Einladung zum Vortrag im Kolloquium Technische Kybernetik

Consensus-based Cooperative Formation Control for a Multi-UAV System

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Abstract

Cooperative control technologies have enormous potential for application to vehicles such as unmanned aerial vehicles (UAVs), artificial satellites, and autonomous mobile observation robots, with rapid advances in computer, network and sensor technologies. The technologies have the advantage in fault tolerance, efficiency and cost. Cooperative control issues for a multi-UAV system are considered in this talk. Specifically, a decentralized cooperative control strategy is proposed for formation flying with collision avoidance capability. We apply a consensus algorithm and leader-follower structure to a group of the vehicles expressed as a first-order system so that they can cooperatively fly in formation. The leader provides each UAV with commands to generate a geometric configuration of the formation. Then, a decentralized cooperative control strategy that UAVs fly in formation is proposed. How to model a UAV and multi-UAV system is stated and the control objective, which is to realize formation flying in three-dimensional space, is defined. Conditions of control gains for the asymptotic stability are derived for the formation control problem. The formation control algorithm can accept any network structure that contains a directed spanning tree. Furthermore, collision avoidance issues for a multi-UAV system controlled by the cooperative formation control algorithm are considered. Convergence is guaranteed even when the control algorithms for cooperative formation and collision avoidance are simultaneously applied to the UAVs. Finally experiments are performed on a group of UAVs to validate the proposed control algorithms.

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Toru Namerikawa received the B.E., M.E and Ph. D of Engineering degrees in Electrical and Computer Engineering from Kanazawa University, Japan, in 1991, 1993 and 1997, respectively. He is currently a Professor at Department of System Design Engineering, Keio University, Yokohama, Japan. He held visiting positions at Swiss Federal Institute of Technology in Zurich in 1998, University of California, Santa Barbara in 2001, University of Stuttgart in 2008 and Lund University in 2010. His main research interests are robust control, distributed and cooperative control and their application to mechatronic systems and power network systems.