Chapter 2.2 Report for A* planning algorithms by ROS

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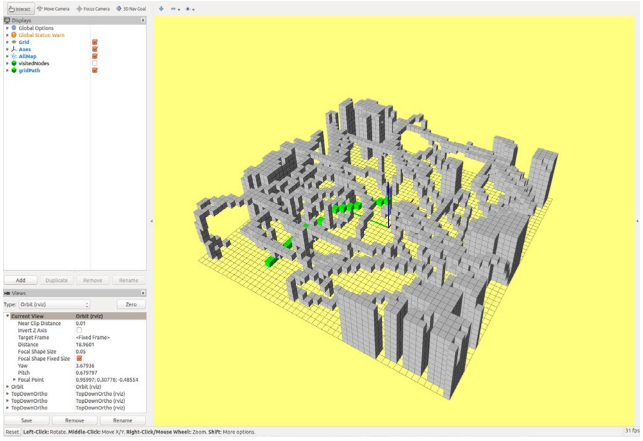
1. Algorithm Flowchart

When the main() function in demo_note.cpp calls "_astar_path_finder->AstarGraphSearch(start_pt, target_pt);", the planning function receive the start and end points of planning task.

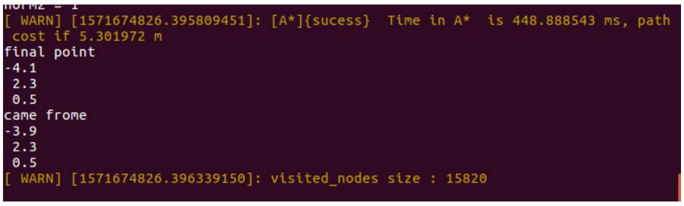
Then the "AstarGraphSearch" fuction in "Astar_searcher.cpp" start.

a) Recode current time time_1
b) Initial the start point pointer startPtr
c) Main loop for expanding
    a) if open list is empty or reach the goal, finish the cicle
    b) get the minimum f node from the open list, delete it and mark it as visited
    c) get all the neighbours of current node
    d) decide whether to put the neighbours to the open list or change the g value in the open list
d) Get current time time_2 and print the search time
e) Track the path back from the terminatePtr to the start
f) Show the path at RVIZ interface

2. Planning Results



```
Current View           Orbit (rviz)
  Near Clip Distance   0.01
  Invert Z Axis        □
  Target Frame         <Fixed Frame>
  Distance             18.9601
  Focal Shape Size     0.05
  Focal Shape Fixed Size ☑
  Yaw                  3.67936
  Pitch                0.679797
  Focal Point          0.95997; 0.30776; -0.48554
Orbit                  Orbit (rviz)
TopDownOrtho           TopDownOrtho (rviz)
TopDownOrtho           TopDownOrtho (rviz)
TopDownOrtho           TopDownOrtho (rviz)
```



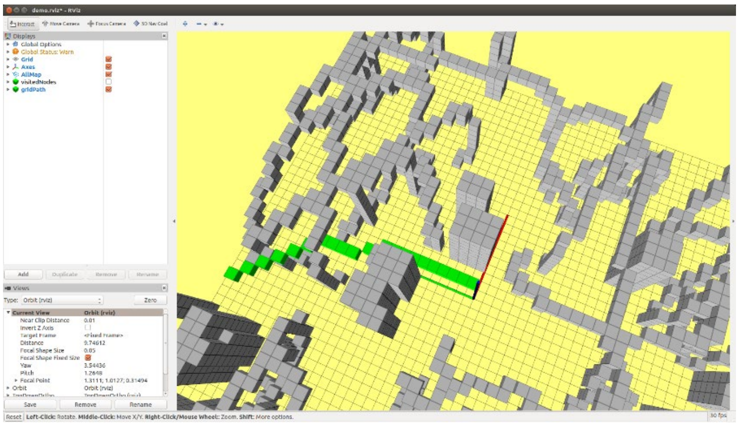
```
[ WARN] [1571674826.395809451]: [A*]{sucess}  Time in A*  is 448.888543 ms, path
 cost if 5.301972 m
final point
-4.1
 2.3
 0.5
came frome
-3.9
 2.3
 0.5
[ WARN] [1571674826.396339150]: visited_nodes size : 15820
```

