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ROBUST ADAPTIVE STABILIZER FOR LINEAR SYSTEMS WITH IMPERFECTLY KNOWN POINT DELAYS USING A MULTI-ESTIMATION MODEL

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Abstract. This paper deals with a robustly stable adaptive pole-placement based controller for a class of linear time-invariant time-delay systems with possibly unknown point delays under unmodeled dynamics and bounded disturbances. A multi-estimation scheme is used to improve the identification error and also to deal with possibly errors between the true basic delay compared to these used in the regression vectors of the adaptive scheme. Robust closed-loop stability is guaranteed for a certain tolerance to delay errors and a typical class of uncertainties. All the estimation algorithms of the scheme run in parallel but only that which is currently in operation parameterizes the adaptive controller to generate the plant input at each time. A supervisor chooses in real time the appropriate estimator subject to a minimum residence time which is the tool to ensure closed-loop stability under switching between the estimators in the estimation scheme.

Keywords. Adaptive control, Multi-estimation, Relative dead-zone, Robustness, Time-delay systems.

AMS (MOS) subject classification: 93B30, 93C40, 39A11, 37N35, 93C55 and 93C83.

1 Introduction

An extensive research in adaptive control has been devoted to robustness issues of continuous and discrete adaptive systems against unsuitable unmodeled dynamics and presence of noise and to the relaxation of classical assumptions like the stability of the plant inverse and the knowledge of the sign of the high frequency gain, [1, 2, 8, 10, 14, 15, 19, 25]. On the other hand, it is well known that time-delay systems are a natural way for modeling some real processes like population growth, signal and fluid transmission, war and peace models, etc. Such systems have an infinite spectrum and the associate modes cannot be ensured to be close to those of their undelayed counterparts as the delay size increases what typically might cause instability, [3, 9, 24]. Important work has been devoted to the stability and stabilization, [6, 13, 16, 17, 20, 27], and robust stability and stabilization of such systems, [4, 23, 24, 27]. The design of memory-less stabilizing controllers has been