

宽带毫米波端射圆极化天线阵列

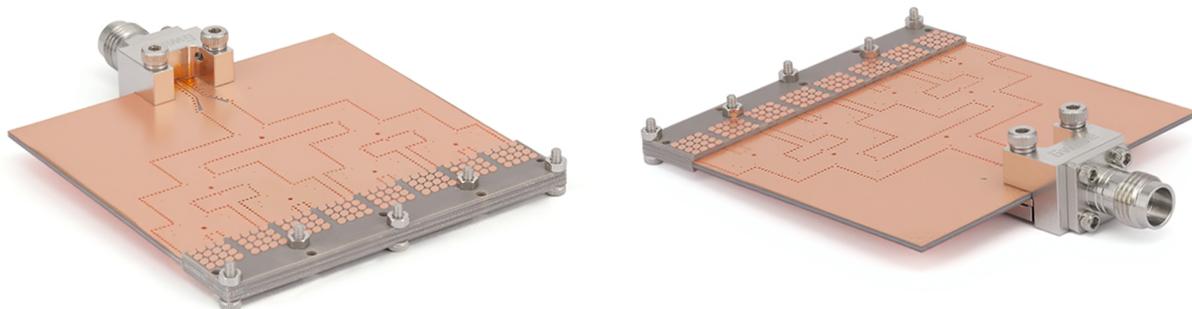
Metasurface-Enhanced Wideband Millimeter-Wave Endfire Circularly Polarized Antenna Array

一种新型宽带毫米波端射圆极化天线及其阵列，该天线通过超表面增强以提升性能。天线单元将一对水平电偶极子与两个垂直取向的基板相结合，同时激发两个正交的电场分量。此外，两个菱形超表面阵列被嵌入基板中，以优化水平和垂直分量之间的幅度和相位平衡。为进一步提高增益，设计并制作了一个 1×8 的线性端射圆极化天线阵列。

整个结构采用PCB工艺制作，使用Rogers RT/duroid 5880 ($\epsilon_r=2.2$, $\tan\delta=0.0009$)高频电路板作为介质基板材料。实测结果表明，该天线的-10dB阻抗带宽为35.52%，3dB轴比带宽为34.69%，峰值增益为16.2 dBi。其优异的性能与紧凑的剖面相结合，使所提出的端射圆极化天线阵列成为宽带毫米波应用的理想选择。

A novel wideband millimeter-wave endfire circularly polarized antenna and its array are proposed, with performance enhanced by metasurfaces. The antenna element combines a pair of horizontal electric dipoles with two vertically oriented substrates to simultaneously excite two orthogonal electric field components. Furthermore, two diamond-shaped metasurface arrays are embedded within the substrates to optimize the amplitude and phase balance between the horizontal and vertical components. To further increase the gain, a 1×8 linear endfire circularly polarized antenna array was designed and fabricated.

The entire structure was manufactured using PCB technology, employing Rogers RT/duroid 5880 high-frequency circuit board ($\epsilon_r=2.2$, $\tan\delta=0.0009$) as the dielectric substrate material. Measurement results show that the antenna achieves a -10 dB impedance bandwidth of 35.52%, a 3 dB axial ratio bandwidth of 34.69%, and a peak gain of 16.2 dBi. The combination of its excellent performance and compact profile makes the proposed endfire circularly polarized antenna array an ideal candidate for wideband millimeter-wave applications.



参数指标 Specifications

连接器类型: 1.85mm Female Connector type 1.85mm Female	工作频段: 32.65-46.75 GHz Frequency 32.65-46.75 GHz
-10-dB阻抗带宽: 35.52% (32.65-46.75 GHz) -10-dB impedance bandwidth 35.52% (32.65-46.75 GHz)	3-dB轴比带宽: 34.69% (33.6-47.7 GHz) 3-dB axial ratio bandwidth 34.69% (33.6-47.7 GHz)
峰值增益: 16.2 dBi@43.2 GHz Peak gain 16.2 dBi @ 43.2 GHz	极化方式: 右旋圆极化 Polarization Right-hand circular polarization (RHCP)
极化器: 电偶极子辐射贴片+菱形超表面阵列 Polarizer Electric dipole radiating patches + diamond-shaped metasurface arrays	阵列尺寸(长×宽×高mm³): 41.5×51.6×2.286 Array dimensions(L×W×Hmm ³) 41.5 × 51.6 × 2.286

