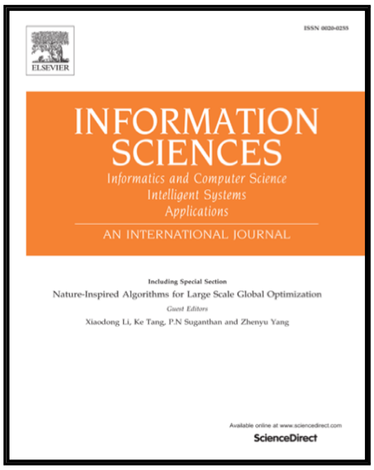

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Adaptive differential evolution with a Lagrange interpolation argument algorithm

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Abstract

Differential evolution (DE) is a simple yet powerful evolutionary algorithm that has been used to solve various complex optimization problems in numerous engineering fields. However, DE has some problems, such as premature convergence and sensitivity to parameter settings. To improve the performance of DE and extend its application, an adaptive differential evolution with the Lagrange interpolation argument algorithm (ADELI) is proposed in this paper. To accelerate the convergence speed of DE, a local search with Lagrange interpolation (LSLI) is introduced into DE. LSLI performs a local search in the neighborhood of the best individual in the current generation to enhance the exploitation capability of DE. Meanwhile, an adaptive argument strategy is presented to adaptively determine whether to use LSLI in terms of its performance in the previous generation, which can balance the global exploration capability and the local exploitation capability of ADELI. To verify the feasibility and effectiveness of ADELI, 30 test functions in the CEC 2014 benchmark sets with different dimensions were simulated. Moreover, a path synthesis problem was also optimized. The results demonstrated that ADELI considerably outperforms other EAs in most functions and obtains the most accurate solution among the compared algorithms in the application of path generation.

Key words: Differential evolution, Evolutionary algorithms, Lagrange interpolation, Local search, Mechanism synthesis.

1. Introduction

Recently, evolutionary algorithms (EAs) have been widely applied to solve optimization problems in various fields such as engineering and science. In contrast to conventional methods based on mathematical programming or formal logics, EAs are found to be more powerful and flexible [43]. However, current EAs may have problems such as the computation becoming trapped in local optima and a slow convergence speed in solving complex optimization problems, such as nonlinear and nondifferentiable problems [47]. There is a need to develop more effective and efficient EAs. To discourage premature convergence and improve the performance of EAs, increasingly more researchers have been devoted to modifying existing EAs or to developing new EAs based on swarm intelligence and genetic evolution.

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