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TWO NANO-SATELLITES FOR FORMATION FLYING IN LOW-EARTH ORBIT: AN UNDERGRADUATE STUDENT DESIGN PROJECT AT DELFT UNIVERSITY OF TECHNOLOGY

Abstract

Delft University of Technology is one of the leading worldwide actors in the development of nano-satellites: two triple unit CubeSats have been launched in the last five years by this University and are still fully operational in orbit. The next challenge will be represented by the development of two twin nano-satellites, that will be launched in a very low-Earth orbit at approximately 300 km altitude with the main aim of performing a formation flying demonstration experiment.

With this extremely challenging mission in mind, a group of 9 third-year students has worked at their own nano-satellite design project in the framework of the Design Synthesis Exercise (DSE), the final step of the Bachelor program at Delft University of Technology. Each DSE is based on a project proposed by a member of the Academic scientific staff and lasts for 10 weeks, during which the group has to perform a complete Phase A design based on the given assignment, under the supervision of three Academic staff members. The DSE assignment described in this paper was inspired by the main requirements of the next Cubesat mission planned by the University, but it was made even more challenging: not only the

design had to be capable of performing the required formation flying demonstration, but in addition a "secondary" mission objective of scientific and educational relevance had to be selected and implemented in the same nano-satellite design.

The paper has been written, as a part of their assignment, by the nine undergraduate students who have participated to this DSE project in Spring 2013. It will discuss all the project phases, from requirements identification to preliminary satellite design, secondary mission objective definition and final Phase A design, complete down to the sub-system level. An accurate orbital decay analysis will be presented in support to the design choices made to accomplish the formation flying objective, including atmospheric drag simulations with solar activity predictions. The design of all satellite subsystems will be shortly discussed, including a first selection of the components among available Commercial-Off-The-Shelf options. The selected secondary mission objective, partial non-destructive re-entry of a capsule covered by a Phenolic Impregnated Carbon Ablator (PICA) heat shield, will be presented and discussed in detail: footprint and landing calculation results will be shown to demonstrate the feasibility of this mission objective.