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Consensus of multi-agent systems with dynamic join characteristics under impulsive control

Key words: Multi-agent system; Network topology; Impulsive input; Dynamic join characteristics; State consensus

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Motivation

1. Multi-agent system is an important carrier of distributed information processing, and consensus is the basis of multi-agent system collaborative work which is worthy of vigorous research.

2. The consensus of multi-agent systems with dynamic join characteristics can be applied to industry to improve the production efficiency.

3. The idea of multi-agent system will have positive effects on the industry.

Main idea

1. We study how to achieve the state consensus of a whole multi-agent system after adding some new agent groups dynamically in the original multi-agent system.

2. We analyze the feasibility of dynamically adding agent groups under different forms of network topologies.

3. The dynamic model of the multi-agent system is analyzed using the impulsive control theory and Lyapunov stability theory.

4. The model proposed in this paper can be applied to many research fields.

Method

1. After analyzing and determining the network communication topology of the multi-agent system and the strategy to achieve consensus, a reasonable communication control protocol is designed to build the dynamic model of the multi-agent system.
2. We use the stability theory to analyze the multi-agent system, and obtain the conditions for the consensus of the multi-agent system with dynamic join characteristics. Finally, we provide a numerical example to verify the practicality and validity of the study.

Major results

The working time of the leader agent x_0 and the dynamic join time of the four agent groups x_1, x_2, x_3, and x_4

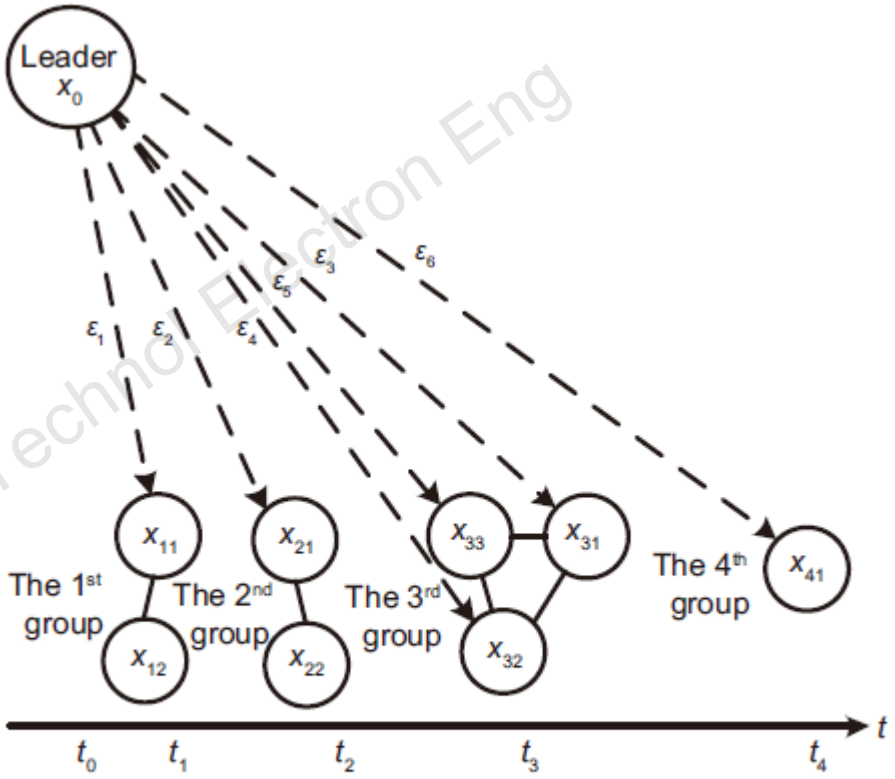

Fig. 7 Working time of the leader agent x_0 and the dynamic join time of the four agent groups x_1, x_2, x_3, and x_4

Major results (Cont'd)