辐射方向图 Radiation Patterns

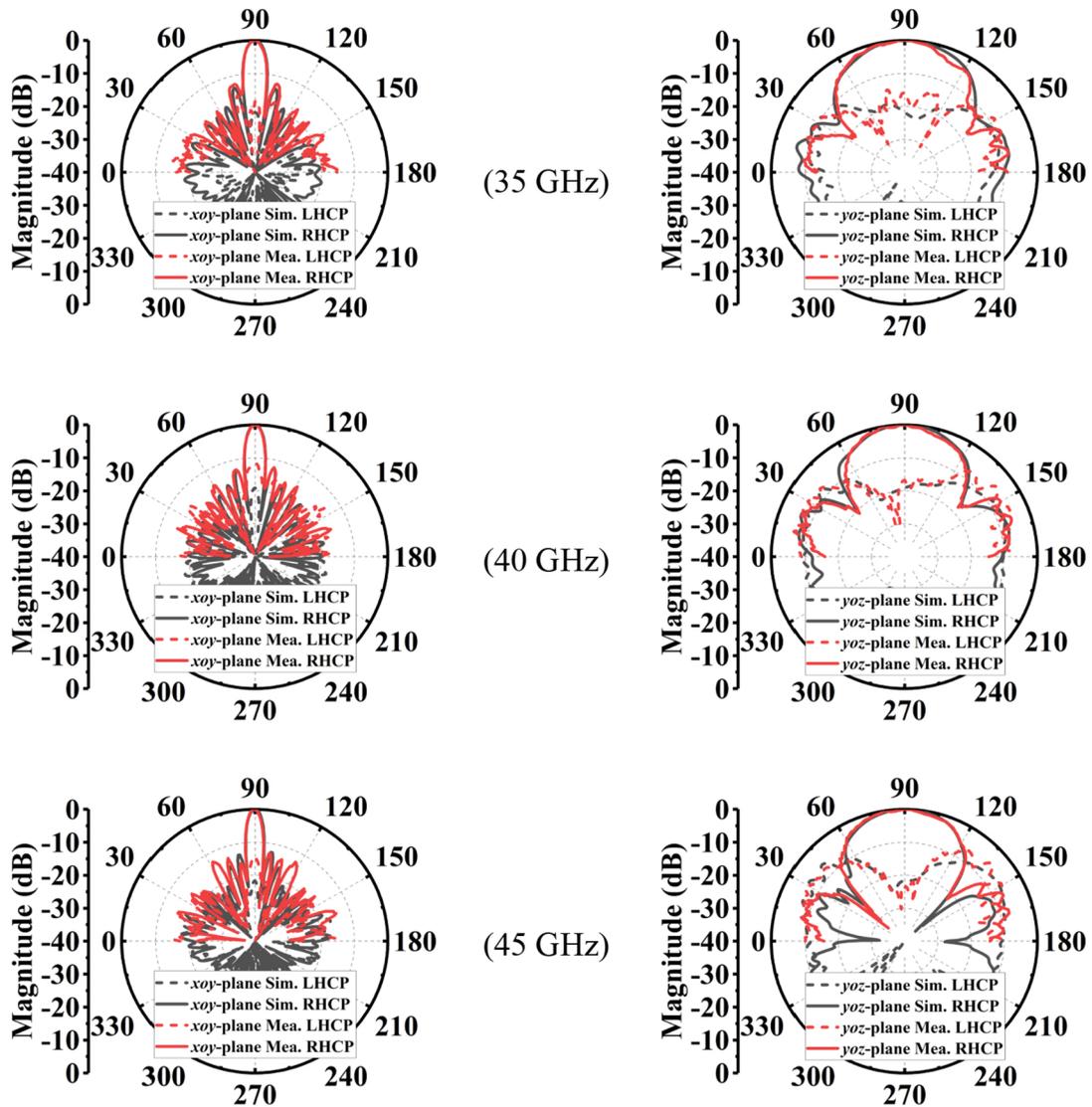


图 1 所提出的 1×8 线性天线阵列在不同频率下的模拟 (Sim.) 和测量 (Mea.) 归一化辐射方向图。

Fig. 1 Simulated (Sim.) and measured (Mea.) normalized radiation patterns of the proposed 1×8 linear antenna array at different frequencies.