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编队卫星分布式鲁棒饱和姿态协同控制

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Decentralized Robust Saturated Attitude Coordination Control of Satellites Within Formation

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摘要 研究跟踪时变参考姿态情况下控制输入饱和的编队飞行卫星姿态协同控制问题。针对不同情形,通过恰当地利用双曲正切函数,提出3种连续有界的协同控制器。首先,在无外部扰动和参数不确定性的情况下,提出一种理想的饱和协同控制器。进一步,考虑角速度不可测量的情况,利用无源滤波器设计无角速度反馈的饱和协同控制器。当外部扰动和参数不确定性存在时,通过在双曲正切函数中引入动态时变参数,提出一种连续的鲁棒饱和协同控制器。由于在本文算法作用下的闭环协同系统是非自治的,通过合理地利用Barbalat引理分析了状态的收敛性。仿真结果表明了所提控制方案的有效性。

关键词: 编队飞行 姿态协同 控制输入饱和 无角速度反馈 鲁棒控制

Abstract: The attitude coordination control problem for formation flying satellites associated with time-varying reference attitude tracking subject to control input saturation is investigated in this paper. According to different cases, three kinds of continuous and bounded coordination controllers are proposed with the novel use of hyperbolic tangent functions. Firstly, an ideal saturated coordination controller is presented in the absence of external disturbances and parametric uncertainty. Furthermore, taking account of unavailability of measurements of angular velocities, passive filters are applied to the angular-velocity-free feedback saturated coordination controller design. When external disturbances and parametric uncertainty exist, by introducing some dynamic time-varying parameters in the hyperbolic tangent functions, a continuous robust saturated coordination controller is proposed. Due to the fact that the closed-loop coordination systems under these algorithms are non-autonomous, Barbalat's lemma is utilized properly for convergence analysis of states. Simulation results are provided to show the effectiveness of the proposed control schemes.

Keywords: formation flying attitude coordination control input saturation angular-velocity-free feedback robust control

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