An Efficient Spectral Domain Method of Moments for Reflectarray Antennas using a Customized Impedance Matrix Interpolation Scheme

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The acceleration method to be presented is a novel interpolation of the impedance matrix elements over *patch size* thereby reducing the number of moment method runs needed in the parameter sweep used to generate the design curves. In the Reflectarray antenna design process, the spherical angles in the plane of incidence, formed by the unit normal vector of the *ith* patch and the incident $\vec{k}$ vector emanating from the feed phase center to the *ith* patch centroid, are unique to each and every element of the Reflectarray. Thus, each and every element demands a unique design curve. For electrically large Reflectarray antennas, say on the order of thousands of elements, this would be a tremendous undertaking using the popular commercially available tools such as HFSS or CST MWS. Even with an in-house developed code based upon the standard SDMoM algorithm, this would still require many hours and possibly days. Also, if one were given a set of requirements that must be met simultaneously, an often popular approach would be to choose global optimizers such as PSO or GA, and if the evaluation of the cost function took hours or days for each evaluation, then this strategy would be unfeasible. There exists, therefore, a strong desire to accelerate the standard SDMoM algorithm to an extremely rapid pace, on the order of seconds to minutes in lieu of hours to days. This is possible using the *Z-matrix Interpolation* scheme as presented in this talk.

Since, in the SDMoM Approach, the real and imaginary parts of the Z-Matrix elements show smooth variation, namely quadratic at best, they are easily interpolated with as few as three data points taken, rather than the 100 or so data points typically taken. In conjunction, when a highly efficient choice of basis functions employing built-in edge conditions are chosen, the Impedance Matrix consists of only a few elements. Thus, the juxtaposition of the interpolation scheme with an efficient set of basis functions has been shown to provide at least 100 times gain in efficiency or run-time improvements over that of the standard SDMoM algorithm.

This talk will provide a quick overview of the original SDMoM algorithm, followed by results generated by an in-house code showing the computed reflection dyadic results for various cases utilizing the original algorithm and the algorithm incorporating the interpolation scheme, both when a few sets of bases are chosen to illustrate the best bases to be used with the interpolation scheme. These results will be compared to results taken from the commercial tool CST MWS for an error analysis.