Biogeography-Based Optimization of a Microstrip Filter

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Biogeography-Based Optimization (BBO) is a recently introduced evolutionary algorithm based on the science of biogeography (Dan Simon, "Biogeography-Based Optimization", *IEEE Trans. Evol.Comput.*, vol.12, no.6, pp.702-713, Dec. 2008). Biogeography is the study of the geographical distribution of biological organisms.

BBO shares some features with other evolutionary optimization methods, such as Genetic Algorithms (GAs) and Particle Swarm Optimization (PSO). This makes BBO applicable to many of the problems that could also be solved with GA and PSO, namely, high-dimension problems with multiple local optima. However, BBO also has some features that are unique among biology-based optimization methods. In fact, in BBO the problem possible solutions are identified as islands or habitats, and its operators are based on the concept of migration, to share information between the problem solutions. In particular, BBO introduces four new parameters:

- suitability index variable (SIV) represents a variable that characterize habitability in an island, i.e. in a solution,
- habitat suitability index (HSI), represents the goodness of the solution, similarly to the fitness score concept in GA,
- emigration rate (μ) indicates how likely a solution is to share its features with other solutions,
- immigration rate (λ) indicates how likely a solution is to accept features from other solutions;

A high performing solution has a high emigration rate and low immigration rate, while a low performing habitat has a low emigration rate and high immigration rate. In fact, the maximum possible immigration rate occurs when there are zero species in the habitat. As the island HSI increases, the number of species grows, the habitat becomes more crowded, and more species are able to leave the island to explore other possible habitats, thus increasing the emigration rate.

To confirm the capabilities of BBO in dealing with EM problems, and to compare its features with those of other more consolidated evolutionary algorithms here it is applied to the design of a microstrip band-pass filter, consisting in a sequence of different width, $\lambda_g/2$ sections of line, The cost function takes into account the bandwidth, the absolute value of the transmission coefficient $|S_{21}|$ in the rejection band and the ripple in the pass band.