IDEA GROUP PUBLISHING

701 E. Chocolate Avenue, Suite 200, Hershey PA 17033-1240, USA
Tel: 717/533-8845; Fax 717/533-8661; URL-http://www.idea-group.com

ITB10420

Chapter IX

The Influence of Pheromone and Adaptive Vision in the Standard Ant Clustering Algorithm

Vahid Sherafat, State University of Campinas, Brazil

Leandro Nunes de Castro, Catholic University of Santos, Brazil

Eduardo Raul Hruschka, Catholic University of Santos, Brazil

ABSTRACT

Algorithms inspired by the collective behavior of social organisms, from insect colonies to human societies, promoted the emergence of a new field of research called swarm intelligence. *The applications of swarm intelligence range from routing in telecommunication networks to robotics. This chapter discusses some of the ideas behind swarm intelligence, focusing on a clustering algorithm motivated by the social behavior of some ant species. The standard ant-clustering algorithm is presented; a brief review from the literature concerning the applications and variations of the basic model is provided; two novel modifications of the original algorithm are proposed and discussed; and a sensitivity analysis of the standard and modified algorithm in relation to some user-defined parameters is performed. A variation of a simple benchmark problem in the field is used to perform the sensitivity analysis of the algorithm and to assess the proposed modifications of the standard algorithm.*

INTRODUCTION AND MOTIVATION

Providing efficient and feasible solutions to complex problems are some of the central challenges in engineering and computing. Finding out new approaches to solve well-known and novel problems is one of the main goals of these areas. From a biological perspective, it is also possible to view each form of life in nature as different "solutions" to the "problem" of surviving (Bonabeau et al., 2000): living organisms compete for limited resources and mating, and adapt themselves to changes in their environment. Therefore, living (surviving) is one of the most successful problem-solving techniques developed to date.

In many cases, organic processes solve complex problems with simple elements; the interaction (cooperation, competition, and coordination) of the elements of the system exerts a more important role than the actions of individual agents themselves. By observing the behavior of a whole ant colony while dealing with several new and unexpected situations, it is possible to have an idea of the variability of emergent behaviors that can arise out of a group of simple agents. Ant colonies can form extremely complex raids in the search for food; they can build bridges with their own bodies in order to carry food over a valley; they can organize and clean their nests and create cemeteries; they can build nests with complicated tunnel and temperature control systems; and so forth.

The study of the behavior of various insects seems to be a good approach to the understanding of some collective phenomena. It also gives us new insights into the development of novel problem solving techniques. Some insects can be particularly more adequate as a source of inspiration because they can be studied and observed without much complication and costs. In this sense, ants are specially relevant due to the large amount of information, both theoretical models and empirical observations, about their behavior. Several papers, books, and essays have already been published and may serve as a base for a bio-inspired problem-oriented study of specific phenomena (Camazine et al., 2001; Franks, 1989; Holldöbler & Wilson, 1994). However, ant colonies are not the only example of the successful collective behavior of simple organisms. A large group of termites working, a colony of bees searching for pollen, and a flock of birds flying synchronously are further examples.

The dynamic and harmonic unity is one common element in all these collective behaviors and a factor whose implications are not well known. There is a lot of knowledge about each part of these (organic) systems; however, an understanding of the interactions of these elements, their integration and coordination, is not always available. Despite that, several researchers from computer science, engineering, and other fields of investigation have been developing tools for solving problems in the most varied domains, motivated by the collective behavior of simple social organisms. One term that has recently been proposed to characterize such systems is *swarm systems* or *swarm intelligence* (Bonabeau et al., 1999; Kennedy et al., 2001).

Algorithms inspired by the collective behavior of diverse groups of animals and insect societies have resulted in new computational tools with applications in areas such as:

- Planning and task allocation (Bonabeau & Théraulaz, 2000);
- Robotics (Kube & Bonabeau, 2000);

Related Content

Complexity and Modularity of MAPK Signaling Networks
George V. Popescuand Sorina C. Popescu (2011). *Handbook of Research on Computational and Systems Biology: Interdisciplinary Applications (pp. 355-368).*
www.irma-international.org/chapter/complexity-modularity-mapk-signaling-networks/52324

A Method for Classification Using Data Mining Technique for Diabetes: A Study of Health Care Information System
Ahmad Al-Khasawneh (2017). *Nature-Inspired Computing: Concepts, Methodologies, Tools, and Applications (pp. 426-449).*
www.irma-international.org/chapter/a-method-for-classification-using-data-mining-technique-for-diabetes/161037

Challenges and Future Prospects of Intelligent Decision Making
Heena Irfan Shaikhand Imran Baig Mirza (2024). *Bio-Inspired Intelligence for Smart Decision-Making (pp. 179-188).*
www.irma-international.org/chapter/challenges-and-future-prospects-of-intelligent-decision-making/347321

Implementation on CUDA of the Smoothing Problem with Tissue-Like P Systems
Francisco Peña-Cantillana, Daniel Díaz-Pernil, Hepzibah A. Christinaland Miguel A. Gutiérrez-Naranjo (2011). *International Journal of Natural Computing Research (pp. 25-34).*
www.irma-international.org/article/implementation-cuda-smoothing-problem-tissue/58064

Materialized View Selection using Marriage in Honey Bees Optimization
Biri Arunand T.V. Vijay Kumar (2015). *International Journal of Natural Computing Research (pp. 1-25).*
www.irma-international.org/article/materialized-view-selection-using-marriage-in-honey-bees-optimization/146882