High order transmission conditions for the homogenization of interface problems

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Abstract

I will present a work which has lots of links with one of the domain of expertise of Monique Dauge : the analysis of singularities and more generally the asymptotic analysis. This is is a field in which Monique has major contributions.This is a joint work with Xavier Claeys (UPMC, University Paris 6) and a former phd student Valentin Vinoles (now at EPFL). It is motivated by the fact that classical homogenization theory poorly takes into account interfaces. This is particularly unfortunate when considering negative materials, because important phenomena arise precisely at their surface (plasmonic waves for instance). We have treated the case of a planar interface between a homogeneous and a periodic half-spaces. Coupling a standard multiscale expansion in the periodic half-space with matched asymptotic techniques near the interface, we have derived high order transmission conditions. The obtained conditions involve Laplace-Beltrami operators at the interface; they require in particular to solve cell problems in a periodicity cell (as in the classical homoenezation theory) and non classical cell problems in infinite strips (to take into account the interface phenomena). The analysis is based on a original combination of the Floquet Bloch theory and a periodic version of Kondratiev techniques. We have then introduced an approximate model for which stability properties have been proven. Error estimates justify that this new model is more accurate than the classical one near the interface and in the bulk. Numerical results will be shown.

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