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AN OPTIMAL APPROACH TO H_-/H_∞ FAULT DETECTION FILTER DESIGN †

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Abstract. An optimal design approach to fault detection filter with H_- index and H_∞ norm for linear time invariant systems is proposed. At first a linear full-order observer is constructed and the dynamics of residual generator which involves unknown inputs represented by disturbances, noise, model uncertainty and faults is acquired. The sensitivity of residual to faults is characterized by H_- index, and the robustness of residual to unknown inputs is denoted by H_∞ norm respectively. By using linear matrix inequality (LMI) method, the existence condition of mixed H_-/H_∞ fault detection observer gain and its solving approach is derived, which leads to an iterative algorithm for optimal solution. Finally the optimal fault detection filter can be achieved with an optimal trade-off between the sensitivity to faults and the robustness against the unknown inputs. A numerical example is employed to illustrate the effectiveness of the present approach.

Keywords. fault detection filter, observer-based approach, robustness, sensitivity, linear matrix inequality, optimization

1 Introduction

Recently the theoretic study and practical application for the observer-based fault detection(FD) technique has made remarkable development [1-3]. In the design of observer-based FD systems, the puzzle is how to design a FD filter that makes it as sensitive as possible to faults and simultaneously as robust as possible to the unknown inputs including disturbances, noise or model uncertainty. Thus the objective of observer-based FD filter design consists in achieving an optimal trade-off between the sensitivity to faults

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