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A VISUAL PERCEPTION AND INTELLIGENCE SERVO SYSTEM USED FOR SPATIAL DEBRIS ACTIVE CLEARING ROBOTS

Abstract

With development of space launch mission worldwide in the recent years, a large number of in-orbit space crafts become invalid, which is a serious challenge of effective utilization of space resources and is a threat to the safe operation of the spacecraft in-orbit. Space-based active space debris removal technology is the root and effective measures to achieve the space resource utilization and harmless management, and will reinforce the near-earth space sustainable recycling ability. First of all, this paper introduces the reasons of space debris and their hazards, and then describes the worldwide measures to eliminate space debris currently taken. The main contribution of our work is the design of a space robot which can clear space debris actively, with the situational awareness capability of space environment in all domains and autonomous decision-making capacity, with a manipulator to catch space debris. The space robot designed breakthrough two main key technologies, one is "moving space target full field scanning and recognition", and another is "intelligent visual servo control". Using the algorithm of deep neural network learning, the robot could recognize waste satellite from any view. Our system applies kernel correlation filtering target tracking technology to provide mechanical crawl accurate position and orientation of the target in real-time. Experimental results show that the system has the ability of remote target acquisition and autonomous identification. By prior knowledge, the system achieves the goal of arrest decision making. The space robot with visual servo system clear the specified waste satellite according to the real time target position information provided by the tracking system.