International Journal of Innovative Computing, Information and Control
Volume **4**, Number **11**, November **2008**

 ISSN 1349-4198
pp. **2793–2802**

A PREDICTIVE CONTROL BASED APPROACH TO NETWORKED WIENER SYSTEMS

Yun-Bo Zhao, Guo-Ping Liu and David Rees

Faculty of Advanced Technology
University of Glamorgan
Pontypridd, CF37 1DL, United Kingdom
{ yzhao; gpliu; drees }@glam.ac.uk

Received August 2007; revised January 2008

Abstract. *A predictive control based approach is proposed to deal with a Wiener type system which is closed through a network. In this approach, an output feedback predictive controller is designed using delayed sensing data with a specially designed state observer. The network constraints, i.e., the network-induced delay and data packet dropout, are compensated in both the forward and backward channels by taking advantage of the characteristics of both the predictive controller and the network transmission. Stability of the closed-loop system is derived by using the separation principle and switched system theory. Simulations illustrate the validity of the proposed approach.*
Keywords: Networked control systems, Predictive control, Wiener system, Network constraints

1. **Introduction.** Networked Control Systems (NCSs) is an emerging research area in recent years. Distinct from conventional control systems, where the links from sensor to controller ("backward channel") and from controller to actuator ("forward channel") are assumed to be connected directly with no data loss or delay through the links, in NCSs, instantaneous and perfect signals between these components are not achievable due to the inserted network [12, 14]. Despite the ability of remote and distribute control that such a configuration brings, the network constraints, i.e., the network-induced delays, data packet dropout, communication bandwidth limitation, data rate constraints and etc. in NCSs present a new challenge to conventional control theory [5, 2, 10, 6, 13].

A challenging aspect of the networked configuration is that we need to compensate for the negative effects of the network constraints to retain stability and performance of the system. For this purpose, a natural and necessary approach is to take advantage of all the information available on the network to design the controller rather than separate the design of the controller and network protocols. Preliminary work on this can be found in a number of publications under the name of "co-design" [3, 15, 16]. Following this idea, a model based control architecture was proposed in [9], where the knowledge of the plant dynamics was used to reduce the usage of the network. Furthermore, a predictive control based control architecture was also reported recently in [4, 8, 16]. In [8], knowledge of the plant dynamics was used to produce future control signals to actively compensate for the random network-induced delay in the forward channel with the use of a corresponding time delay compensator at the actuator side. A better performance can be expected since the predictive control based approach takes greater advantage of the knowledge available. However, only few results on nonlinear NCSs have been reported to date under such a predictive control based framework [11].