1. State error between the first agent group and the leader agent

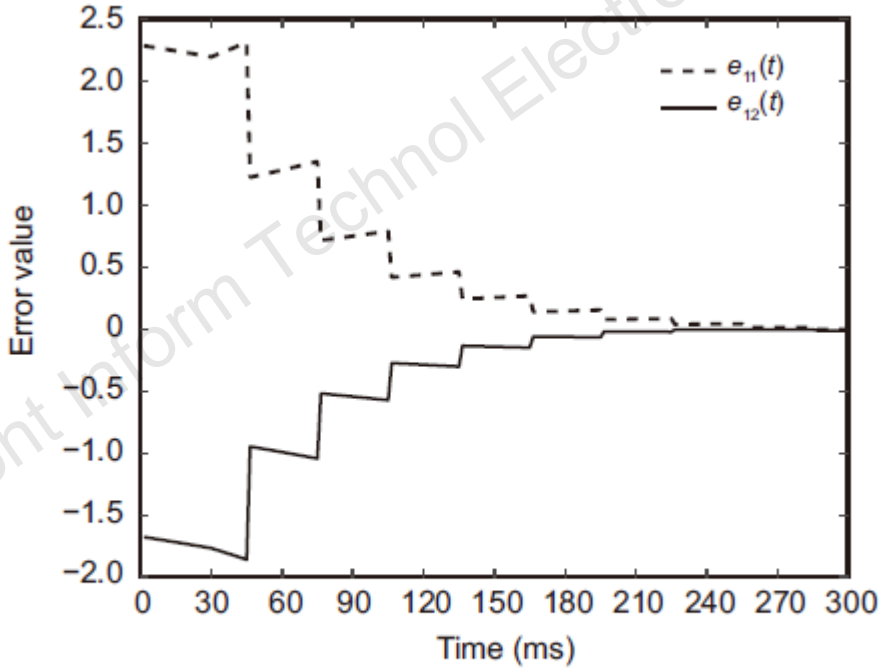

Fig. 8 State error between the first agent group and the leader agent

Major results (Cont'd)

2. State error between the second agent group and the leader agent

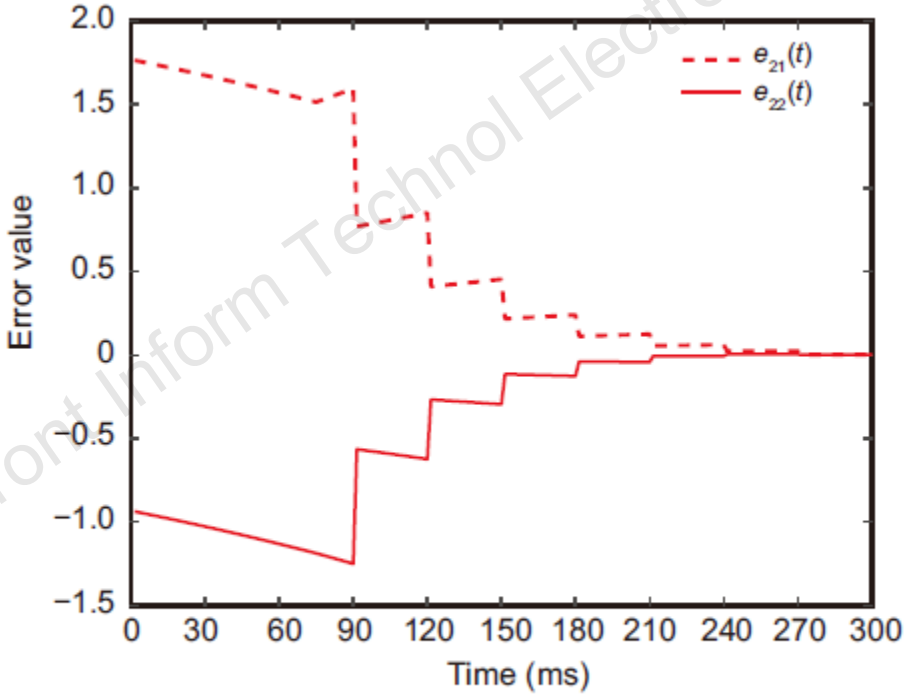

Fig. 9 State error between the second agent group and the leader agent

Major results (Cont'd)

