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RESEARCH ARTICLE

Robotic Motion and Path Planning Via Iterative Method Using Laplacian Technique

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Abstract -The paper deals with Robot motion and path planning programme. The aim of the paper is to develop a path planning programme for mobile robots that is based on laplacian technique using iterative method. One of the most difficult problems in robotics applications is developing robust autonomous motion planning. In order to build a truly autonomous robot, it must have the capability to efficiently and reliably plan a route from start to the goal point without colliding with obstacles in between. we present an algorithm for path planning to a target for mobile robot in unknown environment. The proposed algorithm allows a mobile robot to navigate through static obstacles, and finding the path in order to reach the target without collision. This algorithm provides the robot the possibility to move from the initial position to the final position (target). The field of robotics is closely related to AI. Intelligence is required for robots to be able to handle such tasks as object manipulation and navigation, with sub-problems of localization (knowing where you are, or finding out where other things are), mapping (learning what is around you, building a map of the environment), and motion planning (figuring out how to get there) or path planning (going from one point in space to another point, which may involve compliant motion – where the robot moves while maintaining physical contact with an object).

Keywords: Mobile robot path planning, Behaviour-Based paradigm, Laplace's equation, Explicit Group, Four Point-EGSOR iterative method, harmonic functions

I. INTRODUCTION

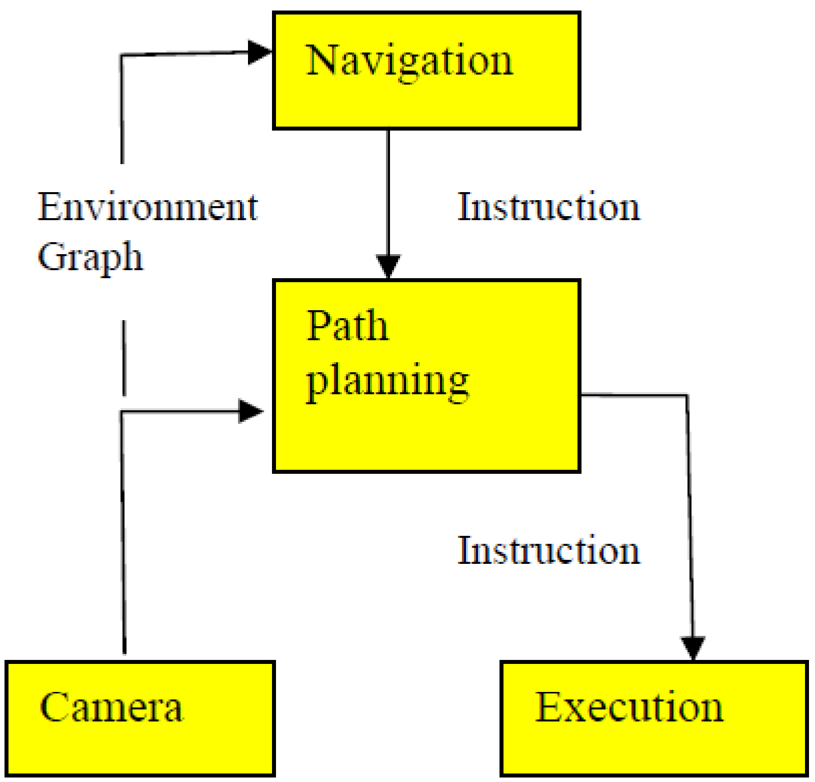
One of the most difficult problems in robotics applications is developing robust autonomous motion planning In order to achieve the wide range of the robotic application it is necessary to provide iterative motions among points of the goals. Many works on this topic have been carried out for the path planning of autonomous mobile robot. Motion planning is one of the important tasks in intelligent control of an autonomous mobile robot. It is often decomposed into path planning and trajectory planning. Path planning is to generate a collision free path in an environment with obstacles and optimize it with respect to some criterion. Trajectory planning is to schedule the movement of a mobile robot along the planned path. We describe two algorithms for static path planning, with the aim of deriving the trajectory that always maximizes the distance of the path from the nearest obstacle.

