Chapter 9
A Novel Hybrid Genetic Algorithm for Unconstrained and Constrained Function Optimization

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ABSTRACT

During the past decade, academic and industrial communities are highly interested in evolutionary techniques for solving optimization problems. Genetic Algorithm (GA) has proved its robustness in solving all most all types of optimization problems. To improve the performance of GA, several modifications have already been done within GA. Recently GA has been hybridized with many other nature-inspired algorithms. As such Bacterial Foraging Optimization (BFO) is popular bio inspired algorithm based on the foraging behavior of E. coli bacteria. Many researchers took active interest in hybridizing GA with BFO. Motivated by such popular hybridization of GA, an attempt has been made in this chapter to hybridize GA with BFO in a novel fashion. The Chemo-taxis step of BFO plays a major role in BFO. So an attempt has been made to hybridize Chemo-tactic step with GA cycle and the algorithm is named as Chemo-inspired Genetic Algorithm (CGA). It has been applied on benchmark functions and real life application problem to prove its efficacy.

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1. INTRODUCTION

Optimization problems arise in almost in every field i.e. Mathematics, Science, Business Administration, Management, and Medicine. These occur in almost every engineering discipline such as Civil Engineering, Mechanical Engineering, Electrical Engineering, Telecommunication Engineering, Chemical and Bio-Chemical Engineering, Design and Manufacturing Systems. Most of the practical problems viz. analysis of electrical circuits, design of chemical production plant, the structural design of buildings or bridges, aircraft scheduling can be modeled through the nonlinear relationships. The problems also involve linear or nonlinear constraints. So, in real life situation we come across many nonlinear optimization problems. Thus, a requirement arises for developing efficient and effective optimization techniques for solving such problems. Many Evolutionary algorithms have been designed in recent past to tackle such problems (Das, 2013; Goldbarg, Goldbarg, Menzes, & Luna,2016; Hu et al, 2015; Qu, Liang, Wang, Chen& Suganthan,2016; Russo,2016;Singh &Das,2016;Wang, Yu & Cheung,2014). In recent past many interesting book came describing the application of Evolutionary technique (Tripathy & Acharjya, 2014a; Tripathy & Acharjya, 2014b). In general; a nonlinear optimization problem may have one or more local optimal solution. In case of linear programming problem, every local optimal solution is also its global optimal solution. Particularly, in case of non linear programming problem, locating the global optimal solution is a difficult task. It is not possible to find the global maxima (or minima) without searching in the neighborhood of every feasible point. As a result, there do not exist such computational algorithm, which can guarantee the solution of an optimization problem in a finite number of steps.

According to (Wolpert & Macready, 1997), all algorithms designed for finding the extremum of the cost function performs equally well when averaged over all the cost functions. According to the authors, if algorithm A outperforms algorithm B in some optimization problems, there exist as many other problems where algorithm B outperforms algorithm A. Hence, from the problem solving perspective, no single state of the art algorithm can handle all sorts of optimization problems. That's why; Now-a-days researchers are more focused on hybridized techniques.

GA and BFO have been hybridized with many nature inspired algorithms for the improvement of the searching capability of the algorithm. To list a few, GA has been successfully hybridized with Baldwin effect (Yuan, Qian, & Du, 2010), with Ant colony optimization (Ciornei & Kyriakides, 2012), with Particle swarm optimization (Kao & Zahara, 2008; Fan, Liang, & Zahara, 2006), with Simulated annealing (Hwang & He, 2006), with Quasi-simplex technique (Zhang & Lu, 2006), with niche technique and Nelder–Mead's simplex method (Wei & Zhao, 2005) and with Quadratic approximation (Deep & Das, 2008).