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Time-Varying Parametric Model Order Reduction by Matrix Interpolation

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Model Order Reduction of parametric linear time-invariant systems has been extensively investigated over the last ten years. For this reason, there exist many different parametric model order reduction (pMOR) approaches, which can be classified in either global or interpolatory methods. The interpolatory technique presented in [4] – based on the interpolation of reduced system matrices – is not restricted to a certain type of parameter dependency and can be applied to efficiently obtain a parametric reduced order model from the precomputed reduced system matrices at different grid points in the parameter space.

In many engineering applications the underlying high-dimensional system may depend not only on different parameters, but on parameters which *vary with time*. Such systems show a time-varying input-output behaviour which is caused by the time variability of the parameters. In this contribution we consider model order reduction for large-scale linear parameter-varying (LPV) systems of the form

$$\begin{aligned} \mathbf{E}(\mathbf{p}(t))\dot{\mathbf{x}}(t) &= \mathbf{A}(\mathbf{p}(t))\mathbf{x}(t) + \mathbf{B}(\mathbf{p}(t))\mathbf{u}(t), \\ \mathbf{y}(t) &= \mathbf{C}(\mathbf{p}(t))\mathbf{x}(t). \end{aligned} \tag{1}$$

Since the system matrices explicitly depend on the time-varying parameter vector $\mathbf{p}(t)$ we develop a projection-based, time-varying parametric model order reduction approach, which we call *p(t)MOR*, to obtain a reduced order model of a large-scale LPV system. Based on this approach, we adapt the reduction method of matrix interpolation to the time-varying case, whereby new time-derivative terms emerge which must be considered during the reduction process.

In this talk, we first present the aforementioned time-varying parametric model order reduction approach by matrix interpolation and then apply this method for the reduction of a system with *moving load*. Unlike the publications [1, 3, 2], the varying load location is here considered as a time-dependent parameter $p(t)$ of the system model with $\dot{p} \neq 0$. Both the standard and the adapted matrix interpolation with additional time-derivative terms will be employed for the reduction and their performance compared to each other.

References

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