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MODELLING AND SIMULATIONS OF ADDITIVELY MANUFACTURED METAMATERIALS

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F. AURICCHIO*, M. CARRATURO*
AND S. MORGANTI†

* Department of Civil Engineering and Architecture, University of Pavia
Via Ferrata 3, 27100, Pavia, Italy

† Department of Electrical, Computer, and Biomedical Engineering, University of Pavia
Via Ferrata 5, 27100, Pavia, Italy

ferdinando.auricchio@unipv.it; massimo.carraturo@unipv.it; simone.morganti@unipv.it

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ABSTRACT

High-performance components produced using Additive Manufacturing (AM) technologies are a reality in many industrially-relevant applications. Nowadays, complex structural parts can be produced using AM technologies with almost unlimited design freedom and locally varying material properties. Therefore, in recent years, the so-called metamaterials, e.g., architected cellular or lattice structures, have known an increasing interest due to the possibility to design structural parts with tailored mechanical properties and performance.

Despite their huge potential, widespread adoption of metamaterial structures has been hindered by concerns about their structural integrity. In fact, considering the complexity of the manufacturing process, many potential process-induced defects can be present in the final component, limiting their reliability and applications.

Numerical models can thus be a crucial tool to shed light on the complex process-structure-property-performance relationships occurring in AM metamaterials. In fact, only a deep understanding of these relationships will allow us to fully control process errors and their effects on the mechanical properties and performances of these kinds of structures.

In the present mini-symposium, the following topics, related to AM metamaterials, will be considered:

- Cell-based modeling for periodic structures
- Instability and structural behavior
- Material modeling, calibration, and validation
- Effects of defects
- Image-based analysis
- Machine learning techniques
- Process simulations
- Fatigue analysis
- Engineering applications
- Computational ontology