3. Comparison of different heuristic functions for the performance of A star planning

Goad: -1.0 4.0 1.5

3.1 Euclidean

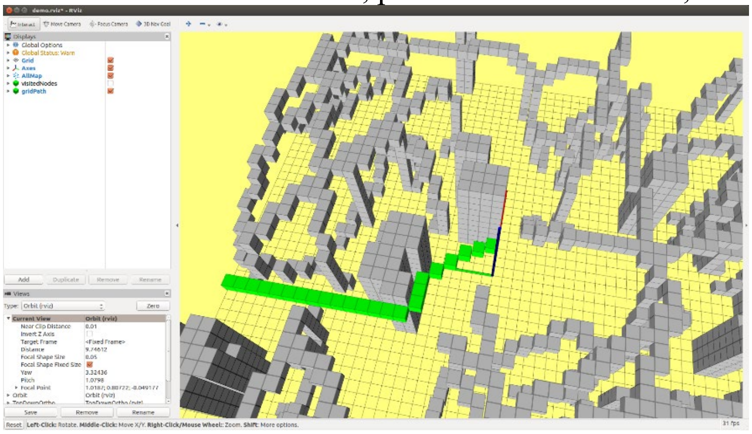
Time in A* is 42.324343 ms, path cost is 4.789877 m, visited_nodes size : 14642



```
Type: Orbit (rviz)
Current View            Orbit (rviz)
  Near Clip Distance    0.01
  Invert Z Axis         □
  Target Frame          <Fixed Frame>
  Distance              9.74612
  Focal Shape Size      0.05
  Focal Shape Fixed Size ☑
  Yaw                   3.54436
  Pitch                 1.2648
  Focal Point           1.3111; 1.0127; 0.31494
Orbit                   Orbit (rviz)
Left-Click: Rotate. Middle-Click: Move X/Y. Right-Click/Mouse Wheel: Zoom. Shift: More options.
```

3.2 Manhattan

Time in A* is 0.297402 ms, path cost is 5.024191 m, visited_nodes size : 22

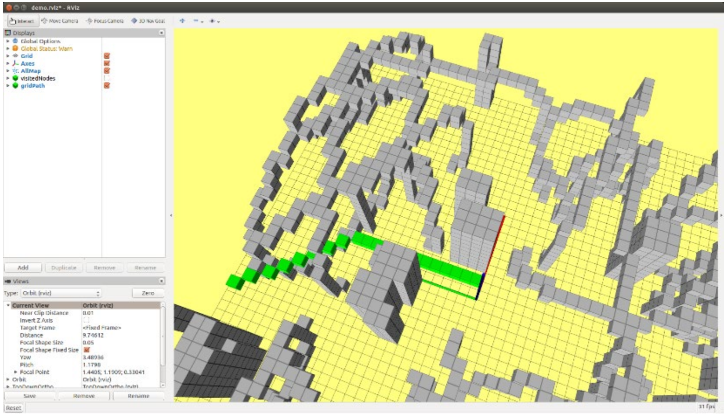


```
Type: Orbit (rviz)
Current View            Orbit (rviz)
  Near Clip Distance    0.01
  Invert Z Axis         □
  Target Frame          <Fixed Frame>
  Distance              9.74612
  Focal Shape Size      0.05
  Focal Shape Fixed Size ☑
  Yaw                   3.32436
  Pitch                 1.0798
  Focal Point           1.0187; 0.80722; -0.049177
Orbit                   Orbit (rviz)
Left-Click: Rotate. Middle-Click: Move X/Y. Right-Click/Mouse Wheel: Zoom. Shift: More options.
```

Fast, but does not get optimal result, due to over estimate of distance and lead to inadmissible.

