SPACE DEBRIS SYMPOSIUM (A6)
Space Debris Removal Concepts (6)

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ACTIVE IN-ORBIT JUNK REMOVERS – AN INDISPENSABLE SERVICE FOR TRUE SPACE DEBRIS MITIGATION

Abstract

In order to remove space debris, dedicated 'junk remover' spacecrafts should be designed to grab the debris and remove them safely through a well-planned and well-controlled trajectory.

This holds not only for existing debris, but for most of the future debris as well, since suggested passive solutions that rely on the Earth atmosphere or electromagnetic field are only relevant in very low altitudes. In addition, passive means must get into work just when their platform is near end of life, and in its reliability limit.

Effective Space Solutions Ltd. (ESS) is presenting a new concept of a de-orbiting spacecraft, the De-Orbiter, equipped with a specially designed rendezvous and docking (RnD) system. This spacecraft may serve for several years in space and complete at least 20 satellite-size debris removal missions.

The RnD system uses LIDAR and cameras to identify the target, and to feed the attitude and orbit control system (AOCS) of the De-Orbiter to safely approach the target. As the De-Orbiter is getting close enough it uses the cameras and the AOCS to match its linear and angular velocities to achieve a complete rendezvous position, accurate to less than 1 mm, using specially designed algorithms.

Next, the De-Orbiter docks to the target by deploying several docking arms mounted around its body. The arms extend towards the target and grip over an appropriate feature of the target. For example, a common feature relevant to many target satellite might be the interface ring of the separation system.

Once docked, the De-Orbiter can manipulate the target using its dedicated propulsion system. The propulsion system includes several thrusters by which the target can be rotated, pushed forward, or pushed laterally without changing the attitude of the target.

The special design of the docking arms enables aligning the thrust direction exactly through the joint center of gravity of the De-Orbiter with the target. This way no parasitic torques are exerted to the couple during the joint maneuver.

Thus, the De-Orbiter can push the target through a well-planned maneuver into the intended de-orbiting trajectory. At that point the removal maneuver ends, and the De-Orbiter release the target to fall and burn all the way down into the ocean, or, alternatively, inject the target into an authorized graveyard orbit. The De-Orbiter itself re-orbits for the next debris removal.