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Distributed consensus observer-based $H_{\infty}$ control for linear systems with sensor and actuator networks.


Summary: This paper proposed a Distributed Consensus Observer (DCO) based $H_{\infty}$ control method for a class of Linear Time-Invariant (LTI) continuous systems with a Sensor and Actuator Network (SAN). The communication topology of the SAN under consideration is represented by a directed graph, in which the sensor nodes are not able to acquire all the control inputs applied to the target system from the actuator nodes. To overcome this difficulty, a set of novel DCOs embedded in the sensor nodes and a set of DCO-based controllers embedded in the actuator nodes are initially constructed to estimate and control the state of the target system in a fully distributed way, respectively. The constructed DCOs take full advantage of their consensus property and replace the unavailable control inputs with the approximate ones computed on the basis of the state estimates of the underlying sensor node and its neighboring sensor nodes. Subsequently, a design method of DCO-based $H_{\infty}$ control is proposed in terms of Bilinear Matrix Inequality (BMI) to ensure that the closed-loop system is exponentially stable while satisfying a prescribed overall $H_{\infty}$ performance of disturbance attenuation. Moreover, in order to make attenuation level as small as possible, a suboptimal $H_{\infty}$ control design problem is formulated as a BMI optimization problem, and a modified path-following method is provided for solving this problem by using the existing Linear Matrix Inequality (LMI) optimization techniques. Finally, simulation results demonstrate the effectiveness of the proposed method.

Keywords: sensor and actuator networks; distributed consensus observer-based controllers; bilinear matrix inequality; path-following method
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