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Cross-Country Path Finding using Hybrid approach of PSO and BCO

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ABSTRACT
In this research paper we will implement new approach in order to find optimized path which is different from the conventional approaches. The newly developed approach will acknowledge the problems like terrain mapping, obstacle detection and avoidance, and goal seeking in cross-country using Swarm Intelligence.
This approach will be used as combination of techniques PSO(Particle Swarm Optimization) for finding out the natural paths moreover keeping the obstacle detection from the satellite image and BCO(Bee Colony Optimization) algorithm for obstacle avoidance and shortest path to the goal

Keywords
Satellite image, Path planning, terrain mapping, obstacle detection and avoidance, and Swarm Intelligence

1. INTRODUCTION
Under swarm intelligence we will broadly classify the two techniques i.e. PSO and BCO . These two techniques are used to study the behavior of social insects and the particles as well whereby the collective behaviours of (unsophisticated) agents interacting locally with their environment cause coherent functional global patterns to emerge This combinational approach of Particle Swarm Optimization (PSO) and Bee Colony Optimization (BCO) describes autonomous navigation for outdoor vehicles which includes terrain mapping, obstacle detection and avoidance, and goal seeking in cross-country using Swarm Intelligence. The algorithm generated will be helpful solving the problems related to off-road autonomous navigation. In cross-country , satellite images of those human made objects and organisms like insects which can not be accessed easily are taken and after that these are implemented for various problems like military transportation,robot navigation etc.

2. CONCEPTUAL DEFINITION AND DETAILS

2.1 Satellite Image
Digital data obtained from sensor carried in satellite. It includes collecting data both in the visible and non-visible portions of the electromagnetic spectrum. Satellite images generated through remote sensing can be analyzed to produce a map-like layer of digital information. Involves laying features over a digital terrain model to provide information on features that lie on the terrain. There terrain model provides the shape of the terrain. Draped features may then include a satellite image of the terrain to show land-use, and vector data to show features such as roads.

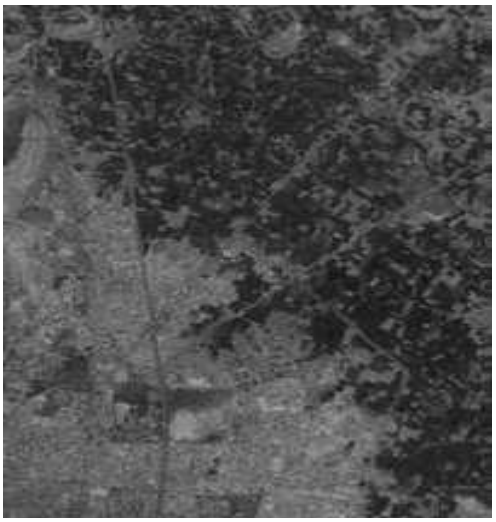

Fig 1: Red band satellite image (input image)

2.2 Particle Swarm Optimization:
This technique is motivated by social behavior of organisms such as bird flocking and fish schooling. PSO algorithm is not only a tool for optimization , but also a tool for representing socio cognition of human and artificial agents, based on principles of social psychology. Sometimes the knowledge is optimized by social interaction and thinking is not only private but also interpersonal. Particle swarm optimization (PSO) is a population based optimization technique developed by Dr. Eberhart and Dr. Kennedy in 1995.Each particle keeps track of its coordinates in the problem space which are associated with the best solution it has achieved so far.

2.3 Bee colony Optimization:
Bee Colony Optimization algorithm is inspired by the behaviour of a honey bee colony in nectar collection .It is a recently proposed, nature-inspired meta-heuristic since it represents a general algorithmic framework applicable to various optimization problems in management, engineering, and control, and it should always be tailored for a specific problem. It has been successfully applied to many combinatorial optimization problems, mostly in transportation, location and scheduling fields. The artificial bee colony behaves partially alike, and partially differently from bee colonies in nature. The algorithm was inspired by

the method adopted of a swarm of honey bees to locate food sources. There are two different honey bee groups that share knowledge in order to successfully locate such sources. We can thus maintain a colony of bees, where each bee will traverse a potential solution path. Once a feasible solution is found, each bee will return to the hive to perform a waggle dance. The waggle dance will be represented by a list of "elite solutions", from which other bees can choose to follow another bee's path.[1] Bees with a better makespan will have a higher probability of adding its path to the list of "elite solutions", promoting a convergence to an optimal solution.

3. METHODOLOGY

Obstacle detection and path extraction of image procedure is to automatically categorize all pixels in image into roads, forest, barren land, water bodies and settlements. We extract the paths from image using PSO algorithm. To do this, appropriate threshold values have to be computed and then segmentation is performed. After doing this we will reach the goal through shortest path using BCO technique.

3.1 Obstacles detection

Obstacle detection (OD) is one of the main components of the control system of autonomous vehicles. In the case of indoor navigation, obstacles are typically defined as surface points that are higher than the ground plane, but in cross-country and unstructured environments the notion of "ground plane" is often not meaningful.

