

ADAPTIVE DECENTRALIZED CONTROL OF INTERCONNECTED SYSTEMS

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Abstract. This paper presents a decentralized adaptive stabilization scheme for a class of interconnected systems using high-gain adaptive controllers. The nominal subsystems are assumed to satisfy some mild conditions required by standard adaptive control schemes, and the interconnections certain structural conditions. The decentralized controllers are high-gain dynamic systems operating on local outputs to generate local control inputs. Both continuous-time and sampled-data controllers are considered. The idea behind the design of continuous-time controllers is the small-gain theorem. The sampled-data controllers are discrete versions of the continuous-time controllers, where local sampling frequencies of the controllers also serve as their gains. The controllers are synchronized by a careful choice of their sampling frequencies. In order to guarantee closed-loop stability when the interconnection bounds are unknown, controller gains are increased, using simple centralized adaptation rule, to sufficiently high values as required by the strength of interconnections. The results are illustrated by a practical example.

Keywords. Interconnected system, Decentralized control, High-gain feedback, Adaptive control, Sampled-data control.

1 Introduction

High-gain feedback control is a standard tool for robust stabilization in the presence of modeling uncertainties (see, for example, [12, 21]). In the case of a single-input/single-output (SISO) system, design of such a controller requires that the system have stable zeros and its relative degree, the sign of its high frequency gain and the bounds of the system parameters or perturbations be known. Similar information is needed for multi-input/multi-output (MIMO) systems. It has been shown in [3] that for systems with relative degree one robust stability can be achieved without the need to know the bounds of the perturbations by tuning the gain parameter adaptively. In [8] a similar result has been obtained for systems with higher relative degree, where an adaptation mechanism is employed to increment the gain parameter