The two algorithms are:
i) Bubble Algorithm
ii) Geometric Algorithm

Commonly, in order to work out any motion planning system which is used in mobile robotic platform and it is necessary to do the following tasks:

- To familiarize with the essence of motion planning task i.e. to observe the algorithm of classical and modern planning;
- To identify the advantages and disadvantages of the algorithm;
- To select the most relevant algorithm;
- To work out system design .

A typical scenario of robotics motion control is described as the following graph:



The system gets the environment topology information by extracting the vertexes, segments information from the image captured by the camera. Navigation layer (and upper layer such as local strategy and global strategy) is more concerned on the problems such as "where to go". Path planning layer is concentrated on the problems such as "how to go". Intuitively, some classical graphic algorithms can be applied here if we present the proper form of the environment topology information to the system. Execution layer consist of some mechanical device such as motor and the basic control system that can perform the instructions such as forward, turn left and etc.

Path planning algorithms attempt to deal with the problem of establishing a medium of communication between initial and final configurations, so that the robot can traverse the field safely.

II. LITERATURE SURVEY

Lot of work is already done to optimize robotic motion and path planning.. Some of work done by the earlier authors to optimize the routing is described in this section.

Azali Saudi, Jumat Sulaiman[1]proposed a behaviour-based paradigm approach known as Laplacian Behaviour-Based Control (LBBC) for solving path planning problem for a mobile robot operating in a structured indoor environment. Gilberto E.

Urroz[2] illustrate the numerical solutionof the Laplace equation we consider the distribution of temperature in a two-dimensional.Here example is taken on temperature.But we can have good result out here so can be implanted in out thesis.

Christopher I. Connolly and Roderic A. Grupen[3]Harmonic functions are solutions to Laplace's equation. Such functions can be used to advantage for potential field path planning, since they do not exhibit spurious local minima. Harmonic functions are shown here to have a number of properties which are essential to robotics application.

Avadhanula, Vamshi Krishna, Lingala, Narsing Mudhiraj[4] according to we primarily concentrate on control architectures for robot navigation. We classify these architectures into three parts, deliberative – which stores configured space information to determine appropriate path across the configured space, reactive system – which have no information about space (i.e. world space) and uses sensors and set of rules for safe navigation and neural network systems that make use of neural network to determine the navigation path.

James Bruce, Manuela Veloso[5] proposed that the path-planning problem is as old as mobile robots, but is not one that has found a universal solution. Specifically, in complicated, fast evolving straints, these methods suffer from the lack of lookahead, which can lead to highly non-optimal paths and problems with oscillation.

Benoit Vanholme[6] The legal safety concept proposes to base driving system design on traffic rules. This allows fully automated driving in traffic with human drivers, without necessarily changing equipment on other vehicles or infrastructure. The driving system uses traffic rules to predict legal or non legal trajectories of objects in its perception zone and worst-case objects outside its perception zone.

Vera Bazhenova [7] Find a sequence of valid configurations that moves the robot from the source to destination.

Azali Saudi, Jumat Sulaiman[8] This paper proposed a behaviour-based paradigm approach to the path planning problem of a mobile robot utilizing fast iteration technique to compute the configuration space rapidly. The technique employs Laplacian Behaviour-Based Control (LBBC) for robust exploration of the configuration space of the robot. The LBBC relies on Laplace's equation that constraint the potential function in the configuration space of the robot

Azali Saudi1, Jumat Sulaiman[9] proposed the solutions of Laplace's equation also called harmonic functions that represent temperature values distribution in the configuration space will be used to simulate the generation of path for mobile robot motion. In the past, various approaches had been used to obtain harmonic functions, but the most common method is via numerical techniques due to the availability of fast processing machine and their elegant and efficiency in solving the problem

