Chapter 10
An Advanced Hybrid Algorithm (haDEPSO) for Engineering Design Optimization Integrating Novel Strategies for Enhanced Performance

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ABSTRACT

This research presents haDEPSO, a pioneering hybrid technique for engineering design optimization. Combining the strengths of Differential Evolution (DE) and Particle Swarm Optimization (PSO), haDEPSO offers a versatile answer to the difficulties of contemporary optimization settings. The methodology combines a precise integration of DE's robust exploration capabilities with PSO's efficient exploitation

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tactics, ensuring adaptability across diverse problem environments. Through 10 trials, performance measures such as fitness function value, convergence speed, and diversity meter reveal haDEPSO's consistent optimization power. Scalability testing reveals the algorithm's effectiveness in addressing situations of varying sizes, yet challenges occur in particularly massive instances. These findings contribute to a deep knowledge of haDEPSO's strengths and restrictions, driving subsequent advancements for better applicability in engineering design optimization.

INTRODUCTION

Engineering design optimization plays a key role in enhancing the efficiency, dependability, and performance of engineered systems across several disciplines (Mehta et al., 2023). The pursuit of optimal solutions in engineering design is frequently delayed by the complexity and multidimensionality of the problems involved (Sukumaran et al., 2023). As sectors strive for innovation and cost-effectiveness, the demand for advanced optimization algorithms has skyrocketed (Kiruba Sandou et al., 2023). This introduction gives a detailed overview of the environment of engineering design optimization, discusses existing difficulties, and highlights the requirement for sophisticated optimization methodologies (Natrayan & Richard, 2023b). It also gives the proposed hybrid algorithm, haDEPSO, as a viable solution to overcome these limitations (Lakshmaiya & Murugan, 2023a). In the realm of engineering design, optimization is a vital process aimed at discovering the ideal collection of parameters or design variables that satisfy given constraints and objectives (Natrayan, 2023). This includes going through a vast solution space to identify optimal solutions that fulfill performance requirements while considering multiple design limits (Velumayil et al., 2023). The complexity of modern engineering problems, marked by non-linearity, high dimensionality, and the existence of several objectives, necessitates the development of new optimization methodologies (Chinta et al., 2023). Traditional optimization approaches generally struggle to cope with the intricacies inherent in these scenarios, necessitating the exploration of innovative and hybrid algorithms to give more effective solutions (Chehelgerdi et al., 2023). The statement of the problem focuses around the limits of contemporary optimization approaches in confronting the complexities of modern engineering design. Conventional algorithms, such as genetic algorithms, particle swarm optimization, and differential evolution, demonstrate strengths in particular situations but may falter when faced with high-dimensional and non-linear optimization problems (Lakshmaiya, 2023b). Additionally, the presence of several conflicting objectives adds another layer of complexity that necessitates specific algorithms capable of addressing such challenges (Saadh et al., 2023). As industries evolve and engineering

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Harish Garg (2016). *Handbook of Research on Modern Optimization Algorithms and Applications in Engineering and Economics (pp. 643-675).*

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