An information-learning approach for multiscale modeling of materials

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Multiscale models which account for material uncertainties at the micro scale is a problem of practical significance since many macroscopic properties depend strongly on geometric variability of the micro-constituents. Techniques for computing a probability distribution function(PDF) of microstructures from limited information rely on techniques such as the principle of maximum entropy [1]. Herein, this PDF is computed in a time-efficient manner by utilizing an information-learning approach. Information-learning is a scheme which utilizes a training set to estimate certain parameters that can be used to reproduce data for any new test set. This scheme uses mutual information measures to obtain optimal parameters. The information-learning scheme is adapted to microstructures by incorporating features such as grain sizes and orientation distribution functions to obtain a PDF of microstructures. The reconstructed microstructures are interrogated using homogenization techniques to evaluate the variability of non-linear macro properties. Numerical examples depicting this method for reconstructing PDF of polycrystalline microstructures and its homogenized properties will be discussed.

References

1. S. Sankaran, N.Zabaras, "A maximum entropy approach for property prediction of random microstructures," Acta Materialia, in press.