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IN-ORBIT RESULTS OF DELFI-N3XT: LESSONS LEARNED AND MOVE FORWARD

Abstract

This paper provides an update of the Delfi programme of the Delft University of Technology (TU Delft), with a focus on the in-orbit results of Delfi-n3Xt, the second Delfi CubeSat that has been launched in Nov 2013.

The paper consists of three primary parts. The first part is a brief introduction of the Delfi programme and an overview of Delfi-C3, the first CubeSat in the Delfi programme, which was launched in April 2008 and is still operational after more than five years.

The second part of the paper provides details of the Delfi-n3Xt satellite. The main objectives of Delfi-n3Xt are to provide hands-on training and research for students, demonstrate novel small space technologies and act as robust and versatile nano-satellite spacecraft bus. In addition to the educational objective that has been reached with more than 80 students involved in the project, most of the technological objectives have also been fulfilled with successful in-orbit demonstrations of payloads and platform. Among these demonstrations, three are highlighted. The first one is the demonstration of a solid cool gas micropropulsion system by ignition of two cold gas generators and several thrust manoeuvres. Internal gas pressure and temperature has been measured at a rate of 30 Hz, providing detailed information about the system performance. The second remarkable demonstration is a more robust Command and Data Handling Subsystem (CDHS) that shows significantly less communication errors and bus lockups compared with Delfi-C3. Another interesting demonstration is a highly integrated Attitude Determination and Control Subsystem (ADCS) that performs three-axis active control using reaction wheels. Although a high level noise on the magnetometer measurement has been observed, all sensors and actuators have however already been successfully tested individually and proven to be working correctly. Details of results from these demonstrations are presented.

Through the development of Delfi-C3 and Delfi-n3Xt, especially the latter, significant experiences and lessons have been learned on subsystem development, satellite design, Assembly, Integration and Test (AIT), in-orbit operation and project management. Being addressed in the last part of the paper, these lessons also motivated a further step towards DelFFi, the third Delfi CubeSat mission, which is expected to be launched in 2016 within the QB50 framework and to demonstrate autonomous formation flying using two CubeSats named Delta and Phi. An update of the DelFFi mission is provided, which reflects the design modifications learned from Delfi-n3Xt.