

# Optimization of Array Antenna Power Patterns Using Woodward Lawson and Schelkunoff's Polynomial Techniques

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A combination of Woodward Lawson (WL) and Schelkunoff's polynomial methods is employed to optimize cosec<sup>2</sup> type power pattern of a seventy-two element traveling wave array to be realized in a slotted ridge waveguide. Initially the desired power pattern is synthesized assuming uniform far field phase by sampling the pattern in cos  $\theta$  space where  $\theta$  is measured from the waveguide axis. The WL synthesized pattern exhibits ripples between sampled points in  $\theta$  space. The roots of the Schelkunoff's polynomial are determined numerically using the Horner's method, in the angular region of the cosec<sup>2</sup> shaped pattern (see Fig. 1). Each root that is off the unit circle may be moved to its reciprocal radial value with the angular value fixed, thus yielding another aperture distribution for the same power pattern. Thus tens of thousands of aperture distributions are obtained, all yielding the same power pattern. All the aperture distributions were analyzed to select the optimum ones, exhibiting large amplitudes near the feed end (see Fig. 2). The quantity  $(-j\beta nd)$  is subtracted from the aperture phase distributions where  $\beta$  is the phase constant of the propagating mode in the ridge waveguide,  $n$  is the slot number starting from the feed end, and  $d$  is the slot spacing. In addition, a phase term of  $\pi$  radians is accounted for because of the alternating offsets of adjacent slots in the waveguide. The resulting aperture phase distribution of the optimum pattern shown in Fig. 2 exhibits slow spatial variation. Such a phase distribution may be realized using a lens in front of the slot array.

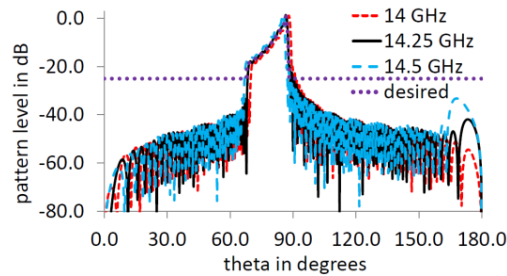


Fig. 1 Cosec<sup>2</sup> power pattern multiplied by the H-plane pattern of a slot

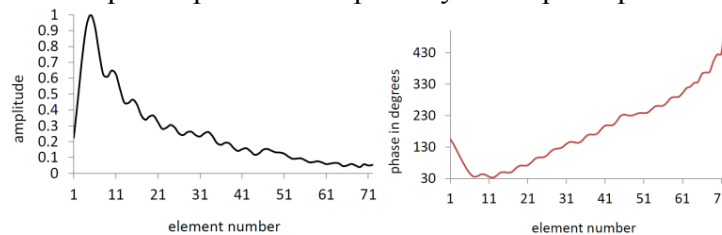


Fig. 2 Amplitude and phase distribution