Computer vision with error estimation for reduced-order modeling of macroscopic mechanical tests

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Abstract

In this contribution, computer vision enables to recommend a reduced order model for fast stress prediction according to various possible loading environments. This approach is applied on a macroscopic part by using a digital image of a mechanical test. We propose a hybrid approach that simultaneously exploits a data-driven model and a physics-based model, in mechanics of materials. During a machine learning stage, a classification of possible reduced order models is obtained through a clustering of loading environments by using simulation data. The recognition of the suitable reduced order model is performed via a convolutional neural network (CNN) applied to a digital image of the mechanical test. The CNN recommend a convenient mechanical model available in a dictionary of reduced order models. The output of the convolutional neural network being a model, an error estimator is proposed to assess the accuracy of this output. This contribution details simple algorithmic choices that allowed a realistic mechanical modeling via computer vision [1].

[1] Franck Nguyen, Selim M. Barhli, Daniel Pino Muñoz, and David Ryckelynck, “Computer Vision with Error Estimation for Reduced Order Modeling of Macroscopic Mechanical Tests,” Complexity, vol. 2018, Article ID 3791543, 10 pages, 2018. https://doi.org/10.1155/2018/3791543.