3. State error between the third agent group and the leader agent

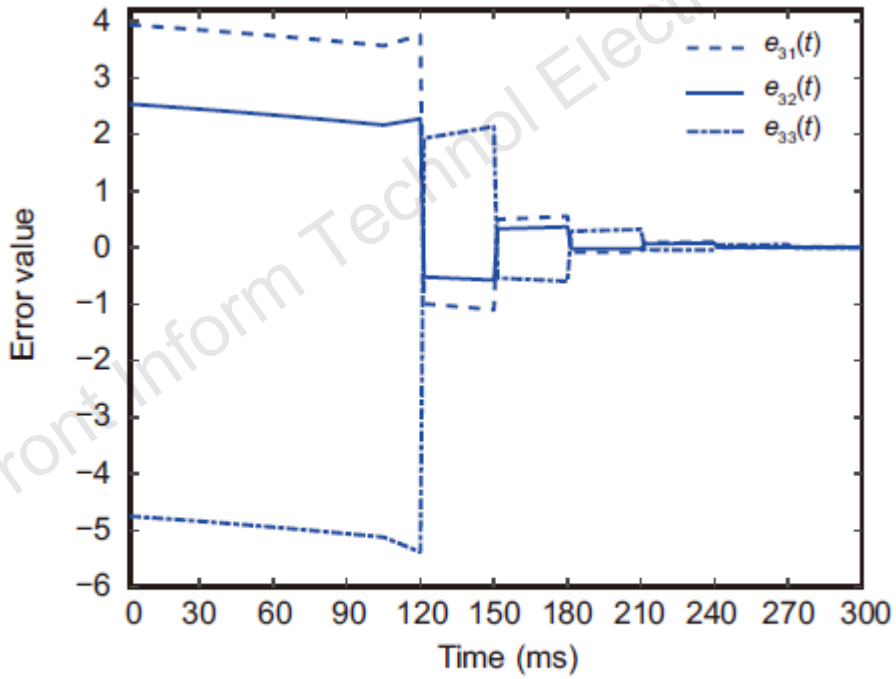

Fig. 10 State error between the third agent group and the leader agent

Major results (Cont'd)

4. State error between the fourth agent group and the leader agent

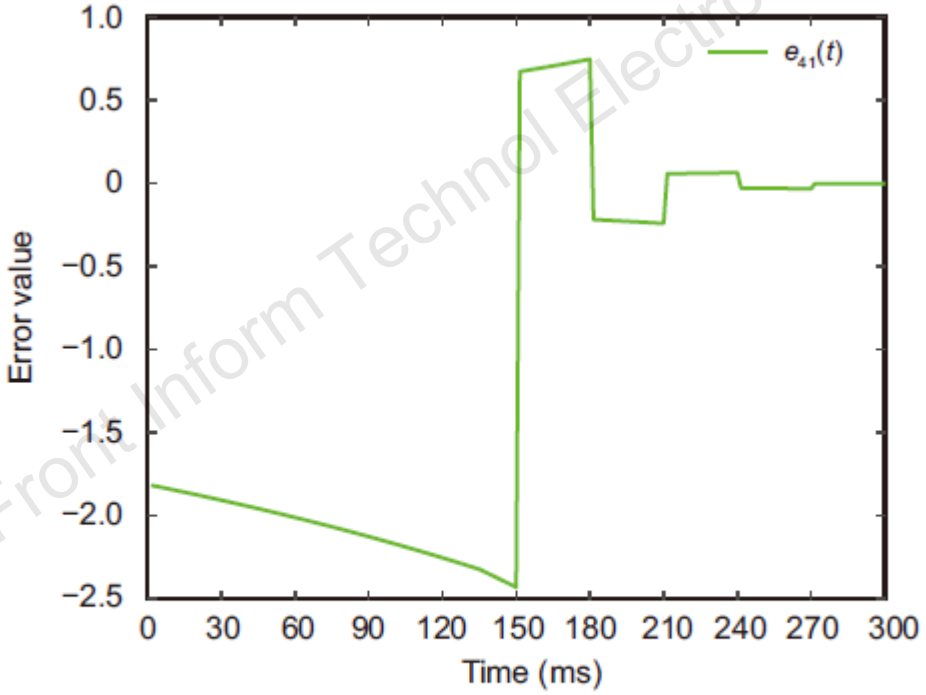

Fig. 11 State error between the fourth agent group and the leader agent

Major results (Cont'd)

