CHINA ASSOCIATION OF INVENTIONS

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Invention: Anti-disturbance maneuver control technology of spacecraft for space debris removal

面向空间碎片清除的航天器抗干扰机动控制技术

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Introduction:

With the increase of space missions, over 170 million space debris has constructed the largest “junkyard” in orbit, and active debris removal has become a research focus. Motivated by the demand of high-efficiency and fast-response de-orbiting control for postcapture combined spacecraft, we have invented an anti-disturbance maneuver control technology for the combined spacecraft with the structure of “satellite platform + space manipulator + space debris”. We have designed a fast disturbance estimation scheme for the flexible vibration of manipulator and solar panel, which can effectively solve the finite-time estimation problem of the complex coupling disturbance. Then, we have proposed the composite attitude control method with center-of-mass variation adaptability, which can achieve fast and robust attitude adjustment in large-angle ranges under highly uncertain environments. We have proposed a high-precision control method for the spacecraft actuator (control moment gyro) under spatial constraints and large torque output range, providing agile maneuver capability for the spacecraft. Finally, aiming at removing space debris, we have accomplished hardware-in-the-loop tests for the “whole-loop” spacecraft anti-disturbance maneuver control methods. Our invention tackles the insufficiency in center-of-mass variations adaptability and response capability of traditional control techniques. Moreover, our invention can apply to the space debris removal task under extreme environments (e.g., large center-of-mass variation) and can provide powerful technological support in cleaning up the Low Earth Orbit environment, ensuring astronaut safety, and creating an ecologic space environment.

