Novel Bio-Inspired Technique of Artificial Social Cockroaches (ASC)

Hadj Ahmed Bouarara, GeCoDe laboratory, Dr. Moulay Tahar University of Saïda, Saïda, Algeria
Reda Mohamed Hamou, GeCoDe laboratory, Dr. Moulay Tahar University of Saïda, Saïda, Algeria
Abdelmalek Amine, GeCoDe laboratory, Dr. Moulay Tahar University of Saïda, Saïda, Algeria

ABSTRACT

This paper deals about a new bio-inspired algorithm that can be classified in the family of swarm optimization algorithms. The authors’ algorithm, which is called Artificial Social Cockroaches (ASC), is inspired from the social behaviour of cockroaches. This inspiration is based on the general phenomenon of real cockroaches that resides in grouping them under the same shelter (place with less lightness) and the way of choosing which shelter and how to get into it. This algorithm has as input a population of artificial cockroaches that will cooperate among them from iteration to another to solve a specific problem using simple rules as the attraction method and the aggregation operators (interaction, individual preference and evaluation). In order to evaluate our algorithm, the authors confronted several experiments facing clustering problem by applying this model on Reuters benchmark and basing on three essential measures: number of Bell, number of Stirling and time complexity.

Keywords: Aggregation Rule, Bio-Inspired, Complex Problems, Number of Stirling, Problem NP-complete, Social Cockroaches, Validation Measure

INTRODUCTION AND BACKGROUND

The last changes in the world had seen the advent of new information technologies and communication such as the internet and social networks like Facebook and Twitter. The information has become a pillar of our civilization, no one can escape it and we find it everywhere. Hence, the evolution of operating systems and the variation of the device capabilities have augmented the complexity of the process and the sources of computer problems.

The appearance of computer technology has permitted humans to resolve many problems. Unfortunately, in the last decade a new class of problem has seen the light named NP complete where researchers have attempted to solve this kind of problems as efficiently as possible such

DOI: 10.4018/IJOCI.2015040103
as: SAT and 3SAT problems in Braich, Chelyapov, Johnson, Rothemund, and Adleman (2002), backpack problem in Lindstrom-Hazel (2008), linear optimization into integers in Bertsimas and Tsitsiklis (1997), multiprocessor scheduling in Hou, Ansari, and Ren (1994), colouring graph in Molloy and Reed (2013).... Etc. For many years, research has been directed toward the proposition of exact algorithms but only for polynomial cases. Nevertheless, the research has turned toward the heuristic methods allowed to find solutions generally good like the separation and evaluation method that had helped to solve these problems optimally, but often for small instances.

The current scientific world was considerably built up with the inaugural appearance of novel concepts and paradigm. The advancement of research and the number of inspiration sources founded in nature represent a genuine opportunity for the future. Actually, for each encountered problem, we must observe the nature; it may already have the same problem, where it had found solutions, long years ago. The bio-mimicry consists to copy the living and doing research, otherwise, get advantage of solutions and innovations made by nature. This discipline is in strong growth, it is the heart of the innovation strategies of companies in many different sectors. Innovate by being frugal in energy and resources, is now viewed as the only solution to evolve the technologies, in many areas. There are three levels of bio-mimicry we can inspire from forms, manufacturing and processes of ecosystems, for example singing of the toad to improve Wi-Fi.

Around this topical science, several studies have been conducted over the behaviour of insects such as: social bees and their life that ensures the right functioning of the hive through the distribution of tasks between the worker bees (Karaboga & Basturk, 2007). The ants colony, this type of insect that lives in a company very organized based on the principle of discovering the shortest path by the mean of pheromone communication between them (Dorigo, Maniezzo, & Colorni, 1996) ... etc.

The swarm insects’ lifestyles, have become a means for researchers to create new artificial models called social inspired techniques in order to generate a new efficient solutions to deal with the NP-complete problem previously seen; they have invaded a several fields as data-mining, meta-heuristics and information retrieval. In order to solve complex problems and dealing different challenges, in the computer community, the content of our work is to develop a new artificial algorithm, inspired by the lifestyle of cockroaches and their collective behaviour who like living in group by the combination of the intelligence of every individual cockroach to have an optimal decision. With a communication mode without a conductor, a functioning as a decentralized system and the intelligence also distributed with the purpose is to solve complex tasks from the sum of individual interactions and their continuous adaptation to the changing environment.

To see the performance and the uses of our proposed algorithm ASC to solve an NP complete problem, we have decided to apply this algorithm for the text clustering problem.

**Aims of our Work**

- Modeling a new bio-inspired techniques by mimicked the natural life of social cockroaches.
- Proposed a general algorithm of ASC that can be applied for different optimization and real world problems.
- Proposed a comparative between our proposed algorithm ASC and others bio-inspired techniques in term of functioning rules and operators.
- Description of the clustering problem.
- Proved that clustering is an NP complete problem with high complexity using sterling theorem and bell number.
- Tested this algorithm on the clustering problem and identify the ideal configuration.
Related Content

Path Relinking Scheme for the Max-Cut Problem within Global Equilibrium Search
Volodymyr P. Shylo and Oleg V. Shylo (2011). *International Journal of Swarm Intelligence Research* (pp. 42-51).
[www.igi-global.com/article/path-relinking-scheme-max-cut/55319?camid=4v1a](www.igi-global.com/article/path-relinking-scheme-max-cut/55319?camid=4v1a)

A Multiobjective Particle Swarm Optimizer for Constrained Optimization
[www.igi-global.com/article/multiobjective-particle-swarm-optimizer-constrained/53722?camid=4v1a](www.igi-global.com/article/multiobjective-particle-swarm-optimizer-constrained/53722?camid=4v1a)
A Multiobjective Particle Swarm Optimizer for Constrained Optimization
[www.igi-global.com/article/multiobjective-particle-swarm-optimizer-constrained/53722?camid=4v1a](www.igi-global.com/article/multiobjective-particle-swarm-optimizer-constrained/53722?camid=4v1a)

Design and Optimization of Microwave Circuits and Devices with the Particle Swarm Optimizer
Massimo Donelli (2013). *Swarm Intelligence for Electric and Electronic Engineering* (pp. 1-17).
[www.igi-global.com/chapter/design-optimization-microwave-circuits-devices/72820?camid=4v1a](www.igi-global.com/chapter/design-optimization-microwave-circuits-devices/72820?camid=4v1a)