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Structured Transfer Functions of Quadratic-Bilinear Systems

As structured interpolation of transfer functions has been proven to be effective in the setting of structured linear and bilinear systems, we are aiming for a similar structure-preserving model order reduction approach for quadratic-bilinear systems, e.g., for quadratic-bilinear mechanical systems \begin{align*} \begin{aligned} 0 &= M\ddot{q}(t) + D\dot{q} + Kq(t)\\ &\quad{}+{} H_{\mathrm{vv}}(\dot{q}(t) \otimes \dot{q}(t)) + H_{\mathrm{vp}}(\dot{q}(t) \otimes q(t)) + H_{\mathrm{pv}}(q(t) \otimes \dot{q}(t)) + H_{\mathrm{pp}}(q(t) \otimes q(t))\\ &\quad{}-{} \sum_{j = 1}^{m} N_{\mathrm{p}, j}q(t)u(t) - \sum_{j = 1}^{m} N_{\mathrm{v}, j}\dot{q}(t)u(t) - B_{\mathrm{u}}u(t),\\ y(t) &= C_{\mathrm{p}}q(t) + C_{\mathrm{v}}\dot{q}(t), \end{aligned} \end{align*} with appropriately sized matrices.

So far, there are quite different frameworks for interpolation of unstructured systems in the literature, e.g., based on symmetric or regular transfer functions. We will develop reasonable generalizations of those transfer functions to the structured system case, which can then be used in a structure-preserving interpolation framework.

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