Lazy_theta_star - a deterministic 3D path planner

Margarida Faria

Acknowledgments

MarineUAS - Doctoral Program

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Margarida Faria[1] mfaria@catec.aero

Ivan Maza[2] imaza@us.es

Antidio Viguria[1] aviguria@catec.aero

[1] Center for Advanced Aerospace Technologies, Sevilla, Spain

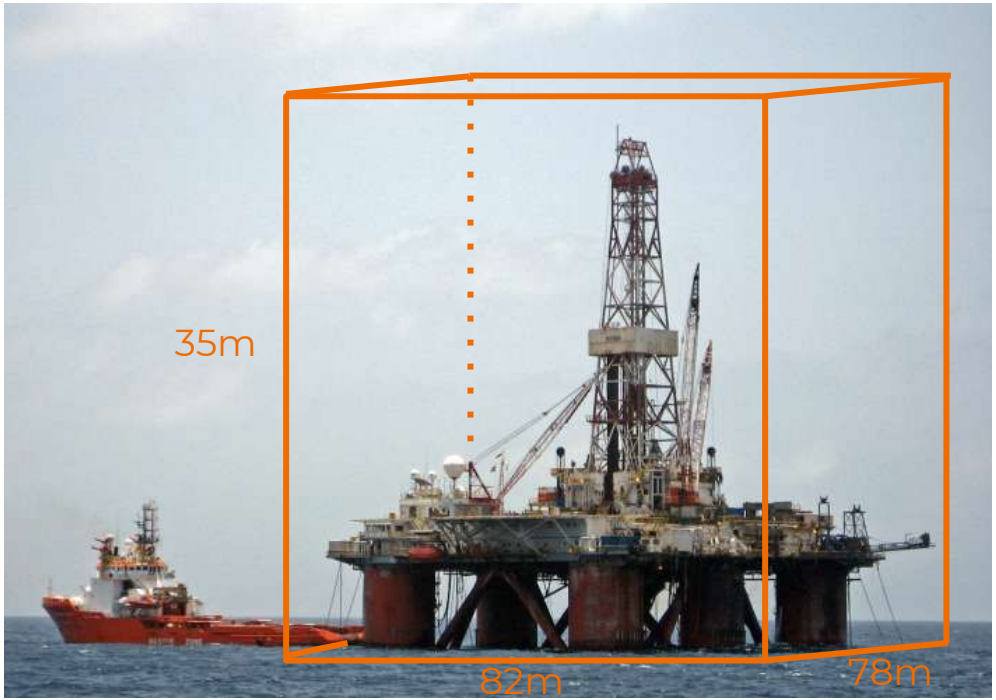
[2] Robotics, Vision and Control Group, University of Seville, Spain

Why another planner?

Standards @ https://xkcd.com/927/

Apply when:

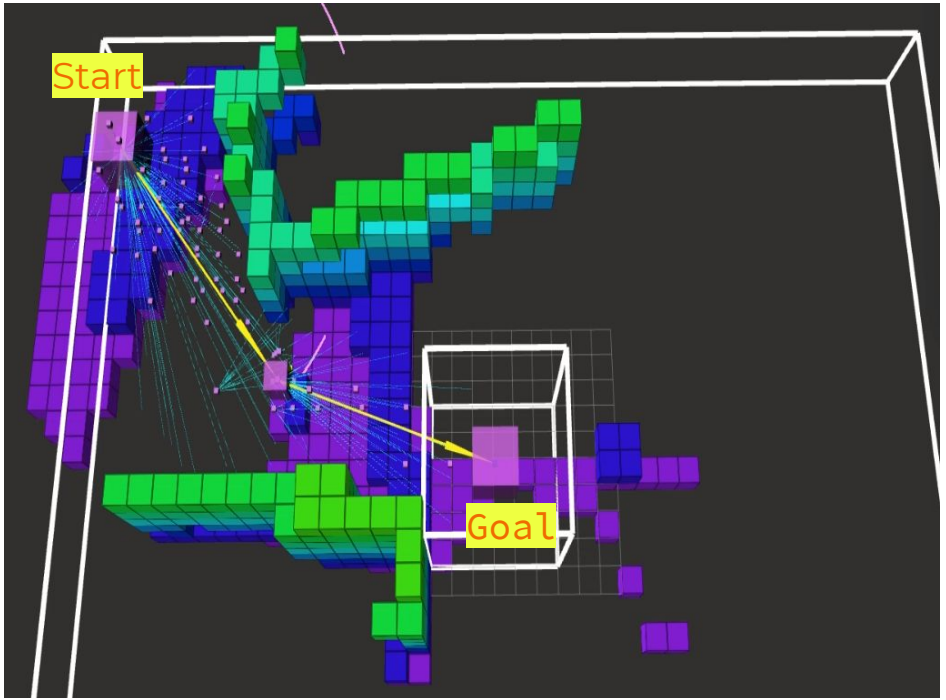
- Large scale: Paths of **100** times the map resolution.
- Repeatability, deterministic
- Online & Onboard UAVs
- 3D



