Master thesis : Thermal design of the OUFTI-Next mission

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Thermal Design of the OUFTI-Next mission

Graduation Studies conducted for obtaining the Master's degree in Aerospace Engineering
by Anthony Kellens

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Abstract

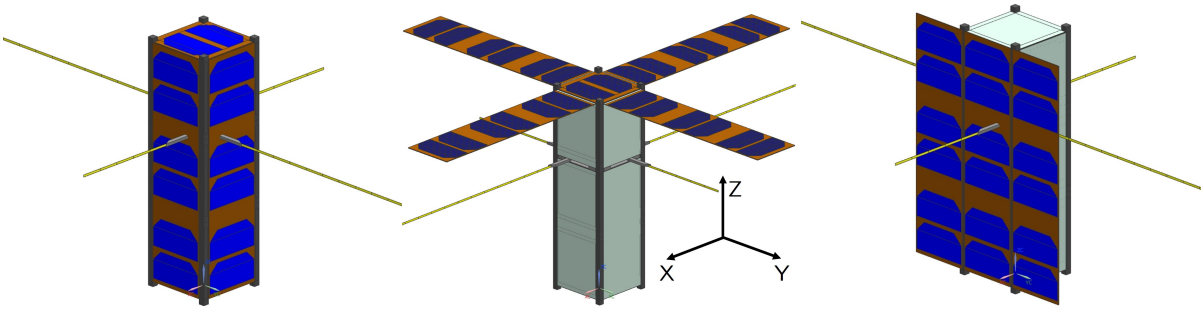
OUFTI-Next is a CubeSat developed by the University of Liège aiming to improve irrigation strategies. Thermal infrared imaging is used to measure the temperature of crops and to assess their level of hydric stress. OUFTI-Next is a technology demonstrator for an ambitious project. The final objective is to launch a constellation of satellites to achieve daily revisits over a particular location.

This Master's Thesis focuses on the thermal modelling and design of the satellite. Because of the early phase of the mission, several spacecraft's shapes and orbits have been considered throughout this study. The goal was to determine the feasibility form the thermal point of view and to guarantee that all the components operate within their allowed thermal range. Various models of increasing complexity have been implemented to analyze the thermal behaviour of the satellite. The computation has mainly been done with the Esatan software and the results have been heavily post-processed by Matlab routines.

The thermal models highlighted the fact that some components were not compliant with their permitted temperature range. To solve this problem, several solutions have been implemented. Special care has also been taken to maintain the payload as cold as possible. Indeed, this critical element requires low temperatures to operate properly.

