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Fuzzy Adaptive Finite-Time Cooperative Control with Input Saturation for Nonlinear Multiagent Systems and its Application

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ABSTRACT

In this paper, the fuzzy adaptive finite-time cooperative control with input saturation (FAFTCCIS) is designed to quickly accomplish the cooperation of nonlinear multiagent systems (MASs) without the risk of bumping among agents. At least one agent must communicate with the leader and the information of neighborhood agents is required to accomplish the assigned task. Each agent, including the leader and the followers, is first approximated by *N* fuzzy-based linear subsystems. To accomplish the null cooperation error in finite time, the proposed adaptive control possesses the switching surface with fraction order, a time-varying switching gain, and an on-line learning of the upper bound of the uncertainties in each fuzzy subsystem of agent *j*. The stability of all the cooperative uncertain systems is then verified by the Lyapunov stability theory. Finally, the application to the cooperative control of intelligent chef is presented to confirm the effectiveness, robustness and feasibility of the proposed FAFTCCIS.

PROBLEM FORMULATION

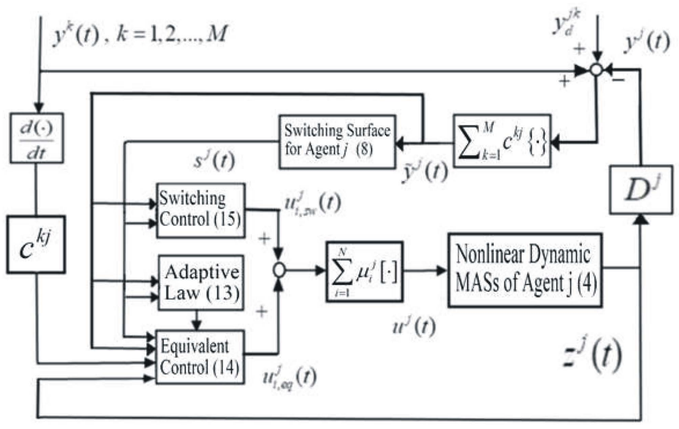

Fig. 1. Control block diagram of the overall System

APPLICATION TO INTELLIGENT CHEF

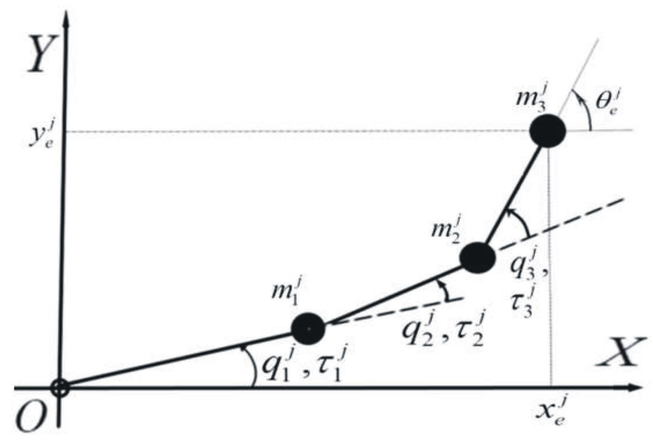

Fig. 2. Kinematics of three-link planar robot *j*.

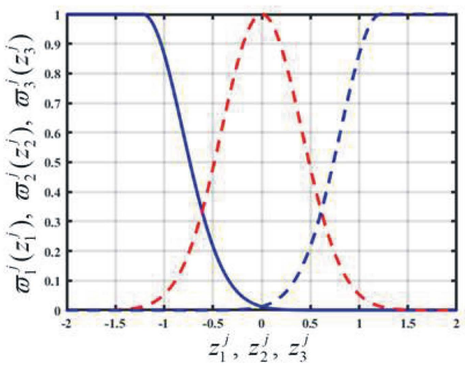

Fig. 3. Membership functions for $z_i^j(t), i=1,2,3, j=1,2.$

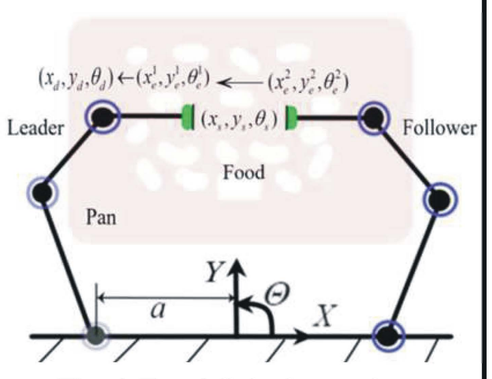

Fig. 4. Two 3-link planar robots for intelligent chef.

