

Mathematical analysis and homogenization of the torsion problem

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Abstract. In this paper we address the limitations of the classical formulation of the torsion problem and give a self-contained survey of the function spaces and formulations that are more suitable for analysing the torsional behavior of composite materials. We also prove some homogenization results for the torsion problem in both the periodic and stochastic setting. Our theoretical results are illustrated by numerical examples.

1. Introduction

The first investigation on the torsion problem goes back to the works of Coulomb and Navier (which included some erroneous conclusions). The most classical results, including applications to a number of cases of technical importance, is mainly due to Saint-Venant. The generalization of the Saint-Venant theory to torsion of bars consisting of different materials joined along their side surfaces has also been known for a long time (see [13], [14] and [15]). This classical theory, which still is popular especially in the elasticity community, requires that the surfaces separating the different