Autonomous Motion Planning for a Maze Navigator Robot Using the Self and Non-Self Immunity Discrimination

T. S. Chingtham[1], **G. Sahoo**[2], **and M. K. Ghose**[3]

Abstract: Autonomous navigation and path planning for a robot in an unknown environment is a challenging situation especially when there is little or no information available for the path to be taken to accomplish the task. This paper describes two different approaches for a robot to find a shortest path in a maze. The two different techniques viz., Artificial Immune System and RRT, resolve the robot to reach its goal using the shortest path in the shortest time span. Natural Immune System has fascinated mankind for a very long time until recently when it was embraced as a promising area of computational Intelligence owing to the resilient results it has proved in the field of computation. The natural immune system comprises of various components. The two main components are the innate and the adaptive or acquired immune response. The innate response forms the first line of defense e.g., the skin, and act as a protective layer for the body cavity from external agents. While the adaptive or the acquired immunity is much more complex and only metaphors of this immunity concept have been used in computational techniques. The work described herein, is an allegory of the concepts of the Self and Non-Self discrimination paradigm of the natural immune system, deployed to obtain the localization information of the robot in the real world. The point of locality is the position in which the robot is currently located and its subsequent position is generated based on this position of the robot until it reaches the final goal. In the second algorithm, a sampling based motion planning algorithm known as advanced Rapidly exploring Random Tree (RRT) as it excels in exploring free space in the environment is deployed. This algorithm has a bias towards the goal and hence the convergence of this algorithm is fast. It biases the randomized generation of points towards unexplored regions. The paper also describes simulation such that a robot placed in a maze should navigate towards a goal, avoiding all the obstacles that lies in its path and stops on reaching its goal. The real world robot test bed comprises a maze through which the robot navigates avoiding all the obstacles and finally finding its goal which is a lighted candle in this case. The simulation result is validated by putting on a robotics test bed that searches a light in a maze like environment and the lighted candle is put out. The algorithms used will find its application in path planning of unknown environments. The immune algorithm yields better result in terms of time taken to accomplish the task.

[1,3] Department of Computer Science & Engineering, Sikkim Manipal Institute of Technology
Majitar, Rangpo, East Sikkim District, Sikkim - 737132, India
chingtham@gmail.com, mkghose@smuhmts.edu

[2] Department of Information Technology
Birla Institute of Technology, Mesra, Ranchi, Jharkhand, India
gsahoo@bitmesra.ac.in