An Optimization Approach to Fault Detection Observer Design for Neutral Delay Systems

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Abstract. In this contribution, problems related to the optimization design of observer-based fault detection system are studied for a class of neutral time-delay systems with unknown inputs. The basic idea is first to introduce a state-memoryless observer-based fault detection filter (FDF) as the residual generator; and then to formulate such a FDF design task as an optimization problem aiming at increasing the robustness of residual to unknown input as well as plant input, while simultaneously enhancing the sensitivity of residual to faults. The main results consist of the formulation of such an FDF design optimization problem and the derivation of solvable conditions, and a systematic solution procedure. The residual evaluation problem is also considered which includes the determination of residual evaluation function and threshold. A numerical example is used to demonstrate the proposed fault detection scheme.

Keywords. Observer-based fault detection filter, neutral time-delay system, robustness, unknown input.

1   Introduction

Since both modelling uncertainty and external plant disturbances are inevitable, the study of robust model-based fault detection and isolation (FDI) has received considerable attention during the past two decades and a substantial amount of results have been achieved. A useful survey of early works on robust FDI can be found in [1, 6, 11]. Different from the robust control problems, robust FDI should be considered in the context that the fault detection system is designed as robust as possible to model uncertainty and exter-