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Author: Mr. Xavier Collaud

Ecole Polytechnique Fédérale de Lausanne (EPFL), Switzerland, xavier.collaud@epfl.ch

Ms. Muriel Richard-Noca

Ecole Polytechnique Fédérale de Lausanne (EPFL), Switzerland, muriel.richard@epfl.ch

Mr. Marc Leroy

Ecole Polytechnique Fédérale de Lausanne (EPFL), Space Engineering Center (eSpace), Switzerland,
marc.leroy@epfl.ch

Mr. Guillermo Julián Moreno

Ecole Polytechnique Fédérale de Lausanne (EPFL), Space Engineering Center (eSpace), (*country is not specified*), guillermo.julianmoreno@epfl.ch

Mr. Xavier Deville

Ecole Polytechnique Fédérale de Lausanne (EPFL), Space Engineering Center (eSpace), Switzerland,
xavier.deville@epfl.ch

Mr. Oliver Kirchhoff

Ecole Polytechnique Fédérale de Lausanne (EPFL), Space Engineering Center (eSpace), Switzerland,
kioliver@student.ethz.ch

Mr. Pierre-Alain Mäusli

Ecole Polytechnique Fédérale de Lausanne (EPFL), Switzerland, pierre-alain.mausli@epfl.ch

SIMULATION AND PROTOTYPING OF THE CLEAN SPACE ONE CAPTURE SYSTEM

Abstract

The objectives of the CleanSpace One mission are to raise the awareness of the orbital debris problem, develop and test technologies for non-cooperative rendezvous, and as a demonstration, de-orbit the Swiss-Cube satellite. The capture system is a "Pacman"-style mechanism composed of five deployment units unrolling bi-stable reelable composite (BRC) booms with a net attached to them. The system is actuated by two motors. The shape and behavior of this net has proven to be critical for the functionality and reliability of the capture. In order to address these concerns, simulations based on net characterizations, as well as full-scale prototyping have been achieved. This paper describes the analysis of the target-net simulations and the functionality test of the prototype. The initial part presents the design of the capture system, including the net, and the capture scenario. The resulting simulation process and net design are then discussed in the main part. The key shape parameters of the capture system (opening angle, length and curvature of the BRC booms) have been defined via the simulations results. To support those results, a full prototype of the net, BRC booms and actuation mechanisms has been realised.

The prototype showed that the design was feasible and viable. The targeted shape could be achieved within the stowing space allowed to the mechanism. It appears that a fully representative test of the capture system must be run under micro-gravity conditions. Test plans evaluations are under further investigation to select the most appropriate means of testing. The research platform of the ISS is currently evaluated as possible candidate for this purpose.