Title : Homogenization of periodic elastic structures leading to second gradient effects

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Abstract

We study a three dimensional elastic structure obtained with a 3D-printer. We hope that this structure behaves as a second gradient material, i.e. a material whose elastic energy depends on the second gradient of the displacement. The structure is made of a homogeneous linear elastic material and we can study its equilibrium from the variational point of view.
Our approach utilizes the tools of Gamma-convergence and two-scale convergence. Making some modeling assumptions, we reduce our three-dimensional problem to a two-dimensional one.
After this 3D-2D dimension reduction the geometry of considered structure is based on a periodic planar graph. We first prove that this latter structure can be studied as a discrete stucture.
Precisely we demonstrate that the sequence of 2D elastic energies is the Gamma-limit of the sequence of elastic discrete energies of a system of nodes linked by bars which work in extension and flexion. We finally determine the effective properties of the considered material.