Disturbance observer-based fuzzy control for flexible spacecraft combined attitude & sun tracking system

ABSTRACT

This paper investigates the combined attitude and sun-tracking control problem in the presence of external disturbances and internal disturbances, caused by flexible appendages. A new method based on Pythagorean trigonometric identity is proposed to drive the solar arrays. Using the control input and attitude output, a disturbance observer is developed to estimate the lumped disturbances consisting of the external and internal disturbances, and then compensated by the disturbance observer-based controller via a feed-forward control. The stability analysis demonstrates that the desired attitude trajectories are followed even in the presence of external disturbance and internal flexible modes. The main features of the proposed control scheme are that it can be designed separately and incorporated into the baseline controller to form the observer-based control system, and the combined attitude and sun-tracking control is achieved without the conventional attitude actuators. The attitude and sun-tracking performance using the proposed strategy is evaluated and validated through numerical simulations. The proposed control solution can serve as a fail-safe measure in case of failure of the conventional attitude actuator, which triggered by automatic reconfiguration of the attitude control components.