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COMPUTATIONAL MODELING OF HETEROGENEOUS STRUCTURES WITHOUT SCALE SEPARATION: AN APPROACH BASED ON NONLOCAL FILTER-BASED HOMOGENIZATION

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In the present work, a computational method is proposed to compute the response of highly heterogeneous structures through a simplified (homogenized) model when no scale separation can be assumed. Based on a recent theory developed by the authors [1, 2], a nonlocal constitutive law is first constructed based on numerical computations on a unit cell. The homogenization framework is based on the use of linear filters instead of classical averaging operators and generalizes the classical homogenization theory, leading naturally to a nonlocal constitutive law. A numerical procedure is developed to compute the response of structures made of periodic cells by using a coarse mesh, associated to a wavelength related to a chosen scale of description. Compared to our previous work, [2], a displacement-based strategy is proposed to implement the constructed nonlocal law in a classical Finite Elements procedure related to the coarse mesh. Unlike other nonlocal elasticity theories, the present method is fully micro-mechanically-funded and re-localization can be achieved to analyze local (strain and stress) fields without solving the fully detailed problem. The methodology is demonstrated by analyzing the response of structures with heterogeneities which have characteristic dimensions comparable to those of the structure itself.

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