Probabilistic and numerical insights onto the spectral properties of the Dirichlet-to-Neumann operator

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In this talk, I show how the spectral properties of the Dirichlet-to-Neumann operator can be used to describe various characteristics of diffusion-controlled reactions, i.e., of reflected Brownian motion in an Euclidean domain with appropriate stopping conditions. For instance, one can derive a spectral expansion for the probability flux density that determines the joint probability law for the stopping time and location of the stochastic process. I discuss the advantages of this approach as compared to conventional spectral expansions based on the eigenfunctions of the Laplace operator. In particular, the Dirichlet-to-Neumann operator allows one to disentangle the diffusive dynamics in an Euclidean domain from surface reactions on its boundary. Various numerical results in the case of planar Euclidean domains with smooth and nonsmooth boundaries will be given. Several conjectures on spectral properties of this operator and related open problems will be presented.