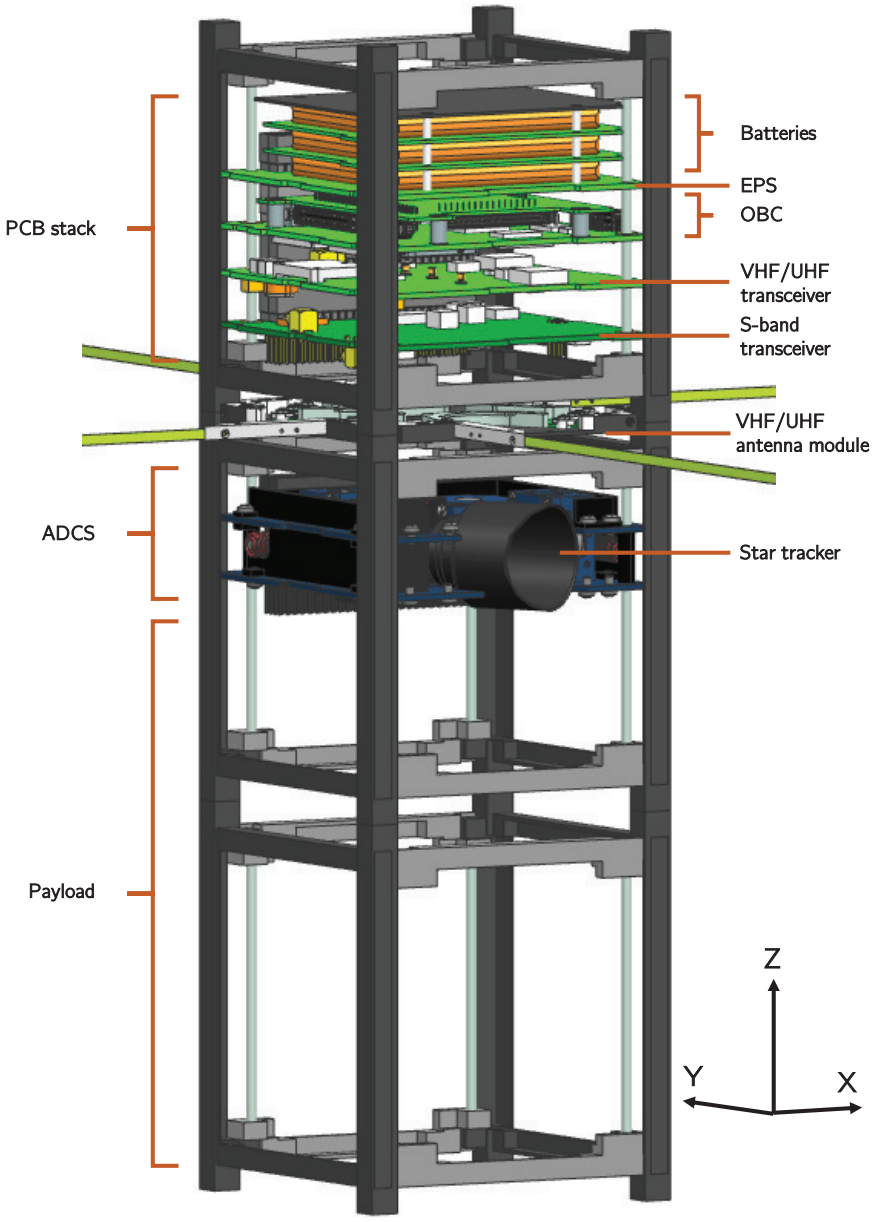
Because the mission was only at its beginning, the different thermal properties have not been fixed yet. Hence their influence on the results has been determined and discussed at several stages of the work thanks to sensitivity and uncertainty analyses.

