Asymptotic analysis of the Steklov spectral problem in thin perforated domains with rapidly varying thickness and different limit dimensions

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We consider a spectral Steklov problem in the thin perforated domain Ω_ε^{n-d}. The thin perforated domain $\Omega_\varepsilon^{n-d} \subset \mathbb{R}^n$ has the limiting dimension $n-d$, i.e., it degenerates into a domain Ω_0 from $\mathbb{R}^{n-d}$ as $\varepsilon \to 0$ ($d \in \mathbb{N},\ d < n$).

Independently of the limiting dimension of the thin domain (for instance, it can be a thin plate or a rod) with the help of the approach developed in [1, 2], we study the asymptotic behaviour of the eigenvalues and eigenfunctions of the spectral problem as $\varepsilon \to 0$.

Under certain symmetry conditions on the geometry of the thin perforated domain Ω_ε^{n-d} and the coefficients of the equations, we construct full asymptotic expansions for the eigenvalues and eigenfunctions. We also obtain asymptotic estimates for the convergence rate of the eigenvalues and eigenfunctions in that case.

[1] T.A. Mel'nyk, Asymptotic expansions of eigenvalues and eigenfunctions for elliptic boundary-value problems with rapidly oscillating coefficients in a perforated cube, *J. Math. Sci., New York*, **75** (3) (1995), pp. 1646–1671.

[2] T.A. Mel'nyk, A.V. Popov, Asymptotic analysis of the Dirichlet spectral problems in thin perforated domains with rapidly varying thickness and different limit dimensions, *Mathematics and Life Sciences. Edited by Roderick V.N. Melnik and Alexandra V. Antoniouk, Berlin: De Gruyter.* (2013), pp. 89–109.