ASTRODYNAMICS SYMPOSIUM (C1)
Guidance, Navigation & Control (2) (4)

Author: Prof. Chuanjiang Li
Harbin Institute of Technology, China

Dr. ZHIYONG SHE
Beijing Aerospace Technology Institute, China
Dr. Dongyu Li
Harbin Institute of Technology, China
Mr. yueyong LYU
Harbin Institute of Technology, China

DISTRIBUTED COORDINATED FINITE-TIME ATTITUDE TRACKING CONTROL FOR MULTIPLE NETWORKED SPACECRAFT SYSTEMS WITH UNKNOWN DEADZONE

Abstract

In this paper, we consider the distributed coordinated attitude tracking control problem for multiple networked spacecraft systems. More specifically, in the case where there exists one single dynamic leader, we propose a distributed tracking control algorithm for multiple networked spacecraft systems such that the attitude of all the followers could track and follow the attitide of the leader in the presence of unknown system dynamics and external disturbances under a general directed graph that characterizes the interaction among the leader and the followers. In reality, we often need the attitude tracking to be achieved in finite time. To enhance the convergence speed of the distributed control system, we first combine the terminal sliding-mode with the distributed attitude tracking controller. Finite time convergence and stability of the closed-loop system can be guaranteed by Lyapunov theory, while the ultimate attitude tracking error and the gain of the terminal sliding-mode controller can significantly be reduced in comparison with the conventional linear sliding-mode controller. Considering practical control systems, deadzone is one of the most common actuator nonlinearities we have to deal with. It is usually known as a static nonlinearity which is insensitive to small signals. We utilize a radial basis function neural network to compensate for the unknown deadzone effect due to their superior approximation capability while the tracking error for the deadzone effect is bounded and converging. Then, the unknown system dynamics and external disturbances of the Spacecraft systems are estimated with another adaptive neural network law. The proposed control algorithm makes use of two neural networks to approximate unknown system dynamics, external disturbances, and deadzone functions, respectively. This method substantially reduces computing resources required. We present a necessary and sufficient condition on the directed graph such that all followers can achieve attitude and angular velocity consensus with a dynamic leader in finite time with unknown system dynamics, external disturbances, and deadzone. All the proposed algorithms are distributed and can be implemented by using only local measurements in the absence of communication. Finally, the proposed control scheme is applied to a group of spacecraft. Simulation results are provided to show the effectiveness of the proposed control algorithms.