Chapter 5
Swarm Intelligence in Solving Bio-Inspired Computing Problems: Reviews, Perspectives, and Challenges

Debi Prasanna Acharjya
VIT University, India

Ahmed P. Kauser
VIT University, India

ABSTRACT

Currently, a huge amount of data is available across various domains including biological data. Classification of these data, clustering, and data analysis is tedious and has become popular in recent research. In particular, bio-inspired computing is the field that mends together mathematics, computer science, and biology to develop tools to store, scrutinize, and interpret the biological data. It is also used to solve real life problems like sequencing biological data, data clustering, and optimization. Swarm intelligence is an emerging field of biologically inspired artificial intelligence technique that is based on the behavioral models of social insects. This chapter provides an overview of swarm intelligence algorithms in solving bio-inspired computing problems. It is an attempt to explore the working nature, applications, and generative power of various bio-inspired computing algorithms. The main intent is to furnish a comprehensive study of swarm intelligence algorithms in the literature so as to inspire further research in the area of biologically inspired computing.

INTRODUCTION

Research and development in the area of Bio inspired computing using swarm intelligence has a deep impact and emphasize on various field of engineering and technology such as healthcare, decision support system, gene expression and microarray classification, etc. Bio inspired computing is an interdisciplinary area which combines bioinformatics, computational biology and computational intelligence.

DOI: 10.4018/978-1-5225-0788-8.ch005

Bioinformatics is a shorten form of 'biological informatics' defined as the application of analytical and computational tools to capture and interpret the biological data. A major activity in bioinformatics is to develop software tools, databases and visualization methods to generate useful biological knowledge. Major research efforts in the field include creating data bases and visualization methods for sequence analysis, gene finding, genome annotation, protein structure alignment analysis and prediction and prediction of gene expression. Though the creation of database is easy, but the classification, clustering and prediction are challenging. A major activity in Bio inspired computing is to design innovative systems like various aerodynamic parts of aircrafts, Artificial intelligent robots, realistic creatures, tele surgery robots and medical diagnosis robots. Major research efforts in the field include algorithm development that could extract metaphor from biological system.

Computational biology on the other hand is the application of computer science, mathematics, and statistics to the problems in biology. A major activity in computational biology signifies the development of algorithms, mathematical models, and methods for statistical inference to understand biology. Major research efforts in the field include identification of disease-causing genes, reconstruction of the evolutionary histories of species, and the unlocking of the complex regulatory codes that turn genes on and off. Computational Intelligence is a glowing recognized prototype with recent systems having many of the characteristics of bio inspired computers. In addition, it is capable of executing an assortment of tasks that are intricate to do using conventional methods. It is a methodology involving adaptive mechanism from nature and an ability to learn that facilitate intelligent behaviour in multifarious and varying environments, such that the system is supposed to possess one or more features of reason, such as generalization, discovery, association and abstraction. In order to achieve these characteristics, these methodologies uses intelligent techniques such as rough set (Pawlak, 1982, 1991), fuzzy set (Zadeh, 1965), neural networks (McCulloch & Pitts, 1943), evolutionary computation and swarm intelligence (Beni & Wang, 1989). Latest development aim to incorporate components to take advantage of harmonizing features and to develop systems that acts together leading to hybrid and abstraction architecture such as rough fuzzy, rough set and swarm intelligence, fuzzy- rough with swarm intelligence, particle swarm optimization, ant colony optimization and K-means etc (Niknam & Amiri, 2010; Tripathy, Acharjya & Cynthya, 2011; Wang, Yang, Teng, Xia & Richard, 2007; Ahmed, Mehdi & Adil, 2013; Ganesh, Aruldoss, Renukadevi & Devaraj, 2012). Swarm intelligence (SI) is artificial intelligence, based on the collective behaviour of decentralized, self-organized systems. It is a scientific theory that discusses complex and sophisticate behaviours of social creature groups like ant colonies, honey bees, and bird flocks. The expression was introduced by Beni & Wang (1989) in the context of cellular robotic systems.

The objective of this book chapter is to highlight the swarm intelligence and bio inspired computing research communities the astonishing applications of swarm intelligence in bio inspired computing. Hence this chapter discusses some inspiring examples to illustrate how swarm intelligence techniques can be applied to solve bio inspired computing problems. Innovative ideas will be stimulated and shared through the fusion of diverse techniques and applications. The motivational examples include. swarm intelligence in healthcare; swarm intelligence in medical decision support system; swarm intelligence in gene expression and swarm intelligence in microarray classification. The chapter is structured as follows. The chapter starts with a general introduction to bio-inspired computing followed by preliminary ideas and fundamental concepts of bio inspired computing. This will be further followed by relevant soft computing and swarm intelligence algorithms that are used in bio-inspired computing. In succession, various applications of these algorithms in real life situations are presented. Further, few open ended