Rapidly-Exploring Random Tree (RRT) Quick Start Guide

Author: Nikolai D. Petsev

DESCRIPTION

This program uses a rapidly-exploring random tree (RRT) algorithm to search a 2D space with geometry/obstacles defined in a user-supplied input file. RRTs represent a Monte Carlo path planning approach with bias towards the largest Voronoi regions in a given configuration space. RRTs work by iteratively sampling new states, and subsequently growing branches extending from the nearest existing nodes towards these new states. After completing the RRT search, the program visualizes the generated tree and corresponding Voronoi cells, and writes its nodes to a dump file.

FILES

- **constraints.py**
- **lattice.py**
- **rrt_main.py**
- **rrt_search.py**
- **vertex.py**

REQUIREMENTS

- Python 3.0 or above
- NumPy
- Matplotlib
- SciPy

GETTING STARTED

The main program script is executed as

```
python rrt_main.py <input file> <output file> <nsamples>
```

In this command:

<input file> - name of file containing space/obstacle geometry

<output file> - name of file for dumping final tree nodes

<nodemax> - the number of nodes that the RRT should generate

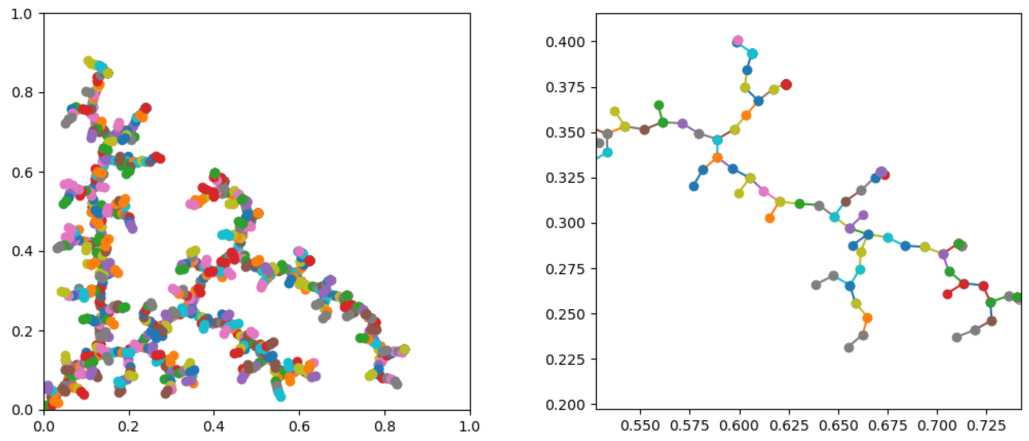
For example, we can generate a tree with 1000 nodes inside a triangular space using

```
python rrt_main.py triangle.txt nodes.txt 1000
```

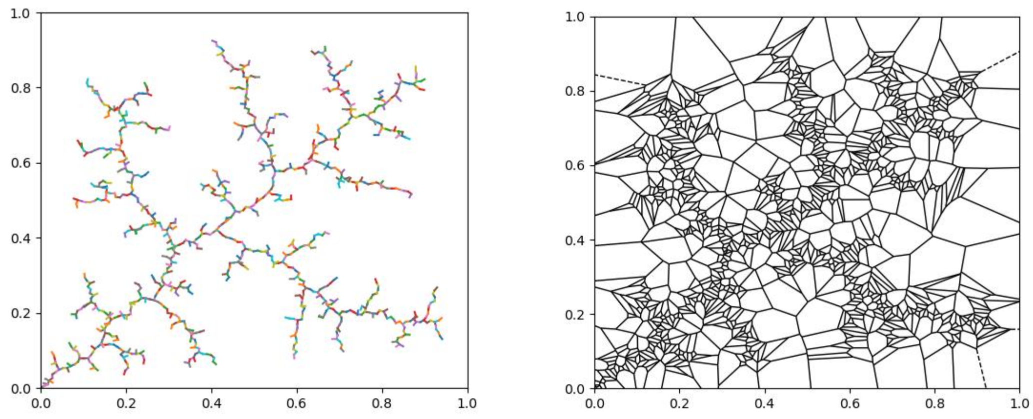
Search space must be defined on the intervals $x \in [0,1]$ and $y \in [0,1]$. The following input files for different geometries are provided:

- **square.txt**
- **triangle.txt**
- **circle.txt**
- **circle_full.txt**

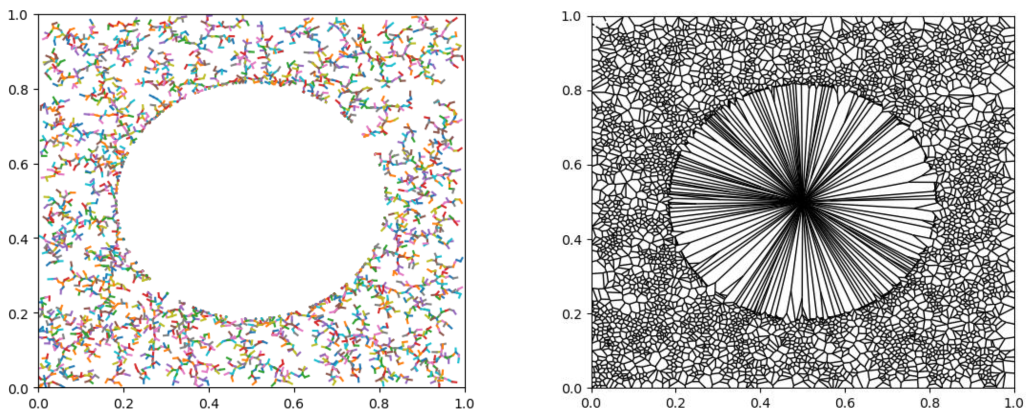
OUTPUT



Visualization 1 - RRT in a triangular space, where the tree begins at the origin. The plot on the right-hand-side is a zoomed-in visualization of one of the branches. These examples use nodemax = 1000 and growth rate of 0.1.



Visualization 2 - RRT exploring a square space without obstacles. The right-hand-side figure shows the corresponding Voronoi regions. Additional branches added to this tree will be biased towards unexplored regions (i.e., the largest Voronoi cells).



Visualization 3 – Large RRT (nodemax = 5000) in a space with a circular obstacle. The right-hand-side is the corresponding Voronoi diagram for this case where the tree has thoroughly explored the available space.