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*How Much Geometry Is Needed to Recover a Spectrum? Quantitative Discretization of Neumann and Steklov Problems*

To what extent can the spectrum of a Riemannian manifold be recovered from coarse geometric information, and with what accuracy? In this talk, I will present a quantitative discretization framework for the Neumann and Steklov problems on compact Riemannian manifolds with boundary. Using weighted proximity graphs constructed from point samples, with weights requiring only minimal geometric information, we obtain explicit estimates for the approximation of both spectra. Importantly, both the constants in these estimates and the thresholds on the discretization parameters can be chosen uniformly over geometrically controlled classes of manifolds. A central feature of the construction is a boundary correction to the graph energy, together with an alternative discrete Steklov problem based on an averaged boundary trace. I will explain how these ingredients allow us to recover the continuous Steklov spectrum and compare this formulation with the classical discrete Steklov problem, for which an additional, necessary scale condition arises. The emphasis will be on the geometric ideas, the main results, and what they reveal about how much information is needed to approximate a manifold's spectrum.