Actinia oil rig @http://www.shipspotting.com/photos/middle/3/2/3/448323.jpg

Usage example

Video at
https://drive.google.com/open?id=15VBqKcMIVNcNrZC9pK9w9MgziomsYE2E



How to use it

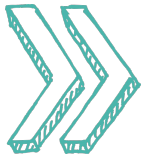
```
<launch>

    ...

    <node name="lazy_theta_star" type="ltStar_async_node"
                                 pkg="path_planning" output="screen" />

    ...

</launch>
```

https://github.com/margaridaCF/FlyingOctomap_code

How to use it

Input Topic

std_msgs/Header	header
int16	request_id
geometry_msgs/Point	**start**
geometry_msgs/Point	**goal**
int32	**max_time_secs**
float32	**safety_margin**

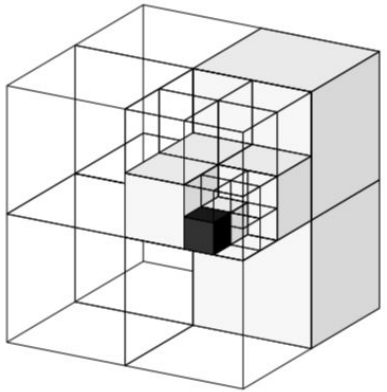


Output Topic

std_msgs/Header	header
uint32	request_id
bool	**success**
uint32	**waypoint_amount**
geometry_msgs/Pose[]	**waypoints**

Octomap

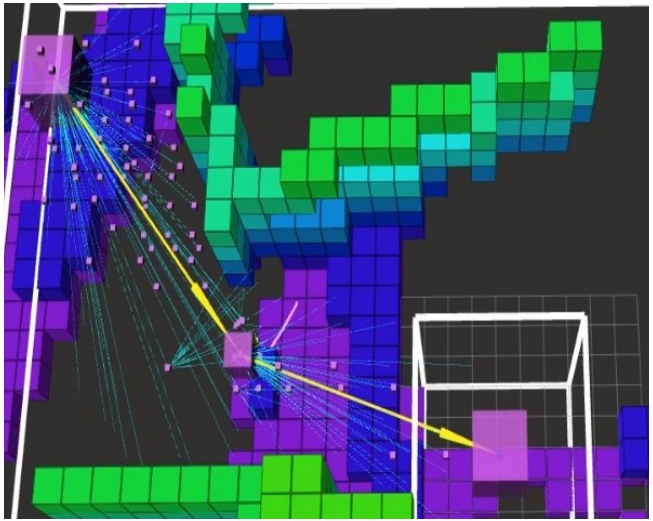
- **Multi-resolution**: merge same state voxels
- **Suitable states**: Free / Occupied / Unknown
- **Light structure**
- **Obstacle avoidance**
- **3D**

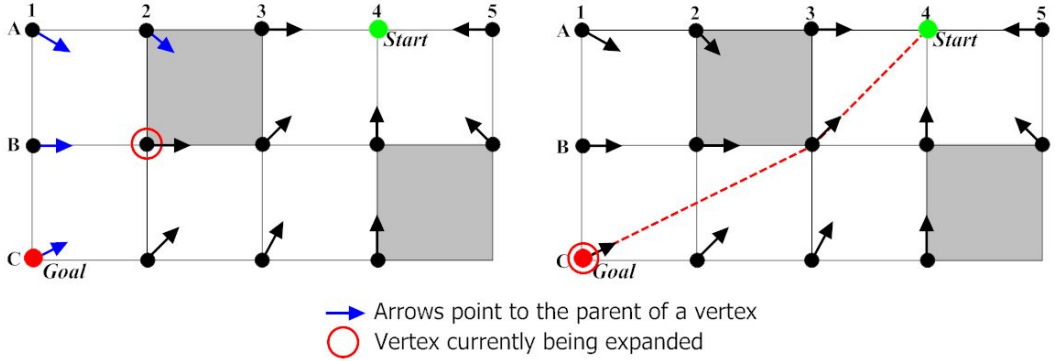


A. Hornung, K. M. Wurm, M. Bennewitz, C. Stachniss, and W. Burgard, “OctoMap: An efficient probabilistic 3D mapping framework based on octrees,”

Lazy Theta *

A. Nash and S. Koenig and C. Tovey (2010). Lazy Theta*: Any-Angle Path Planning and Path Length Analysis in 3D. Proceedings of the AAAI Conference on Artificial Intelligence

