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COMPUTATIONAL MECHANICS IN INDUSTRY: FROM MULTISCALE TO DATA-DRIVEN APPROACHES

JAVIER GÓMEZ[*], BORJA ERICE[†]

[*] ADVANCED MATERIAL SIMULATION SL
Elcano 14, Bilbao, Bizkaia, 48008, Spain
Javier.gomez@amsimulation.com

[†] Mondragon Unibertsitatea, Faculty of Engineering, Department of Mechanics and Industrial Production, IKERBASQUE, Basque Foundation for Science
Loramendi 4, Mondragon 20500, Gipuzkoa, Spain
berice@mondragon.edu

ABSTRACT

Research and innovation in computational mechanics and materials science are fundamental for sustainable technological and industrial development in Europe. Modern materials science addresses complex materials and advanced manufacturing processes, necessitating new methodologies for material modelling. The evolving landscape of industrial applications requires a robust and innovative approach to computational mechanics. This session will showcase examples of how to bridge the gap between advanced computational theories and their practical implementation in industry. It will explore the transformative potential of integrating multiscale modelling techniques with data-driven methodologies to address complex industrial challenges.

Multiscale modelling has emerged as a powerful tool to capture the behaviour of materials and structures across different scales, from the atomic to the macroscopic level. By integrating information from different scales, multiscale modelling enables more accurate predictions and optimizations of material behaviour under diverse conditions. The industrial application of this modelling methodology has revolutionized product development and manufacturing processes across various sectors by providing a comprehensive understanding of material properties and mechanical behaviour. The session will present examples of industries that have particularly benefited from this technology.

Data-driven models represent a new paradigm in Computational Mechanics and Material Science. The potential of big data, machine learning, artificial intelligence, and data management is still largely untapped. Emerging branches like materials informatics and hybrid modelling illustrate this growth. These models offer powerful alternatives to traditional physical modelling, utilizing innovations in machine learning and deep learning to provide real-time solutions. The rise of data-driven methodologies is revolutionizing computational mechanics, offering new ways to analyse large datasets, uncover hidden patterns, and enhance predictive capabilities.

The session will highlight advancements, practical applications, and challenges in implementing these techniques. Participants will gain insights into the latest research and future directions in industrial applications of multiscale and data-driven approaches.