Genetic Algorithm Radiation Pattern Optimization of Microstrip Patch Antenna Arrays Conformal to the Surfaces of Circular Cylinders

R. J. Allard* and D. H. Werner
Applied Research Laboratory
The Pennsylvania State University
P.O. Box 30
State College, PA 16804
rja5@psu.edu and dhw@psu.edu

A Genetic Algorithm (GA) radiation pattern synthesis technique for linear arrays of microstrip antenna elements mounted axially along a PEC circular cylinder was recently introduced in (R.J. Allard, D.H. Werner, and P.L. Werner, *2001 IEEE Antennas and Propagation Society International Symposium,* **2**, 366 - 369, 2001). An extension of this GA radiation pattern synthesis procedure is presented here that is capable of evolving the optimal set of excitation magnitudes and/or phases for the elements of one- or two-dimensional microstrip patch antenna arrays conformal to the surfaces of dielectric-coated PEC circular cylinders. The goals of the optimization include the ability to achieve a desired beam-steering capability as well as to meet specified beamwidth and sidelobe level requirements. A variety of optimization schemes will be considered, including those based on synthesizing an ideal cosine pattern, a Gaussian pattern, or a sector pattern. It will also be shown that a point-by-point weighting function may be defined over critical regions of the radiation pattern in order to improve the convergence properties of the GA. The total fitness of a GA population member in this case is defined to be the combined squared difference between the desired array patterns and the actual array patterns.

This paper presents examples of optimizations performed using this GA procedure for several different one- and two-dimensional conformal microstrip antenna arrays mounted on dielectric-coated PEC circular cylinders. The advantages and disadvantages of using each of the available objective functions for the synthesis of specific classes of radiation patterns are investigated, as well as the possible benefits of optimization scenarios for arrays that employ magnitude-only, phase-only, or both magnitude and phase excitation. In addition to this, an efficient algorithm for use in conjunction with GA optimization procedures will be presented for calculating the gain associated with cylindrically-mounted arrays of arbitrarily shaped microstrip antennas. This algorithm is based on the domain-decomposition/reciprocity technique previously presented in (R.J. Allard, D.H. Werner, and J.S. Zmyslo, *2000 IEEE Antennas and Propagation Society International Symposium,* **1**, 2 – 5, 2000). Some examples where the gain characteristics of cylindrically mounted microstrip antenna arrays are optimized directly will also be presented and discussed.