SPACE DEBRIS SYMPOSIUM (A6)
Space Debris Removal Technologies (5)

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VALIDATION RESULTS OF SATELLITE MOCK-UP CAPTURING EXPERIMENT USING NETS

Abstract

The PATENDER activity (Net parametric characterization and parabolic flight), one of two parallel activities on funded by the European Space Agency (ESA), aims to validate a simulation tool for designing nets for capturing space debris. This validation will be performed through a set of different experiments under microgravity conditions. An elastic net will be launched in order to capture a satellite mock-up. This paper will detail the architecture of the software dynamics simulator together with the foreseen cross-correlation results of the deployment experiment. The net dynamics has been modelled using lumped parameters method, where every string is discretized into lumped masses connected by springs and dampers: the ropes constitutive law is represented with linear Kelvin-Voigt model. A key aspect of the net deployment is to compute accurately the involved physics equations through a rigorous mathematical modelling. During the net wrapping phase it is needed to identify and manage the collisions arisen between the different elements. A collision detector engine is in charge of assessing the contact between the net and the target satellite. Contact dynamics has been implemented taking into account normal and tangential forces as result of the penetration depth and stiffness, damping and friction coefficients. The simulator is implemented within Blender framework in order to provide a highly configurable tool, able to reproduce faithfully different scenarios for Active Debris Removal missions. The parabolic flight will allow performing at least eighteen parabolas offering around 18s of zero-g conditions. Square nets will be launched at different initial velocities and launching angles using a pneumatic-based dedicated mechanism. High-speed motion cameras will record the experiment allowing 3D reconstruction of the net motion. The net knots have been coloured to allow the images post-process using colour segmentation, stereo matching and iterative closest point (ICP) for knots tracking. The final objective of the activity

is the validation of the net deployment and wrapping simulator using acquired results during a parabolic flight. The parabolic flight images will be post-processed to generate the reference data for the simulator validation. The simulator will be properly configured according to the parabolic flight scenario, and executed in order to generate the validation data. The high speed camera images will be used to determine accurately the initial conditions.