Implementing Lazy Theta Star over octrees

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Acknowledgments

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Exploring large structures

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Scaling the challenge

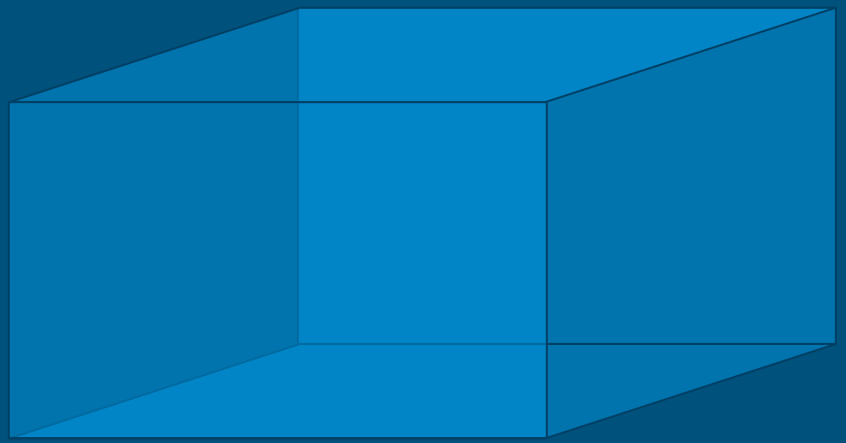
Large volumes
Complex composition

What points to visit?

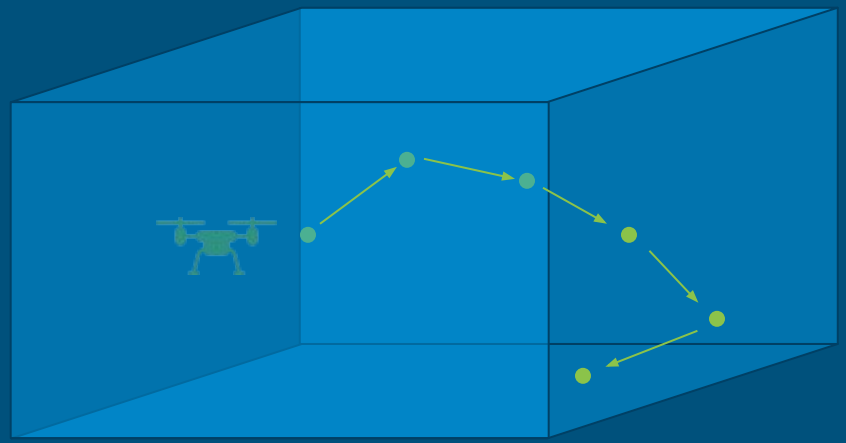
Photo @ https://en.wikipedia.org/wiki/Oil_platform

What goes in & What comes out

In: Volume to explore &
Data collection specification



Out: Online dynamic waypoint sequence for full coverage & **Point cloud** of volume



Why? Structure evaluation

Photo from 3D reconstruction of a damaged school during Tainan earthquake in 2016 using VisualSFM (DJI:0010)

