New Unit-Cell Elements for Perforated Dielectric Transmitarray

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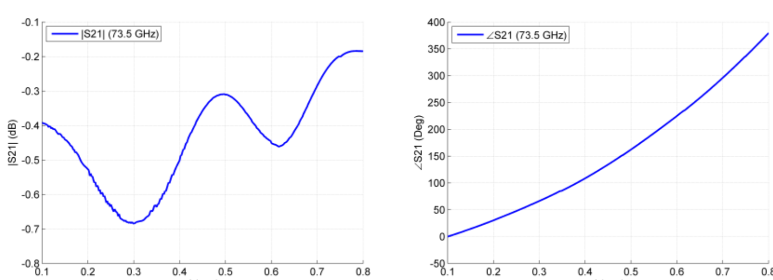
In the recent years the interest for Transmitarrays (TA) antennas increases, since they represents a good solution for obtaining high gain and beam steering, with a configuration that coupled the advantages of lenses and planar arrays. Among the different possible technological solution adopted for the realization of a Transmitarray, a particularly convenient seems to be the one adopting a perforated dielectric layer: the resulting antenna is characterized by ease of manufacturing, that could be done also adopting a 3D additive manufacturing technique, low cost, low profile and low losses.

The idea behind the realization of a perforated dielectric TA is that of locally changing the phase of the transmission coefficient properly acting on the size of the hole in the dielectric, through which it is possible to control the effective dielectric constant of the substrate, maintaining the S_{21} amplitude as much as it is possible close to 1 . Different solutions have been presented in literature, aimed to improve the performances of the transmitting layer, playing with the shape and the number of hole in each unit-cell and/or the number of dielectric layers. In fact it was notice that increasing the number of layers, and especially adding one layer on each side of the transmitting one acting as a sort of matching element between the unit cell of the TA and the air, the antenna performances increase (M.Wang, S. Xu, F. Yang and M. Li, 2016 IEEE Int. Symposium on Antennas and Propag. and URSI/USNC National Radio Science Meeting). Starting from these considerations, here a new type of unit-cell has been introduced: it consist in a three layer structure, where a square hole is drilled in the center of the unit-cell of the middle layer and its size *d* is used to control the phase of the transmission coefficient, while in the upper and lower layers the hole has a linearly tapered shape. The structure has been designed to work in E-band and the adopted dielectric material has a dielectric constant $\varepsilon_r = 6.15$. The unit cell has been simulated with CST using the infinite array method. The variation of the amplitude and phase of S_{21} with *d* is plotted in Fig.1. These results show that, while the phase variation covers a range even larger than 360°, the amplitude of S_{21} has minimum variations, confined between -0.7 and -0.2 dB. Results on the design and analysis of an entire TA adopting this type of unit-cell will be provided at the Conference.



(a) (b)

Figure 1. TA unit cell, variation of the transmission coefficient with *d*: (a) amplitude; (b) phase.