Active Element Patterns for Large Arrays

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In this study a new approach to active element pattern analysis, for large phased array antennas, was created using Floquet's theorem. The classic approach to finding active element patterns uses a full array simulation that can become slow and produce patterns that are specific to certain elements in the array, though basically identical away from the array edge. For large arrays, classic approaches tax the computational process and use excessive time for the computation. Instead of producing specific active element patterns an average active element pattern could be created and then applied that to the array.

The average active element pattern can be used for every element in the array with a small margin of error for large arrays. Computing far-field patterns for a large array is very time consuming and can have some irregularities due to the edge effects of the array. Using Floquet's theorem reduces any differences between elements in the array and gives the most accurate active element pattern within a reasonable time constraint. Floquet average active element patterns are computed by using an infinite array and a summation is done for the far-field radiation values of a finite array based on the number of elements using typical pattern multiplication techniques. Therefore, accuracy of the Floquet element approach is excellent for arrays on the size of hundreds to thousands of elements.

An active element pattern is determined by scanning the array and taking the far-field radiation value at each beam scan angle. Each beam scan angle value is a summation of the element radiation patterns in that specific direction. These beam scan angle values are then reduced by the number of elements in the array to form a radiation pattern. This radiation pattern is the average active element pattern.

This process should also be applicable to a physical phased array, allowing an array to be tested in the field while in use instead of having to be sent to a lab for testing. The active element pattern may also be used directly with pattern multiplication to evaluate arrays with both uniform and tapered array feeds.