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Convergence of asymptotic series in singular perturbation problems

The singular perturbations under investigation are geometric and depend on a common pattern P and on a parameter ε that will tend to zero. The unperturbed domain is denoted by A. Its boundary ∂A is supposed to contain the origin. The perturbed domain is defined as $\mathsf{A}_\varepsilon = \mathsf{A} \cap (\varepsilon \mathsf{P})$, so that the perturbation shrinks to a boundary point of the unperturbed domain. The Dirichlet Laplacian is solved on A_ε. We consider solutions u_ε associated with a common right-hand side f that is real analytic on the closure of the unperturbed domain A. We put a special emphasis on the case when A is singular at the origin, namely, when it has a corner.
Multi-scale expansions are available for u_ε in numerous configurations. The novelty here is the notion of *absolute convergence* of such expansions. Our method is based on the Functional Analytic Approach that allowed to prove convergence for small holes in the smooth case. We also deal with perforations, now shrinking to a polygonal corner of opening ω. We prove absolute convergence of asymptotic series in (non-integer) powers of ε, after a possible explicit rearrangment/grouping of terms. The necessity of such a grouping is related to the arithmetic properties of π/ω.

Based on the joint work:

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