Dynamics of Continuous, Discrete and Impulsive Systems
Series **B:** *Algorithms and Applications* **11 (2004)** 411-427

STABILIZATION BY THREE TERM CONTROLLERS

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Abstract. This paper presents recent techniques for determining the *complete set* of stabilizing, three term controllers for a given single-input single-output, linear, time invariant, continuous or discrete time plant of arbitrary order. Important special cases are first order and PID controllers. For digital PID controllers, a Generalized Hermite-Biehler theorem is utilized to characterize the stabilizing region in the controller parameter space in term of sets of linear programming problems. For the case of general three term (and first order) controllers, the method involves mapping the stability boundary in the frequency domain into the parameter space. The resulting surface(s) divides the parameter space into regions. Every point (i.e. controller) in a region will result in a corresponding closed loop characteristic polynomial with a fixed number of unstable closed loop poles. The stability region will consist of such regions corresponding to no unstable closed loop poles.
Keywords. Stability, three term controllers, PID, first order controllers, digital

1 Introduction

It is well known [1] that the majority of controllers in industry today are some form of PID and/or first order controllers. In general, lower order controllers are preferable over controllers of higher order if they satisfy the design requirements. Despite obvious advantages of lower order controllers, modern control design methodologies have had minimal success in incorporating this important feature. The reason for this is that modern control methods are based on the YJBK [15] characterization of all stabilizing controllers. Unfortunately, this characterization does not allow the order of the controller to be specified and most often yields controllers of unnecessarily high order. In fact there are few results that deal with fixed structure, modern control [2, 6].