Interpolatory Model Reduction in $\mathcal{H}_\infty$-Controller Design

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In engineering problems, it is often desired to attenuate the influence of external noise and to deal with uncertainties in a dynamical system. Classically, this amounts to the design of so-called $\mathcal{H}_\infty$-controllers which results in very difficult nonconvex and nonsmooth optimization problems. The corresponding numerical methods require multiple evaluations of the $\mathcal{H}_\infty$-norm and its gradient with respect to the controller variables. In this talk we address new efficient methods for the computation of the $\mathcal{H}_\infty$-norm of large-scale dynamical systems with possibly irrational transfer functions. We discuss a subspace projection approach for solving this problem using interpolatory techniques that are well-known in model reduction. More precisely, after performing the reduction, we compute the $\mathcal{H}_\infty$-norm of the reduced transfer function and choose the point at which the $\mathcal{H}_\infty$-norm is attained as a new interpolation point to update the projection matrices. We will discuss convergence properties of this procedure and illustrate it by various examples. One focus of this talk will be on delay systems which are reduced by employing the Loewner framework, This is useful in order to get a sequence of linear reduced models whose $\mathcal{H}_\infty$-norm can be evaluated more efficiently. Finally, we show how to apply these techniques in the context of controller design.