P. J. Antsaklis, "Constrained Stabilizing Controllers" (Invited), 7 th I ntern. S ymposium o n t he M athematical T heory o f N etworks a nd S ystems , Stockholm, Sweden, June 10-14, 1985.

MTNS - 85

Session: Commutative Algebraic Methods in System Design

Paper: Constrained Stabilizing Controllers

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ABSTRACT

Given plant y=Pu, the class of all stabilizing controllers u=-Cy has recently been conveniently characterized using a number of different parameters. It is of interest to parametrically characterize, if possible, the stabilizing controllers which also satisfy additional design requirements; and of particular interest are convenient, easy to use in design, characterizations of such constrained stabilizing controllers.

The additional design requirements might be direct constraints on the stabilizing controllers C (e.g. C: stable, minimum-phase, diagonal, PID controller, state feedback plus observer etc.) or they might be expressed as design specifications (e.g. regulation of step disturbances, design of specific input-output responses etc.) which lead to constraints on the controller C. It is of course known that many such design requirements can only be accomplished when the plant satisfies certain conditions. Therefore the problem involves two separate issues.

(i) Under what conditions on the plant there exist stabilizing controllers which satisfy the given constraints?

(ii) Assuming that the plant satisfies the conditions in (i), is it possible to characterize these controllers in a convenient (parametric) way?

The first issue (i) is an alternative formulation of the question of existence of solutions under internal stability in control problems; and a variety of results, depending on the particular control problem, do exist. There are however very few published results addressing the second issue.

In this paper, the problem of constrained stabilizing controllers is formulated and studied using parameterizations of all stabilizing controllers and examples are presented. Parameterizations of all stable or minimum-phase stabilizing controllers are discussed and those conditions on the plant which make such characterizations convenient to use are identified. Furthermore, constrained stabilizing controllers which achieve regulation are also discussed.