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# Rank-1 ODE for structured eigenvalue optimization

A new approach to solve eigenvalue optimization problems for large structured matrices is proposed and studied. The class of optimization problems considered is related to compute structured pseudospectra and their extremal points, and to structured matrix nearness problems such as computing the structured distance to instability. The structure can be a general linear structure and includes, for example, large matrices with a given sparsity pattern, matrices with given range and co-range, and Hamiltonian matrices. Remarkably, the eigenvalue optimization can be performed on the manifold of complex rank-1 matrices, which yields a significant reduction of storage and computational cost. The method relies on a constrained gradient system and the projection of the gradient onto the tangent space of the manifold of complex rank-1 matrices. It is shown that near a local minimizer this projection is very close to the identity map, and so the computationally favorable rank-1 projected system behaves locally like the gradient system.

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