Structured Linearizations for structured Matrix Polynomials

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One approach to deal with nonlinear eigenvalue problems represented by matrix polynomials is to linearize the matrix polynomial and solve the generalized eigenvalue problem. To this end, the well-known Frobenius companion forms can be used. However, in case matrix polynomials are specially structured (e.g. symmetric, alternating, palindromic) the companion forms do not share these structural properties. As structured matrix polynomials frequently arise in applications and in general possess structure in its spectra (e.g. eigenvalue pairing) or its eigenvectors, it is thus reasonable to look for structure-preserving linearizations to maintain these properties. For instance, numerical methods for structured generalized eigenproblems are capable of preserving spectral symmetries despite the presence of rounding errors. This usually leads to more effcient and sometimes more accurate algorithms.

Based on the work in Dopico et al. (2018) and Faßbender et al. (2018) we present a unifying framework for the construction of structure-preserving linearizations with respect to various structures. As in Mackey et al. (2006) our approach leads to large vector spaces of structured matrix pencils most of which are linearizations for the matrix polynomial at hand. From this pool of linearizations the one with the most favorable properties in terms of, e.g., conditioning and backward errors of eigenvalues or sparsity patterns can be selected.

References:

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