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Pareto optimization for resonances

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An optical cavity (resonator) is a region where electromagnetic field is well confined, but not completely confined. Because of leakage, each standing wave decays in time. The energy loss and the frequency of oscillations can be characterized by complex resonaces ω. The imaginary part $\operatorname{Im}\omega$ corresponds to the decay rate, the real part $\operatorname{Re}\omega$ to the frequency. Resonators with small decay rate are required in Optical Engineering because they enhance intrinsically small light-matter interactions. The problem is to design the medium's structure that generates a resonance with minimal possible $|\operatorname{Im}\omega|$ under certain constraints on the medium. Our goal is to present a rigorous two-parameter perturbation approach to resonance optimization. Structural theorems and nonlinear eigenvalue problems for optimizers are obtained. In the case of L^1-type constraints, structural theorems allows us to find optimizers for low frequencies explicitly.

[1] I. M. Karabash, *Journal of Differential Equations* **257**, (2014) no. 2, p.374–414.