Computation of Invariant Pairs and Matrix Solvents via Hankel Pencils

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We study the invariant pair problem for matrix polynomials. Invariant pairs extend the notion of eigenvalue-eigenvector pairs, providing a counterpart of invariant subspaces for the nonlinear case. They have applications in the numeric computation of several eigenvalues of a matrix polynomial; they also present an interest in the context of differential systems.

Here, we adapt the Sakurai-Sugiura moment method to the computation of invariant pairs, including some classes of problems that have multiple eigenvalues, and we analyze the behavior of the scalar and block versions of the method in presence of different multiplicity patterns. Results obtained via direct approaches may need to be refined numerically using an iterative method: we study and compare two variants of Newton's method applied to the invariant pair problem.

The matrix solvent problem is closely related to the invariant pair problem. Therefore, we specialize our results on invariant pairs to the case of matrix solvents, thus obtaining a moment-based computational approach.