Wide Angle Beam Steering Cylindrical Parabolic Reflector with Phased Array as a Feed Source for Ku-Band Applications

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A 3D metal printed cylindrical parabolic reflector is investigated at Ku-band for wide angle beam steering using phased array antenna as a feed source. The parabolic cylindrical reflector provides wide beam scanning at low *f*/*D* compared to a conventional parabolic reflector antenna (Y. Rahmat-Samii et al., "Advanced precipitation Radar antenna: array-fed offset membrane cylindrical reflector antenna," in *IEEE Trans. on Antennas and Prop.*, vol. 53, no. 8, pp. 2503-2515, Aug. 2005). In addition to wide beam scanning, the sidelobe level can also be reduced by distinct control of the excitation weights. Also, the cost of the beamforming components is reduced significantly due to reduced RF components. The wide angle beam scanning is achieved in a single plane along the cylindrical axis. The stacked patch antenna array is used to illuminate the reflector and is arranged along the focal line of the cylindrical axis of the reflector.

The cylindrical parabolic reflector surface is generated in MATLAB and analyzed using Ticra GRASP. The maximum dimension of the reflector is 50 cm and is placed in an offset arrangement with *f*/*D* = 0.4. The stacked patch antenna is analyzed in Ansys HFSS to provide wide impedance matching bandwidth, low cross polarization and stable radiation pattern from 12 GHz to 15 GHz. The phased array of size 8 × 4 is used to illuminate the cylindrical parabolic reflector. The peak directivity of the secondary pattern is around 28 dBi and an overall beam scanning of ±35° is achieved along the cylindrical axis of the reflector. The simulated reflector will be 3D metal printed and the effect of finite conductivity, surface roughness and strut effects will also be analyzed.

The phased array feed source is steered using the integrated analog beamforming network (BFN) which will be designed using conventional PCB technique. Beam steering is achieved using Ku-band Anokiwave AWMF-0117 integrated silicon core chips. The chip features half duplex operations with +20 dB transmit channel gain, +28 dB receive channel gain with 3 dB noise figure. 6-bit amplitude and 6-bit phase controls are included with low RMS amplitude and phase errors.

The fabricated BFN board will be assembled with the 3D metal printed cylindrical parabolic reflector and the scan performance will be experimentally verified. Additional simulated and measured results will be presented during the symposium.