Homogenization Results for a Wave Equation with Interior and Boundary Damping

C. TIMOFTE

Faculty of Physics, University of Bucharest, P.O. Box MG-11, Bucharest-Magurele, Romania
E-mail: claudiatimofte@yahoo.com

The asymptotic behavior of the solution of a singularly perturbed wave equation with dynamic boundary conditions in a periodically perforated medium is analyzed.

We consider, at the microscale, an ε-periodic structure obtained by removing from a bounded connected open set Ω in $\mathbb{R}^n$ a number of closed subsets of characteristic size ε. As a result, we obtain an open set Ω^ε, which will be referred to as being the *perforated domain*. In this domain, we consider a wave equation, with interior sources and damping and with dynamic boundary conditions imposed on the boundaries of the perforations.

Assuming suitable initial conditions, we prove that this boundary value problem is a well-posed one. This type of boundary-value problems can be encountered in the modelling of various phenomena arising, for instance, in electricity, magnetism, in the theory of elasticity, in vibrations theory or in hydrodynamics.

We are interested in describing the asymptotic behavior, as the small parameter ε which characterizes the size of the perforations tends to zero, of the solution of such a problem. Using an homogenization procedure, we prove that the effective behavior of this solution is governed by a new parabolic equation, defined on the nonperforated domain Ω.

Key words: homogenization, perforated domain, damping and source terms.

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