Uncertainty quantification in multiscale deformation processes

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We present a non-intrusive method for modeling the propagation of uncertainty in process conditions and initial microstructure on the final product properties in a deformation process. The stochastic deformation problem is modeled using a sparse grid collocation approach that allows the utilization of a deterministic simulator to build interpolants of the main solution variables in the stochastic support space. The ability of the method in estimating the statistics of the macro-scale microstructure-sensitive properties such as ductility and hardness and constructing the convex hull of these properties is shown through examples featuring randomness in initial texture and process parameters. A data-driven model reduction methodology together with a maximum entropy approach is used for representing randomness in initial texture in Rodrigues space. Comparisons are made with the results obtained from Monte-Carlo method.