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OBSERVER-BASED OPTIMAL/SUB-OPTIMAL DIGITAL TRACKERS FOR ANALOG NEUTRAL SYSTEMS WITH MULTIPLE DISCRETE AND DISTRIBUTED TIME DELAYS

Tzong J. Tsai[1], Jason S. H. Tsai[1], Shu-Mei Guo[2] and Guanrong Chen[3]

[1]Department of Electrical Engineering
National Cheng Kung University, Tainan 701, Taiwan, R. O. China
[2]Department of Computer Science and Information Engineering
National Cheng Kung University, Tainan 701, Taiwan, R. O. China
[3]Department of Electronic and Engineering
City University of Hong Kong, Hong Kong SAR, P. R. China

Abstract. In this paper, observer-based finite/infinite time optimal hybrid tracking problems for analog neutral systems with multiple discrete and distributed time delays are formatted and studied. Two continuous-time optimal performance indices with a high-gain property are used for tracking control specification. The Newton center interpolation formula and the linear interpolation formula, together with a newly modified rectangular ruler and an extended state vector, are utilized to construct the associate problems of extended discrete-time finite/infinite stage optimal regulators. Consequently, using the discrete-time optimal control theory and the new alternative digital redesign technique with a predictive feature, three effective digital trackers are designed for a given analog neutral system. When the states of the system are not available, a new optimal digital observer for the original analog neutral system is developed for achieving the desired goals of tracker design.

Keywords. Optimal control, observer, tracking control, neutral time-delay system, discrete time-delay, distributed time-delay, digital redesign.
AMS (MOS) subject classification: 49N35, 34K28, 93C23, 93C57, 93B51

1 Introduction

It is well known that most physical systems inherently contain time-delays, which are often encountered in various mechanical, physical, biological, medical, economic, and electrical engineering systems. Time-delay systems are also called systems with aftereffect or dead-time, hereditary systems, equations with deviating argument, or differential-difference equations. They belong to the class of functional differential equations (FDEs), which are infinite dimensional, as opposed to ordinary differential equations (ODEs). In practical applications, there are numerous control systems that depend not only on state delays and input delays but also on the derivatives and integral of past states [3, 12, 15, 19]. Such systems are referred to as neutral time-delay