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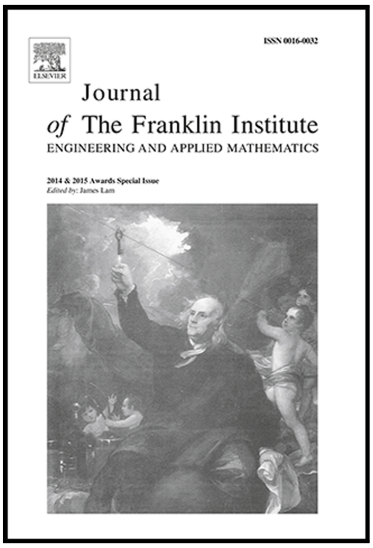


A Sampled-Data Approach to Distributed $H_\infty$ Resilient State Estimation for A Class of Nonlinear Time-Delay Systems over Sensor Networks

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# A Sampled-Data Approach to Distributed $H_\infty$ Resilient State Estimation for A Class of Nonlinear Time-Delay Systems over Sensor Networks

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**Abstract**

This paper deals with the distributed sampled-data $H_\infty$ state estimation problem for a class of continuous-time nonlinear systems with infinite-distributed delays. To cater for possible implementation errors, the estimator gain is allowed to have certain bounded parameter variations. A sensor network is deployed to acquire the plant output by collaborating with their neighbors according to a given network topology. The individually sampled sensor measurement is transmitted to the corresponding estimator through a digital communication channel. By utilizing the input delay approach, the effect of the sampling intervals is transformed into an equivalent bounded time-varying delay. A set of sampled-data distributed estimators is designed for the addressed nonlinear systems in order to meet the following three performance requirements: 1) the asymptotic convergence of the estimation error dynamics; 2) the $H_\infty$ disturbance attenuation/rejection behavior against the exogenous disturbances; and 3) the resilience against possible gain variations. A Lyapunov functional approach is put forward to obtain the existence conditions for the desired estimators which are then parameterized in light of the feasibility of some matrix inequalities. An illustrative numerical example is given to demonstrate the usefulness of the proposed estimator design algorithm.

**Index Terms**

Distributed state estimation, $H_\infty$ state estimation, infinite-distributed delays, resilient state estimation, sampled-data, sensor networks.

## I. Introduction

The past two decades have witnessed a quiet yet steady upgrading in every aspect of sensor networks that have enjoyed wide applications in engineering practice such as safety monitoring [1], intelligent transportation [2], health care system [3], and process automation [4]. In traditional sensor networks, a large number of sensors are purposely deployed within a spatial region of interest. These networked sensors, which are capable of sensing, computing and wireless communication, collaborate each other to fulfill some collective tasks with *distributed state estimation* as a typical example, where the estimator utilizes the available measurements from both the sensor itself and its neighbors according to a given network topology [5], [6]. So far, a great deal of literature has been available on

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