Matrix Polynomials in Non-Standard Form

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Matrix polynomials $P(\lambda)$ and their associated eigenproblems are fundamental for a variety of applications. Certainly the standard (and apparently most natural) way to express such a polynomial has been

$$P(\lambda) = \lambda^k A_k + \lambda^{k-1} A_{k-1} + \cdots + \lambda A_1 + A_0,$$

where $A_i \in \mathbb{F}^{m \times n}$. However, it is becoming increasingly important to be able to work directly and effectively with polynomials in the non-standard form

$$Q(\lambda) = \phi_k(\lambda) A_k + \phi_{k-1}(\lambda) A_{k-1} + \cdots + \phi_1(\lambda) A_1 + \phi_0(\lambda) A_0,$$

where $\{\phi_i(\lambda)\}_{i=0}^k$ is some other basis for the space of all scalar polynomials of degree at most $k$. This talk will describe some new approaches to the systematic construction of families of linearizations for matrix polynomials like $Q(\lambda)$, with emphasis on the classical bases associated with the names Newton, Hermite, Bernstein, and Lagrange.