Sidelobe Reduction of a Linear Array's Radiation Pattern

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The problem of reducing the sidelobe level of a linear array's pattern has been considered many times with the most well-known methods being the Dolph-Chebyshev method (C.L. Dolph, Proc. IRE, 34, pp. 335-348, June, 1946) and that of Taylor (IRE TRANS, AP-3, pp. 16-28, Jan., 1955). In this paper, we consider the pattern A(u) of an array of 2N+1 elements whose mainlobe width is equal to that of a 2N+3-element array with uniform current amplitudes. Moreover, A(u)'s sidelobes are of equal width between nulls and with amplitudes near the mainlobe which are relatively high but diminish with distance from the mainlobe maximum.

To improve such an array pattern, we initially add two more elements to have an array of 2N+3 elements. From each element, the received signal is divided into two. Then the two sets of outputs are used to form two patterns, A(u) and B(u), and the two patterns are added to form C(u)=A(u)+B(u) as the final output pattern of the array. The pattern B(u), the sidelobe reducing pattern, has a small negative value at u=0 so that C(0) is slightly less than A(0). Moreover, B(u) also has a null at the first null of A(u) so that C(u) has a beamwidth, measured to the first null, also equal to that of A(u). In the sidelobe region, B(u) is made equal to the negative of A(u) at N values of u including the last maximum of A(u) at u=pi. Numerically, in the case of a 9-element original array (N=4), if B(0) = -2, the first sidelobe maximum of A(u) is -3.82, whereas that of C(u)=A(u)+B(u) is -1.93. Moreover, in the far sidelobe region, the reduction is much greater, with A(180°) = -2.84 and the peak of C(u)'s last sidelobe at u=160° is C(160°) = 0.237. Finally, for larger arrays with N much larger than 4, the far sidelobe reduction is extreme.