Efficient ABC Algorithm for Dynamic Path Planning

Priyanka Goel
Department of Computer Science & Information Technology,
Moradabad Institute of Technology
Ram Ganga Vihar, Phase-II
Moradabad, Uttar Pradesh, India

Devendra Singh
School of Computer Engineering and Applications,
Department of Computer Science
IFTM University
Lodhipur Rajput, Delhi Road (NH-24)
Moradabad, Uttar Pradesh, India

ABSTRACT
The path planning of mobile robot is an important issue in the field of robotics. Many algorithms have been designed to solve the path planning problem, including classical as well as intelligent approaches. The main aim of path planning is to construct collision free path from a specified start position to the target position. Moreover, the path should be optimal in some context such as distance, time or processing. This paper presents an efficient algorithm which is a variation of artificial bee colony algorithm. The environment modelled is in the form of grid consisting of obstacles. The algorithm works on two problems- the first problem is to find collision free path in the presence of static obstacles and the second problem is to determine shortest collision free path in the presence of dynamic obstacles.

Keywords
Path planning, efficient, dynamic, optimal

1. INTRODUCTION
Robots are now serving almost every field ranging from domestic assistance to robot-assisted surgery and are taking place of human beings especially for accomplishing various hazardous tasks such as bomb diffusion, manufacturing processes, mining etc. Earlier, the path planning problem used to be studied in the field of robotics but today it has gained importance in other fields such as simulation, computer graphics, geographic information systems, very large scale integrated (VLSI) designing and games. This field remains the core area in many of the robotic applications such as autonomous vehicle designing and perceptive systems. The scope of path planning can be categorized into various streams depending on the problem statement, environment modeled, and types of sensor [1]. The path planning problem can be solved to attain various optimization goals such as minimizing distance travelled, maintaining smooth trajectory or satisfying the clearance requirements [2]. Path planning problem can be solved off-line or off-line. In the first case, the environment and the positions of obstacles are known before determining the feasible path and global view of the environment is analyzed beforehand. In the latter case, local view of the environment and the obstacles is obtained and the path planning is performed using the local information obtained with the help of some sensing device. The traditional algorithms used for path planning have certain limitations such as low search efficiency, complex search paths, large convergence time and trap into local maxima[3-8]. So the interest of researchers switched to intelligent algorithms which are proven to be much better than classical approaches. Many philosophers and researchers have been working for centuries on the problem of social choice. The main interest is to study how different creatures in nature work together in a group to accomplish a task. A branch of nature inspired algorithms which are known as swarm intelligence is focused on insect behavior so as to develop some meta-heuristics which can imitate the way insects used to solve their problems [10-16]. Swarm intelligence consists of many algorithms such as ant colony optimization, particle swarm optimization, wasp nets and fish schools.

Swarm intelligence approaches imitate nature‘s way to find optimal solution. These approaches generate population of solutions for every iteration. All population based approaches follow a strategy that generates variations in the solutions. This strategy may employ greedy criterion or non-greedy criterion to decide which solution to retain. This method selects a solution which increases the value of objective function (assuming the objective function is maximization function).

2. PROBLEM FORMULATION
The proposed algorithm works on two-dimensional environment which is modelled in the form of grid. The grid is discretized in the way that each cell (called as node) is assigned a number so as to simplify the representation of the path. The source and destination positions are chosen by the user. The user is free to place the static and dynamic obstacles and their number is determined by the grid size. The robot is considered to have constant speed in order to determine shortest path [17]. The proposed work in this paper considers following assumptions:

i. Static obstacles have pre specified shape.
ii. Moving obstacles have same speed and their trajectories are in linear direction.
iii. The robot has been considered as a point object to keep the minimum safety distance from the robot to the obstacles.

The proposed work aims to determine the shortest collision free path from the specified source position to the destination position. Each solution generated is termed as path and each path is composed of nodes. The number of nodes in a path is kept fixed for simplification purposes.

3. BEES’ BEHAVIOUR IN NATURE
There are many examples which show perfect coordination and decision making in an animal group. A striking example is the swarm of bees which consists of about 10,000 honey bees. The process involves finding a better nesting site which is performed by dozens of bees together. This process has been studied widely, investigated and examined thoroughly and the conclusion drawn is that this group intelligence is a product of disagreement and contest and not consensus or