On the Optimization Method ABC and Application

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Abstract

Considering the optimization method based on the bees behavior *Artificial Bees Colony* (ABC). Their performance is analyzed and compared to methods known to be effective. In addition, we seek to expand its applicability by merging it with another method, the *Sequential Cutting Plane* (SCP).

Introduction

Currently there are many problem that make use of methods to optimize process in order to minimize some factor. The need arises to study optimizations methods.

The enhancement of optimization methods came in part from the analysis of the behavior of nature. It was possible to note how optimized survival processes are highlighted in the way the species evolved.

When studying the optimization methods coming from nature, it was possible to develop the *Particle Swarm Optimization* (PSO), which analyzes the behavior of each individual (particle) in a population (swarm) through a simulation, with the objective of evolving the search result of each individual for the purpose of finding the minimum of scenarios (variable space of a function, search configurations in a graph, etc).

In this sense was developed a search method with characteristic PSO based on the behavior of bees related to the search for resource fields around the hive. This method, called (ABC) makes use of neighborhood exploration and random exploration, bringing optimal or near results in a timely manner.

We will make applications of this method to two problems that will be better explained in the objectives.

Objectives

In the first ambit, we intend to consider the Vehicle Routing Problem (VRP) estimating its complexity and then understand the application of the ABC method to the VRP constraint, which is the *Capacitated Vehicle Routing Problem* (CVRP). This application aims to find the best routes configuration in order to minimize factors such as distance, time, vehicle wear, cost per trip, etc.

Also part of the objectives is the study of the application of ABC in real variable functions exploring the variation given by the contour map.

In addition, we intend to consider a continuous variable problem that has a nonlinear programming characteristic and to approach such problem by adequate discretization so that ABC is useful in some comparison scale.

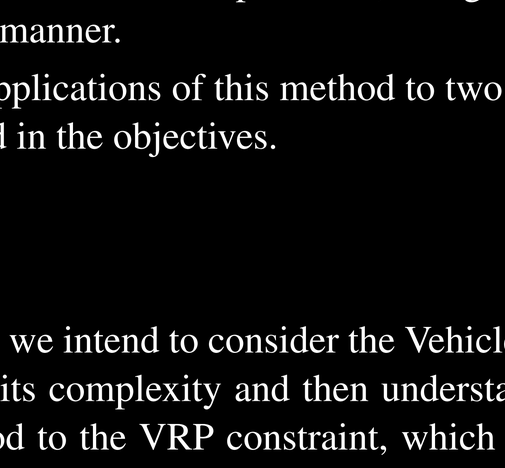

Figure 1: Exploration of the particles applied to the contour map.

Results

Seeking an improvement, modifications can be made in the algorithm, with the aim of improving the search. Thus, it is necessary to study such modifications so that they are made according to the scenario of the problem. Depending on the way the search is performed, it is possible that the scenario is unsuitable.

On the applications of the ABC and of the enhanced ABC

When implementing ABC in its basic form, that is, unchanged, a CVRP result was generally worse than best classics. However, once the improvements have been made specifically a result was indeed better than all previous ones. [1]

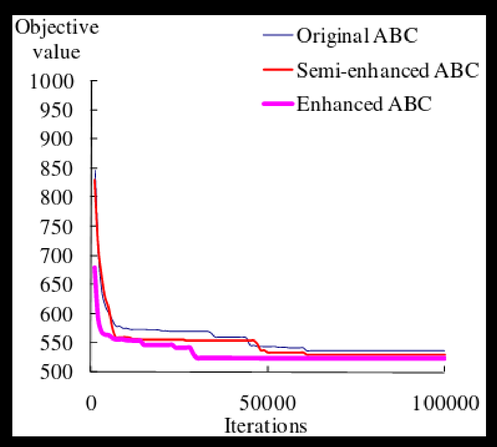

Figure 2: Converging processes of the basic ABC heuristic and its variants.

On the applications of the ABC in search in the contour maps

Once we have an object function that satisfies the condition that its spatial graph builds a contour map, we can apply diligently the ABC in search of the great places, reaching with very good overall performance, or near.

On the application of the ABC conjunct to SCP

If we consider the operational and computational utility of ABC, even if there is a strong restriction on the objective functions, we seek an improvement with the use of a method *Sequential Cutting Plane* (SCP) so that we can solve partially or completely results with nonlinear programming character.

Conclusion

In addition to the results expected and exposed throughout the sections, it is in our interest to improve the ABC method and also present a multifaceted version. Which would take the method to other horizons of discussion and possibilities.

References

[1] W.Y. Szeto, Yongzhong Wu, and Sin C. Ho. An artificial bee colony algorithm for the capacitated vehicle routing problem. *European Journal of Operational Research*, 215(1):126 – 135, 2011.

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