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A SWARM INTELLIGENCE OPTIMIZATION APPROACH FOR SMART HIVE FINDING IN HONEY BEES

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ABSTRACT

Swarm Intelligence is a problem-solving behavior that occurs as a result of a multiplicity of interactions between independent components that make up the entire system Swarm intelligence comes from the biological study of social insect and insight about how they manage to solve complex problems in their daily lives. Research field as swarm systems are examples of behavior based systems.

The proposed approach can be useful in traveling salesman problem also in optimized way of path finding. The Smart approach of swarm honey bees for the Hive finding is the novel approach. Our intention is to use this kind of methodology in our conventional problems to solve efficiently. BCO model has adopted mainly two natural behaviors from the social bees' life: The mating process behavior and the foraging process behavior.

KEYWORDS: Swarm Intelligence, Hive, Piping, Quorum.

INTRODUCTION

Nature has always inspired researchers. By simple observing we can sometimes notice the patterns, the set of rules that make seemingly chaotic processes logical. How do we think and how do we memorize? Why is evolution so important for the survival of species? How do the social insects know how to follow the path to a source of food without the global knowledge? These questions are partially answered by computational intelligence (CI).

Traditional optimization search methods may be classified into two distinct groups: direct-search and gradient-based search methods. Swarm intelligence systems are candidates to meet the requirements of complex path and fault management problems in today's networks.

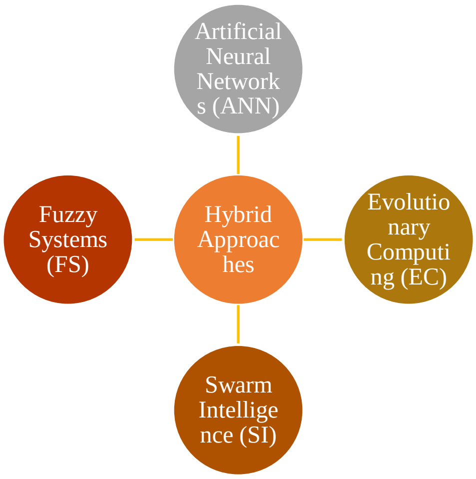

Figure. 1: General Optimization Approaches

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Bee colony algorithm is currently used in many areas to solve combinatorial optimization problems. In their algorithm, servers and HTTP request queues in an Internet server colony are modeled as foraging bees and flower patches respectively. This section describes the existing work done on this area of research. Nakrani and Tovey (2004) first proposed the use of a honey bee algorithm for dynamic allocation of Internet servers. The experimental results show that the algorithm performs reasonably well in the dynamic allocation problem. Social insect colonies can be considered as dynamical system gathering information from environment and adjusting its behaviour in accordance to it. While gathering information

LITERATURE REVIEW

Joshua Kirby et al.[1] introduced a novel swarming interpolation framework and validated its effectiveness on static fields. Proposed framework can be used to control autonomous mobile sensors into flexible spatial arrangements in order to interpolate values of a field in an unknown region. Sorin Ilie and Costin Badica [2] proposed a framework based on Ant Colony Optimization on a Distributed Architecture (ACODA), for implementation of SI algorithms aimed at solving complex graph search problems. In [3] Jiraporn Kiatwuthiamorn and Arit Thammano proposed an optimization technique based on the ant colonies. Sifat Momen[4] investigates that effects of biasness in brood caring on the performance of the colony, it is observed that a little biasness in brood caring results in a statistically improvement in the performance of the colony. Omid Nezami et al. [5] found the appropriate regions of search space by introducing new artificial particles based on historical information.
Imane Fahmy et al. [6] proposed the The Predictive Energy Efficient Bee-inspired Routing algorithm for Mobile Ad-hoc Networks (MANETs). The proposed algorithm was to find the optimal path among a number of potential paths between a certain source-destination pair. Patrick Benavidez et al. [7] investigated the problems related to swarm robots to coordinate their actions to accomplish a given task in multi domain systems and developed protocol which is flexible enough to handle different types of data such as GPS, image, and control commands. John Baras et al. [8] proposed a set of routing algorithms for MANETs based on the swarm intelligence paradigm. It observes that end-to-end delay for swarm based routing is low compared to AODV. However, the good put for these algorithms is lower than for AODV in scenarios with high mobility [10].

ECOLOGY-BASED CONCEPTS FOR OPTIMIZATION

This section describes the basic organization of a computational ecosystem and presents some fundamental ecological concepts that can be explored in the context of problem solving. Simulating this behavior of real honey bees is described for solving multidimensional and multimodal optimization problems.

Basic Description: A computational ecosystem for optimization is composed by candidate solutions (individuals) scattered in an environment that, itself, is the search space of the problem being solved. Figure 2 shows a possible representation for the elements of the proposed computational ecosystem. This figure shows three populations where each population behaves according to the mechanisms of intensification and diversification, tuned by the control parameters, specific of a optimization strategy. In this example, the behavior of individuals is driven by the foraging strategies of bees, the foraging strategies of ants, and by the flocking behavior of birds, respectively.

Figure. 2: Elements of Computational Ecosystem.

