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CONCEPT FOR DETUMBLING OF SPACE DEBRIS USING MAGNETORQUERS

Abstract

In the field of Space Traffic Management, it is becoming increasingly difficult and expensive to avoid collisions and have situational awareness for the satellites in orbit. Active Debris Removal (ADR) is one of the only long-term solutions to mitigate the risks. One major challenge of ADR is the tumbling attitude of debris objects which makes close-proximity operations complicated. This abstract presents a new approach for detumbling of a target in space with the help of electromagnets. To that extent, a target can be approached and captured while lowering the risks of further complications that arise due to its high angular velocity. The proposed method consists of a two-step process which targets non-magnetic, as well as ferromagnetic debris. The first step would induce ferromagnetism to the target. This can be done in many ways, such as wrapping a ferromagnetic net around the target body. The next step would take advantage of 3-axis electro-magnetic device, like magnetorquers, to apply a magnetic force on the target. Thus, the target is expected to experience a braking torque inside the magnetic field, which will result in slowing down the spinning motion. This motion would be monitored with a camera, and then analysed in order to determine its angular velocity. The forces in each of the axes of each of the electro-magnet would be modulated to maximise the braking torque in the target based on the analysed motion of the target. The effect of the angular momentum transfer on the mission spacecraft would be mitigated using active and passive attitude control systems. The concept can be tested using a free floating platform on a flat surface that can simulate a target. In this setup, one or multiple 2 axis electromagnets can be mounted on a robotic arm that can simulate the mission spacecraft in close proximity operation. The motion can be monitored using an on hand camera or an environment camera that can be then used to analyse the motion to modulate the power in each of the axes of each of the electromagnets. The results obtained from the experiment can provide a possible method to detumble objects in microgravity in a safe and controlled manner.