International Journal of Innovative Computing, Information and Control
Volume **3**, Number **5**, October **2007**

ICIC International ©2007 ISSN 1349-4198
pp. **1109–1120**

ROBUST DECENTRALIZED CONTROLLER DESIGN FOR SYSTEMS WITH ADDITIVE AFFINE-TYPE UNCERTAINTY

Alena Kozáková and Vojtech Veselý

Faculty of Electrical Engineering and Information Technology
Slovak University of Technology
Bratislava, Ilkovičova 3, SK-812 19 Bratislava, Slovak Republic
{vojtech.vesely; alena.kozakova}@stuba.sk

Received July 2006; revised January 2007

Abstract. *The paper proposes a new frequency domain approach to the design of robust decentralized controllers (DC) for continuous-time systems given by a set of transfer function matrices. To describe such systems the additive affine-type uncertainty model has been introduced and related robust stability conditions developed and modified for the application in the decentralized controller design.*
Keywords: Decentralized control, Frequency domain, Robust stability, Additive affine type uncertainty

1. **Introduction.** Multiple input - multiple output (MIMO) systems usually arise as interconnection of a finite number of subsystems. In the case of such systems practical reasons often make restrictions on controller structure necessary or reasonable. The controller is split into several local feedbacks and becomes a decentralized controller (DC). Compared with centralized full-controller systems the DC structure brings about certain performance deterioration; on the other side there are important benefits, e.g. hardware, operation and design simplicity, and reliability improvement [1-4,10-12].

Development of DC in the 70s's has attracted much attention and the DC design techniques still remain popular, in particular the frequency domain ones which provide insightful solutions and link to the classical control theory. With the rise of robust frequency domain approaches in the 80's, several practice-oriented techniques have been developed [1-3,10,11,15]. In principle, the DC design comprises two steps: 1) selection of control configuration. 2) design of local controllers. In the Step 2 either the independent design e.g. [1,3,9], the sequential design e.g. [15] or some appropriate detuning method [6,10] may be applied. In this paper the independent design philosophy has been applied, according to which local controllers are designed without considering interactions with other subsystems; the effect of interactions is transformed into bounds for individual controller design to guarantee robust stability and desired performance of the overall system.

The paper proposes a novel frequency domain approach to the robust decentralized controller design for continuous-time systems that are described by a set of transfer function matrices. To describe such systems a new uncertainty model has been introduced, namely the additive affine-type uncertainty. For this uncertainty type, the M-Δ structure based robust stability conditions have been developed and modified for the decentralized