Application of glide-symmetric holey structures to the design of gap waveguide technology components

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In the last decade, the use of periodic structures has given raise to new innovative applications. Among them, the revisited concept of soft/hard surfaces and AMCs gave origin in 2009 to the gap waveguide technology (Kildal et al., *Local metamaterial-based waveguides in gaps between parallel metal plates*, in IEEE Antennas and Wireless Propagation Letters, vol. 8, pp. 8487, 2009). Since the presentation of the basis of this technology, there has been a continuous evolution of it in all aspects. Special attention has been given to manufacturing techniques and how to decrease the cost, which is a key aspect to make this a mass production technology. The main application of gap waveguide technology is foreseen at millimeter range frequencies, and here the manufacturing of the typically used AMC (the bed of nails) can be very critical.

The use of alternative options to the pins to create the required periodic structure acting as AMC has been already proposed (E. Rajo-Iglesias and P. S. Kildal, *Numerical studies of bandwidth of parallel-plate cut-off realised by a bed of nails, corrugations and mushroom-type electromagnetic bandgap for use in gap waveguides*, in IET Microwaves, Antennas & Propagation, vol. 5, no. 3, pp. 282-289, Feb. 21 2011). Recently a new structure based on the use of holes instead of pins, has been proposed to this aim (M. Ebrahimpouri et al., *Low-cost metasurface using glide symmetry for integrated waveguides,* in 2016 10th EuCAP). With this structure that uses glide symmetry as shown in the Figure, the manufacturing is simplified whilst the bandwidth is kept. Along this presentation we will introduce the use of glide-symmetric holey structures for gap waveguide applications.

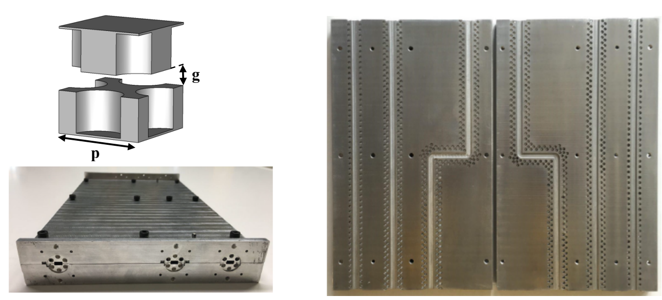

Figure 1: Unit cell and prototype of groove gap waveguide based on glide symmetry.

First, design guidelines of the holey structure will be presented. Based on the parametric studies, the main parameter determining the frequency of operation is the periodicity, whilst both the ratio diameter/period and the gap affect the bandwidth. Afterwards, the first designs of different groove gap waveguide components will be shown. In particular, a wideband phase shifter, a mode converter and a slot array antenna will be presented.