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A FLEXIBLE AND ADAPTIVE CAPTURE DEVICE FOR ORBITAL DEBRIS REMOVAL BASED ON
OCTOPUS-INSPIRED PNEUMATIC SOFT ROBOT

Abstract

After decades of human space activities, the increasing orbital debris becomes the No.1 potential threat for the spacecraft. Active Debris Removal is an effective form of remediation. This paper puts forward a flexible and adaptive capture device based on octopus-inspired pneumatic soft robot for orbital debris removal, which is mainly made up of octopus-inspired tentacles and deployable arm. The device has functions with distant reaching, end position and pose adjusting, debris capturing and target recognition and measurement. The device can capture orbital debris reliably and nimbly with single tentacle bending or multi tentacles twining. Its tentacles are realized based on the mechanism of pneumatic soft robot, which can be compatible and adaptive with the irregularly shaped debris and absorb energy from the contact and impact. The deployable arm is driven by pneumatic actuation, so it is with light weight and high shrink ratio. Gecko-inspired biomimetic nano-sacle adhesive arrays are also used on the surface of the tentacle to ensure reliable grasping. According to the analysis of the task and bionics revelation, in this paper, the overall design of the capture device is presented, the solutions of some main subsystem are proposed, and some task simulations are carried out to validate the feasibility.