TOWARDS MULTISCALE COMPUTATIONAL DESIGN OF SHOCK-ABSORBING METAMATERIALS:

(II) FROM THE LOW-SCALE TO THE UPPER-SCALE

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ABSTRACT

To explore the computational design of shock-absorbing metamaterials, this work is a continuation of the one that was presented in COMPLAS 2021 " Towards the Multiscale Computational Design of Shock-absorbing Metamaterials: (I) From the Upper-Scale to the Low-Scale" (see [1]).

Once explored there the mechanisms for mechanical dissipation that arise from propagating shocks on the high scale via "theoretical" nonconvex hyperelastic materials, the concept of multiscale metamaterial design is retrieved by defining a mesoscale constituted by a beams lattice, which buckles due to the interaction with the macro-scale (Hill-Mandel energetic equivalence principle), thus giving rise to a homogenized constitutive behavior exhibiting, on the macro-scale, the nonconvexity requested to exhibit "extrinsic" dissipation features. The goal now is exploring the computational challenges associated to this computational modeling i.e. 1) The homogenization of a representative volume element (RVE), made of 1D buckling beams at the mesoscale, into a 2D constitutive model at the macro-scale, 2) the controversial issue of the dependence of resulting homogenized macro-scale behavior on the RVE size, 3) the efficiency in generating mechanical dissipation at the upper scale, this qualifying the proposed setting as amenable for shock absorbing metamaterial design purposes.

Representative examples show the degree of achievement of solutions to the aforementioned challenges.

[1] A. Nuñez-Labielle, J. Cante, A.E. Huespe, J. Oliver, *Towards shock absorbing hyperelastic metamaterial design. (I) Macroscopic scale: Computational shock-capturing*, Comput. Methods Appl. Mech. Engrg. Volume 393, April 2022, 114732, https://doi.org/10.1016/j.cma.2022.114732