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A Pico-Satellite Design to Demonstrate Trajectory and Science Applications.

Mehmet Sevket Uludag*, Stefano Speretta, Alessandra Menicucci, Casper Broekhuizen, Michael van den Bos, Maxime Bielders, Jasper Haenen, Eberhard Gill.

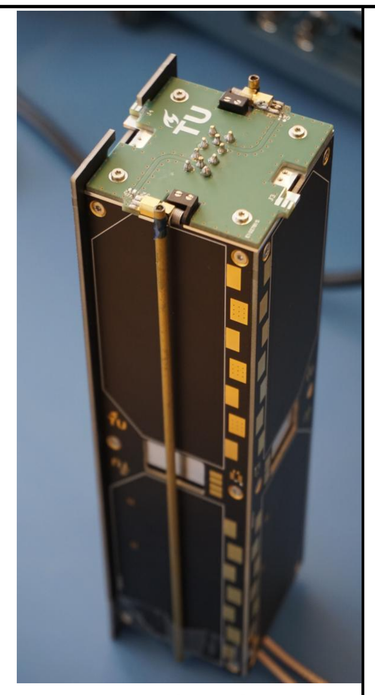
* ***Corresponding author email: M.S.Uludag@tudelft.nl***

Space System Engineering Section,
Department of Space Engineering,
TU Delft (The Netherlands)

Abstract: This paper presents the design, integration and testing of a pico satellite, Delfi-PQ, a 3P PocketQube developed by Delft University of Technology, expected to be launched at the end of 2020. The main goal of this project is creating a miniaturized platform for future space missions with performances comparable to CubeSats, taking advantage of the miniaturization of electronic components and their integration. Education of aerospace engineering students is a second key goal of the project, where students involved in the project as part of their curricular activities.

Delfi-PQ Characteristics

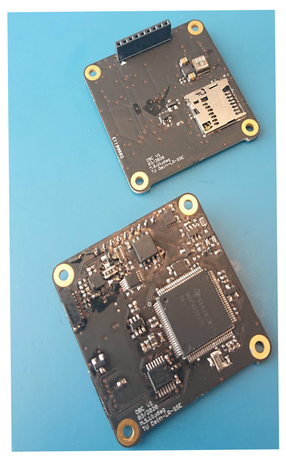
Delfi-PQ measures 50X50X178mm and has maximum weight of 750 grams. All the critical subsystems are included in this confined form factor: electrical power system (solar panels, battery), on-board computer, attitude determination and control (with 3 axis magnetorquers) and communication system all compliant with the PQ-9 Standard.



Delfi-PQ .

Orbit average available power is approximately 1 Watt, requiring a better energy efficiency with respect to CubeSats. Delfi-PQ has been equipped with a miniaturized GPS receiver which is expected to provide a position accuracy better than 10 m.

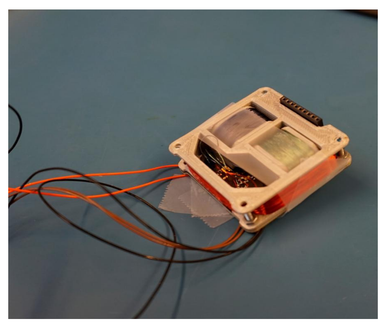
In future, a swarm of PocketQubes carrying GPS receivers can be used for atmospheric density estimation by relative position measurements between two satellites located in close proximity.



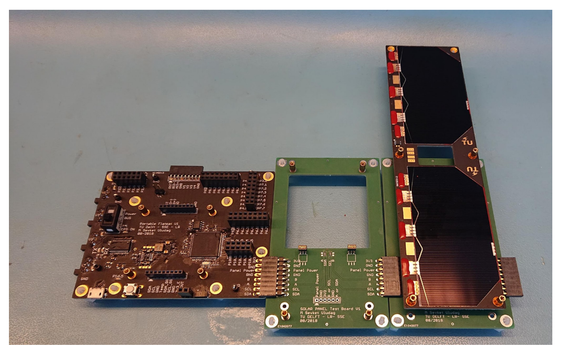
On-board computer

Assembly, integration and testing

The standardized stacking configuration, small structure as well as the absence of connectors enables to integrate the Pocketqube in about 30 minutes. Aside from the assembly and integration, an automated, small scale test setup is also being developed. This setup creates an uninterrupted, remotely accessible and easy to carry test environment to control the functionality of a satellite for a long duration. Unit testing was performed at hardware level and full hardware-in-the-loop simulation has been used throughout the development process to verify system functionality and compliance to mission requirements. Fully automated test enables the possibility to test the satellite continuously. A halogen lamp is being used as a light source to supply power to the satellite via the solar panels.The inhibit switches (kill switches and remove before flight pins) were tested as well.



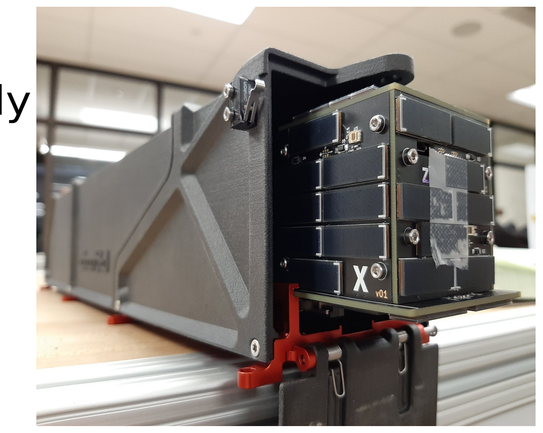
3-axis magnetotorquers



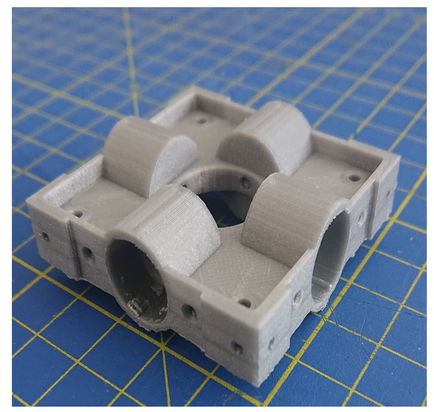
Delfi-PQ Flatsat

Launch

Delfi-PQ will be launched in December 2020 with the Space-X Falcon-9 launcher from the Kennedy Space Center in Cape Canaveral. It will integrated in the Albapod deployer, developed by Alba Orbital, which can carry up to 6p PocketQubes. Delfi-PQ will be injected into a Sun-Synchronous circular orbit of ~500 km. The satellite has been equipped with four laser corner-cube reflectors to allow being tracked by the International Laser Ranging Service, providing a further independent estimation with respect to the satellite position derived from the on-board GPS.



Albapod deployer



Laser reflectors holder

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