Asymptotic analysis of spectral problems in thick junctions with the branched fractal structure

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Abstract

A spectral problem is considered in a domain Ω_{ε} that is the union of a domain Ω_{0} and a lot of thin trees situated ε-periodically along some manifold on the boundary of $\Omega_{0}.$ The trees have finite number of branching levels. The perturbed Robin boundary condition $\partial_{\nu}u^{\varepsilon} + \varepsilon^{\alpha_i} k_{i,m}u^{\varepsilon} = 0$ is given on the ith branching layer; $\{\alpha_i\}$ are real parameters. The asymptotic analysis of this problem is made as $\varepsilon\to0,$ i.e., when the number of the thin trees infinitely increases and their thickness vanishes. In particular, the Hausdorff convergence of the spectrum to the spectrum of the corresponding nonstandard homogenized spectral problem is proved, the leading terms of asymptotics are constructed, and the corresponding asymptotic estimates are justified for the eigenvalues and eigenfunctions.
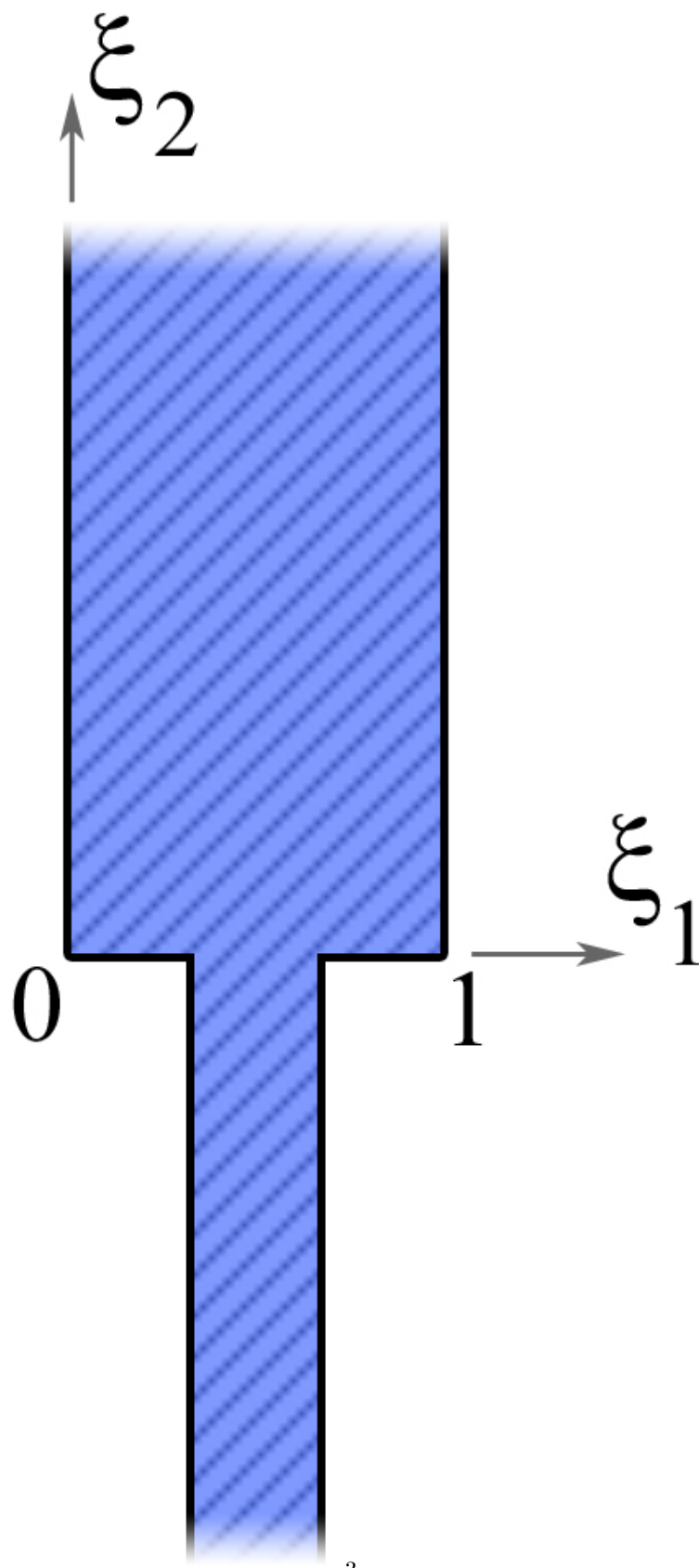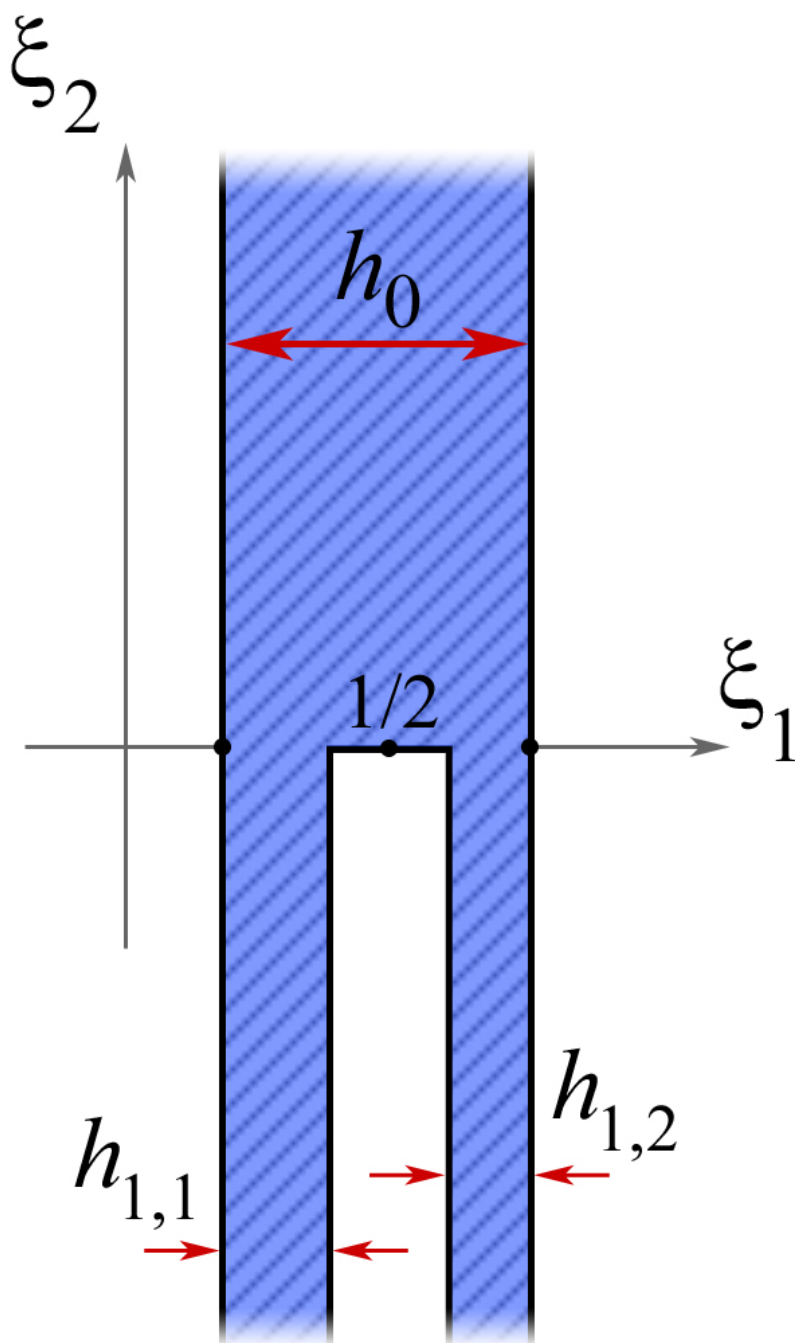
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figures/branched-junction/branched-junction-eps-converted-to.pdf

ξ_2

ξ_1

0

1

3

figures/graph-1/graph-1-eps-converted-to.pdf

$\mu_n^{(1)}$ $\longrightarrow$ $\quad$ $\mu_n^{(2)}$ $\longrightarrow$ $\quad$ $\mu_n^{(3)}$ $\longrightarrow$

0 $\qquad$ p_1 $\qquad\qquad$ p_2 $\qquad\qquad$ p_3