5. State value of the first group

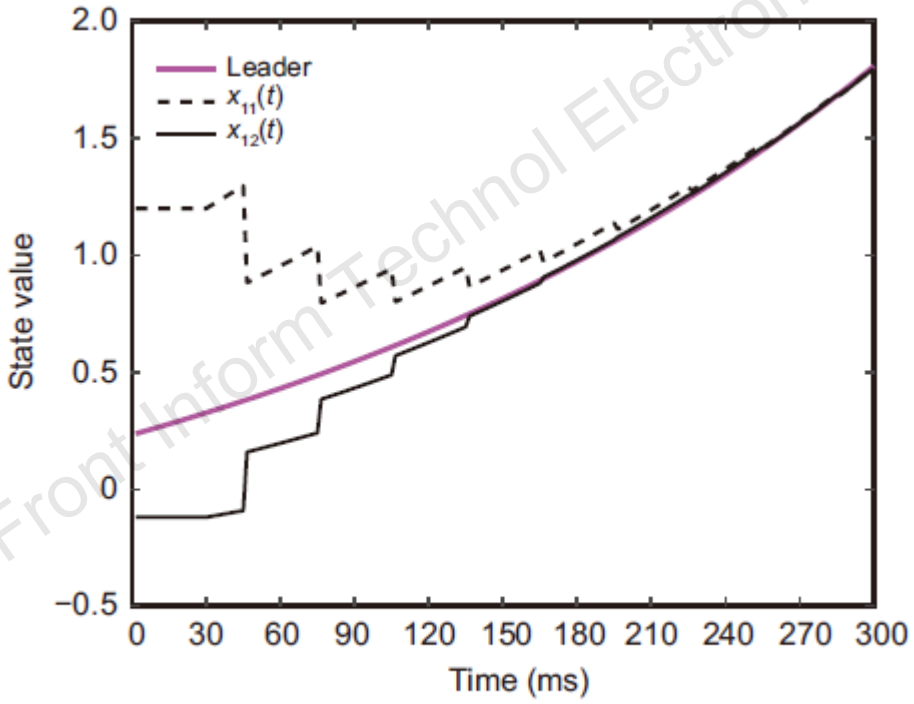

Fig. 12 State value of the first group

Major results (Cont'd)

6. State value of the second group

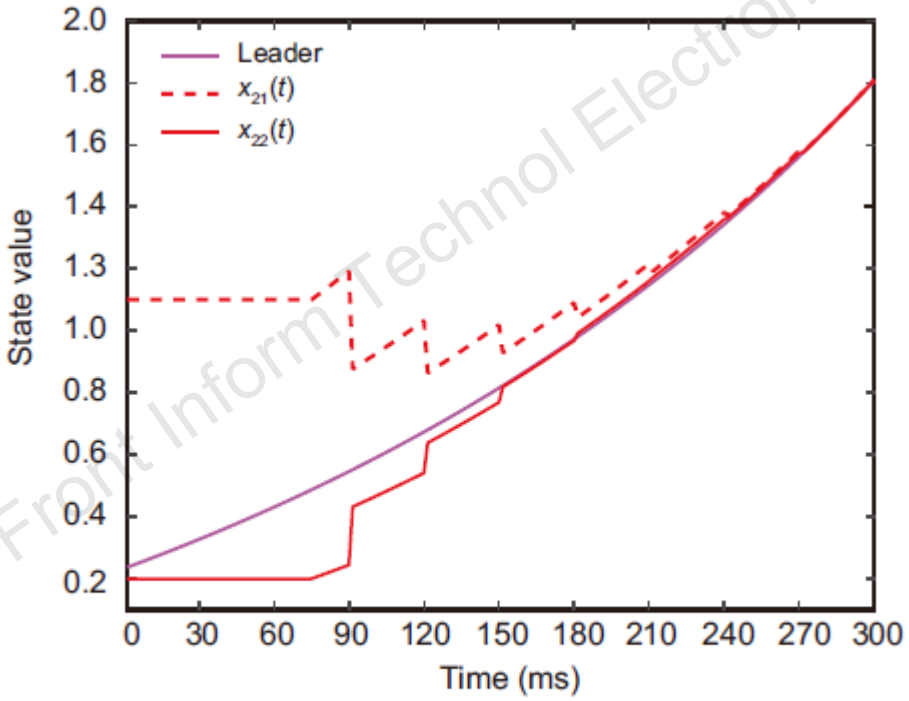

Fig. 13 State value of the second group

Major results (Cont'd)

