Dynamic observers for sensor faults detection and diagnosis

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Abstract

Most observer-based methods applied in *fault detection and isolation* (FDI) schemes for linear time invariant systems use the classical *Luenberger* observer structure. This structure is considered as a two-degrees of freedom approach in which a *constant matrix* is used to stabilize the observer error dynamics while a *post filter* helps to achieve some desired properties for the *residual* (fault information) signal.

In this paper, we consider the use of a more general framework which is the dynamic observer structure in which an observer gain is seen as a filter designed so that the error dynamics has some desirable frequency domain characteristics. This structure offers extra degrees of freedom over the classical Luenberger structure and we show how this freedom can be used for the sensor faults detection problem. The use of appropriate weightings to transform this problem into a standard H_∞ optimal control problem is demonstrated. Moreover, application of this work in the problem of sensor faults estimation is considered with the objective to make the residual converge to the faults vector achieving detection and estimation at the same time.

The introduced strategies are applied to the $PROCON^{TM}$ level/flow/temperature process training system (manufactured by the Feedback Instrument Limited) in the Advanced Control System Laboratory (ACSL) at university of Alberta. Based on the identified linear state space model, different sensor FDI schemes are developed and applied to the process.

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