Real-Time Path Planning for Humanoid Robot Navigation **Jens-Steffen Gutmann Masaki Fukuchi Masahiro Fujita[10]** gives that Path-planning is one of the fundamental problems in mobile robot navigation. It has been shown long before that the problem of moving an object through space is *PSPACE-hard* with a time complexity exponential in the degrees of freedom of the object

O.Hachour [11] This present work, we present an algorithm for path planning to a target for mobile robot in unknown environment. The proposed algorithm allows a mobile robot to navigate through static obstacles, and finding the path in order to reach the target without collision. This algorithm provides the robot the possibility to move from the initial position to the final position (target). The proposed path finding strategy is designed in a grid-map form of an unknown environment with static unknown obstacles. The robot moves within the unknown environment by sensing and avoiding the obstacles coming across its way towards the target.

N.I.M. Fauzi and J. Sulaiman[12]. In this paper, iterative methods particularly a family of Successive Over Relaxation (SOR) methods are used to solve system of linear equations generated from discretization of second-order two-point boundary value problems through cubic spline approaches

P. Svestka and M. H. Overmars[13] The robot path planning problem, which asks for the computation of collision free paths in environments containing obstacles, has received a great deal of attention in the last decades. In the basic problem, there is one robot present in a static and known environment, and the task is to compute a collision-free path describing a motion that brings the robot from its current position to some desired goal position. Variations and extensions of this basic problem statement are numerous.

III. PROPOSED WORK

We are using much method earlier for robot path planning. Earliest we use Grid-Based Search, Interval-Based Search, Sampling-Based Algorithms etc. All have fine accuracy but its path is not smooth. EGSOR ITERATIVE METHOD USING four -POINT LAPLACIAN to make it path smoother. But somehow there need smoother path. For more smooth movement of robots we need higher level of calculation required. We are using EGSOR ITERATIVE METHOD USING NINE-POINT LAPLACIAN. It give much smoother path for Robots.

IV. RESEARCH METHODOLOGY

Laplacian Behaviour-Based Control Traditional approach robot programming assumes the availability of a complete and accurate model of the robot and its environment, relying on planners to generate actions [16]. Unfortunately, this approach has several disadvantages. One main drawback is that they require huge amounts of computational resources. This drawback is much obvious for an autonomous mobile robot that must carry its own computational resources. Secondly, this approach must be based on highly accurate model, thus it requires a number of high-precision sensors which are also often expensive. These sensors, however, are subject to noisy data. Finally, this sense-plan-act paradigm is by nature sequential, thus it would fail if the world happens to change in between of phases. Furthermore, there is always delay between sensing and act, due to longer time required in planning. As an alternative to the traditional approach, a new paradigm called subsumption architecture, also known as behaviour-based control, is devised [17]. In this architecture, sensors are dealt with only implicitly in that they initiate behaviours. Each behaviour is simply layers of control systems that all run in parallel. Higher level behaviours have the power to temporarily suppress lower level behaviours. Therefore, a set of priority scheme is used to resolve the dominant behaviour for a given scenario. A more rigorous explanation of behaviour-based approach for controlling robot is presented in [18]. In this work, inspired by the behaviour-based paradigm approach to robotics control, the searching algorithm employs Laplacian Behaviour-Based Control (LBBC) for robust space exploration of the configuration space. The LBBC comprises four core behaviours i.e. *keep-forward*, *follow-wall*, *avoid-obstacle*, and *find-slope*. All these core behaviours make use of the potential values represented by temperature distribution in the configuration space which are computed numerically to provide guidance during search exploration.

A. Keep-Forward Behaviour

The *keep-forward* behaviour is a core behaviour that keeps the searching moving forward in the same direction as long as the temperature at current location is higher than the next location. When the searching encounters ascending slope, flat region, obstacles or walls, the *keep-forward* behaviour stops, and other behaviours would take over. The main aim of this behaviour is to guide the searching by following the descending slope until the goal location is found.