7. State value of the third group

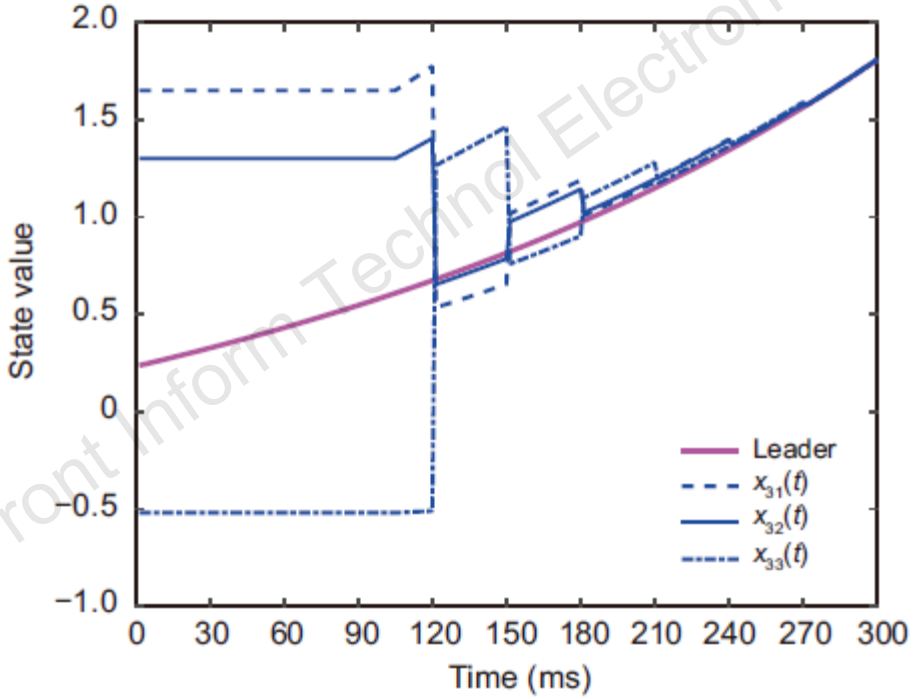

Fig. 14 State value of the third group

Major results (Cont'd)

8. State value of the fourth group

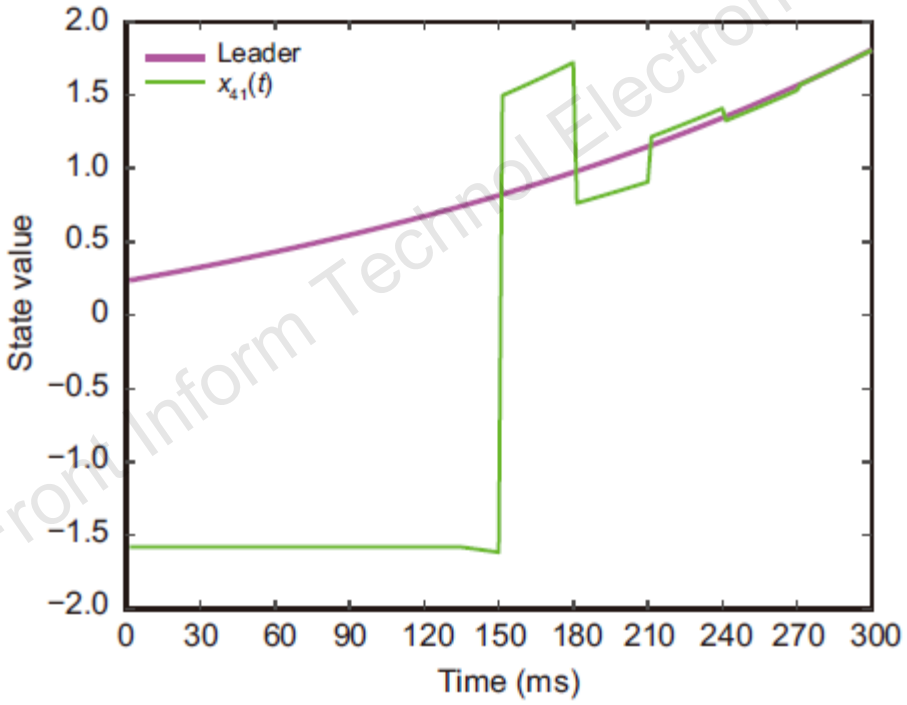

Fig. 15 State value of the fourth group

Conclusions

1. We have studied the state consensus problem of multi-agent systems with dynamic join characteristics under impulsive control. To the best of our knowledge, we have given the definition of dynamic join characteristics of multi-agent systems for the first time.
2. We have divided the schemes of the state consensus of multi-agent systems with dynamic join characteristics into four cases. We have obtained four feasible schemes in theory, including the best one for actual industrial production.
3. The idea and theorem are of significance in industrial production and can be widely used in the industry.

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