IMPROVED NETWORK-BASED ROBUST H_∞ FILTERING FOR UNCERTAIN LINEAR SYSTEMS

Chen Peng, Dong Yue, Engang Tian and Yijun Zhang

School of Electrical and Automation Engineering
Nanjing Normal University
Nanjing, Jiangsu 210042, P. R. China
63050@njnu.edu.cn

Abstract. *This paper proposes an improved design method for network-based robust H_∞ filter for linear systems with norm-bounded uncertainty. Unlike the existing techniques, the proposed method employed neither free weighting matrices nor any model transformation, which can efficiently reduce computational demand as well as improve integrated performance. By using the Lyapunov-Krasovskii functional approach, some delay-dependent stability conditions can be obtained for the asymptotical stability of the H_∞ filter system, which are expressed as a set of Linear Matrix Inequalities(LMIs). Numerical examples were given to demonstrate the effectiveness of the proposed method.*
Keywords: Networked control systems, Robust stability, H_∞ filter design, LMIs, Interval time-varying delay

1. **Introduction.** The use of data networks as the media to interconnect various components of control systems is rapidly increasing. Control systems over data networks are commonly referred to as Networked Control Systems (NCSs). Advantages of using data networks in control systems include simplicity, scalability, and cost-effectiveness. However, integration of communication networks into feedback control loops inevitably leads to non-ideal network Quality of Services (QoS). These make the analysis and design of NCSs more complex than those for traditional control systems. Therefore, networked control with non-ideal QoS has received increasing attention in the last few years, e.g., [1, 2, 3, 4] and the references therein.

The topic of H_∞ filtering for linear systems has received increasing attention in the past decade(see, for example [5, 6, 7, 8, 9, 10, 16] and references therein), which plays important roles in general signal processing and specific engineering applications, such as three-phase signal filtering and audio filtering. Otherwise, in modern engineering systems, sensors, controllers and actuators are often connected over a common data network. Due to the introduction of network in NCSs, it is greatly different from the traditional systems, for example, the signal estimation must be carried out through a common network[3], then the communication delay from sensor to controller and from controller to actuator should be taken into consideration. Therefore, the filter design method in aforementioned literatures can not be directly applied to networked control systems and it is of great significance to consider robust H_∞ filtering of network-based system, which is one of the motivations of this study.

More broadly, the problem of H_∞ filtering of linear system with fast interval time-varying delay has also received much attention. For example, in 2006, following the network modeling presented in [13], Yue and Han [7] studied the network-based robust H_∞ filter design through employing free weighting matrices to deal with cross product