University of Girona

Spain

Autonomous Robotics
Lab 4 - Rotational Plane Sweep Algorithm (RPS)

Submitted by :
Nayee Muddin Khan DOUSAI

1 Introduction

In this lab, we are going to implement and discuss the implementation details of a visibility graph. We are using the rotational plane sweep (RPS) algorithm for this type of problem. For the building of RPS we will need vertices of all the given polygon obstacles. All the implementation code is written in MATLAB.

2 Rotational Plane Sweep Algorithm

Rotational Plane Sweep Algorithm basically starts with a starting position and mentioning about a end position. Once we have the positions we will search for the visible vertices from this location. The first position is also called as the first vertex and the end position as end vertex. We have to find the edges of all the given polygons in an environment at first. This algorithm can be followed in different steps as Sorting the Nodes, Checking the visibility and at the end updating the edges list.
For sorting the nodes in RPS algorithm we will find the angles from the current vertex. We will check all the vertex angles and save them, this is sorted in ascending order. Once the angles are arranged in order the number of vertices are obtained for processing because we will continue the algorithm with the next vertex. The next thing is to initialize the S list which contains the edge numbers which intersect the node line. To obtain this list we will draw a horizontal line on the right side of the obstacle edges. The list is sorted in terms of the distance of the edges from the current vertex or node.
Once we initialize the S list we will check for the visibility of the nearest vertex. We then check the vertex with the least angle with the current vertex and check all the edges that intersect or obstruct the path. All the edges that intersect are added to the S list. This process is repeated for all the vertices according to their angle with the current vertex and the S edges lists are updated accordingly. Once we find all the visible vertices we will end the process.
After the visible vertices we will update the edges list. Even the edges which are not included in the vertex list are added to the edges list as being considered with visibility graph. We will draw the polygons in the below sections, the red line is marked as visibility graph for the given environment where as blue lines are considered as obstacles. The goal and end positions are marked with black and green stars respectively.

3 Results

For this section, we are considering a small environment with two polygons. The environment is constructed by the given vertices from the document.

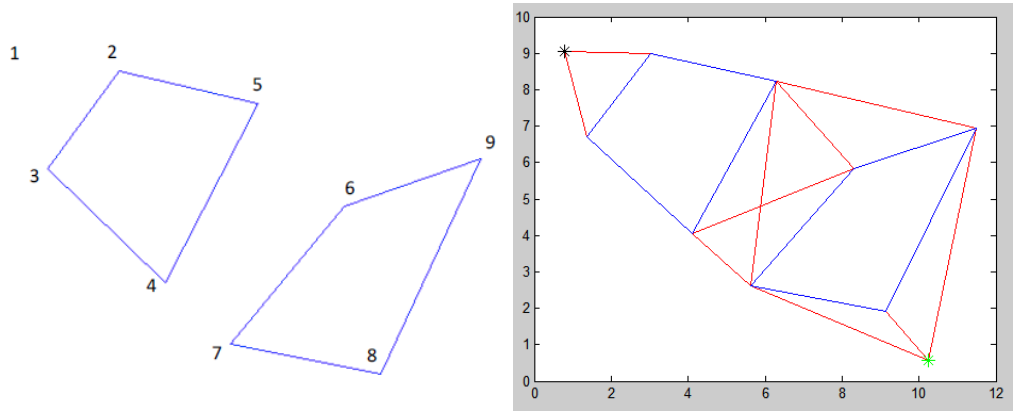
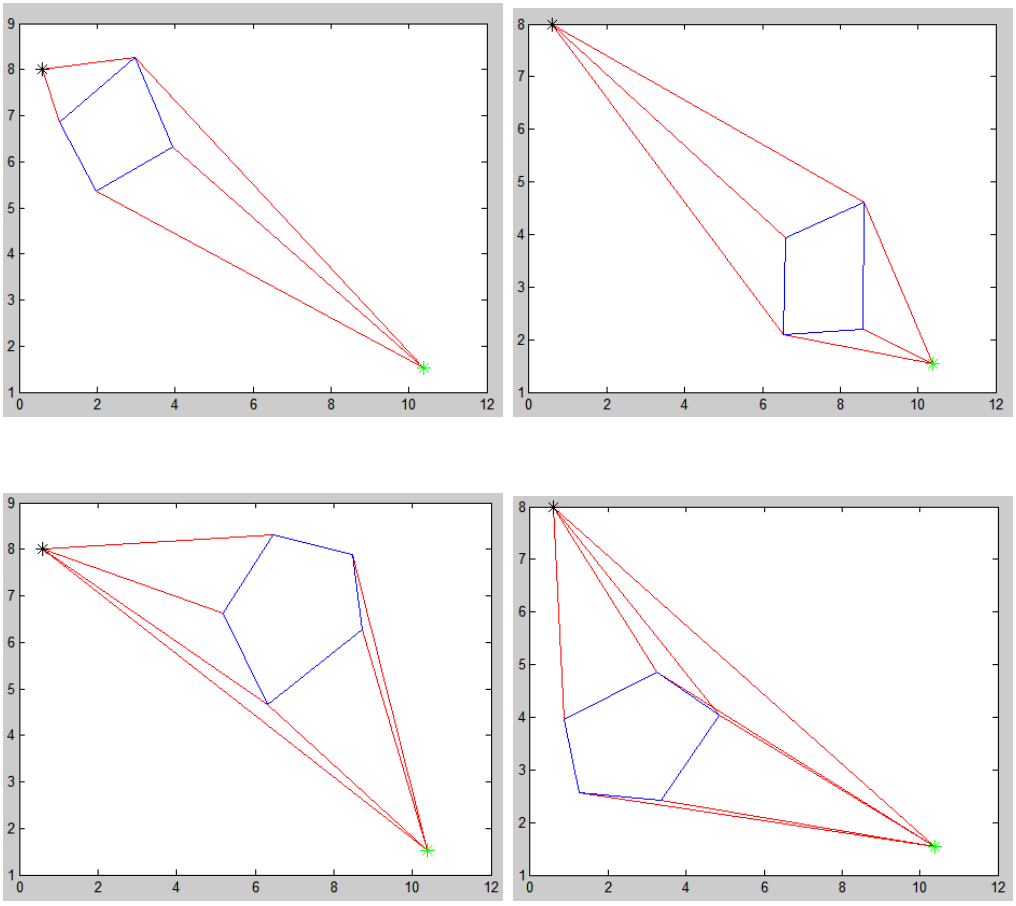


