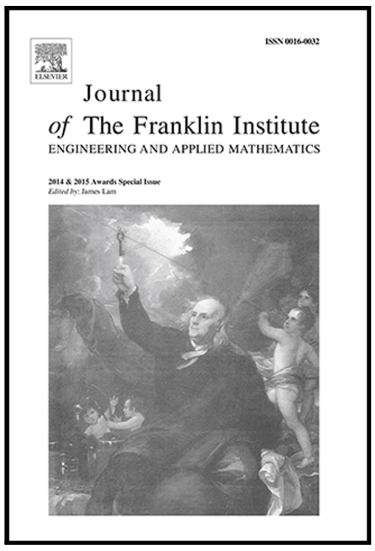

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Fundamental Performance Limitations of Networked Control Systems with Novel Trade-off factors and Constraint Channels *

Chao-Yang Chen[a,b], Zhi-Hong Guan[a,†], Ming Chi[a,†], Yonghong Wu[a], Rui-Quan Liao[c], Xiao-Wei Jiang[a]

[a] *College of Automation, Huazhong University of Science and Technology, Wuhan, 430074, P. R. China*

[b] *School of Information and Electrical Engineering, Hunan University of Science and Technology, Xiangtan, 411201, P. R. China*

[c] *Petroleum and Engineering College, Yangtze University, Jingzhou, 420400, P. R. China*

Abstract

This paper focuses on the optimal tracking performance issues for linear time invariant system with bandwidth limited and additive coloured white Gaussian noise (ACGN) simultaneously. The nonminimal phase and unstable plant are considered, and multi-repeated zeros and poles is investigated. The objective function of tracking response is minimized jointly with the control effort. In order to more fully reflect the performance of the network control systems(NCSs), the performance index is measured by the tracking error energy, input channel energy and plant input energy using novel trade-off factors. The novel trade-off factors can be measured each frequency band for each signal, which are stable and minimal phase transfer function. To obtain the optimal performance, the two-parameter controller is adopted. The tracking performance is given by explicit expression, which is critically dependent on the intrinsic characteristics of the given plant(unstable poles and nonminimal phase zeros), communication parameters (bandwidth and statistical characteristics of network noise) and statistical characteristics of reference signal. Finally, the simulation results demonstrate the effectiveness of the proposed control scheme.

Keywords: Performance limitation, trade-off factor, bandwidth limited, channel noises.

1 Introduction

During the past decade, more and more researchers are interested in networked control systems (see [1–6] and reference therein). The most problems under consideration focus on how to model the networked control system and stabilization analysis with quantization effects [4, 8–10], time delays [11, 12], bandwidth constraint [13, 14], and packet loss [15, 16]. In spite of the significant progress on stability or stabilisation issues of networked control systems, the more inspiring but difficult control performance problem remains open.

Performance of the control system has been attracting a growing amount of interests in the control community, see [18–28] for example. For conventional feedback control systems, it is known that the optimal tracking performance is determined by the unstable poles and nonminimum phase zeros of a given plant [26]. For a control system with communication channel, it plays an important role as well for control

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†Corresponding author. E-mail: zhguan@mail.hust.edu.cn (Z.-H. Guan), chiming@hust.edu.cn (M. Chi).