Identification of heterogeneous material response through data-driven computational mechanics

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ABSTRACT

A method to identify the strain-stress relations of materials based on the data-driven computational mechanics paradigm was proposed by Leygue et al. (2018), which waives the need of any underlying constitutive equation. Given a strain field, the algorithm solves a minimization problem constrained to equilibrium and compatibility conditions in order to create a database of mechanical states that sample the response of the material for such strains.

In this work, the method was tested for trusses with two distinctive linear elastic materials in order to simulate a plate with additions in it. The data was synthetically manufactured by using the finite elements methods in order to compare the precision of the solutions. The firsts results have shown that the algorithm is completely capable of converging and identifying two different constitutive equations. The precision of the results is highly dependent on the parameters chosen to tune the algorithm, mainly the amount of materials states used to define the problem and the pseudo-stiffness C. After the underlying constitutive laws are retrieved, different methods can be used for separated linear regression. Correspondence analysis has proven to be an effective method for sorting points into their respective curves, while an heuristic approach with image processing has also given results within an acceptable margin of error.

Further analysis should be performed in order to obtain an efficient method for tuning parameters, as well as different analytic methods that could allow to obtain more precise regressions.

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