Theoretical and Practical Convergence of a Self-Adaptive Penalty Firefly Algorithm for Constrained Global Optimization

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In this paper, we propose a self-adaptive penalty function and present a penalty-based algorithm for solving constrained global optimization problems. We prove that the general constrained optimization problem is equivalent to a bound constrained problem in the sense that they have the same global solutions. Some properties regarding the convergence of the penalty-based algorithm are established. The global minimizer of the penalty function, subject to a set of bound constraints, is obtained by the firefly algorithm (FA), a swarm intelligence method inspired by the social behavior of fireflies and based on their flashing and attraction characteristics. The FA is hybridized with a local direct search procedure aiming to enhance the quality of the obtained solutions. Numerical experiments using a set of benchmark global optimization problems are carried out to analyze the performance of the proposed algorithm. A comparison with other penalty-based approaches shows that the algorithm is effective in reaching the global solutions.