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Closed Loop Frequency Domain Identification of Fractional Model Representations using a Maximum Amplitude Criterion

R.A. de Callafon

Mechanical Engineering Systems and Control Group,
Delft University of Technology, Mekelweg 2, 2628 CD Delft, The Netherlands.
e-mail: callafon@tudw03.tudelft.nl

Abstract

An iterative scheme of identification and model based control design can be used to tackle the problem of designing an enhanced and robust control system for a plant with unknown dynamics (Schrama 1992). In such an iterative scheme, closed loop experimental conditions are indispensable to obtain data from the (possibly unstable) plant. However, by employing the knowledge of the controller used during the experiments, the algebraic framework of fractional representations gives rise to an equivalent open loop identification of a stable factorization of the plant (Van den Hof *et al.* 1993) and a unified approach to handle both stable and unstable plants.

In order to improve the performance of the controlled plant in the iterative scheme, compatible criteria in both the identification and the model based control design are a prerequisite. For an H_∞–norm based control design paradigm, this unleashes the need for a maximum amplitude criterion in the identification stage (Bayard *et al.* 1992, Hakvoort and Van den Hof 1994) and should be used to estimate a stable factorization of the plant.

The aim of this presentation is to present a procedure for performing an approximate identification of a possibly unstable plant by estimating a stable factorization of the plant, based on frequency domain data obtained from closed loop experiments and a maximum amplitude criterion. Due to the stability requirements on the factorization, the maximum amplitude criterion has a close relation with the H_∞–norm and the gap–distance measure (Georgiou 1988). It will be shown that the minimization can be handled by the parametrization of all stable factorization of a certain McMillan degree, based on the results of Ober (1991), and a certain non–linear constrained minimization. The procedure will be illustrated by an example.

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