Modelling of lattice structures by strain gradient elasticity theories

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ABSTRACT

The first and second strain gradient elasticity theories are studied in the framework of continualization, or homogenization, of lattice structures. As simple examples, we consider triangular planar lattice structures of different types.

In our first approach, we consider a longish planar truss structure. Classical homogenization procedures are first applied in order to find out the effective material parameters of a continuum counterpart of the truss. With these material parameters, the truss is modelled by using a beam model following the first strain gradient elasticity theory. In our second approach, a planar spring lattice structure is modelled by using a continuum model following the second strain gradient elasticity theory.

Model comparisons show that the generalized continuum models are able to capture the essential features of the lattice structures including size-effects. Numerical simulations utilized in the analysis are accomplished by using a commercial finite element software: standard finite elements following the classical elasticity theory and isogeometric user-defined elements following the strain gradient theories.

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