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AN ILMI APPROACH TO GUARANTEED COST CONTROLLERS WITH AN OBSERVER

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Abstract. This paper presents a design scheme of an observer-based guaranteed cost controller for uncertain linear systems, in which the full state variables cannot be measured. The perturbations are assumed to be described by structural uncertainties. An iterative linear matrix inequality (ILMI) approach is used to design the observer-based controller. A numerical example is given to illustrate the results of the paper.

Keywords. Robust control, Guaranteed cost control, ILMI, Observer, Lyapunov function

AMS (MOS) subject classification: 49K15, 49N05, 93C73, 93D09, 93D15

1 Introduction

During the last decades, considerable attention has been directed to the problem of robust stability analysis and robust stabilization of systems with parameter uncertainties. In addition to the simple stabilization, there has been much effort to design a controller which not only achieves the stability of the uncertain system but also guarantees an adequate level of performance. One approach to this problem is the guaranteed cost control method originally introduced by Chang and Peng [1]. A lot of related studies are reported; e.g. see [2] and the references therein. The guaranteed cost control approach has been recently extended to the time-delay systems [3-5].

Although the controller is usually constructed by using state variables, it may not be possible to measure all the states of the system in many cases. A state observer reconstructs the state of a dynamic system. Hence, the observer-based control is probably well suited in such situations. Observer-based controllers via linear matrix inequality (LMI) technique, which is a powerful tool in the control theory and applications, have been used efficiently in the recent years [6, 7]. Therefore, the problem of designing an observer-based guaranteed cost controller has received some attention [8, 9]. However, the algorithm presented by Lien cannot be implemented by the LMI control toolbox of MATLAB because it contains the equality condition [8]. Mahmoud *et al*. deal with the case where both the controller and the observer gain matrices have prespecified forms, and they don't discuss the reduction of the upper bound of the performance index [9].