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Numerical and experimental characterization of 3D printed lattice structures

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Numerical characterization of 3D printed lattice structure mechanical behavior is a challenging task due to the inhomogeneous material micro-structure and the complex geometry of these components [1].
In the first part of the presented contribution an empirical procedure suitable to define a lattice material model is presented and validated. Starting from micro-indentation measurements the yield stress and the Young modulus of the material are obtained at nodal and truss locations on two different planes: the former parallel to the building direction and the latter perpendicular to the building plane. By means of an exponential plastic law the micro-indentation measurements are used to define four isotropic material models. Experimental tensile tests were conducted using Digital Image Correlation (DIC) technique showing that the actual mechanical behavior of a lattice tensile specimen lies between the numerical curves.
In the second part, we address the geometrical issues of lattice components. In fact, it is well known form the literature that the elastic behavior of lattice structures is dramatically underestimated when computed on the as-designed geometry [2]. Therefore, the actual 3D printed geometry as acquired for instance by Computed Tomography (CT) scan has to be used for the analysis. However, such a geometry can be very challenging to mesh, thus an efficient immersed boundary method, namely the Finite Cell Method, has been proposed to perform accurate numerical simulations of 3D printed lattice components [3].

REFERENCES

[1] Carraturo M., Alaimo G., Marconi S., Negrello E., *et al.*, Experimental and Numerical Evaluation of Mechanical Properties of 3D-Printed Stainless Steel 316L Lattice Structures. *JMEP*, 2021.

[2] Alaimo G., Carraturo M., Korshunova N., Kollmannsberger S., Numerical evaluation of high cycle fatigue life for additively manufactured stainless steel 316L lattice structures: Preliminary considerations. *MDPC*, 2021.

[3] Korshunova N., Alaimo G., Hossein S.B., Carraturo M., *et al.*, Bending behavior of octet-truss lattice structures: Modelling options, numerical characterization and experimental validation. *Material & Design*, 2021.