3.3 Diagonal Heuristic

Time in A* is 43.626084 ms, path cost is 4.789877 m,   visited_nodes size : 4642



```
Type: Orbit (rviz)
Current View            Orbit (rviz)
  Near Clip Distance    0.01
  Invert Z Axis         □
  Target Frame          <Fixed Frame>
  Distance              9.74612
  Focal Shape Size      0.05
  Focal Shape Fixed Size ☑
  Yaw                   3.48936
  Pitch                 1.1798
  Focal Point           1.4405; 1.1909; 0.33041
Orbit                   Orbit (rviz)
```

The visited node will be much less

3.4 The effect of Tie Breaker

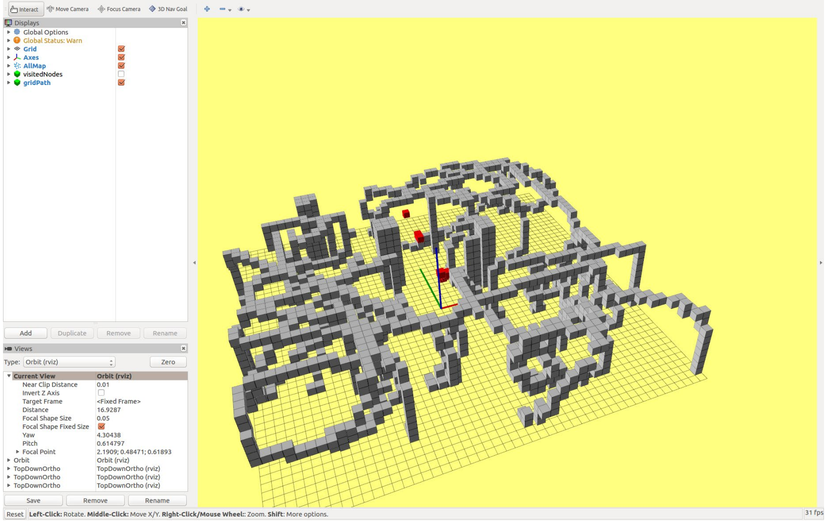
Further reduce the visited node size for open area.

4. The comparison of A* and JPS (when to use A* and when to use JPS)

Randomly selected two goal points from the map. It is shown that the JPS is faster and has less visited nodes.

```
 [A*]{sucess}  Time in A*  is 29.629715 ms, path cost is 2.892820 m, visited_nodes size : 7137
[JPS]{sucess} Time in JPS is 1.745710 ms, path cost if 2.892820 m visited_nodes size : 129
```

```
[A*]{sucess}  Time in A*  is 6.634882 ms, path cost is 3.175663 m, visited_nodes size : 1323
[JPS]{sucess} Time in JPS is 6.469833 ms, path cost if 3.175663 m visited_nodes size : 286
```



- Global Options
- Global Status: Warn
- Grid ☑
- Axes ☑
- AllMap ☑
- visitedNodes ☐
- gridPath ☑

Type: Orbit (rviz)

Current View	Orbit (rviz)
Near Clip Distance	0.01
Invert Z Axis	☐
Target Frame	<Fixed Frame>
Distance	16.9287
Focal Shape Size	0.05
Focal Shape Fixed Size	☑
Yaw	4.30438
Pitch	0.614797
Focal Point	2.1909; 0.48471; 0.61893
Orbit	Orbit (rviz)
TopDownOrtho	TopDownOrtho (rviz)
TopDownOrtho	TopDownOrtho (rviz)
TopDownOrtho	TopDownOrtho (rviz)

Left-Click: Rotate. **Middle-Click:** Move X/Y. **Right-Click/Mouse Wheel:**: Zoom. **Shift:** More options.