Phased Array Antenna Handbook

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steering, and the switches are used to truncate the illumination so that only a finite sector of the array is used at any time, a procedure that is required for sidelobe control.

Butler matrices (see Chapter 8) have been used to excite the phase modes of circular arrays directly. As originally proposed by Shelton [36] and developed by Sheleg [25], a matrix-fed circular array with fixed phase shifters can excite current modes around the array, and variable phase shifters can then be used to provide continuous scanning of the radiated beam over 360°. The geometry is shown in Figure 4.8. Another extension of this technique proposed by Skahil and White [37] excites only that part of the circular array that contributes to the formation of the desired radiation pattern. The array is divided into a given number of equal sectors, and each sector is excited by a Butler matrix and phase shifters. With either of these circuits, sidelobe levels can be lowered by weighting the input excitations to the Butler matrix. The technique by Skahil and White was demonstrated by using an 8 × 8 Butler matrix, eight phase shifters, and eight single-pole, four-throw switches to feed four 8-element sectors of a 32-element array. The design sidelobes were –24 dB and measured data showed sidelobes below –22 dB.

Cylindrical sector arrays are excited by currents to focus the far-field distribution for each ring $F_k(\theta, \phi)$ [see (4.8)] to some point (θ_0, ϕ_0). Assuming element patterns with constant far-field phase, one uses

$$I_{nk} = |I_{nk}| e^{-jk[a_k \sin\theta_0 \cos(\phi_0 - n\Delta\phi_k) + z_k \cos\theta_0]} \tag{4.24}$$

This excitation is applied only to the desired illuminated sector, while the other elements of the array are, ideally, terminated in matched loads. In this manner,

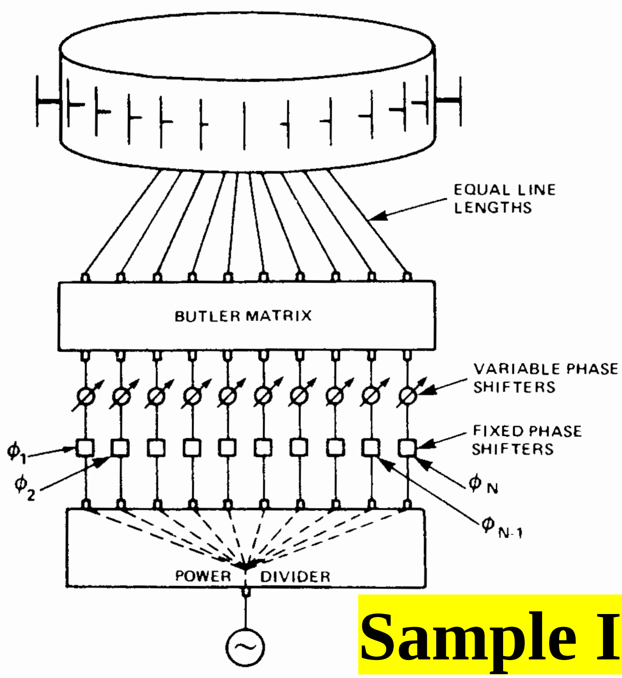

Figure 4.8 Matrix scanning system. (*From:* [25]. © 1968 IEEE. Reprinted with permission.)