



Contribution ID: 24

Type: **Talk**

## Foresail: An Open Satellite Platform Beyond the LEO

*Wednesday, 16 October 2019 09:40 (20 minutes)*

The FORESAIL project is a scientific Cubesat-satellite project by the Finnish Centre of Excellence in Research of Sustainable Space. The project is funded by the Academy of Finland and it focuses on research of the solar wind interactions in the Earth's magnetosphere in high temporal resolution [1] and investigates new sustainable methods for space technology and research. The project aims to design and build two Cubesat-sized satellites, FORESAIL-1 and FORESAIL-2, for Low Earth Orbit (LEO) and Geostationary Transfer Orbit (GTO).

FORESAIL-1 is a 3-unit sized Cubesat designed for scientific mission on LEO. The main payload of the satellite is dual particle telescope (PaTe) instrument which measures the energy dependent pitch angle spectra of the precipitating radiation belt particles, and solar ENA flux. As secondary mission, FORESAIL-1 will demonstrate the effectiveness of the plasma brake (PB) as a means of manipulating the spacecraft orbit in operation and lowering the spacecraft altitude to speed up de-orbiting at the end of the mission, thus addressing the sustainability of LEO space operations. Additionally, the satellite will carry a commercial of the shelf (COTS) camera and a scientific magnetometer for technology demonstration. Satellite's avionics system and the platform, consisting an Electrical Power System, UHF Communication System, On-Board Computer and Attitude Determination and Control System, is completely designed and built in Aalto University, Finland. The design and build process of the satellite was started in the beginning of 2018 and planned to be launch in 2020 with five years operational lifetime in orbit. [1]

FORESAIL-2 aims to be one of the firsts Cubesats launched GTO orbit. The satellite aims to investigate similar solar wind phenomenons as its predecessor but at greater altitudes. In the GTO, the satellite experiences high radiation environment due to trapped high energetic particles in Van Allen belts. To cope with the radiation environment, the FORESAIL platform is designed to be radiation tolerant in affordable manner and utilizes techniques such as radiation protecting vault as shielding, varying redundancy strategies in sub-component level and results learned from component radiation test campaigns. Many of these design requirements of GTO environment are already taken in consideration in FORESAIL-1 system design. Building of Foresail-2 is planned to start in the beginning of 2020.

To achieve its goals for more sustainable space technology, the Foresail's platform team aims to publish the designs of the avionics platform for the benefit of the Cubesat community. Professional designed platform aims to help new arising Cubesat teams to get involved to space technology without need to reinvent the wheel by themselves and thereby supporting more sustainable technology development. The project does not aim to create an open sourced managed project but a professional open space-grade designs and documentation for a complete satellite which can fulfill the requirements of a complex high reliability satellite mission. Beside the Foresail-project, the research group guides a student lead Aalto-3 Cubesat mission which aims to design and build an open source 1U Cubesat technology demonstration satellite.

### References

[1] M. Palmroth, J. Praks, R. Vainio, P. Janhunen, E. K. J. Kilpua, N. Y. Ganushkina, A. Afanasiev, M. Ala-Lahti, A. Alho, T. Asikainen, E. Asvestari, M. Battarbee, A. Binios, A. Bosser, T. Brito, J. Envall, U. Ganse, H. George, J. Gieseler, S. Good, M. Grandin, S. Haslam, H.-P. Hedman, H. Hietala, N. Jovanovic, S. Kakakhel, M. Kalliokoski, V.-V. Kettunen, T. Koskela, E. Lumme, M. Meskanen, D. Morosan, M. R. Mughal, P. Niemelä, S. Nyman, E. P. Philipp Oleynik, Adnane Osmane, Y. Pfau-Kempf, J. Peltonen, J. Plosila, J. Polkko, S. Poluianov, J. Pomoell, D. Price, A. Punkkinen, R. Punkkinen, B. Riwanto, L. Salomaa, A. Slavinskis, T. S`antti, J. Tammi, H. Tenhunen, P. Toivanen, J. Tuominen, L. Turc, E. Valtonen, P. Virtanen, and T. Westerlund. FORESAIL-1 cubesat mission to

measure radiation belt losses and demonstrate de-orbiting. Journal of Geophysical Research: Space Physics, May 2019.

**Primary author:** Mr NIEMELÄ, Petri (Aalto University)

**Co-authors:** Mr PELTOLA, Tatu (Aalto University); Mr CHEREMETIEV, Kiril (Aalto University); Mr ALHO, Arno (Aalto University); Mr CLAYHILLS, Bruce (Aalto University); Mr KETTUNEN, Ville-Valtteri (Aalto University); Mr JOVANOVIĆ, Nemanja (Aalto University); Mr RIWANTO, Bagus (Aalto University); Mr BOSSER, Alexandre (Aalto University); Mr MUHAMMED, Mughal (Aalto University); Prof. PRAKS, Jaan (Aalto University)

**Presenter:** Mr NIEMELÄ, Petri (Aalto University)

**Session Classification:** Talks

**Track Classification:** CubeSat Missions and Systems