Resume of "Genetic Algorithm Optimization Applied to Electromagnetics: A Review"

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The objective of the paper it is introduce the Genetic Algorithm (GA), showing the main characteristics of it, and giving an explanation of its most common operators. Following this, it is given examples of the GA in electromagnetic applications. Finally, it is briefly commented about the advanced operators that were used in some applications.

1. In the first section it is introduced the GA. It is commented about non linear problems in electromagnetic that used to be solving by deterministic optimization methods. Easy to implement GA in non differentiable functions and discrete search space and its motivation in Darwin's theory.

2. In section two is described how works the GA and its operators. It is presented the concept of genes and chromosome that make up a population and the operators of selection, crossover and mutation. Schemata. Its given some implementations guidelines.

   - Population size proportional to the chromosome length should suffice;
   - GA's work best if the optimal solution is a member of schemata which have few defined bits that are packed tightly together, and the involved schema have a low- standard deviation;
   - For binary-coded GA's, the crossover and mutation rates most often quoted in the literature are $0.6 < p_{cross} < 0.9$ and $0.001 < p_{mut} < 0.01$;
   - Problems with real design parameters are often (but not always) better handled by real-coded GA's;
   - Binary tournament selection generally works faster than roulette-wheel selection, and it avoids convergence troubles;
   - When the GA stagnates, raising the mutation rate often yields useful information;
   - Many difficult problems will succumb to GA optimization after the inclusion of an advanced operator.

3. Section three is for given examples of application of GA in electromagnetic.

   - Genetic Algorithm Antenna Design. This is the most studied application of GA's in electromagnetics. For instance,an array built with ten 3-b phase shifters can be encoded into a chromosome of 30-b, composed of a concatenation of ten 3-b phase shifter settings. But the most interesting cases is which the GA itself suggests the wire antenna design;
   - Design of layered Electromagnetic Devices. Design of multilayered optical filters (minimizing the difference between the observed and desired filter characteristic), absorbers consisting of a perfect electric conductor(PEC) (minimize reflection of impinging waves) and frequency selective surfaces (FSS's) (similar to the multilayered optical filters, but the chromosome used is different).
   - Applications of genetic Algorithms in Statics. This application it is about the shape of magnetic pole pieces or insulator, in order to produce a desired distribution of the field in the space (chromosomes is the location of points in the space and objective function is some norm of the vector difference between the fields produced and desired at point).
   - Miscellaneous Applications of Genetic Algorithms to Electromagnetics. Some other examples are given in which GA is used to be applied, such as the design of wireless communication networks, lenses, waveguide junctions, dielectric gratings, and RF coils.

4. In section four it is presented examples using the Advanced GA Operators. It said that in the section three a basic patter of GA is used with little or no deviation and for problems of increasing complexity, the GA needs to be augmented to optimize faster or more globally, using advanced GA techniques such as dominance and diploidy, community structure, sharing, or knowledge-based operators.

5. REFERENCE:
D. S. Weile and E. Michielssen, "Genetic algorithm optimization applied to electromagnetics: a review," in IEEE Transactions on Antennas and Propagation, vol. 45, no. 3, pp. 343-353, March 1997, doi: 10.1109/8.558650.