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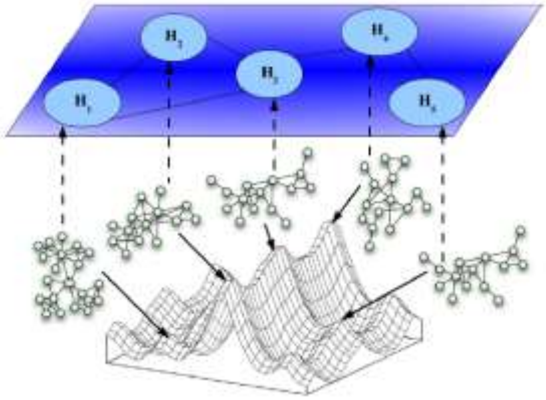

Figure. 3: Generical View of Computational Ecosystem.

In Figure 3, hyper-surface of the search space. Intermediate level: intra-habitats communication topologies where each small circle represents a population. Upper level: five habitats connected through inter-habitats communication topology. In the intermediate level of Figure 2, small circles represent populations Qi with i= 1, 2, ..NQ, where NQ is the total number of populations in the ecosystem [R1]

BEE'S SMART HIVE FINDING

Worker bees in the hive are most important in ensuring order and that the work in the hive is performed without anything going wrong. Due to the large numbers of bees in the hive, a lot of work needs to be done. The workers, who at other times forage for pollen, nectar or water, now set about seeking a new site for their colony. 4.1 Scout Bees in Action: While one part of the colony waits in a mass, the scout bees are very active. The scouts carefully examine the fissures and tree trunks in which they might establish a new hive. The large numbers of scouts seek possible new locations for the colony and literally carry out settlement planning, make various calculations to arrive at a common decision of the suitability of the new hive site. Then they again act together, returning to the colony and leading it to the new site. The decision-making process over the site of the new hive may last for several days. Each scout inspects each potential site very carefully, and it takes time for up to 500 workers to compare different alternatives and agree on a common decision [12].

EXPERIMENTAL SETUP:

In this section, we are going to elaborate the working model of Honey bees for the hive finding. The proposed model called as Bee Smart Hive Finding, some of the terminologies considered are,

Initial Percentage = Initial Scouts (%) fly away from swarm in different directions.
Hive Number = Number of Hives/ randomly placed.
Initial Explore Time = Explore space for maximum time.
Quorum = Bees on a certain Hive site observe a certain number of bees on the same site.
Some of the plots are used are as follows,
Committed = Number of scouts that are committed to inspecting & advocating for each hive site.
On_site = Shows count of bees on each site.
Watching Vs Working = The change in number of idle and working bees.
Piping = A bee start to pipe, when the decision of the best hive is made.

Sites are potential targets that the swarm tries to pick. They are box-shaped agents that never move. At each setup, they are placed randomly in the view.

At each tick, a robot moves around randomly and sees if there is any dancing agent within one step in its 30 degrees cone of vision. If there is, the robot may follow the dance based on a probability that is proportional to the interest (the value of the bee-timer variable) of the dancer. If the robot decides to follow the dance, it targets the hive site advocated by the dancer and flies out to evaluate it. When arrived at a site, the robot adjusts its interest according to the quality of the site and fly back to the swarm to dance for it.

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The waggle dances in this model are represented by agents turning left and right. One possibility for extending the model is to use the actual waggle dance pattern (the figure-8 dance, included in the BeeSmart Hive Finding model) to make the dances more realistic and informative. [13]

SIMULATION ENVIRONMENT

The BeeSmart Master model shows the swarm intelligence of honeybees during their hive-finding process. A swarm of tens of thousands of honeybees can accurately pick the best new hive site available among dozens of potential choices through self-organizing behavior.

Table 1: Simulator Parameters

Simulator Environment	NetLogo-5.3.1
Hive Number	[5..10]
Initial Percentage	[5..25]
Initial-Explore-time	[100..300]
Quorum	[0..50]

Plots:

As per the input varies with the data set following outputs shows the regression in analysis.
Here following data sets are considered for the Smart Hive Finding,
Hive Number=5
Initial Percentage=25
Initial-Explore-time=100
Quorum=50

Figure 4: Global View of Honey bees for Smart Hive finding.

Piping = A bee start to pipe, when the decision of the best hive is made.

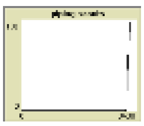

Figure. 5: Piping of Honey bees for Smart Hive

Committed = Number of scouts that are committed to inspecting & advocating for each hive site.

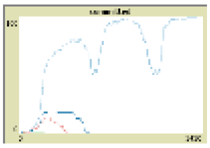

Figure. 6: Committed graph for Smart Hive

CONCLUSION

The Bees Algorithm is an optimization algorithm inspired by the natural foraging behaviour of honey bees to find the optimal solution. The Honey bees path finding outperformed other techniques in terms of speed of optimization and accuracy of communication. In our case we chose honeybee colonies because the foraging behavior of bees could be transformed into different types of agents performing different routing tasks in telecommunication networks. As well as their hive finding methodology is an innovating approach considering the environmental changes and basic approaches in natural insects.

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