An Improved ABC Algorithm for Optimal Path Planning

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Abstract: ***This paper presents an improved algorithm for path planning using Artificial Bee Colony Algorithm. This algorithm is used to find collision free shortest path from the start position to destination. The environment considered here is a two dimensional space consisting of both static and dynamic obstacles. The ABC algorithm used is inspired by the collective behavior of bees to find better food sources around the hive .The path generated by the original algorithm may be shorter but may not be optimized. So, the final path is optimized using triangle inequality method.***

Keywords: path planning, obstacles, collision, Artificial Bee Colony Algorithm, shortest paths

1. Introduction

Today robotics has emerged as a rapidly growing technique that includes research, design and construction of robots. The goal of an autonomous robot is to construct a map of the environment in which it is placed and to localize its position. Thus these should be intelligent and should be capable of determining their actions. The main focus is to make autonomous robots self sufficient while imitating human nature. Thus the designing of robots is very intensive task. Moreover the environment complexity is a specific problem due to its vastness, imprecise and changing nature. The autonomous robots should be capable of recognition, learning and decision making.

Path planning is an important issue in the field of robotics. It is a method to find collision free path from the start location to target location, given an environment consisting of obstacles. The path should be optimized using some reasonable algorithm where the optimization criteria can be time, distance or energy depending on the problem [1].

Path planning can be done in known or unknown environment. It is very difficult task to obtain path in unknown environment since the map of the environment is not certain. Though robots are employed with sensors and global positioning system but due to uncertainty it is not a feasible idea to have detailed plan beforehand. Path planning techniques can be categorized as- classical approaches and intelligent approaches.

Classical approaches include visibility graphs, voronoi diagrams, artificial potential field methods and quad trees. These approaches had certain limitations such as inefficiency in solving larger scale combinatorial and/or highly non-linear problems and their inflexibility to adapt the solution algorithm to a given problem. Generally a given problem is modeled in such a way that a classical algorithm has to make several assumptions which might not be easy to validate in many situations. so, the interest of the scientific community switched to the intelligent techniques such as Genetic algorithms, swarm intelligence approaches. Many of the researchers are inspired by the nature to develop new algorithmic models to solve problems especially in the field of optimization.

A branch of nature inspired algorithms which are known as swarm intelligence are focused on insect behavior so as to develop some meta-heuristics which can imitate the way insects used to solve their problems. Bonabeau has defined swarm intelligence as any attempt to design algorithms or distributed problem solving devices inspired by the collective behavior of social insect colonies and other animal societies [2]. Swarm intelligence consists of many algorithms such as ant colony optimization, particle swarm optimization, wasp nets and fish schools.

2. Literature Survey

Artificial Bee Colony optimization is a population based optimization technique which was first introduced by Karaboga in 2005. It is an algorithmic model to imitate the foraging behavior of bees to solve unconstrained optimization problems with continuous valued domains [3].

In late spring or early summers, bees divide themselves by a process of swarming. This is a process in which the queen and about half the worker bees leave their hive to establish a new colony. Meanwhile a daughter queen and the remaining of the worker bees live in the old hive. When the swarm of bees leaves its parental hive, the bees unite themselves, live on a nearby tree branch and continue searching for a new home.

Bees form colonies that extend over very long distances and in multiple directions in order to exploit food sources. The flower patches containing large amount of nectar that can be extracted with minimum difficulty are visited by most of the bees while the nectar sources with less amount of nectar are discarded. The foraging process begins by scout bees which are sent to collect nectar. The search starts randomly by the scout bees from one patch to another. When the scout bees