Design, realization and experimental characterization of a 40dB gain metasurface antenna

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Metasurface (MTS) antennas are versatile low profile radiators that exploit the interaction between a surface wave (SW) and a modulated impedance surface to create radiation patterns with different shape and polarizations. Recently, an effective and powerful design procedure has been developed for this kind of antennas (G. Minatti, *et al.*, "Synthesis of Modulated-Metasurface Antennas With Amplitude, Phase, and Polarization Control," in *IEEE Transactions on Antennas and Propagation*, vol. 64, no. 9, pp. 3907-3919, Sept. 2016.) thus, providing the possibility to obtain MTS antennas with unprecedented performances.

A remarkable example is the development performed in the framework of the project "Ultra flat VSAT antenna for Institutional and Civilian Applications" funded by the European Space Agency in the framework of the ARTES Program. The objective of the project was the design of an antenna system for SatCom operating in Ka-band, combining a transmitting aperture and a receiving aperture with minimum gain of 39dBi and 31dBi, respectively, with an operative bandwidth of 500MHz. An additional requirement was the compliance with the radiation mask of Telenor Thor 7 satellite for both co- ad cross-polar radiation patterns.

The design at equivalent impedance model was performed with the aforementioned procedure; the resulting equivalent impedance profile was then implemented through a proper distribution of electrically small patches, printed over a Rogers RO3003 substrate (ε_r = 3 and tanδ = 0.001) of thickness 0.762mm. The central feed of the two apertures was designed to maximize the launch of SW. Measurements of the realized prototypes have confirmed the fulfillment of all the requirements. In particular, the transmitting antenna has a measured gain of 39.5dBi (which could be further improved by adopting a connector optimized for Ka band operation) and a directivity of 41.2 dBi. Measured co-polar radiation patterns are shown in Fig. 1.

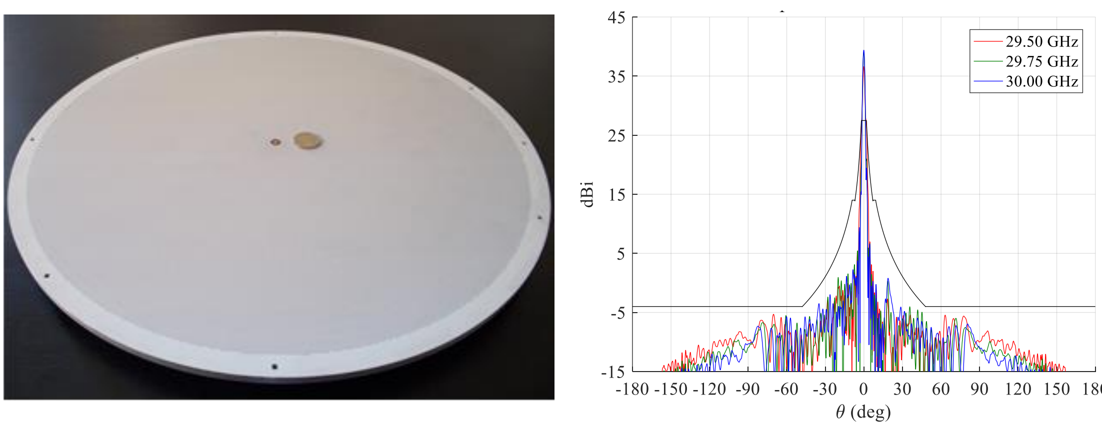

Figure 1. Picture of the realized prototype and relevant measured gain pattern at different frequencies.