Structural Design, Integration of Micro Propulsion units and Thermal Analysis of UWE (University of Wurzburg's Experimental Satellites) Platform

Arunkumar Rathinam[*], Philip Bangert[*], Daniel Bock[+], Mathias Pietzka[†], Martin Tajmar[+], Klaus Schilling [‡]

* *University Würzburg, Informatik VII, Am Hubland, D-97074 Würzburg, Germany*
+ TU Dresden, Institute of Aerospace Engineering, Space Systems Chair, 01062 Dresden, Germany
† University of the Federal Armed Forces München, Werner-Heisenberg-Weg 39, 85577 Neubiberg, Germany
‡ Zentrum für Telematik, Allesgrundweg 12, 97218 Gerbrunn, Germany

Abstract:

Pico satellites have seen major technological advancements and economic boost in recent years. Operating within the framework of Cubesat Design Specifications (CDS) allows everybody from start-up organizations to Universities, to learn, adopt and utilize the technologies that are readily available and use commercially off the shelf products to design and develop Cubesats. In the UWE program (University of Wurzburg's Experimental Satellites), a roadmap was set to utilize a Picosatellite formation flying for Earth observation based on multi-point measurements. UWE-3 mission (3rd cubesat in UWE program) was successful in implementing a real-time miniature attitude determination and control system on-board the satellite. The next UWE mission objective is to demonstrate orbit maneuvering capabilities combined with the precise attitude control using a micro propulsion system.

The scope of the paper covers the research done in structural design to integrate the thruster units and analysis (structural and thermal) to understand the behavior of the system. The propulsion systems considered for the mission are the Micro Vacuum Arc Thrusters (μVAT) developed at University of the Federal Armed Forces in Munich, Germany and the NanoFEEP (highly miniaturized Field Emission Electric Propulsion) thrusters developed at TU Dresden, Germany. The modular architecture of the UWE platform seamlessly allows integration of the power processing board (as a new electronic subsystem) to the cubesat system. Details on the development of structures for the UWE platform, diverse concepts to integrate the thrusters and technical constraints imposed by the propulsion subsystem on the cubesat are presented. The precise CAD models for individual components and assemblies are designed using Solidworks CAD software. The CAD model is then subjected to Finite Element modelling and analysis using NX software, to ensure the structure will withstand the launch. Structural analysis is done with NX Nastran to simulate the static and dynamic environment during launch with their respective conditions and results are presented. Based on recent in-orbit data from the predecessor satellite UWE-3 a precise orbital heating analysis is performed using NX Space Systems Thermal suite to predict the orbital thermal conditions and its effect on the satellite. Based on the results, the generic design is qualified for launch and is expected to serve as a platform for future satellites.