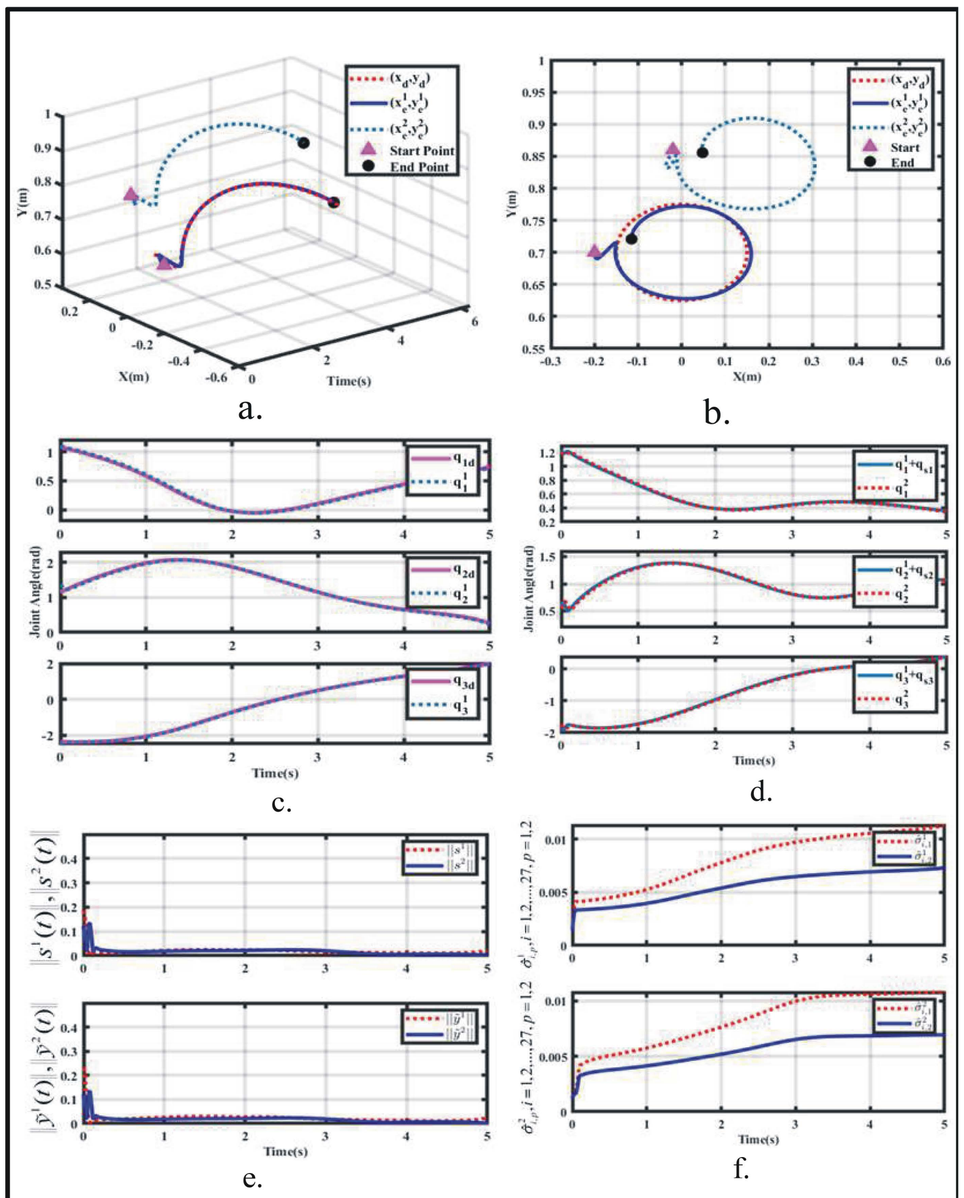

Fig. 5. Response for the cooperation of intelligent chef

CONCLUSIONS

- The cooperation of nonlinear multi-agent dynamic systems is accomplished by the proposed fuzzy adaptive finite-time cooperative control with input saturation (FAFTCCIS).
- Each agent, including the leader and followers, is approximated by N fuzzy-based linear subsystems to design the proposed FAFTCCIS.
- The successful application to intelligent chef confirms the effectiveness, robustness, and feasibility for many cooperation or formation problems of nonlinear multi-agent systems.

RESEARCH EXPRIENCE

- August 2011-February 2017, Lecturer in Adigrat University, Tigrai, Ethiopia
- February 2017-Present, PhD student, NTUST (published 2 articles)