Sidelobe Suppression of a Uniform Amplitude Linear Array's Pattern

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A linear array of uniform amplitude elements (assumed isotropic) has a narrow beamwidth but relatively high sidelobes (R.S. Elliot, Antenna Theory and Design, 113-122, Prentice-Hall, 1981). Sidelobe reduction is achieved by tapering the amplitudes of the array elements. However, this results in a broadening of the array's mainlobe. The well-known Dolph-Chebyshev array pattern (C.L. Dolph, Proc. IRE, 34, pp.335-338, 1946), with a tapered amplitude distribution, has a pattern with equi-amplitude sidelobes but also has a wider mainlobe, significantly wider when the sidelobe level is very low.

In this presentation, there are two patterns formed. The first, A(u), is that of a uniform amplitude array. We then add two more elements, one at each end of the array, and form a second pattern B(u). This pattern is designed to have its sidelobes equal in magnitude but opposite in sign to those of A(u). Then the two patterns are added to form C(u) = A(u) + B(u). All of the sidelobes of C(u) are very much lower than those of A(u) with nulls at where A(u) has sidelobe maxima. Moreover, B(u) has a first null coincidental with the first null of A(u), thereby producing the first null of C(u) which is unchanged from that of A(u). Furthermore, B(u) can be negative in the mainlobe region of A(u) but can vanish at u = 0, thereby narrowing the mainlobe of C(u) relative to that of A(u). In summary, by creating two patterns A(u) and B(u) and simply forming their sum C(u), we can obtain a pattern which has significantly lower sidelobes than those of A(u) but also has a mainlobe which is narrower and has the same first null. Finally, this method of forming two patterns to be then combined can be used for other cases such as the Dolph-Chebyshev or the Taylor arrays. Moreover, it can also be extended to planar arrays.