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.