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# A STUDENT APPROACH FOR THERMAL MODELLING, VALIDATION AND TESTING OF THE 6S CUBESAT

**Abstract**

The increase in emphasis on small satellites developed in recent years has led to a substantial increase in their usage for a wide range of space missions. However, CubeSats have a high in-orbit failure rate due to their dimensions. Detailed computational analysis followed by an accurate testing campaign allows for assessment of the performance and prediction of any possible failure, increasing the possibility of a successful outcome.

The 6S CubeSat is the first student-made 1U CubeSat of Politecnico di Milano. Since January 2023, it has been part of the pilot edition of ESA's "Fly Your Satellite! Design Booster" program, aiming to provide support from ESA experts via frequent reviews. Achieving the mission goals requires optimal thermal control. The Thermal Control Subsystem needs to model the satellite, simulate it in space, and tune the design to ensure safe temperatures throughout the mission. A refined analysis and an appropriate test campaign ensure validation of the simulation and reliability of the results obtained with ESATAN.

This paper describes the approach followed throughout the timeline of the mission. First, the thermal model was built in ESATAN-TMS, analyzing six operating modes: nominal, detumbling, safe, and three payload-testing-related ones. Detailed modelling of interfaces was performed with Ansys to estimate thermal resistance between nodes correctly and refine the model. The planned actions then involve a complete testing campaign. The model philosophy is based on the Structural Thermal Model, performing thermal balance tests in a thermal vacuum chamber. The paper concludes by presenting the results and the Lessons Learned from the reviews done by ESA experts, addressing discrepancies in the design. This

paper describes the approach taken to ensure optimal thermal control of the 6S CubeSat, understand its thermal behaviour, address criticalities, and respect the mission requirements.