Fiedler companion pencils of rational matrix functions and recovery of minimal bases and minimal indices

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Abstract

Linearization is a standard method for computing spectral data (e.g., eigenvalues, eigenvectors, minimal bases and minimal indices) of matrix polynomials in which matrix polynomials are transformed to matrix pencils and has been studied extensively over the years. Fielder companion pencils of matrix polynomials provide an important class of linearizations of matrix polynomials. For computing spectral data (e.g., eigenvalues, poles, minimal bases and minimal indices) of rational matrix functions, a notion of linearization of a rational matrix function has been introduced recently. We describe construction of Fiedler and generalized Fiedler (GF) companion pencils of a rational matrix function $G(\lambda)$ and show that these pencils are linearizations of $G(\lambda)$. We also describe recovery of minimal bases and minimal indices of $G(\lambda)$ from those of the Fiedler and GF pencils. In fact, we show that the recovery of minimal bases are operation-free, that is, the minimal bases of $G(\lambda)$ can be recovered from those of the Fiedler and GF pencils without performing any arithmetic operations.