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# Revisiting the performance of evolutionary algorithms

Tejas M. Vala[a,*,1], Vipul N. Rajput[b,2], Zong Woo Geem[c,3], Kartik S. Pandya[d,4], Santosh C. Vora[e,5]

[a] Department of Electrical Engineering, Gujarat Technological University, Ahmedabad 382424, Gujarat, India
[b] Department of Electrical Engineering, Dr. Jivraj Mehta Institute of Technology, Anand 388340, Gujarat, India
[c] Department of Energy IT, Gachon University, Seongnam 13120, South Korea
[d] Department of Electrical Engineering, Charotar University of Science and Technology, Changa-388421, Gujarat, India
[e] Department of Electrical Engineering, Institute of Technology, Nirma University, Ahmedabad 382481, Gujarat, India

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ABSTRACT

The advent of numerical computational approaches permits evolutionary algorithms (EAs) to solve complex, real-world engineering problems. The additional modification or hybridization of such EAs in academic research and application demonstrates improved performance for domain-specific challenges. However, developing a new algorithm or comparison and selection of existing EAs for challenges in the field of optimization is relatively unexplored. The performance of different well-established algorithms is, therefore, investigated in this work. The selection of algorithms using nonparametric tests encompasses different categories to include- Genetic Algorithm, Particle Swarm Optimization, Harmony Search Algorithm, Cuckoo Search Algorithm, Bat Algorithm, Firefly algorithm, Differential Evolution, and Artificial Bee Colony. These algorithms are applied to solve test functions, including unconstrained, constrained, industry specific problems, CEC 2011 real world optimization problems and selected CEC 2013 benchmark test functions. The three distinct performance metrics, namely, efficiency, reliability, and quality of solution derived using the quantitative attributes are provided to evaluate the performance of the employed EAs. The categorical assignment of performance attributes helps to compare different algorithms for a specific optimization problem while the performance metrics are useful to provide the common platform for new or hybrid EA development.

## 1. Introduction

The EAs have appeared over the last few decades as a powerful tool for finding optimal solutions to complex engineering optimization problems (EOPs) (Chen, Xu, Wang, & Zhao, 2019; Kuk et al., 2020; Rajput, Adelnia, & Pandya, 2018; Zhou et al., 2019). Number of EAs such as genetic algorithm (John, 1992), cuckoo search algorithm (Yang & Deb, 2009), particle swarm optimization algorithm (Eberhart and Kennedy, 1995), harmony search algorithm (Lee & Geem, 2004), bat algorithm (Yang, 2010b), firefly algorithm (Yang, 2010a), differential evolution (Storn & Price, 1997) and artificial bee colony (Akay & Karaboga, 2012; Karaboga & Basturk, 2007), and many more have been widely used to obtain optimal designs and overcome the computational limitations of traditional optimization methods. The advantages of handling highly complex problem structures, random sampling, broad applicability, relatively much less time, and parallelism motivates the use of EAs (Abdel-Basset, Abdel-Fatah, & Sangaiah, 2018; Gogna & Tayal, 2013).

Exploration and exploitation serve as a core to obtain the solution for these EAs. The robust exploration covers the entire search space mostly through the random generation of individuals. But if randomization is persisting longer, till stopping criteria of the algorithm, it may explore stochastically too many locations. There are some individuals in the population which, by incorporating exploitation, can provide the best

* Corresponding author.
*E-mail address:* valatejasre@gmail.com (T.M. Vala).
1 https://orcid.org/0000-0002-1801-2654.
2 https://orcid.org/0000-0001-6016-534X.
3 https://orcid.org/0000-0002-0370-5562.
4 https://orcid.org/0000-0002-0155-000X.
5 https://orcid.org/0000-0002-4017-0843.

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