Chapter 89
A Comprehensive Literature Review on Nature-Inspired Soft Computing and Algorithms: Tabular and Graphical Analyses

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ABSTRACT

Soft Computing techniques are capable of identifying uncertainty in data, determining imprecision of knowledge, and analyzing ill-defined complex problems. The nature of real world problems is generally complex and their common characteristic is uncertainty owing to the multidimensional structure. Analytical models are insufficient in managing all complexity to satisfy the decision makers' expectations. Under this viewpoint, soft computing provides significant flexibility and solution advantages. In this chapter, firstly, the major soft computing methods are classified and summarized. Then a comprehensive review of eight nature inspired – soft computing algorithms which are genetic algorithm, particle swarm algorithm, ant colony algorithms, artificial bee colony, firefly optimization, bat algorithm, cuckoo algorithm, and grey wolf optimizer algorithm are presented and analyzed under some determined subject headings (classification topics) in a detailed way. The survey findings are supported with charts, bar graphs and tables to be more understandable.

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INTRODUCTION

Nature is the main source of inspiration among scientists in order to develop several scientific methods and solution algorithms. To survive in natural life, speed, adaptability, flexibility and cooperation are the a few basic features. Actually, all these characteristics are expected from the development of a software in the computational environment. The nature-inspired soft computing techniques are emerged as a simulation of the real biological system or a modelization of human mind. Many nature-inspired soft computing techniques have been developed to solve combinatorial optimization problems. If these techniques are compared with the traditional methods, they can provide more successful performances since the nature-inspired soft computing techniques can easily be adapted to real life problems and they can deal with huge, inconsistent and incomplete model data thanks to their reasoning capabilities.

Soft Computing techniques are relatively efficient methods to describe real world complexity. Soft computing methods are widely used in various applications due to the capability of dealing with uncertain, incomplete and complicated data or model structures. Soft computing approaches are emerged as an alternative in case traditional approaches could not find appropriate solutions in multidimensional models which consist of multiple variables, complicated structures and ill-defined real cases. The core methodologies of soft computing are Fuzzy logic (FL), evolutionary computation (EC) and swarm intelligence (SI), neural networks (NN) and probabilistic models that all mainly concern with making rational decisions in imprecise and unstable conditions taking example of human thinking system in various applied area. Beside these techniques, the soft computing methods include machine learning (ML), belief networks, chaos theory, and support vector machines.

Soft computing techniques and computational intelligence methods are generally confused with each other because of the similar structures and working principles. According to Kacprzyk (2015), these methods are not the same but closely related to each other. Computational Intelligence (CI) is integrating the fields of Artificial Neural Networks, Evolutionary Computation, and Fuzzy Logic. Soft Computing is the collocation for the same fields as CI expanded with Probabilistic Reasoning, Swarm Intelligence, and partly Chaos Theory. These techniques provides a broader view of scope in complex mathematical modelling than traditional approaches.

Through the review of the existing literature, nature-inspired soft computing techniques have become one of the most promising tools that help to implement hard combinatorial problems. Particularly, in real world we have to design some strict mathematical models, but these models may not respond the decision makers' expectations due to the hardness of transferring all reality to the model. Most of the researchers have preferred to use nature-inspired soft computing techniques in various computational science areas and difficult engineering problems with a growing interest because of their easiness and flexibilities. The aim of this chapter is to provide a comprehensive review of nature inspired soft computing methods. This survey led to some observations and the identification of some deficiencies on nature-inspired soft computing literature. Based on the review, we will also present our suggestions on inspired soft computing and algorithms for future research.

In this chapter, a brief outline of soft computing techniques are discussed in Section 2. Section 3 provides a brief outline of the nature inspired soft computing techniques and tabular and graphical analyses of these techniques. Some directions for future research are provided in Section 4 and the conclusions are presented in Section 5.