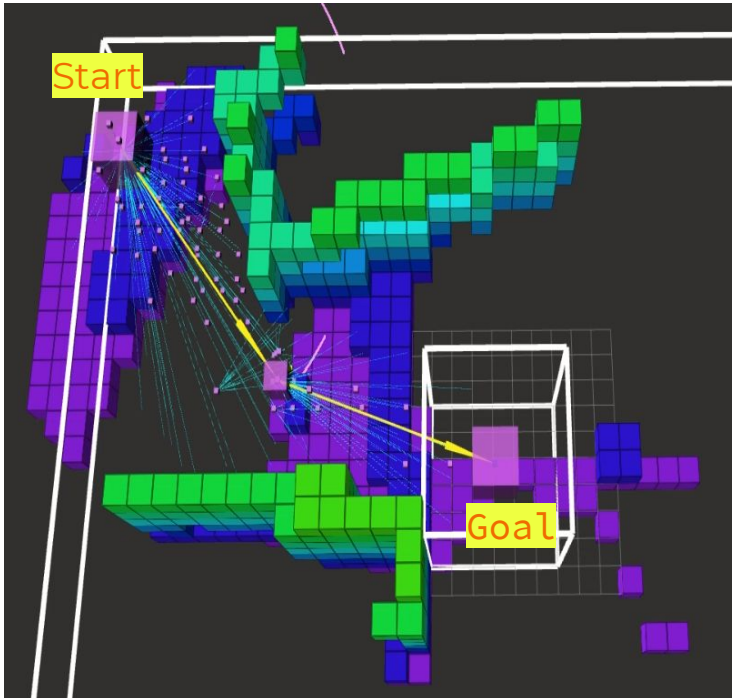


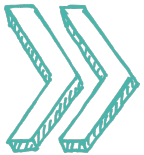


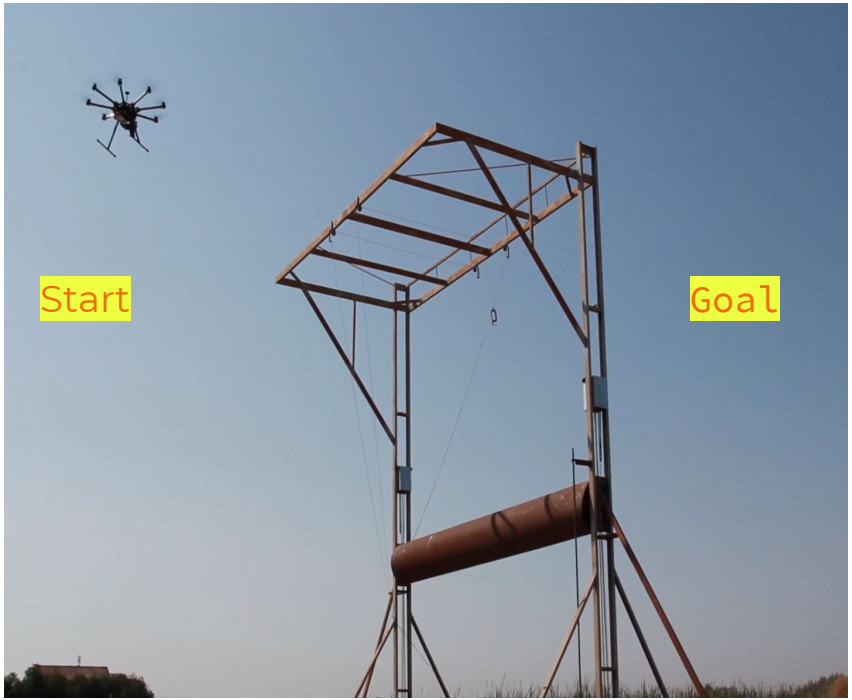
http://aigamedev.com/wp-content/blogs.dir/5/files/2013/07/lazy_trace.png

- **Any-angle**: smoother paths
- **Lazy**: Minimum line of sight checks

Path planning with Lazy Theta *







References

- ★ A. Nash and S. Koenig and C. Tovey (2010). Lazy Theta*: Any-Angle Path Planning and Path Length Analysis in 3D. Proceedings of the AAAI Conference on Artificial Intelligence
- ★ Hornung, A., Wurm, K. M., Bennewitz, M., Stachniss, C., & Burgard, W. (2013). OctoMap: An efficient probabilistic 3D mapping framework based on octrees. Autonomous Robots, 34(3), 189–206.
- ★ Faria, M., Maza, I., & Viguria, A. (2018). Applying Frontier Cells Based Exploration and Lazy Theta* Path Planning over Single Grid-Based World Representation for Autonomous Inspection of Large 3D Structures with an UAS. Journal of Intelligent & Robotic Systems.

Proposal video at https://youtu.be/EMfS2lRTAZY