**Motivation**

Electromagnetic modeling and discretization of electric devices often leads to linear system descriptions of the form

\[ P_\pi z^{(\pi)}(t) + \ldots + P_1 z^{(1)}(t) + P_0 z(t) = 0, \quad P_i \in \mathbb{C}^{p,q}, \]

which are no longer passive, i.e., they generate energy in some frequency ranges.

**Background**

With \( P(\lambda) = \lambda^\pi P_\pi + \ldots + \lambda P_1 + P_0 \) being a polynomial of degree \( \pi \in \mathbb{N} \) the problem of passivation leads to a structured eigenvalue problem for the matrix polynomial

\[
\begin{bmatrix}
0 & P(\lambda) \\
-P^T(-\lambda) & H(\lambda)
\end{bmatrix},
\]

where \( H(\lambda) = H^T(-\lambda) \) itself is a fixed structured matrix polynomial that measures the energy.

**Research highlights**

- R. Byers, V. Mehrmann, and H.Xu *A structured staircase algorithm for skew-symmetric/symmetric pencils*: implementation of the algorithm as production software
- T. Reis *Circuit synthesis of passive descriptor systems - a modified nodal approach*
- S. Bora and V. Mehrmann *Perturbation theory for structured matrix pencils arising in control theory*

**Future goals**

- Generalize to polynomial systems (this includes non-regular problems, descriptor systems)
- Obtain discrete-time equivalents
- Implement passivity checking and passivity enforcement
- Exploit the structure of the original model

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