Figure 1: RPS Algorithm for the given small environment



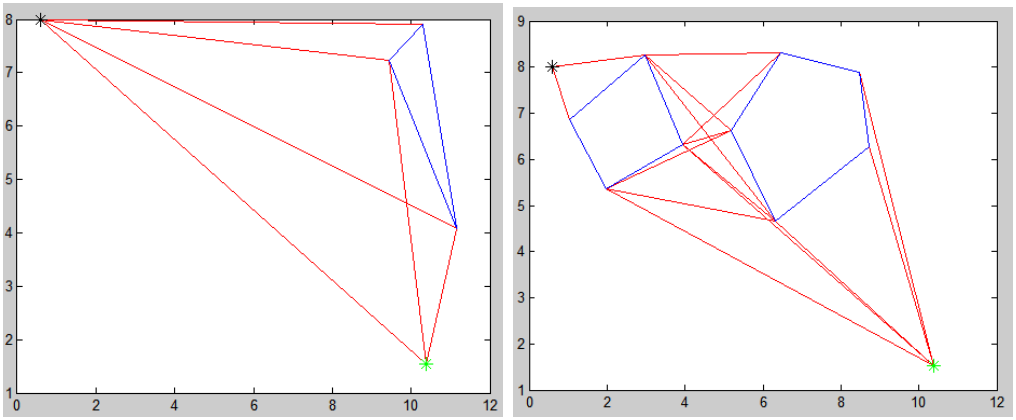


Figure 2: Planned visibility graph for different polygons using RPS Algorithm

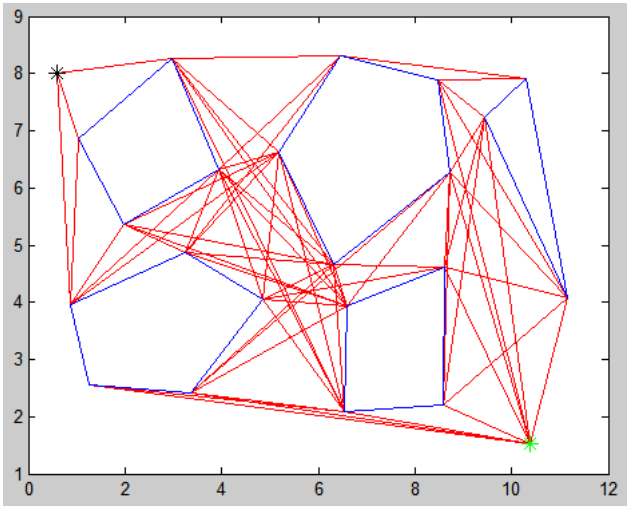


Figure 3: Visibility graph drawn for the given polygons using RPS Algorithm

4 Conclusion

In this lab, we have implemented RPS algorithm for visibility graph for the given polygons. The results are evaluated and labelled in graph and the attached matlab files. It has implemented on small and large environments.The RPS algorithm limitation is, it can be applied on the obstacles which ahs the polygon type environment and it can't be implemented on cylinder type obstacles.