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SPACE PROPULSION SYMPOSIUM (C4)
New Missions Enabled by New Propulsion Technology and Systems (6)

Author: Mr. Ivan Krusharev
Delft University of Technology (TU Delft), The Netherlands, i.krusharev@student.tudelft.nl

Mr. Rob Poyck
Delft University of Technology (TU Delft), The Netherlands, r.m.a.poyck@student.tudelft.nl
Mr. Quirino Bellini
Delft University of Technology (TU Delft), The Netherlands, q.bellini@student.tudelft.nl
Mr. Barry Zandbergen
Delft University of Technology (TU Delft), The Netherlands, B.T.C.Zandbergen@tudelft.nl
Dr. Angelo Cervone
Delft University of Technology (TU Delft), The Netherlands, a.cervone@tudelft.nl

CUBESAT MICRO - PROPULSION SYSTEMS FOR EXTENDING THE CAPABILITIES OF ACADEMIC PROJECTS

Abstract

The format and size specifications of the CubeSat platform require highly miniaturized subsystems. One of the most challenging ones being the propulsion system. Up to date, according to the authors' knowledge, only two CubeSats have successfully operated a propulsion system in space: CanX-2 in 2008 and Delfi-n3Xt in 2013. The importance of developing and demonstrating a miniaturized propulsion system for CubeSats is to be able to attain or obtain an optimal orbit. It is even more important for missions where satellites are required to fly in a formation. As a next step, a formation flying technology demonstration is planned in the next milestone mission of Delft University of Technology (DelFFi), as part of the QB50 project.

This paper gives an outline of the present development status of micro–propulsion systems at Delft University of Technology. The main design driving criteria are provided by the DelFFi satellites requirements, but also looking at a much further horizon with the possibility of extending the system to meet even more challenging needs. Keeping in mind the educational environment in which the work is performed, safety drives the requirements: thus, propellants have to be non–toxic and easy to handle. Additionally, present requirements aim at a thrust level in the range of 1 to 10 mN and a total ΔV of 15 m/s or more. Wet mass, when installed in triple-unit CubeSats, shall be less than 450 g, and peak power consumption less than 10 W. Finally a discussion on the CubeSat requirements relevant to propulsion systems, such as pressurized vessels and liquid propellants, and their applicability will also be given.

A number of Commercial-Off-The-Shelf (COTS) systems have been investigated to find suitable candidates that fulfill these minimum requirements. However, it has been concluded that all presently available systems have low Technology-Readiness-Level (TRL) or their performance is out of the required range. It was thus necessary to start working at custom designed systems, which will be discussed in the paper. Design options include the use of different manufacturing techniques, such as micro–machining and Micro Electro Mechanical Systems (MEMS). Other design choices are represented by the type of propellant (liquid or gaseous) and the pressurization system (pre-pressurized tank or gas generators). A complete design option tree will be presented in the paper, including a specific trade–off to the DelFFi mission, which should present a overview of CubeSat propulsion systems available and their applicability to academic institutions.