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STATE-FEEDBACK STABILIZATION OF 2D CONTINUOUS SYSTEMS WITH DELAYS

Abdellah Benzaouia[1], Mohamed Benhayoun[1] and Fernando Tadeo[2]

[1]LAEPT-EACPI, Department of Physics
Faculty of Sciences Semlalia
University Cadi Ayyad
B.P. 2390, Marrakech 40000, Morocco
{ benzaouia; mbenhayoun }@ucam.ac.ma

[2]Departamento de Ingenieria de Sistemas y Automatica
Universidad de Valladolid
Paseo Prado de la Magdalena, Valladolid 47005, Spain
fernando@autom.uva.es

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Abstract. *The stability and stabilization under state-feedback of 2D continuous systems with delays is solved in this paper. First, sufficient conditions for asymptotic stability of 2D Roesser systems are presented. Then, the synthesis of the required controllers is given under the form of Linear Matrix Inequalities. Some illustrative examples are also treated.*

Keywords: 2D Roesser model, 2D continuous systems, 2D state-feedback, Lyapunov-Krasovskii functionals, LMIs

1. **Introduction.** The problems of stability and stabilization of linear two-dimensional (2D) continuous systems with delay are studied and solved in this paper. The 2D linear models were introduced in the seventies [1, 2] and have been applied, among others, to problems in digital data filtering, image processing [3] and modeling of partial differential equations [4]. For Roesser models [3] and Fornasini-Marchesini models [5], some important problems such as realization, controllability, minimum energy control and stabilization in the absence of delays, have been extensively investigated. For example, it has been shown that checking the stability of a 2D system can be reduced to check the roots of a 2D characteristic polynomial [6, 7, 8, 9]. Furthermore, in the literature, various types of easily checkable and sufficient conditions for asymptotic stability, and stabilization of 2D linear systems without delays have been proposed [7, 8, 10, 11, 12, 13, 14]. Recently, the control synthesis problem has been tackled using Linear Matrix Inequalities (LMIs) [15, 16], also for 2D positive systems [17] and 2D Markovian jumping systems [18].

However, the existence of transport delays is inherent to many control problems that can be described in terms of 2D systems (for example, in process control, irrigation systems and thermal systems). Unfortunately, the results mentioned above are not valid for these systems, so this paper proposes new results, specifically tailored for 2D continuous systems with delay. In particular the stabilization problem is solved, as the presence of a delay is known to affect the stability of the system [19]. Although the stabilization of 1D systems with delays has been extensively studied in the literature (see [14, 19, 20, 21, 22, 23, 24, 25]) and the references therein), for 2D systems, some works deal with this problem: we can cite [16, 26], where stability and stabilization conditions were proposed, that depended or not on the magnitude of the delay. However, these results are only available for discrete