A—2—3 Improved Performance in Wideband Phased-Array Pulse Compression Systems

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SYNOPSIS

In recent years many authors have studied the different distortions that arises when a modulated signal is transmitted and received through a phased array. These effects assume significance specially in case of arrays using large bandwidth signals, necessary for high resolution radars. The distortions resulting because of the array dispersion characteristics are function of various system parameters like the type of feed used, array aperture length, signal band-width and the array beam pointing direction. It can easily be shown that in an array if all the other parameters are fixed, then the output signal envelope is a function of the look direction and results in a varying mismatch to a fixed matched filter as the array beam is scanned.

A new appraoch has been investigated to overcome the problem of varying mismatch with array pointing direction. The above objective is achieved by perturbing the phase shifter setting to obtain a fixed desired array output at all the scan angles. The filter is designed to match the desired array output. The phase perturbations, to be introduced in each element, are obtained using an optimization technique. A suitable error function is defined between the actual array output and the desired array output. Fletcher-Powell algorithm for optimization is used to minimize the error function with respect to the perturbation phase shifts.

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Simulation studies carried out on an array with linear FM pulse waveform showed a considerable reduction in signal distortion at the matched filter output. The results so obtained are summarised in illustrations 1 to 4. In Fig.1 is shown the matched filter output for a beam pointing angle of 30^{0} from broadside and the fractional bandwidth of 0.05 for a 49 element array. The amplitude is normalised to the ideal desired output. Fig.2 illustrates the loss in S/N or the mismatch loss at the filter output as a function of θ (i.e. beam pointing angle) and with bandwidth as a parameter. Percentage change in half power pulse width from ideal is shown in Fig.3. against θ and signal bandwidth. In Fig.4 is illustrated the level of first range sidelobe. All the above results are a considerable improvement over the results obtained without any perturbations.

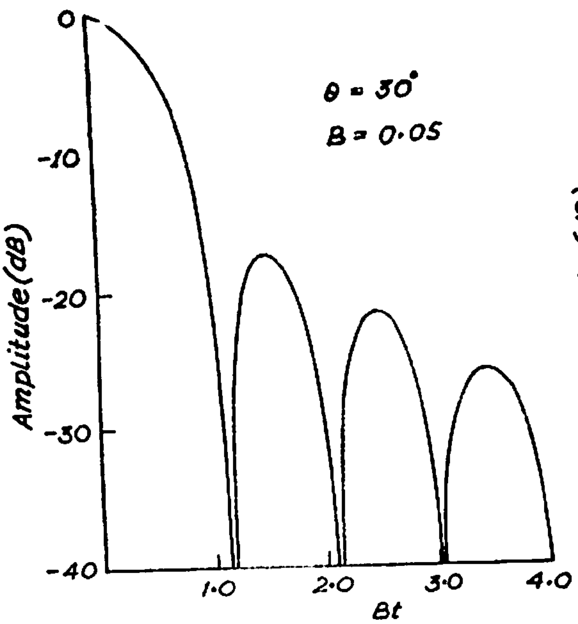

Fig. 1

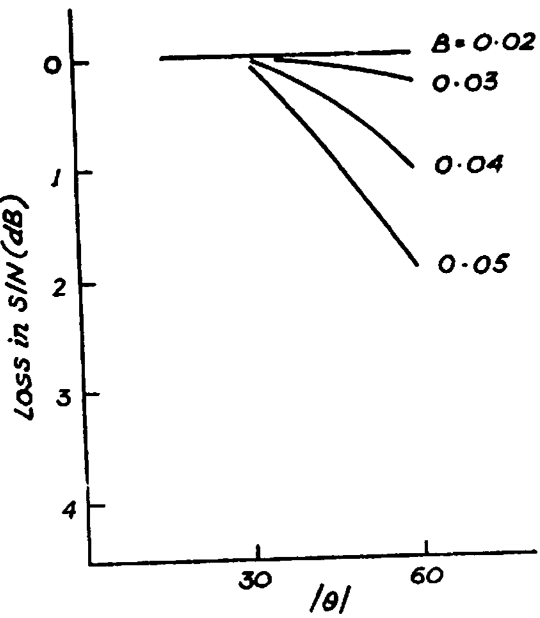

Fig. 2

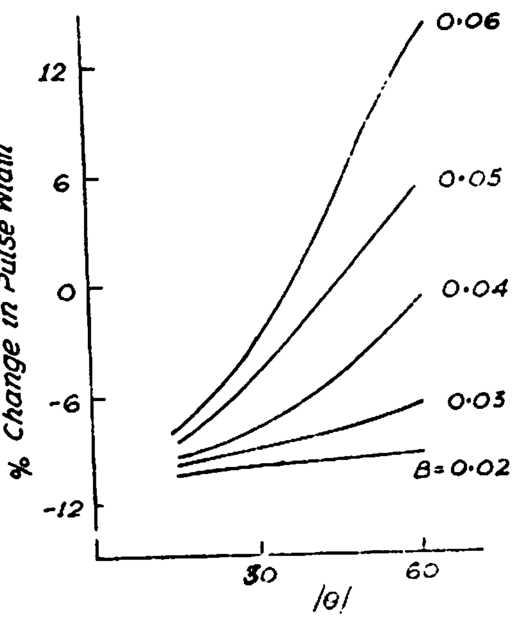

Fig. 3

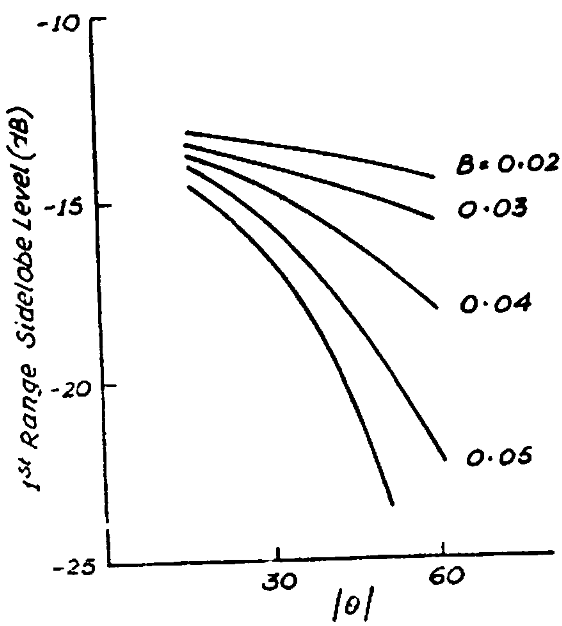

Fig. 4