Halton Based Initial Distribution in Artificial Bee Colony Algorithm and its Application in Software Effort Estimation

Tarun Kumar Sharma, Indian Institute of Technology Roorkee, Saharanpur Campus, India

Millie Pant, Indian Institute of Technology Roorkee, Saharanpur Campus, India

ABSTRACT

Artificial Bee Colony (ABC) is an optimization algorithm that simulates the foraging behavior of honey bees. It is a population based search technique whose performance depends largely on the distribution of initial population. Generally, uniform distributions are preferred since they best reflect the lack of knowledge about the optimum's location. Moreover, these are easy to generate as most of the programming languages have an inbuilt function for generating uniformly distributed random numbers. However, in case of a population dependent optimization algorithm like that of ABC, random numbers having uniform probability distribution may not be a good choice as they may not be able exploit the search space fully. This paper uses quasi random numbers based on Halton sequence for the initial distribution and have compared the simulation results with initial population generated using uniform distribution. The proposed variant, termed as Halton based ABC (H-ABC), is validated on a set of 15 standard benchmark problems, 6 nontraditional shifted benchmark functions proposed at the special session of CEC2008, and has been used for solving the real life problem of estimating the cost model parameters. Numerical results indicate the competence of the proposed algorithm.

Keywords: *Artificial Bee Colony (ABC), Global Optimization, Halton Distribution, NASA Software, Software Effort Estimation*

INTRODUCTION

Artificial bee Colony (ABC) algorithm is a new optimization method, based on swarm intelligence and is motivated by the intelligent behavior of honey bees. It was originally proposed by Karaboga, Erciyes University of Turkey in 2005 (Karaboga, 2005). ABC algorithm has been proved to possess a better/ or at par performance for function optimization problems, when compared to genetic algorithms (GA), differential evolution (DE) and particle swarm optimization (PSO) (Karaboga & Akay, 2009; Karaboga & Basturk, 2007, 2008). The comparisons were made on various numerical benchmark functions, including unimodal and multimodal functions. The comparison results

DOI: 10.4018/jncr.2012040105

showed that ABC is more effective than the other methods in several optimization problems (Kang et al., 2009; Karaboga, 2009; Singh, 2009).The main advantage of ABC algorithm lies in the fact that it conducts local search in each iteration, thus the probability of finding the optimal results is significantly increased.

Artificial Bee Colony (ABC) simulates the foraging behaviour that a swarm of bees perform. In this algorithm the foraging labor is divided over three groups of bees, *the employed bees* (bees that determines the food source (possible solutions) from a prespecified set of food sources and share this information (waggle dance) with the other bees in the hive, *the onlookers bees* (gets the information of food sources from the employed bees in the hive and select one of the food source to gathers the nectar) and *the scout bees* (responsible for finding new food sources). A brief overview of the algorithm is given.

ABC, however, like its counterpart population based search algorithms suffers from some inherent drawbacks like slow or premature convergence while dealing with certain complex models (Karaboga & Akay, 2009). In order to further improve the performance of ABC, several modifications are available in literature (Akay & Karaboga, 2010; Alatas, 2010; Baykasoglu, Ozbakir & Tapkan, 2007; Coelho & Alotto, 2011; Gao & Liu, 2012; Haijun & Qingxian, 2009; Kang, Li & Ma, 2011; Quan & Shi, 2008; Sharma & Pant, 2011a; Sharma et al., 2011; Tsai et al., 2009; Zhu & Kwong, 2010). The recently comprehensive literature survey of ABC can be found in (Karaboga et al., 2012). In the present study, we propose an improved solution search space by initializing the initial population using Halton sequence.

Generation of initial population is a crucial task in a population based search technique.

In case no *a priori* information about the solution is available, random initialization is the most popular method of generating the initial population. This is also an easier method to generate the random numbers as most of the programming languages have an in-built random number generator based on uniform probability distribution. However, pragmatically speaking this may not be the best form of distribution. What we need in a population based search technique is a distribution with the help of which we are able to extract the domain knowledge more efficiently. Instead of using random numbers, if we use quasi random numbers, the performance of an optimization algorithm may improve. This has also been shown in some previous studies (Bratley & Bennett, 1988; Morokoff & Caftisch, 1994; Pant & Thangaraj, 2009; Uy et al., 2007). In the present study we propose Halton distribution, a quasi random distribution for generating the initial population of ABC.

Here we would like to mention that a preliminary version of this work has been presented in a conference (Sharma & Pant, 2011b). However, in this study we present its elaborated version. Here we provide a comprehensive set of experimental verifications of the proposed H-ABC.

The remaining of the paper is organized as follows; in the next section we give a brief overview of the basic ABC algorithm. In the next section, proposed algorithm is described. Next, the Benchmark Problems are defined. Parameter settings and simulation results are given. Software effort estimation is discussed. Experimental results are given and finally the paper concludes.

A BRIEF OVERVIEW OF ABC ALGORITHM

ABC is one of the newest algorithms based on the foraging behavior of insects. It tries to model natural behavior of real honey bees in food foraging. Honey bees use several mechanisms like waggle dance to optimally locate food sources and to search new ones. Waggle dance is a means of communication among bees by which the successful foragers share the information not only about the direction and distance of the food sources but also about the amount of nectar available to the other foragers. This information exchange among bees helps

A Grasp with Path-Relinking for the Workover Rig Scheduling Problem

Alexandre Venturin Faccin Pacheco, Glaydston Mattos Ribeiro and Geraldo Regis Mauri (2012). *Nature-Inspired Computing Design, Development, and Applications (pp. 90-103).*

www.igi-global.com/chapter/grasp-path-relinking-workover-rig/66772?camid=4v1a