Homogenization of highly contrasted elastic checkerboards

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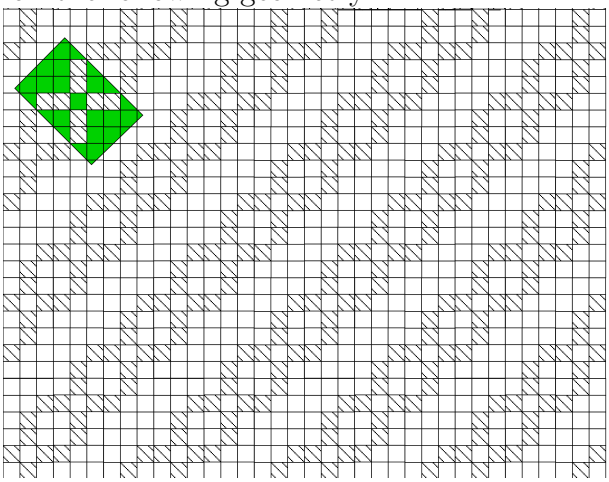
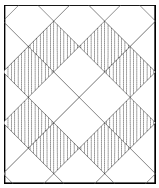
We are interested in the homogenization of a soft elastic matrix containing very stiff inclusions. In the framework of two dimensional linear elasticity, we consider irregular checkered patterns : the stiff inclusions are rectangles arranged periodically and joining at corners. Such a geometry may lead to interesting phenomena. Indeed, stiff inclusions touching each other at corners may behave like rigid bodies linked together with pivot joints. In this way complex mechanisms can be simulated.

Here we will focus on the following geometry



in which the following period can be identified



Considering, for sake of simplicity a vanishing Poisson coefficient, the elastic energy is

$$E_\varepsilon(u) := \int_\Omega \mu_\varepsilon(x)\|e(u)\|^2 dx$$

where the elastic stiffness takes the value $\mu_e(x) = a_\varepsilon$ or $\mu_e = b_\varepsilon$ respectively in the soft (white) and hard (black) part of the domain. We will study the limit of this energy when all the quantities a_ε, $(b_\varepsilon)^{-1}$ and ℓ_ε tend to zero. We show that these limits do not commute and we describe a critical case where the effective medium is intermediate between the classical elastic one and the pseudo-rigid model.