href="http://www.tetrapak.com">http://www.tetrapak.com</a>
<b>By number of months at the company</b>	6
<b>Institution or company where the candidate will spend the period abroad (name and brief description)</b>	to be defined
<b>By number of months abroad</b>	6

<b>Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information</b>
<p><u>Universities, Companies, Agencies and/or National or International Institutions that are cooperating in the research:</u></p> <ul style="list-style-type: none"> <li>• Universitat Politecnica de Catalunya - Barcelona</li> <li>• Tetra Pak Packaging Solution (Modena)</li> <li>• MUR PRIN Project "XFAST-SIMS: Extra fast and accurate simulation of complex structural systems"</li> </ul> <p><u>Educational activities</u> (purchase of study books and material, funding for participation to courses, summer schools, workshops and conferences): The Ph.D. course supports the educational activities of its Ph.D. students with an additional funding equal to 10% of the scholarship, starting from the first year.</p> <p><u>Teaching assistanship</u> (availability of funding in recognition of support to teaching activities by the PhD student): Ph.D. students are encouraged to apply, upon prior authorization, to the calls to support teaching activities at the undergraduate and Master levels at Politecnico, being paid for that. The teaching assistantship will be limited up to about 80 hours, maximum half of them devoted to teaching and classroom activities and the rest to support classworks and exams.</p> <p><u>Computer availability and desk availability:</u> Each Ph.D. student has his/her own computer for individual use. Each Ph.D. student has his/her own desk, cabinet and locker.</p>