B. Follow-Wall Behaviour

The *follow-wall* behaviour provides the search with the capability to follow the wall for a specified number of steps. With this behaviour, it will command the searching to keep turning gradually until its direction is parallel with the wall. It provides the searching with the capability of traversing the narrow path and sharp corner. In this implementation, the *follow-wall* behaviour is executed for every a specified number of steps. After that the searching switches to *find-slope* behaviour.

C. Avoid-Obstacle Behaviour

When the searching hits an obstacle or wall, it will trigger the searching to backup and turn 90 degrees to the left or right alternately. By turning alternately to the left and right, it provides the searching with the capability to escape from a difficult position such as sharp corner.

D. Find-Slope Behaviour

When the *find-slope* behaviour takes over, it will command the searching to move randomly hoping to encounter a descending slope that consequently triggers *keep-forward* behaviour. With this behaviour, the searching is capable of moving away from a flat region to continue its descending move towards goal location.

V. ALGORITHM

1. Initialize velocity vectors $\mathbf{c}(i,j) = 0$ for all (i,j).

2. Let k denote the number of iterations. Compute values u^k, v^k for all pixels (i,j)

$$u^k(i,j) = \overline{u}^{k-1}(i,j) - f_x(i,j)\frac{P(i,j)}{D(i,j)}$$
$$v^k(i,j) = \overline{v}^{k-1}(i,j) - f_y(i,j)\frac{P(i,j)}{D(i,j)}$$

   The partial derivatives f_x, f_y, f_t can be estimated from the pair of consecutive images.

3. Stop if

$$\sum_i \sum_j E^2(i,j) < \varepsilon$$

   where ε is the maximum permitted error; return to step (2) otherwise.

