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INTEGRATING PLANAR ANTENNAS AND SOLAR CELLS INTO THE OLFAR SATELLITES

Abstract

The evolution of technology has driven the emergence of a new segment in space hardware focused on miniaturized spacecraft, and this opened up the path for a new range of applications. The Orbiting Low Frequency Antennas for Radio Astronomy (OLFAR) project is one of those applications, and aims to implement a space based aperture-synthesis radio telescope using a swarm of nano-satellites. In order to accomplish the main goal—low-frequency radio astronomy—the members of the swarm will have to observe celestial radiation and share the data with each other for further processing. Therefore, it will be mandatory to establish RF inter-satellite links (ISLs) between different entities of the OLFAR swarm.

In previous work we showed that it is possible to transfer data at high rates between nano-satellites by using a power-efficient baseband processing scheme and a smart antenna system. By combining multiple planar antennas placed on different faces of the satellite an omnidirectional coverage can be obtained so that the ISLs can be established and maintained without a priori knowledge of the satellites' position. While integrating the antenna system into the nano-satellite platform all mission aspects have to be taken into consideration, especially the solar power conversion system. The surface of an OLFAR satellite will accommodate both photovoltaic cells and antennas for the ISLs. Few concepts have been proposed in literature to optimize the antenna gain and the generated power of such a system. By using either thin film solar cells or meshed antennas, transparency to RF or light waves can be achieved, respectively. Thus, the surface of the satellite can be shared more efficiently. Nevertheless, this will deteriorate the mechanical, thermal and electrical properties of the system. Changes in the radiation pattern of the individual elements will occur. Hence, it is important to limit the antennas' back radiation and mutual coupling.

In this paper we present the design consideration of the antenna system to be used for OLFAR's inter-satellite link. Our aim is to develop a highly reliable, mechanically and thermally robust efficient antenna system and combine it with photovoltaic cells in order to meet both gain and power requirements. Multiple solutions for managing the limited surface of the satellites are investigated and EM simulations are performed to determine their eligibility for the OLFAR mission.