Spectral analysis of the biharmonic operator subject to Neumann boundary conditions on dumbbell domains

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A dumbbell domain is the union of two bounded domains joined by a thin channel. We will give an account of recent advances in the spectral analysis of the biharmonic operator subject to Neumann boundary conditions on a planar dumbbell domain. The principal aim is to identify the limit of the eigenvalues and of the eigenprojections as the width of the channel goes to zero. We prove spectral convergence results in the spirit of the articles by J.M. Arrieta et al. for the Neumann Laplacian. In particular we prove that the limiting spectrum is strictly bigger than the sequence of eigenvalues obtained by solving the eigenvalue problem for Δ^2 in the two disjoint domains (corresponding to the dumbbell without the connecting channel). In applications to linear elasticity, the fourth order operator under consideration models the deformation of an elastic plate, a part of which shrinks to a lower dimensional manifold. In contrast to what happens with the classical second order case, it turns out that the limiting equation is here distorted by a strange factor depending on a parameter which plays the role of the Poisson coefficient of the represented plate.
These results were obtained in collaboration with J.M. Arrieta and P.D. Lamberti.