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Designing a novel consensus protocol for multiagent systems with general dynamics under directed networks

Key words: Multi-agent; Consensus; PID control; Linear matrix inequality

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Motivation

- Over the last several years, the consensus problem for multi-agent systems (MASs) has been a primary topic in the field of cooperative control.
- The general linear dynamic is more universal than other forms and is very representative .
- The proportional-integral-derivative (PID) controller has mature algorithms and is very robust; therefore, it has been widely used in the design of coordinated control.

Main idea

- This paper proposes a novel consensus protocol based on a distributed PID control, and the dynamics of MAS are assumed to be continuously linear time invariant and can be of any-order.
- The control system is implemented with a dual-loop structure, including an outer-loop controller to guarantee consensus and an inner-loop one to adjust the dynamic property of the whole system.

Method

1. Distributed PID control.
2. The consensus problem is converted into an asymptotic stability problem through transformations.
3. Through state projection method the consensus condition is proved and the explicit expression of the consensus function is given.
4. A Lyapunov function is constructed and the gain matrices of the protocol are given based on the linear matrix inequality.

Major results

- The distributed PID control can eliminate the state error of the MAS.

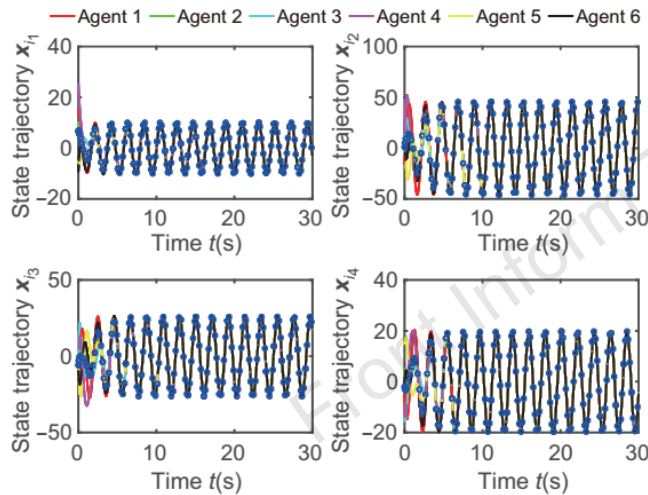


Fig. 3 State trajectories of multi-agent system under PID control ($i = 1, 2, \dots, 6$) (References to color refer to the online version of this figure)

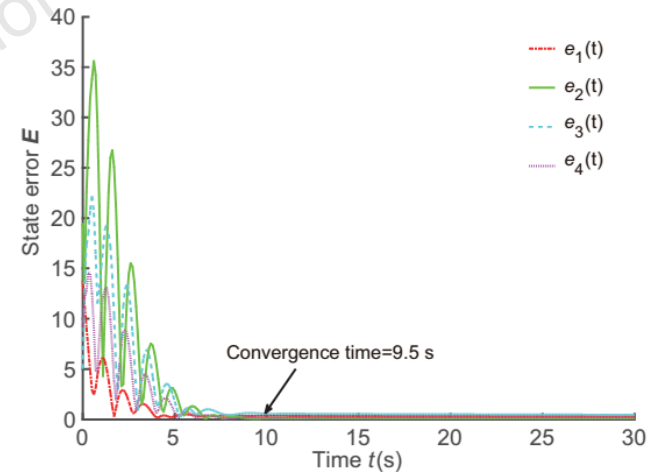


Fig. 5 State errors of multi-agent system under PID control

Conclusions

- The distributed PID control can eliminate the state error of the MAS.
- The PID control can achieve consensus in a shorter time.
- The proposed consensus algorithm in this study can still achieve consensus with the presence of disturbance