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Design of Non-Uniform Linear Array via Linear Programming and Particle Swarm Optimization and Studies on Phased Array Calibration

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Abstract

For a linear array, the excitation coefficients of each element and its geometry play an important role, because they will determine the radiation pattern of the given array. Side Lobe Level (SLL) is one of the key parameters to evaluate the radiation pattern of the array. Generally speaking, we desire SLL to be as low as possible. For the linear array with uniform spacing, there are some classic methods to calculate the excitation coefficients to make the radiation pattern satisfy the given requirements. For the linear array with non-uniform spacing, linear programming and particle swarm optimization are proposed to calculate the excitation coefficients to make the array get minimum SLL in this thesis. They are demonstrated for symmetric and asymmetric array in the first part of this thesis. In the second part of this thesis, a simple method is proposed for correcting excitation coefficients of a linear phased array. This proposed method corrects the coefficients through using the Normalized Least Means Squares(NLMS) algorithm, dither signal and a near-field sensor being used for sensing the field emitted by the array. The advantage of this proposed method is that it avoids the problem of estimating the largest eigenvalue of the coefficient matrix to get optimal step size. Its robustness in different environments is demonstrated as well as the effect of noise with various Signal-to-Noise Ratio (SNR), and mutual coupling. In addition, the effect of using discrete dither signal to the array is considered, because the continuous dither signal cannot be generated in practice.

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