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Nonlinear Eigensolver based on Padé Approximants

In this presentation, we discuss a strategy for finding nontrivial solutions (λ, x) for a class of nonlinear eigenvalue problems of the form $F(\lambda)x = 0$. Specifically, we focus on problems related to the modeling of waveguide-loaded accelerator cavities through a finite element discretization of Maxwell's equation, where some of the matrices involved exhibit low-rank properties. We use rational functions to approximate the nonlinear terms of the problem, together with Padé approximants. This allows a linearization of the original problem, through a generalized eigenvalue of dimension larger than the original problem. We show the impact of the degree of the Padé approximants in the linearization process and convergence, and alternatives for solving the resulting linearized problem.