Defects in Homogenization Theory and related computational issues

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We review a series of works that address homogenization for partial differential equations with highly oscillatory coefficients. A prototypical setting is that of periodic coefficients that are locally, or more globally perturbed. We investigate the homogenization limits obtained, first for linear elliptic equations, both in conservative and non conservative forms, and next for nonlinear equations such as Hamilton-Jacobi type equations. Some emphasis will also be placed on the consequences of the above theoretical endeavour on strategies for modeling actual materials and simulating them using multiscale approaches, such as MsFEM methods. The works presented have been completed in collaboration with a number of colleagues, in particular with Y. Achdou, X. Blanc, P. Cardaliaguet, F. Legoll, P.-L. Lions, A. Lozinski, and R. Biezemans, R. Goudey.