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# ANTENNA SYSTEM DESIGN FOR OLFAR'S INTER-SATELLITE LINK

**Abstract**

Exploration of low frequency radio waves in space has recently increased its relevance in radio astronomy, since new science drivers have emerged for frequencies below 30 MHz. Observing this band will provide new information about known phenomena and lead to unforeseen scientific discoveries. However, these long wavelengths are difficult to explore from Earth, mainly because of ionospheric distortions, its opaqueness below 10 MHz and man-made radio interference.

The Orbiting Low-Frequency Array for Radio astronomy (OLFAR) project aims to develop a distributed radio telescope in space using an autonomous swarm of nano-satellites. The swarm will act as a large-aperture antenna array that observes the very low frequency range of 0.3 - 30 MHz. To achieve this, the satellites will perform the radio observation, a distributed pre-processing of the acquired signals and the downlink to Earth of the pre-processed data.

For the distributed pre-processing, the information acquired by each satellite must be shared with all the others, since each satellite will perform the correlation of a different frequency sub-band. Because the observation data rate is relatively high (around 6 Mbits/s), efficient exchange of information is required for the distributed correlation. Moreover, the power available for communication between satellites is limited. Then, the antenna system becomes a significant part of the inter-satellite communication link, since it has a direct impact on the required transmission power and available data rate.

The nano-satellites used in OLFAR will be cubesats equipped with one antenna on each face. This way, because the satellites can be in any orientation with respect to each other, the most suitable antenna for a specific link can be selected. However, a more efficient implementation of the antenna system is possible if the properties of the satellite and the antennas are considered.

In this paper we present the design of the antenna system for the inter-satellite communication link for OLFAR. A tailored beamforming scheme which considers the directivities and orientation of the antennas on each satellite is proposed. With this scheme it is possible to track the link between two satellites and steer the beam accordingly. Furthermore, suitable antenna parameters for the proposed system are discussed, including radiation pattern, polarization, and size. Finally, possibilities of using phased arrays on each face of the cubesat are also considered, which provides a higher antenna system gain at the expense of increased complexity.