Min-max harmonic maps and extremal metrics for Laplacian eigenvalues

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I'll describe recent work with Mikhail Karpukhin, in which we relate the problem of maximizing Laplacian eigenvalues over unit-area metrics on a given Riemann surface to natural constructions of harmonic maps to high-dimensional spheres, via min-max methods for the Dirichlet energy. I'll explain how our methods give a new construction of conformal metrics maximizing the first and second Laplacian eigenvalues, and yield new estimates for other shape optimization problems in spectral geometry–for instance providing asymptotically sharp upper bounds for the first two Steklov eigenvalues on surfaces with fixed genus and any number of boundary components.