Novel Multi-Swarm Approach for Balancing Exploration and Exploitation in Particle Swarm Optimization

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Abstract. Several metaheuristic algorithms and improvements to the existing ones have been presented over the years. Most of these algorithms were inspired either by nature or the behavior of certain swarms, such as birds, ants, bees, or even bats. These algorithms have two major components, which are exploration and exploitation. The interaction of these components can have a significant influence on the efficiency of the metaheuristics. Meanwhile, there are basically no guiding principles on how to strike a balance between these two components. This study, therefore, proposes a new multi-swarm-based balancing mechanism for keeping a balancing between the exploration and exploitation attributes of metaheuristics. The new approach is inspired by the phenomenon of the leadership scenario among a group of people (a group of people being governed by a selected leader(s)). These leaders communicate in a meeting room, and the overall best leader makes the final decision. The simulation aspect of the study considered several benchmark functions and compared the performance of the suggested algorithm to that of the standard PSO (SPSO) in terms of efficiency.

Keywords. Swarm Intelligence, Exploration, Exploitation, Metaheuristics, Optimization, Computational Intelligence.

1 Introduction

Over the past 2 decades, nature-inspired metaheuristics have attracted much attention due to their efficiency in establishing accurate solutions to complex industrial and engineering problems, especially the NP-complete problems. Most nature inspired metaheuristics are classified as stochastic techniques. These stochastic algorithms randomly pick a set of solutions and improve them based on the algorithmic mechanism. The solutions are