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Homogenization of spectrum of Riemannian manifolds with complicated microstructure

Let M^ε be a compact Riemannian manifold depending on a small parameter ε in such a way that the topological genus of M^ε goes to infinity as $\varepsilon \to 0$. More precisely, we consider the manifolds consisting of either one or several copies of a fixed compact manifold (we call it "basic manifold") with a large number of small holes attached edge to edge by means of "handles" and "bubbles"; the number of holes depends on ε and tends to infinity as $\varepsilon \to 0$.

Our goal is to study the asymptotic behavior of the spectrum of the Laplace-Beltrami operator Δ^ε on M^ε as $\varepsilon \to 0$. It turns out that under some assumptions on the scales of the manifold M^ε the spectrum of Δ^ε tends to the spectrum of some homogenized operator on a basic manifold. Its structure can essentially differ from the prelimit operator Δ^ε.

In our talk we discuss various homogenized spectral problems. In particular, we are interested in the examples for which the homogenized operator has (in contrast to Δ^ϵ) non-empty essential spectrum. The results are published in [1, 2, 3].

[1] Khrabustovskyi A. // Applicable Analysis — 2008. — **87**, N 12.

[2] Khrabustovskyi A. // J.Math.Phys.Anal.Geom. — 2009. — **5**, N 2.

[3] Khrabustovskyi A. // Math.Meth.Appl.Sci. — 2009. — DOI: 10.1002/mma.1128.