Abstract

Developing efficient evolutionary algorithms attracts many researchers due to the fact that numerous real-world applications can be stated as optimization problems. Hence, many evolutionary algorithms were successfully developed to handle the challenges in solving optimization problems with complex landscapes. Differential evolution is one of the efficient and powerful evolutionary algorithms for solving complex optimization problems with diverse characteristics. In this research, we study differential evolution variants that can be successfully applied to solve numerical optimization problems, and develop new efficient differential evolution algorithms. The main objective is to develop new improved differential evolution algorithms which are able to solve challenging optimization problems efficiently when compared to other existing state-of-the-art algorithms. We develop new improved differential evolution algorithms by introducing new ideas such as: hybridizations that combine the strengths of different canonical algorithms, proposed new ensemble control parameter settings and an improved crossover strategy that is used to build a suitable coordinate system during the search. To validate the performance of the developed algorithms, different challenging test suites from the recently developed IEEE-CEC benchmarks were used. Those benchmarks are among the widely used benchmarks which have attracted many researchers to use for testing their developed algorithms. Each of them constitutes problems that are tested on different dimensionalities with a various set of problem features and characteristics, including ruggedness, noise in fitness, multimodality, ill-conditioning, interdependence and non-separability. Moreover, a variety of real-world optimization problems taken from diverse fields are used as well. The results statistically affirm the efficiency of the proposed approaches to obtain better results compared to state-of-the-art algorithms from the literature.

List of publications:

1. Noor H. Awad, Mostafa Z. Ali, Rammohan Mallipeddi, Ponnuthurai N. Suganthan, An Improved Differential Evolution Algorithm using Efficient Adapted Surrogate Model for Numerical Optimization. Inf. Sci, vols. 451–452, pp. 326-347, 2018.
2. Noor H. Awad, Mostafa Z. Ali, Ponnuthurai N. Suganthan, Ensemble of parameters in a sinusoidal differential evolution with niching-based population reduction, Swarm and Evolutionary Computation, vol. 39, pp. 141-156, 2017.
3. Noor H. Awad, Mostafa Z. Ali, Ponnuthurai N. Suganthan, Edward Jaser, A decremental stochastic fractal differential evolution for global numerical optimization, Inf. Sci., vol. 372, pp. 470-491, 2016.
4. Noor H. Awad, Mostafa Z. Ali, Ponnuthurai N. Suganthan, Ensemble sinusoidal differential covariance matrix adaptation with Euclidean neighborhood for solving CEC2017 benchmark problems, in Proc. IEEE Congr. Evol. Comput., CEC 2017, pp. 372-379.
5. Noor H. Awad, Mostafa Z. Ali, Ponnuthurai N. Suganthan, Robert G. Reynolds, Ali M. Shatnawi, A novel differential crossover strategy based on covariance matrix learning with Euclidean neighborhood for solving real-world problems, in Proc. IEEE Congr. Evol. Comput., CEC 2017, pp. 380-386
6. Noor H. Awad, Mostafa Z. Ali, Ponnuthurai N. Suganthan, Robert G. Reynolds, An ensemble sinusoidal parameter adaptation incorporated with L-SHADE for solving CEC2014 benchmark problems, in Proc. IEEE Congr. Evol. Comput., CEC 2016, pp. 2958-2965.
7. Noor H. Awad, Mostafa Z. Ali, Ponnuthurai N. Suganthan, Edward Jaser, Differential evolution with stochastic fractal search algorithm for global numerical optimization, in Proc. IEEE Congr. Evol. Comput., CEC 2016, pp. 3154-3161.