

## Computing macroscopic mechanical properties of heterogeneous composites

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Generalized Hashin-Shtrikman variational principle with different order of statistics is used to compute a rigorous approximation on the macroscopic effective elastic moduli for composite materials with different internal structures. For this purpose, the statistical and morphological features of the material are directly extracted from simulated or tomographic images and applied to the model. An interesting application with Liquid Crystal Elastomer (LCE) network composites will be introduced by coupling the model with piezoelectricity.

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