Chapter 61
Soccer Game Optimization:
An Innovative Integration of Evolutionary Algorithm and Swarm Intelligence Algorithm

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ABSTRACT

A new metaheuristic algorithm is proposed. The algorithm integrates the information sharing as well as the evolution operators in the swarm intelligence algorithm and evolutionary algorithm respectively. The basic soccer player movement is used as the analogy to describe the algorithm. The new method has two basic operators; the move off and the move forward. The proposed method elaborates the reproduction process in evolutionary algorithm with the powerful information sharing in the swarm intelligence algorithm. Examples of implementations are provided for continuous and discrete problems. The experiment results reveal that the proposed method has the potential to become a powerful optimization method. As a new method, the proposed algorithm can be enhanced in many different ways such as investigating the parameter setting, elaborating more aspects of the soccer player movement as well as implementing the proposed method to solve various optimization problems.

INTRODUCTION

In the last two decades, metaheuristic algorithm has emerged as powerful optimization algorithm, especially in engineering, science, business, economic and finance. The algorithm provides a higher framework of heuristic methods to explore the search space more efficiently and effectively.

The term metaheuristics was introduced by Glover (1986). The word derives from the Greek words: heuriskein and meta. Heuriskein means "discover" or "find" and it is generally accepted as the term for approximate methods while meta means "in upper level." Metaheuristic can be described as a higher level of general methodology that provides guidance based on the heuristic search to solve various

optimization problems. An important property that distinguishes between heuristic and metaheuristic algorithms is: the heuristic algorithm is problem dependent while the metaheuristics algorithm is problem independent.

A lot of successful applications of metaheuristic algorithms have been published. The metaheuristic algorithms emerge as a powerful method to solve various optimization problems (Bianchi et al., 2008; Deep et al., 2009). The method gains significant interests in research and industrial practices due to its effectiveness and general applicability. In many cases, the classical approaches based on mathematical and dynamic programming are feasible only for small size instances of problems and generally require a lot of computational efforts, therefore the metaheuristics turn up into promising alternatives to classical optimization methods (Bianchi et al., 2008). The metaheuristic algorithms exploit randomness and set of rules to produce solutions. Due to the nature of heuristic methods, the metaheuristic methods do not guarantee optimal global solutions; however, they will provide acceptable solutions for large-sized and complex problems in a reasonable time (Talbi, 2009). Compared to the exact solution, metaheuristic algorithms are more flexible in their adaptability to fit the need of various optimization problems and they do not need to put formulation of the optimization problem. However, the algorithms need considerable problem specific adaptation in order to achieve good performance (Sorensen and Glover).

Metaheuristic methods have been applied in various problems such as: logistic (Shimizu et al., 2007; Wang and Hsu., 2010,), scheduling (Zhang et al., 2011; Deng and Lin., 2011), data mining (Sorensen and Janssens, 2003; Srinivasa et al. 2007), assembly lines (Lee et al., 2001; Simaria and Vilarinho, 2009; Kim et al., 2000; Purnomo et al., 2011) and supply chain management (Silva et al., 2009; Melo et al., 2012). The development of metaheuristic methods continually

evolves to cope with the growing of optimization problems. Therefore, developing a new metaheuristic method is an important contribution to solve optimization problems in engineering and operations research. The objective of this chapter is to describe a new metaheuristic method, which combines the evolutionary algorithm and swarm intelligence concepts. The method mimics the soccer player movement during a game, and for this rationale, we name it Soccer Game Optimization (SGO). The proposed method combines the local search and global search with the use of cognitive learning as well as social learning. This chapter illustrates the work of the proposed method. Examples of continuous and discrete problems are provided in order to help understand the proposed method easily.

BACKGROUND

Metaheuristic methods are used to solve both continuous and discrete problems. In the classical method, gradient information is needed to solve the problems that have real-valued searchspaces. In the real problems, the gradient search approaches could become very difficult and even unstable. The metaheuristic methods could overcome the limitation of the conventional, computational based methods, by eliminating the need for gradient information (Lee and Geem, 2005). In combinatorial optimization, the search space is finite; however, the search space grows exponentially with the size instance of the problem. Moreover, the multidimensional combinatorial problems also suffer from the curse of dimensionality. These problems cause the enumeration based exact algorithms to have slow convergence rate or the exhaustive search for the optimal solution becomes infeasible. On the other hand, the metaheuristic algorithm does not need the gradient information and is capable of finding good solutions for realistic size instances of problems

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