VI. RESULT

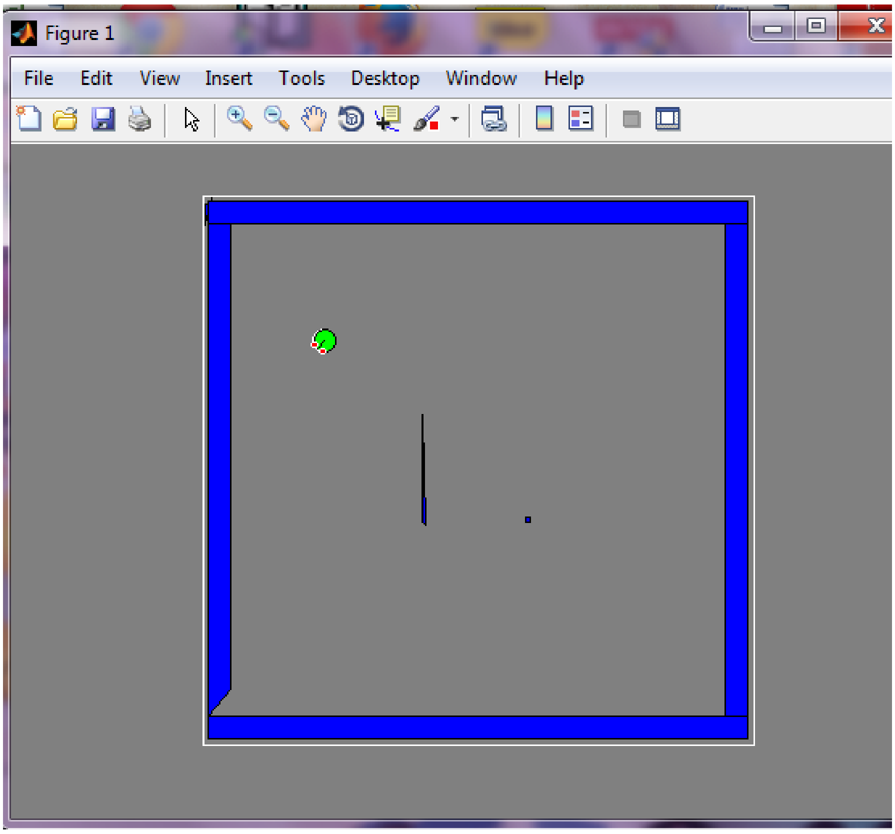


Fig1 . Motion of robot in level1 robot move without colliding with obstacle

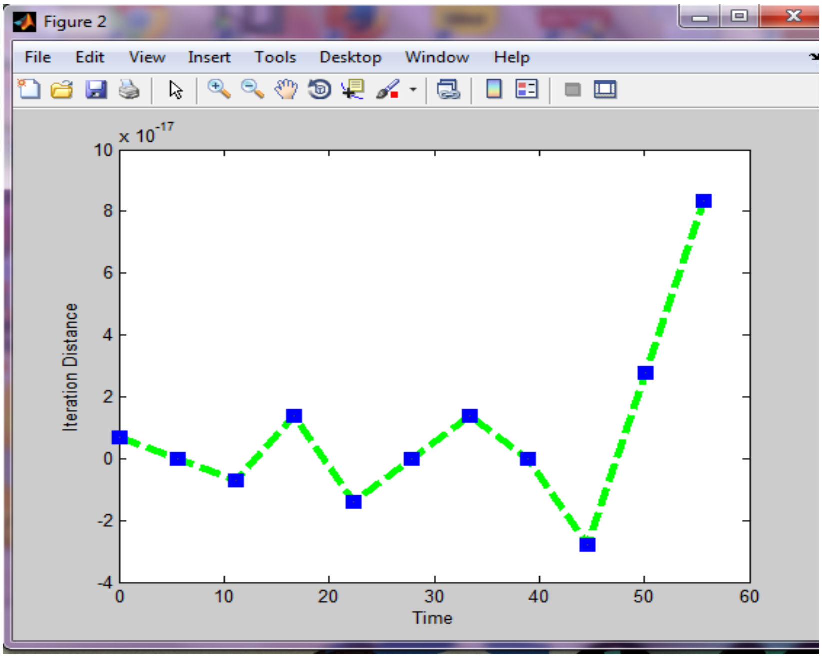


Fig2 . No. of iteration in level 1 using 9point laplacian

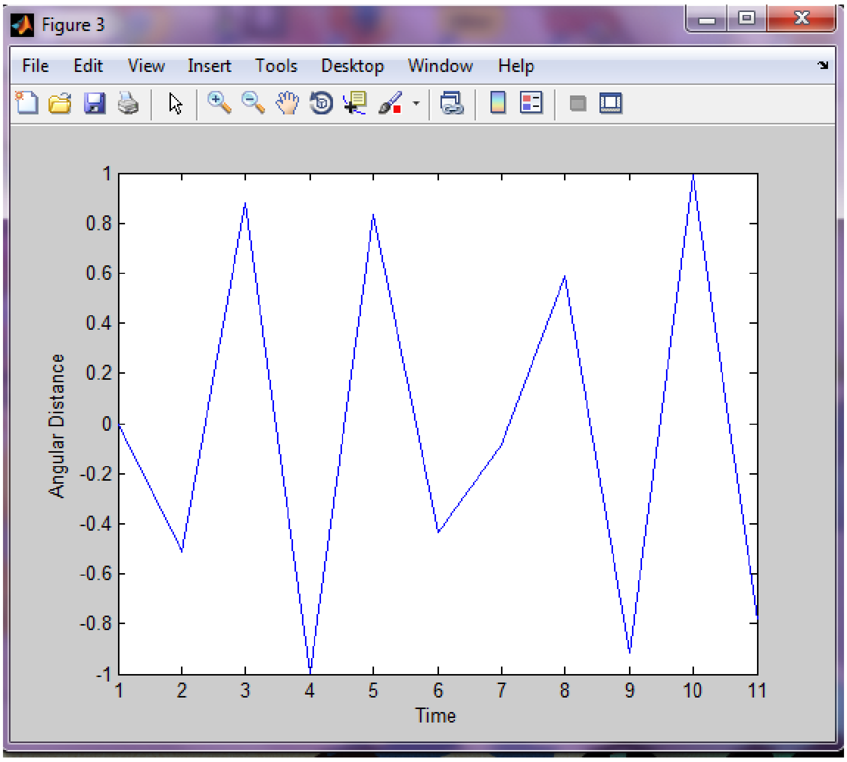


Fig3. . Frequency of robot motion in level 1

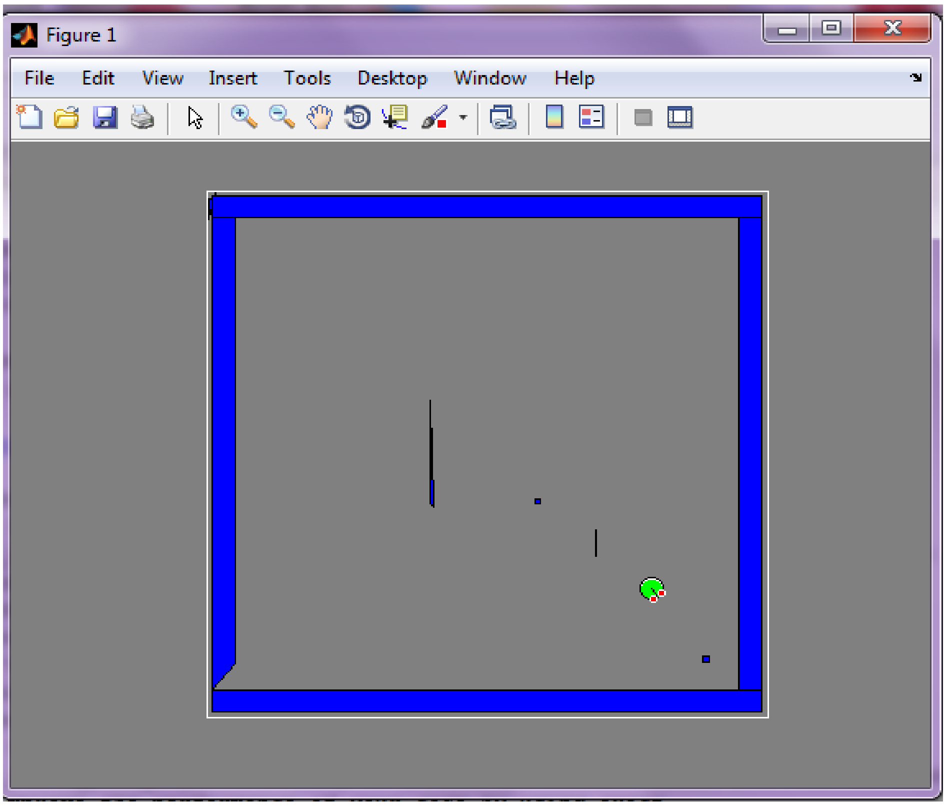


Fig4. Motion of robot without coilding with obstacle in level 2

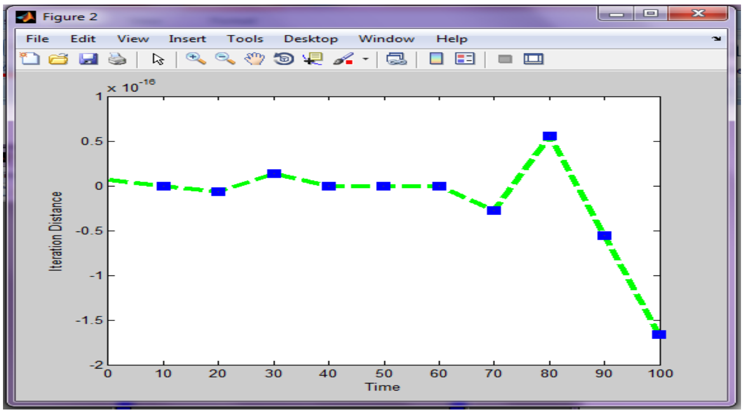


