A New Heuristic for Global Optimization

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Global optimization attracts attention from researchers in different disciplines, because many real life problems in areas such as physics, chemistry and molecular biology, involve nonlinear functions of many variables with attributes (multimodality, discontinuity, etc.) that are difficult to handle by conventional mathematical tools. Classical gradient-based algorithms such as the Quasi-Newton method, modified steepest descent algorithm, or conjugate gradient method may be trapped by local optima when the feasible region around the global optimum is not well-conditioned. To overcome the difficulties described above, probabilistic search methods which rely heavily on computer power have been developed since the 1980s. This paper proposes a new heuristic algorithm that can be used in stochastic global optimization. The proposed algorithm simulates the electromagnetism theory of physics by considering each sampled point as an electrical charge. Like most stochastic algorithms, it starts with sampling random points from the feasible region. Analogous to electromagnetism, we can think each sampled point as a charged particle that is released to the space. The charge of each point relates to the objective function value which we are trying to optimize. This charge determines the magnitude of attraction of the point over sample population. The better the objective function value the higher the magnitude of attraction. Our approach follows this analogy for solving global optimization problems. High attraction of valleys will encourage points to converge to the global or local minimizers. The attraction of certain regions will be emphasized by the particles visiting the neighborhood of that region. The regions that have higher attraction will signal other points to move towards them. In other words, highly charged points indicate a local optimum region for other points. In addition, a repulsion mechanism is introduced to explore new regions for even better solutions. Some test results on nonlinear functions in the category of ”minor to moderate difficulty” are included. The ease of implementation and the flexibility of this heuristic show the great potential of the new algorithm.

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