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OCC4SAT: OPTICAL CAMERA COMMUNICATIONS FOR INTRA-SATELLITE DATA TRANSFER

Abstract

Harness reduction is a recognized need in spacecraft, as it can account for up to 10% of the dry mass and generate complications during design and Assembly, Integration and Testing (AIT) phases. Small spacecraft and CubeSats can be particularly sensitive to these complications due to their small internal volume and clearances. The OCC4SAT project, funded by the European Union's Horizon Europe research and innovation programme, aims to mature the Optical Camera Communications (OCC) technology for intra-satellite data transfer, with the objective of reducing part of the related harnesses.

Optical camera communications are a type of VLC (Visible Light Communications) using cameras as receivers. Data exchange via OCC is performed via diffuse light signals that can travel across small clearances or be reflected before being received. Thus, these signals do not require line of sight and are tolerant to misalignments and inaccurate pointing, making the design phase more flexible and adaptable to late redesigns. Optical signals also offer excellent electromagnetic compatibility compared to traditional cabling, and an OCC system can help reduce the total harness mass by replacing the low data rate cabling. The advantages of using cameras as receivers lie in their high resolution, sensitivity, and image-forming capabilities; they increase the maximum exchanged data rate and add design flexibility by allowing the detection of multiple emitters simultaneously, even if the received power is low. The expected advantages of implementing OCC for intra-satellite communications thus consist of reduced dry mass, more flexible design options (even in case of late redesigns or moving parts), and easier AIT activities thanks to reduced cabling.

OCC4SAT aims to validate the OCC technology in an intra-satellite environment, maturing it to TRL 5 via simulation and testing. The optical network performances will be assessed in a realistic simulation environment that represents geometric and optical properties of typical microsatellites configurations. Subsequently, intra-satellite OCC networks will be tested by implementing transmitter and receiver nodes in microsatellite mock-ups, validating the technology in its relevant environment.

The OCC4SAT consortium aims to ultimately mature the technology to TRL 9 and accelerate its adoption in spacecraft to streamline design and integration activities. The consortium is composed of partners

covering all the required areas of expertise: Argotec for microsatellites and space systems, E.RE.CA. for high-speed signal processing and embedded systems, and Pi Lighting and Universidad de Las Palmas de Gran Canaria for LED technologies and VLC/OCC.