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THREE-DIMENSIONAL SOLIDS AND STRUCTURES WITHIN STRAIN GRADIENT ELASTICITY: NUMERICAL METHODS AND MODEL COMPARISONS

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Literature on the most common dimensionally reduced structural models within different theories of generalized continuum mechanics is vast, most probably due to the relative commonness, simplicity and applicability of the corresponding well-known models of the classical continuum mechanics and the small amount of generalized constitutive parameters incorporated into these reduced models. On the contrary, literature on the three-dimensional formulations of generalized continuum mechanics is still quite limited, obviously due to the large number of constitutive parameters incorporated into the models and the relatively high complexity and computational cost of the related numerical methods [1, 2].

This contribution focuses on comparing the structural dimension reduction models to the corresponding three-dimensional "parent" models of strain gradient elasticity, especially in the context of microarchitectural, lattice or cellular, structures [2, 3]. These comparisons rely on analytical and numerical solutions corresponding to the different models and incorporate constitutive parameters obtained by different computational homogenization techniques. For microarchitectural structures, non-homogenized fine-grain models of classical elasticity provide reference solutions, and hence enable a simulation-based model validation. Ritz–Galerkin methods, in the form of higher-order finite element methods, are adopted for obtaining reliable numerical solutions to problems lacking for analytical benchmark solutions.

Some of the main characters of the structural models are in accordance with the three-dimensional models, whereas some features of the structural models are questioned according to the model comparisons with the underlying three-dimensional models.

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