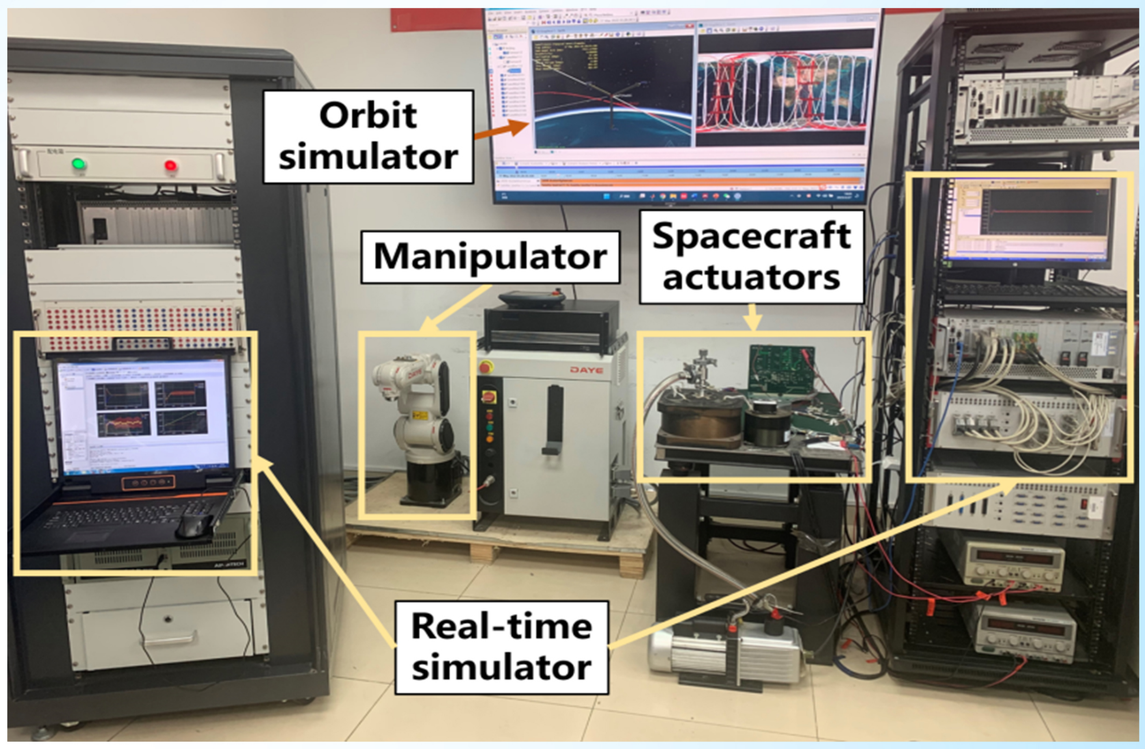

Figure 2 Test platform of the spacecraft control performance

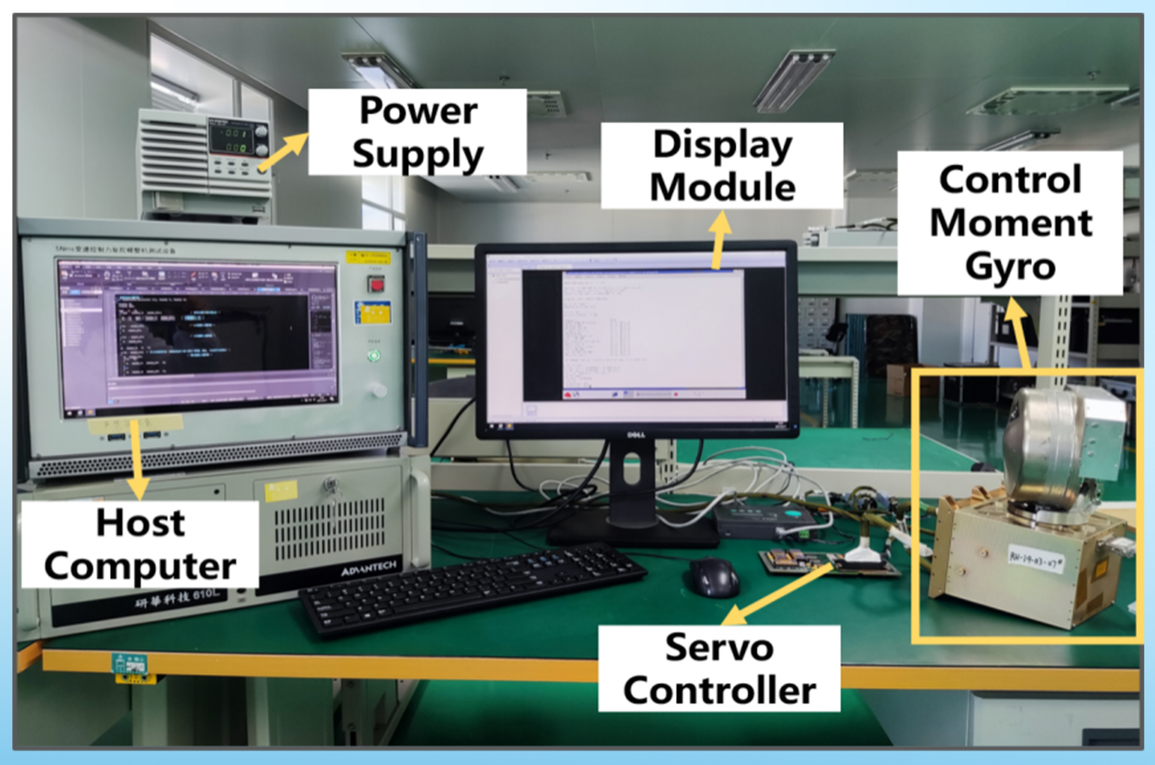

Figure 3 Test platform of the spacecraft actuator

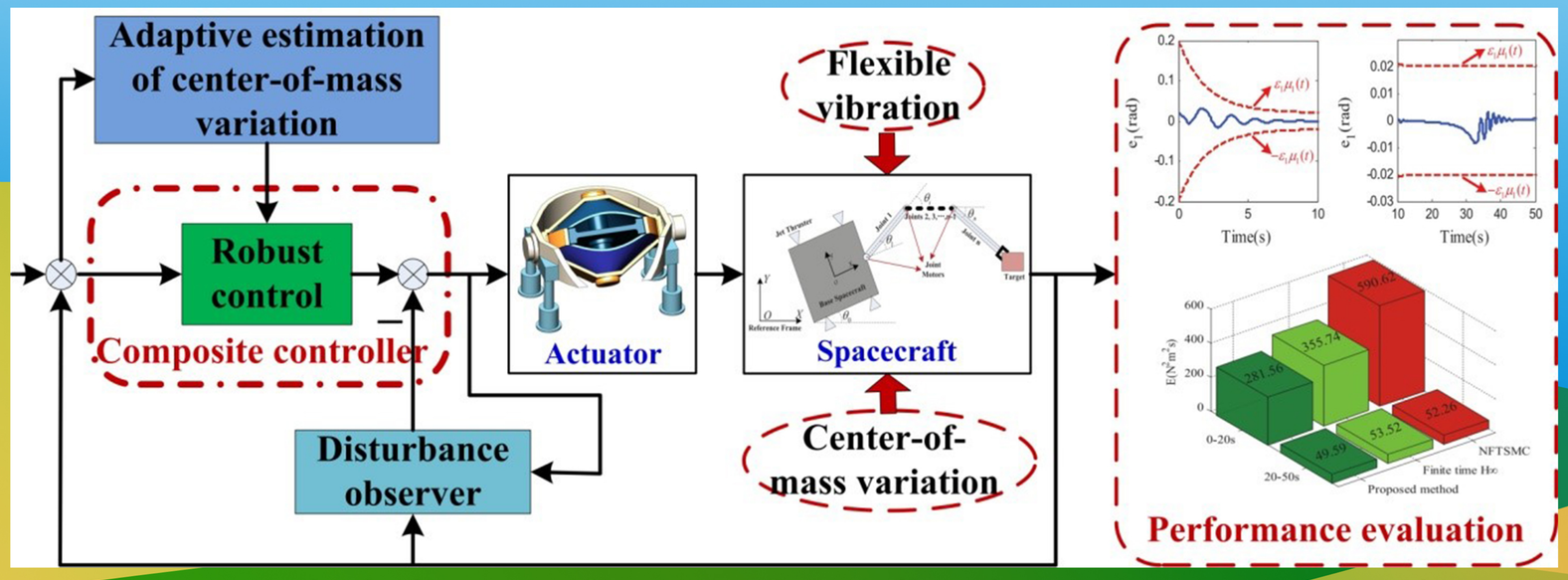

Figure 1 Block-diagram of spacecraft anti-disturbance maneuver control

Figure 4 Patents, publications, and award

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