A Study of Firefly Algorithm, Ant Colony Optimization, and Artificial Bee Colony Algorithm

Utsav Poudel* and Sembiam R. Rengarajan
Department of Electrical and Computer Engineering
California State University, Northridge, CA 91330-8346
utsav.poudel.584@my.csun.edu, srengarajan@csun.edu

Genetic algorithms and particle swarm optimization have been employed in numerous electromagnetics and antenna applications. There is a whole host of nature inspired algorithms presented in the literature. We investigated three such techniques and made some comparisons to genetic algorithms and particle swarm optimization methods. Firefly Algorithm (FA) mimics the flashing pattern of fireflies (R. Kalyana and S. N. Aruna, Int. Conf. Wireless Communications, Signal Processing and Networking, 2017) while the Ant Colony Optimization (ACO) is based on ants using pheromone as a chemical messenger (O. Quevedo-Teruel and E. Rajo-Iglesias, IEEE Antennas Wireless Propagt. Lett., 5, 349-352, 2006). Artificial Bee Colony (ABC) optimization simulates the foraging behavior of honey bees (X. Zhang et al., IEEE Trans. Magnetics, 49, pp. 4811-4816, 2013).

The three algorithms were tested using standard mathematical functions such as Rosenbrock function, Ackley function, Sphere function, Branin function, and Goldstein-Price function. It is found that ACO and ABC outperform the FA. Subsequently we tested the three algorithms for the case of an array pattern synthesis for a radiometer application. Previously a genetic algorithm (GA) was used to synthesize the pattern of this planar array consisting of 64 elements with quadrantile symmetry (S. R. Rengarajan, IEEE Antennas and Propagation Society International Symposium, Charleston, SC, 2009). All three methods converged to produce the desired power pattern. ACO was found to be four times faster than GA while FA was 1.5 times faster than GA. ABC was about 1.6 times slower than GA. Additional examples will be presented in the conference.