Chapter 6
Nature-Inspired Optimized Artificial Bee Colony for Decision Making in Energy-Efficient Wireless Sensor Networks

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ABSTRACT

In recent times, there has been a surge in the popularity of nature-inspired algorithms (NIAs) for addressing challenging and complex nonlinear difficult problems. Wireless sensor networks (WSNs) provide a wide range of concerns and challenges that must be addressed when formulating methodologies and algorithms aimed at conserving energy and enhancing the overall lifespan of the network. This chapter examines and analyzes optimization-based energy-efficient strategies for clustering and routing using optimization algorithms. The major challenges in WSNs are to provide low energy consumption, enhancing network lifetime, minimizing interference in communication, improving data rate, balancing network load and quality network functioning, etc. The chapter improves the quality of service of the network by lengthening network lifetime for more packet transmission. The proposed optimized artificial bee colony (OABC) outperformed in comparison to the existing algorithms in terms of less packet loss, higher network lifetime, minimum energy consumption, and lesser average execution time.

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INTRODUCTION

The significance of optimization in addressing numerous engineering problems is essential in recent situations. In an overview, optimization techniques may be used to minimize a specific function while considering a range of both equal and unequal constraints. Generally, these functions exhibit a nonlinear and offer significant difficulties in terms of finding solutions. There is an extensive variety of algorithms, including several types like linear, quadratic, convex, conjugate, inner point, trust area, numerous, etc. These algorithms have the competence to successfully report difficult iterative challenges, ranging from traditional techniques to evolutionary approaches and nature-inspired meta-heuristic methods. In current times, there has been a recent increase in the popularity of nature-inspired algorithms (NIAs) for solving interesting and complex nonlinear problems. This may be due to their obvious features, such as flexibility, improved efficiency, and openness. The algorithms mainly trust on swarm intelligence, which pursues to duplicate the miscellaneous characteristic realized in nature. Although the research on optimization is extensive, there is a substantial deviation between hypothetical and experiential characteristics.

The practical use of nature-inspired algorithms has shown to be effective in solving a wider range of real-world challenges. While conventional algorithms demonstrate strong performance in executing many tasks and solving a broad range of issues, comprehending their precise mechanisms may be somewhat challenging (Liu, 2019). It is necessary to possess a comprehensive understanding of multi-disciplinary numerical, mathematical, dynamic system investigation, as well as proficiency in computational complexity analysis and the associated tools. This task creates a significant challenge. In contrast, nature-inspired algorithms primarily concentrate on the examination of the fundamental attributes of the methodology, its constituent parts, search patterns, and approaches used to get optimal solutions. Usually, NIAs are characterized by initial steps, search characteristics and dynamics of algorithm. All algorithms use population size or numerous search agents, such as ants, bees, bats, swarms, and so on. Every search agent establishes communication with a designated key vector and typically has a fitness goal that represents the best-known optimal solution. The presence of several solutions within a population size contributes to the variety seen, as well as the existence of distinct fitness goals.

There are various algorithms that exhibit significant differences in terms of their random size and distinct behavior when applied to local and global search scenarios. The process of selecting optimal solutions is often conducted using a “fit to survive” approach, which aims to maintain a population of the most beneficial individuals for the purpose of encouraging the whole population to converge into an integrated and well-structured unit, while minimizing variability (Mood, 2019). WSNs provide a wide range of concerns and challenges that must be addressed when formulating methodologies and algorithms aimed at conserving energy and enhancing the overall lifespan of the network. Network optimization performs a dynamic part in the area of WSN, subsequently it includes the use of optimization methods to get a perfect solution for this specific problem. The variety of a suitable algorithm is of utmost importance in any optimization method, given the reality of numerous optimization algorithms intended to concentrate various tasks (Oren, 2017).

Optimization denotes to the organized method used to obtain the optimal result within a specific set of conditions. The term “optimum” is frequently recognized to denote to either the highest or minimal value, varying the particular situations. When generating a WSN, it is important to focus the issues associated to energy efficiency, cost, and application necessities. Attaining effectiveness in WSNs contains the optimization of both hardware and software mechanisms. There is a diversity of optimization methods that are intended to focus several issues areas. The selection of a suitable algorithm has

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