51st IAF STUDENT CONFERENCE (E2)
Student Conference - Part 2 (2)

Author: Ms. Shabadini Sampath
University of Strathclyde / Mechanical and Aerospace Engineering, United Kingdom,
shabadini.sampath@strath.ac.uk

Dr. Feng Jinglang
University of Strathclyde, United Kingdom, fjlangabc@gmail.com

INTELLIGENT AND ROBUST CONTROL OF SPACE MANIPULATOR FOR ACTIVE REMOVAL OF SPACE DEBRIS

Abstract

Keywords: Space Sustainability, Active Debris Removal, GNC, Intelligent Controllers With huge kinetic energy, space debris poses a major threat to astronauts' space activities and spacecraft in orbit if a collision happens. The active removal of space debris is required in order to avoid frequent collisions that would occur. In addition, the amount of space debris will increase uncontrollably posing threat to the safety of the entire space system. But the safe and reliable removal of large-scale space debris has been a huge challenge to date. During the process of capturing and deorbiting space debris, the space manipulator has to achieve high control precision. However, due to uncertainties and unknown disturbances, there is difficulty in coordinating the control of the space manipulator. To address this challenge, this paper focuses on developing a robust and intelligent control algorithm that controls joint movement and restricts it on the sliding manifold by reducing uncertainties. A neural network adaptive sliding mode controller (NSMC) is applied with the objective to find the control law such that the joint motions of the space manipulator follow the given trajectory. A computed torque control (CTC) is an effective motion control strategy that is used in this paper for computing space manipulator arm torque to generate the required motion. NSMC will serve as a compensator to CTC such that the joint motions of the robotic manipulator follow the desired trajectories. Based on the Lyapunov stability theorem, the proposed intelligent controller NSMCTC guarantees the robustness and global asymptotic stability of the closed-loop control system. Finally, the controllers used in the paper are modelled and simulated using MATLAB Simulink. The results are presented to prove the effectiveness of the proposed controller approach.