

Chapter 11

Significance of Biologically Inspired Optimization Techniques in Real-Time Applications

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ABSTRACT

The techniques inspired from the nature based evolution and aggregated nature of social colonies have been promising and shown excellence in handling complicated optimization problems thereby gaining huge popularity recently. These methodologies can be used as an effective problem solving tool thereby acting as an optimizing agent. Such techniques are called Bio inspired computing. Our study surveys the recent advances in biologically inspired swarm optimization methods and Evolutionary methods, which may be applied in various fields. Four real time scenarios are demonstrated in the form of case studies to show the significance of bio inspired algorithms. The techniques that are illustrated here include Differential Evolution, Genetic Search, Particle Swarm optimization and artificial bee Colony optimization. The results inferred by implanting these techniques are highly encouraging.

1. INTRODUCTION

Today computers are so well developed that it can perform all sorts of complex computations and act as a huge repository to store massive quantity of data. Still its memory usage depends on the available resources used to develop a system. Many memory enhancement methodologies are initiated to maximize the computing capacity of a computer that can solve complex problems. In spite of great advancements made, still nature forms a formidable force that decides the outcome of several approaches. Bio-inspired approach is one of the nature binding techniques that can be capitalized in handling complex domains that are complicated to deal with in normal circumstances. This approach of computation is a defining aspect of nature that is derived from the semantics, behaviour and methods of a natural system. In present era complex and real time problems are being solved very easily through the evolving techniques of computation. These computation techniques may be sophisticated, but still they are not flexible enough and lack a well-defined mathematical structure. To counter these techniques new natural approaches are starting to emerge to increase the simplicity in problem solving.

Bio-inspired methods of computing work in a decentralized manner which generate specific rules and apply such rules to find a suitable solution to a problem. Such techniques are generally very adaptable to environment and work in distributed platforms. In addition to its potential applications, such as DNA computation, nanofabrication, storage devices, sensing, and health care, bio-computation also has implications for basic scientific research. It can provide biologists, for example, with an IT-oriented paradigm for looking at how cells compute or process information, or help computer scientists construct algorithms based on natural systems, such as evolutionary and genetic algorithms. It has the potential to be a very powerful tool. The environmental demands of such organisms are different and this helps them to deal with complex issues that are different than engineering approach (Ullas, 2008). These methods started to show its presence since early days when the first digital computer was discovered by Von Newman and it was based on the human brain. But recent development of algorithms directly mimicking natural organisms' behaviour and has proved more adaptive and precise than conventional methods. It deals with field of research that allow the development of new computational methods (in software or hardware) to solve problems that leads to the formation of natural patterns and behaviours and may result in designing systems that implements natural media to compute. The nature is in itself has parallel, asynchronous, decentralised and collective behaviour. The nature-inspired techniques are an excellent match for computing environments that exhibit these characteristics. It is vital that disciplined scientific and engineering investigations are undertaken to successfully transfer these algorithms, techniques and infrastructures into emerging computing environments (Gupta, Bhardwaj & Bhatia, 2011). A brief comparison between conventional technique and bio-inspired technique is presented in Table 1.

1.1. Agent based Solving Using Bio-Inspired Computing

Biologically motivated computation is highly dependent on component behaviour. They employ a bottom-up mechanism in a decentralized manner while dealing with problem solving. They are perceived as computationally intelligent since they are highly adaptive and the method to solve a problem is not known at prior. It reaches the solution by cohesive and iterative behaviour of its components thereby developing an emergent behaviour. This emergent nature propels to find a suitable solution to a problem. Basically three concepts are followed to acquire this bottom-up emergent nature (Brownlee, 2005). These are:

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