Fig5. Iteration of above robot motion in level2 using 9 point laplacian

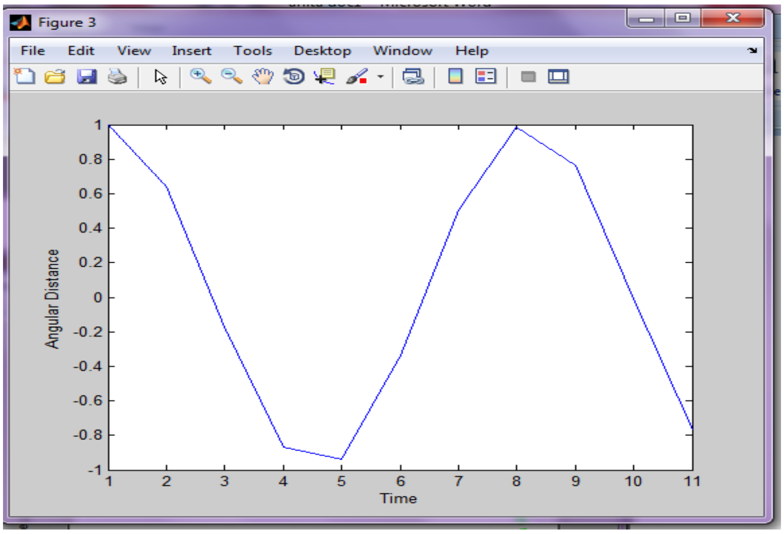


Fig.6 Frequency of above robot motion

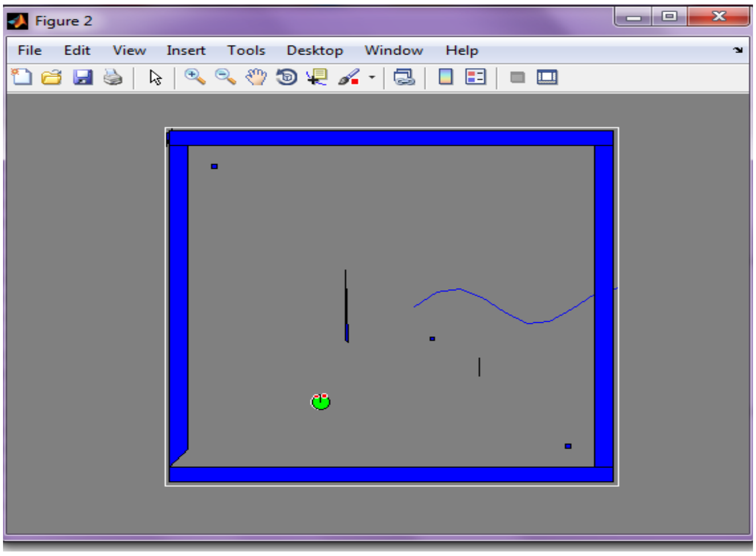


Fig7. Motion of robot with in different obstacle. It move without coilding With obstacle.

CONCLUSIONS

We use various algorithms exist trying to solve this problem but all have shortcomings. The difficulty is due to the complexity of path planning problem, where it increases exponentially with the dimension of the configuration space. We use Nine point laplacian method to get appreciable result and path complexity is been reduced. Here we also use of some geometrical analysis to reduce its path complexity. EGSOR ITERATIVE METHOD USING NINE-POINT LAPLACIAN. It give much smoother path for Robots. It proved to be very fast compared to the previous iterative methods.

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