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Special Focus on Distributed Control of Nonlinear Multi-Agent Systems and Applications doi: 10.1007/s11432-015-5499-z

Editor's Note

Many complex engineering tasks are performed by coordinating the efforts of a group of individual systems. Typical examples include the coordination of mobile robots, formation of unmanned flight vehicles, mobile sensor area coverage, containment control of moving bodies, control of electric power grids, transportation systems, manufacturing production lines, chemical processes. These engineering applications have given rise to the exciting research topic: cooperative control of multi-agent systems.

The past decade has witnessed significant progress on multi-agent systems and control. To date, the research has reached the stage that emphasizes developing methodologies for complex multi-agent systems characterized by heterogeneity, uncertainty, nonlinearity, and time-varying communication topologies. This special issue reports new research results on the control of complex multi-agent systems.

The work by Profs. Cai and Huang studies the leader-following adaptive consensus problem for multiple uncertain rigid spacecraft systems. The problems caused by parameterized uncertainties and directional information flows are addressed by converting the leader-following consensus problem into an adaptive stabilization problem of a well-defined error system, which is solvable through a distributed adaptive control law. Parameter convergence issues are also discussed.

In the article by Profs. Gan, Chen, Huang, Dou and Fang, a null-space-based behavioral control strategy is presented to solve the formation control problem of multiple Euler-Lagrange systems. Both model uncertainties and obstacles in environment are taken into account. By introducing a null-space-based behavioral control strategy, the problem is decomposed into elementary missions with different priorities. A class of novel coordination control algorithms is constructed and utilized to achieve accurate formation task while avoiding obstacles and guaranteeing the model uncertainty rejection objective.

The work by Profs. Liu, Lu and Jiang applies the idea of distributed control and multi-agent systems to dynamic traffic assignment with convergence analysis. By considering the traffic assignment problem as a control problem, this paper develops a new real-time route guidance strategy for accurate convergence of the traffic flows to UE or SO, in the presence of drivers' response uncertainties. With the new guidance strategy, the drivers can make routing decisions based on the route guidance information from junction to junction.

In the article by Profs. Qi and Hu, evacuation strategies with crowd density are designed for agents in complex surroundings. A second-order stochastic model describing a large-scale crowd is formulated, and an efficient evacuation strategy is proposed and solved numerically. The method consists in reshaping the crowd contour by making use of the crowd density feedback that is commonly available from geolocation technologies, and Kantorovich distance is used to transport the current shape into the desired one.

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