

Compact Wide-Angle Circular Polarized Sequential Rotated Quarter Sector Patch Antenna with Notches for Phased Array Applications

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A novel compact wide-angle circular polarized sequential rotated antenna element is proposed at Ku-band and its application in phased array configuration is investigated for beam steering. The proposed antenna exhibits symmetric radiation patterns for the principal as well as diagonal planes. In addition, it provides high front-to-back ratio, low cross polarization, and wide axial ratio beamwidth. Right-hand circular polarization (RHCP) with an axial ratio (AR) less than 3 dB is maintained over the entire upper hemisphere. This antenna is advantageous for communication systems that require wider circularly polarized coverage and gain performance. In addition, it can also be used as the feed for various reflector antennas due to its low cross polarization and symmetric radiation pattern properties, which is part of the future study.

The proposed unit element consists of 2×2 sequentially rotated quarter sector microstrip antennas with fan-shaped notches at the vertices of each sector. The required phase difference of 0° , 90° , 180° and 270° between the sectors is obtained using single series feeding. These fan-shaped notches in addition to the sequential rotation of the sectors provide a wide-angle axial ratio (AR < 3dB) beamwidth. This antenna utilizes 30 mil thick Rogers 6006 substrate with $\epsilon_r = 6.15$ and loss tangent of 0.0019. Higher dielectric constant assists in making the antenna compact and suitable to be used as a radiating element in phased array applications. The radius of each of the quarter sector in the proposed unit element of 2×2 sequentially rotated sectors is $0.18\lambda_0$, where λ_0 is the free space wavelength at 12 GHz. The 3 dB beamwidth of the antenna is around 83° and the radiation pattern is symmetric in all the principal and diagonal planes. The axial ratio (AR < 3 dB) beamwidth is around 170° for all the planes. Thus, the proposed antenna can be suitable for applications which require circular polarization near the horizon.

The proposed sequential rotated sector antenna is then used as a radiating element for 2×2 planar phased array configuration. The inter-element spacing between the elements is selected as $0.6\lambda_0$ at 12 GHz. This allows for beam steering of around $\pm 40^\circ$ without any grating lobes. Additional simulated and measured results on the unit element and the phased array will be presented during the conference.