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Glide symmetries and their application for 5G antennas and microwave devices

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A periodic structure possesses glide symmetry if it is invariant after a translation and a mirroring [1,2]. Although the properties of one-dimensional periodic structures with glide symmetries were first studied in the 60s and 70s, recent discoveries on two-dimensional structures have revitalized this research field. Some of these recently discovered properties are of interest for future 5G antennas and microwave devices, which are aimed to operate at higher frequencies (i.e., mm-waves).

For example, the use of glide symmetries increases the equivalent refractive index of the first mode propagating through periodic structures. This property has been employed to design low-profile and low-loss Luneburg lens antennas for 5G communications in the Ka-band [3]. A photo of this prototype is depicted in Fig. 1.

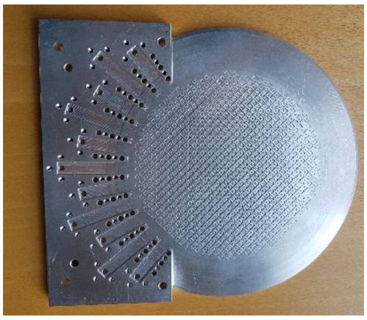

Figure 1. Photo of the prototype proposed in [3], which is a Luneburg lens antenna operating at Ka-band.

Another recent discovery is that glide-symmetric holes in a parallel plate produce electromagnetic bandgaps with higher attenuation and larger bandwidth than conventional holey structures. This property is attractive for producing cost-effective gap-waveguides [4] and flanges [5]. Glide-symmetric holes have been also applied for producing low-loss and highly directive point-to-point leaky-wave antennas at 60 GHz [6,7]. Finally, these electromagnetic bandgaps have been proposed for producing low-cost filters, as an alternative to waffle-iron filters [8]. One prototype of these filters is illustrated in Fig. 2.

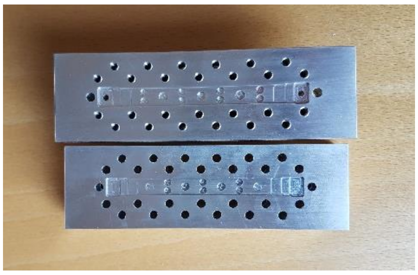

Figure 2. Photo of a filter produced with glide-symmetric holes as proposed in [8].

Finally, glide-symmetric configurations recently demonstrated to being able to produce high levels of anisotropy, which is an interesting feature for compressing the size of lenses [9]. Additionally, glide-symmetric structures can be used to create composite electric/magnetic materials, being possible to match high refractive indexes, even at oblique angles of incidence [10]. These properties are useful to reduce the reflections at the contour of lenses or to produce absorbers.

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