Chapter 90
A Survey of Computational Intelligence Algorithms and Their Applications

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ABSTRACT

This chapter subscribes in the framework of an analytical study about the computational intelligence algorithms. These algorithms are numerous and can be classified in two great families: evolutionary algorithms (genetic algorithms, genetic programming, evolutionary strategy, differential evolutionary, paddy field algorithm) and swarm optimization algorithms (particle swarm optimisation PSO, ant colony optimization (ACO), bacteria foraging optimisation, wolf colony algorithm, fireworks algorithm, bat algorithm, cockroaches colony algorithm, social spiders algorithm, cuckoo search algorithm, wasp swarm optimisation, mosquito optimisation algorithm). We have detailed each algorithm following a structured organization (the origin of the algorithm, the inspiration source, the summary, and the general process). This paper is the fruit of many years of research in the form of synthesis which groups the contributions proposed by various researchers in this field. It can be the starting point for the designing and modelling new algorithms or improving existing algorithms.

INTRODUCTION

Background

The algorithms play an important role in IT and for several real applications. It delivers an objective is to find answers, which are probably best likened to the runtime environment. In late years, engineers and decision makers are confronted daily with complex problems (NP-hard) that generally involve all sectors. Historically, researchers have attempted to resolve these problems as efficiently as possible. For many years ago, research has been conducted towards the proposition of exact algorithms for polynomial

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special problems. Afterwards, the appearance of heuristic algorithms allowed generally finding solutions with good quality but often solutions for small instances, so why the need to find new types of algorithms that can lead to a major breakthrough for the practical resolution these problems became paramount.

Today, a huge success was achieved through modelling of organic and natural intelligence resulting in what is called "computational intelligence algorithms". This class of algorithms (include artificial neural networks, evolutionary computations, collective intelligence, artificial immune systems, human organ systems and fuzzy systems) constitutes a part of meta-heuristic and bio-mimicry areas. They have demonstrated their strength face to different complex issues where they are even attempting to determine the optimal solution from a finite number of existing solutions and offer a high performance results in experimental studies. It is frequently hard to understand why they perform well in a particular context. Another significant advantage is that these algorithms can often be applied without much knowledge about the problem, which makes them very suitable for various applications.

The conception of such algorithm requires the presence of the three characteristics to facilitate the implementation of these algorithms on a new problem:

- Choose a representation of possible solutions.
- Determine a function to measure the quality of a solution.
- Define the operators producing from a current set of solutions a new set of solutions.

It is no overstatement to state that this type of algorithm is everywhere, from design engineering to business planning and from routing of network to travel planning. In all these actions, we strain to reach some goals or optimize something like the quality of performance and the execution time. The delegation of this paper is a very important way to consolidate a number of new algorithms inspired by nature and have been offered in the literature. It is composed from more than 20 algorithms that were unionised in 2 parts classified by the biological source of inspiration of each one of them as illustrated in the next Figure 1.

The Organization of Our Work

We describe the algorithm following the next structure:

- **The Origin of the Algorithm:** It describes the start and the first appearance of this algorithm with references regarding the creator or developer of the algorithm.
- **The Inspiration Source:** It traces the inspiration phenomenon of the algorithm that can be natural, biological, physical or social.
- **The Summary of the Algorithm:** It summarizes the general cognitive process and the primary goal of the algorithm.
- **The General Process of the Algorithm:** It describes in more detail the various steps of the algorithm and the architecture, in the form of the figure.
- **The Procedure:** It is the structured image of the algorithm which describes its arrangement in terms of the necessary parameters, the input/output, the stopping criterion, and the intercourse between the different calculations performed by the constituents of the algorithm.