3.2 Computing the Threshold using PSO

To evaluate the threshold values, we created ten agents which scan their respective regions assigned to them from the image. Every agent scans the image row wise to find local best values for each row and eventually evaluates its global best for the assigned region. Among these regional global bests the agents select the most suitable candidate solution by communicating with each other. This is known as the Threshold value or the Global best.

3.3 Morphological operations

Morphology is a technique of image processing based on shapes. The value of each pixel in the output image is based on a comparison of the corresponding pixel in the input image with its neighbors. By choosing the size and shape of the neighborhood, you can construct a morphological operation that is sensitive to specific shapes in the input image.

3.4 Path Planning Using BCO

This approach presents a novel method to solve the problem of path planning for mobile robots based on bee colony algorithm. The method is inspired by collective behavior of honeybees to find food sources around the hive. The proposed method includes two steps. The first step is to use a simple rule to establish an initial collision-free path from the starting point to the target and the second step is utilizing bee colony algorithm to optimize the initial path.

3.5 Simulation

The proposed algorithm is implemented with Matlab . The algorithm is based on combined approach of PSO and BBO applied on satellite image. Firstly red band satellite image was taken and calculated threshold using PSO for paths extraction and obstacle detection. To obtain the threshold value, agents were randomly initialized in a specified area and global best position was calculated. Then obtained paths were refined using morphological operations to minimize the detection of shadows, trees and inconvenient areas. Figure 3 shows the refined image after morphological operations. Finally, BCO was implemented in which ants were initialized and they find the shortest path avoiding the obstacles from given source to destination according to the goal defined.

The pseudo-code of the proposed algorithm is given in as:

Step 1: take satellite image as input image

Step 2: for each agent

Initialize the random position

Calculate the fitness value at that position

if fitness(n)<fitness(n-1)

then update best position

else not update

end-for

find global best position

for each agent

update position and velocity

end-for

Step 3: calculate the threshold value (path extracted and obstacles detected)

Step 4: refine paths using morphological operations

Step5: Initialization: Spray *ne* percentage of the populations into the solution space

randomly, and then calculate their fitness values.

Step 7. Move the Onlookers: Calculate the probability of selecting a food source

Step 8. Move the Scouts: If the fitness values of the employed bees do not be improved by a continuous predetermined number of iterations

Step 9. Update the Best Food Source Found So Far

Step 10. Termination Checking otherwise go back to the Step 2.

4. RESULTS

Figure which is shown here shows the paths extracted and the shortest path from source to target from the satellite image using Swarm Intelligence.

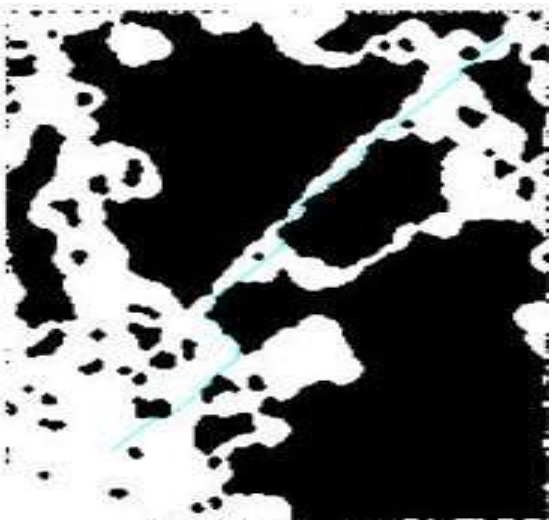

Fig 2: Final safest and shortest path to target

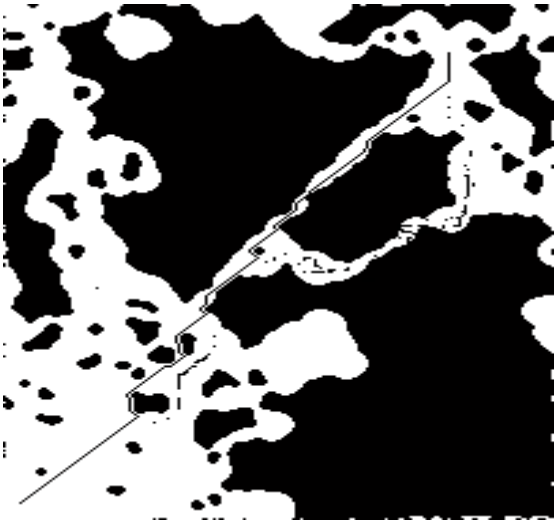

Fig 3: final safest and shortest path to target.

5. CONCLUSION

In the proposed paper , PSO is used for path extraction and BCO is used for finding the shortest path.To make a path more smooth morphological operations were implemented to minimize the effects of shadows, trees and inconvenient areas. It can quickly plan an optimized path even in a complex environment. The results prove that proposed approach effectively extracts the obstacles and finds the shortest and safest path.

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