Upscaling and spatial localization of non-local energies with applications to crystal plasticity

José Matias
Instituto Superior Técnico, U. of Lisbon
jose.c.matias@tecnico.ulisboa.pt
Marco Morandotti
Politecnico di Torino
marco.morandotti@polito.it
David Owen
Carnegie-Mellon University
do04@andrew.cmu.edu
Elvira Zappale
La Sapienza, U. di Roma
elvira.zappale@uniroma1.it

An integral representation result is obtained for the asymptotics of energies including both local and non-local terms, in the context of structured deformations. Starting from an initial energy featuring a local bulk and interfacial contribution and a non-local measure of the jump discontinuities, an iterated limiting procedure is performed. First, the initial energy is relaxed to structured deformation, and then the measure of non-locality is sent to zero, with the effect of obtaining an explicit local energy in which the nonlinear contribution of submacroscopic slips and separations is accounted for. Two terms, different in nature, emerge in the bulk part of the final energy: one coming from the initial bulk energy and one arising from the non-local contribution to the initial energy. This structure turns out to be particularly useful for studying mechanical phenomena such as yielding and hysteresis. Moreover, in the class of invertible structured deformations, applications to crystal plasticity are presented.