International Journal of Innovative Computing, Information and Control
Volume **4**, Number **6**, June **2008**

ICIC International ©2008 ISSN 1349-4198
pp. **1251–1266**

MULTIPLE-MODEL BASED INTELLIGENT CONTROL TECHNIQUES FOR LTI SYSTEMS WITH UNKNOWN EXTERNAL DELAYS PART II: UNKNOWN RATIONAL COMPONENT

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Received January 2007; revised June 2007

Abstract. *This second part addresses the problem of controlling a continuous-time linear time-invariant plant with external point delays using a multi-estimation scheme. The plant is supposed to posses parametric uncertainty while the delay is supposed to be unknown but belonging to a known compact subset. Firstly, the continuous-time plant is discretized by using a ZOH. The discretization step allows converting a real-valued delay uncertainty in a discrete-type one. Thus, the estimation scheme is composed of a bank of estimation algorithms running in parallel, being each one associated to a discretization of the plant with a different nominal value of the discrete time delay. Then, a high-level supervisor selects the most appropriate model to be used to parameterize the adaptive controller at each time interval. In this way, a conceptually simple control design for the adaptive control of unknown plants with unknown external point delays is presented. Furthermore, the scheme has revealed to be potentially capable of estimating an approximation of the actual delay of the plant as simulation examples have pointed out. This is an important novelty since there is not effective method to estimate simultaneously the delay of the continuous plant and its parameters.*

Keywords: Time-delayed systems, Adaptive control, Switching, Multiestimation, Digital control

1. **Introduction.** The control of uncertain time-delayed systems has attracted much interest during last years with a great number of solutions proposed. Basically, these solutions can be condensed into three categories, namely, robust [4,12,22], adaptive [3,8] or robust/adaptive combinations [5]. Among them, adaptive techniques have received much attention due to its capabilities of estimating the plant parameters and delay. However, many of the proposed adaptive approaches provide complex control laws making its implementation difficult while facing involved stability proofs, [3,8]. Furthermore, the simultaneous identification of plant parameters and delay is still an open problem in time-delayed control systems research, (see [2,11] and references therein for actual problems on adaptive identification of delays) while very few results are available. In [17,24], Orlov et al. proposed an adaptive scheme for the simultaneous identification of plant parameters and delays. Nevertheless, the number of parameters increase as the delay uncertainty does, making the method computationally inefficient for large uncertainty intervals. Indeed, it