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Robustness Analysis for Real Parametric Uncertainty*

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Abstract

This paper has a twofold purpose. First, to review some key results in the literature in the area of robustness analysis for linear feedback systems with structured model uncertainty, and secondly to present some new results.

Model uncertainty is described as a combination of real uncertain parameters and norm bounded unmodeled dynamics. We will mainly focus on the case of parametric uncertainty. An elementary and unified derivation of the celebrated theorem of Kharitonov and the Edge Theorem will be presented. Next, an algorithmic approach for robustness analysis in the cases of multilinear and polynomic parametric uncertainty (i.e. the closed loop characteristic polynomial depends multilinearly and polynomially respectively on the parameters) is given. The latter cases are most important from practical considerations.

Some novel modifications in this algorithm which result in a procedure of polynomial time behavior in the number of uncertain parameters will be outlined. Finally, we show how the more general problem of robustness analysis for combined parametric and dynamic (i.e. unmodeled dynamics) uncertainty can be reduced to the case of polynomic parametric uncertainty, and thus be solved by means of our algorithm.

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