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Polarization Re-configurable Flat-Top Pattern Synthesis Using Phase Gradient Metasurface

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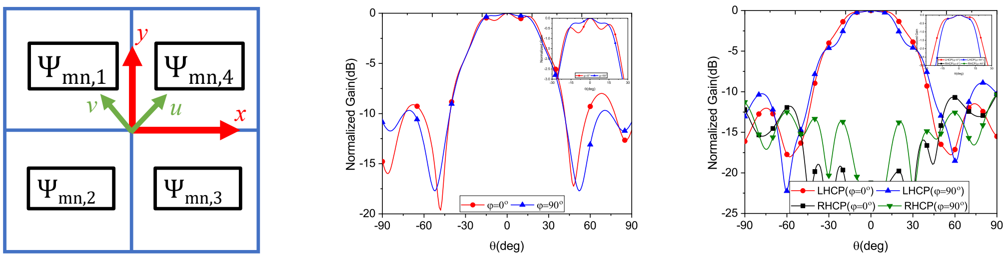
Extended Abstract

This paper presents a flat top radiation pattern synthesis technique based on phase gradient metasurface. The polarization of the generated beam can be reconfigured based on the polarization of the incident wave. Literature flat top pattern was generated by optimizing the local phase characteristics of the metasurface [1, 2]. Here, the basic idea to synthesize a flat-top radiation pattern is to divide the entire metasurface(MTS) into four sub-regions, each of which directs the beam in a particular direction as shown in Fig 1a. The proper optimization of the beam direction angle gives the desired flat top pattern [3]. In order to control the MTS characteristics with incident wave polarization, the elliptical shaped patches with a rectangular loop is considered. The required phase distribution over each sub-region is obtained with a one-to-one phase matching of unitcell. For a x-polarized incident wave, the cross polarized transmission is very low and the perpendicular dimension of the ellipse does not affect the transmission response of the unit cell. Hence, the dimension of the ellipse can be independently controlled to obtain the required phase characteristics for the generation of linear and circular polarization. A LP flat-top pattern is obtained for a x-polarized incident wave. For a u- polarized incident wave, the phase between two orthogonal components is maintained at 90^o, which gives a CP-flat top pattern. The proposed PGMS consists of 15×15 unitcells with a four layer elliptical patches embedded in a square loop printed on three FR4 dielectric substrates with a thickness of 1.58 mm. The proposed method is validated by exciting the MTS by a rectangular patch antenna operating at 10 GHz. The simulation results show a linear and circular polarized flat top pattern for E_x and E_u incidence, respectively. For a x-polarized incident wave, LP flat top pattern has been observed within 36^o beam width is shown in Fig. 1b. Similarly, for u-polarized wave incidence, a flat top with a 30^o beam width is achieved with an axial ratio value less than 2 dB is show in Fig. 1c. Th AR is well below 3 dB for the entire flat-top beam width.



(a) **(b)** **(c)**

Figure 1. Flat-top pattern synthesis with MTS where the antenna is placed in $-$ve z-direction: (a) Sub-regions of the MTS, Simulation results at 9.9 GHz, (b) radiation pattern for E_x incident wave, (c) LHCP and RHCP gain pattern for E_u incident wave

References

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