Keywords: OUFTI-Next, CubeSat, Thermal design, Esatan

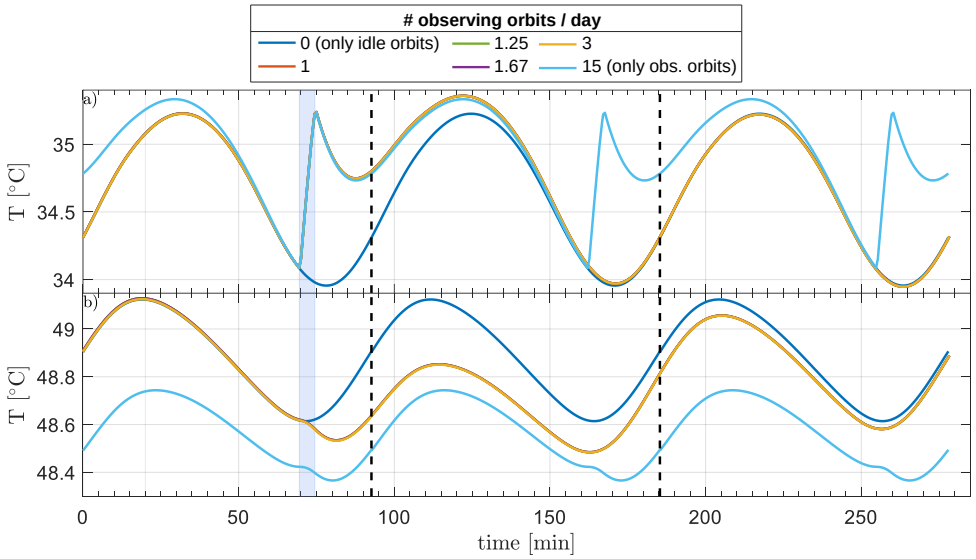


Body Mounted Cross Table

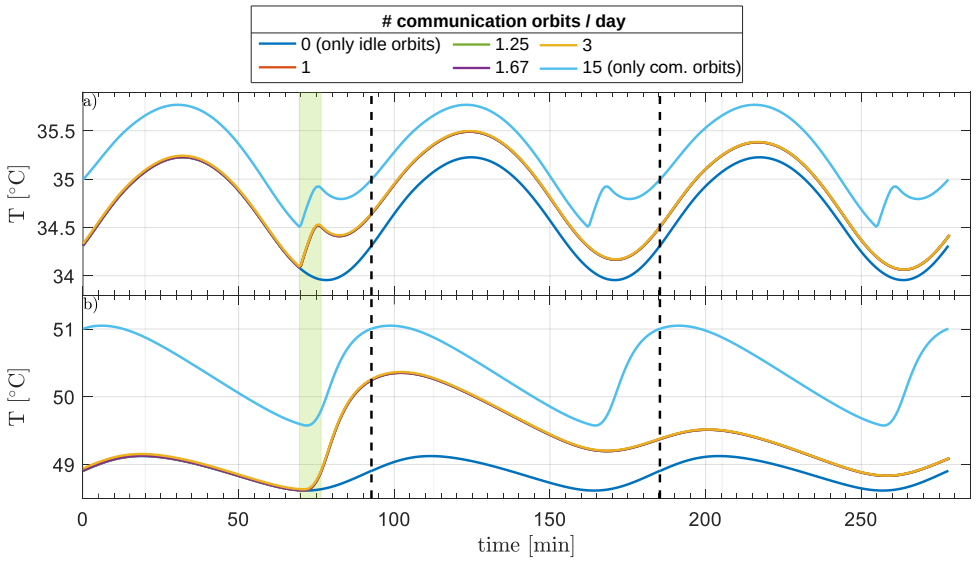
OUFTI-Next's configurations.



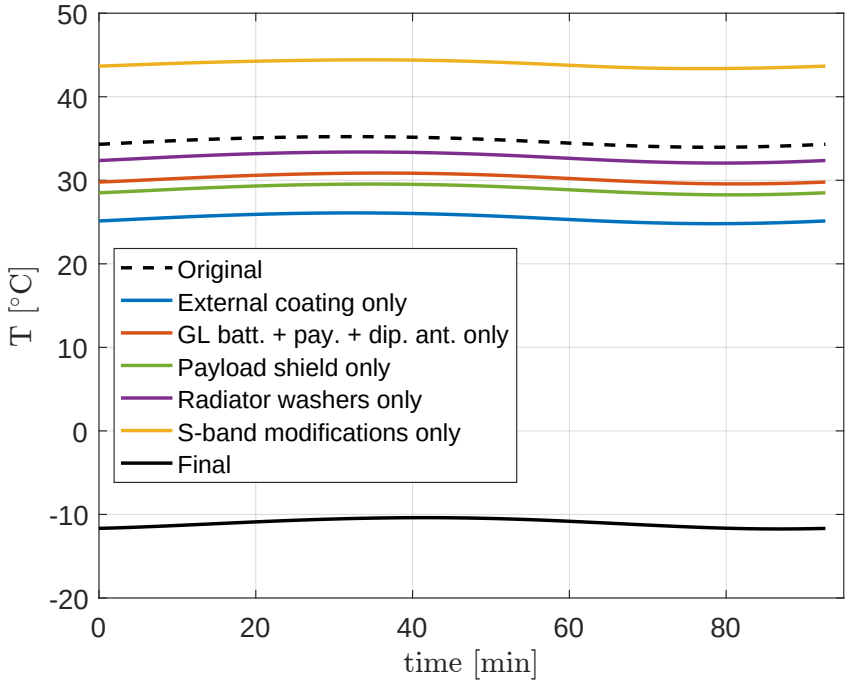
OUFTI-Next's interior.



Influence of the acquisition frequency on the temperatures of the payload (a) and batteries (b) for the *Body Mounted* configuration, hot ISS orbit.



Influence of the communication frequency on the temperatures of the payload (a) and batteries (b) for the *Body Mounted* configuration, hot ISS orbit.



Payload's temperature for several design modifications for the hot ISS orbit.
Color curves: each modification is applied individually, black solid curve: all applied together.