ROBUST CONTROL OF SYSTEMS SUBJECT TO HARD CONSTRAINTS

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ABSTRACT

Most practical control problems are dominated by *constraints*. Valves can only be operated between fully open and fully closed, pumps and compressors have a finite throughput capacity and tanks can only hold a certain volume. These input- or actuator-constraints convert the linear plant into a nonlinear one. Exceeding these prediscribed bounds causes unexpected behaviour of the system – large overshoots, low performance or (in the worst case) instability.
Process models are always inaccurate – even extremely detailed models may contain unknown or changing physical parameters; so the controller has to manage the difference between the model (used for design) and the real plant. (Control-)Systems, that tolerate these plant uncertainties or parameter variations are called *robust*.
Either the effect of uncertainty or the effect of constraints is well-studied in control theory. The field of robust control of systems with constraints became interesting foremost in the last years.

Within this thesis, a procedure for simple and systematic design of robust and constraint controllers is presented. Therefore, the well known $\mathcal{H}_\infty$ Loop Shaping Design Procedure is extended so that the resulting controller meets the control variable's bound for a given set of reference signals. A strategy for the straightforward and systematic adjustment of the design weights after a loop shaping step is given. The presented procedure works for LTI multivariable (non-square) plants. Three detailed design examples illustrate the handling.
A comprehensive overview of state-of-the-art methods in robust or constraint control (located at the thesis' beginning) may serve as introductory survey on robust or constraint control as well.

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