Of any kind

Photo by Harald Pettersen/Statoil

The big picture

Architecture

Frontier points

Waypoint sequence

Trajectory

Data storage

Sensors & platform

Architecture

Frontier points

Waypoint sequence

Trajectory

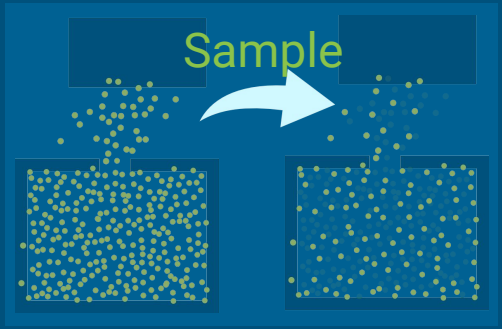
Data storage

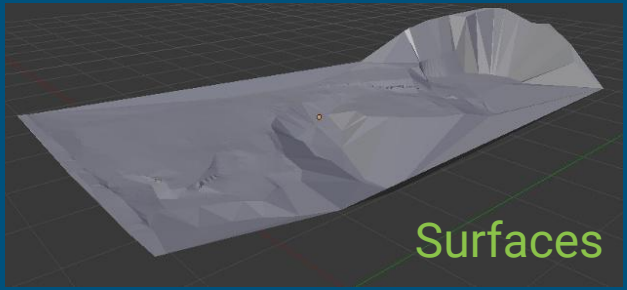
Sensors & platform

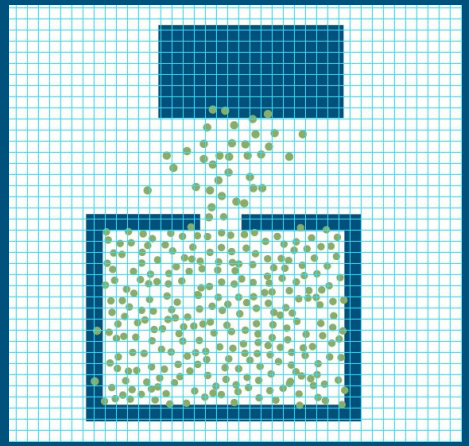
How to store the data

Storage space
Access speed
Organization

Survey of available options

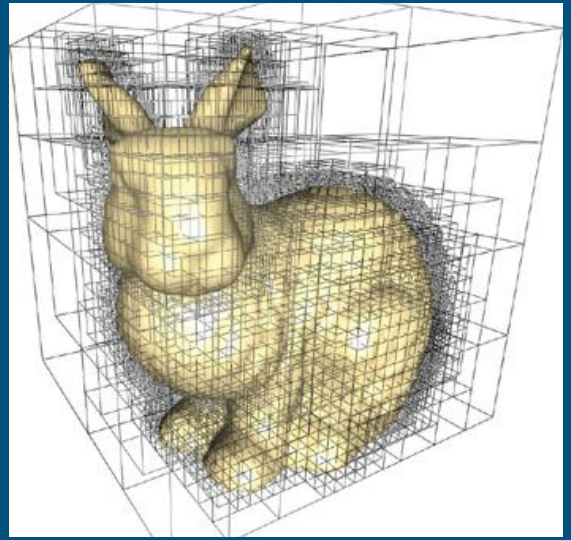






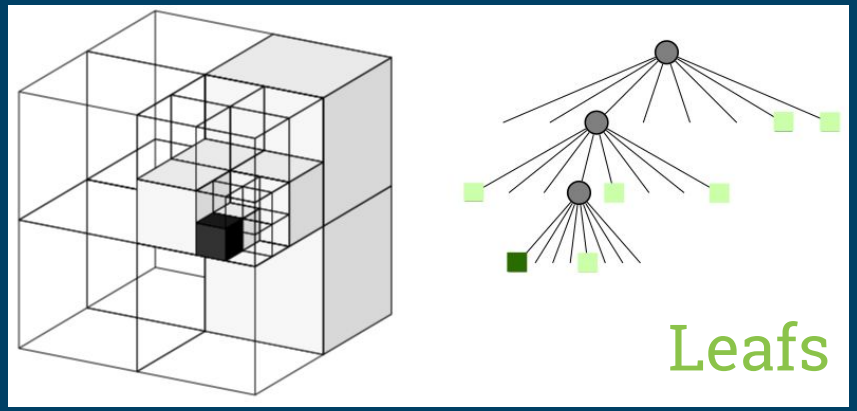
Regular grids

Sparse grids



Selected: Sparse Tree

- Space state: free, occupied or unknown
- Probabilistic integration of points
  => low storage
- Organization



Adapted from A. Hornung, K. M. Wurm, M. Bennewitz, C. Stachniss, and W. Burgard, “OctoMap: An efficient probabilistic 3D mapping framework based on octrees,” Autonomous Robots, vol. 34, no. 3, pp. 189–206, 2013

Architecture

Frontier points

Waypoint sequence

Trajectory

Data storage

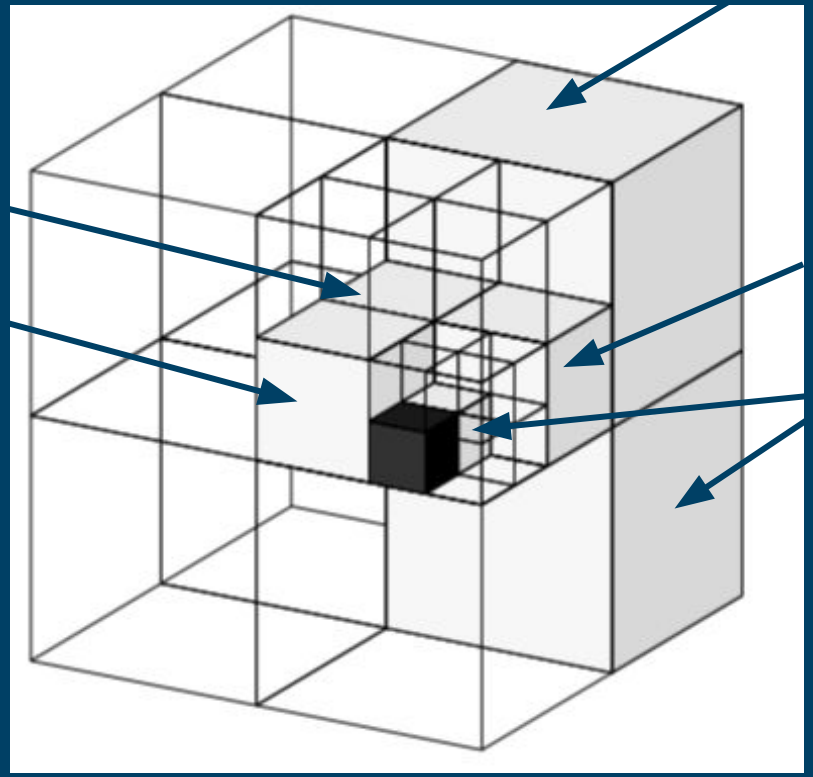
Sensors & platform

Exploring an unknown environment.

Finding points with new information

Frontier points

- Known
- Free
- Have unknown neighbors



Exploration frontier

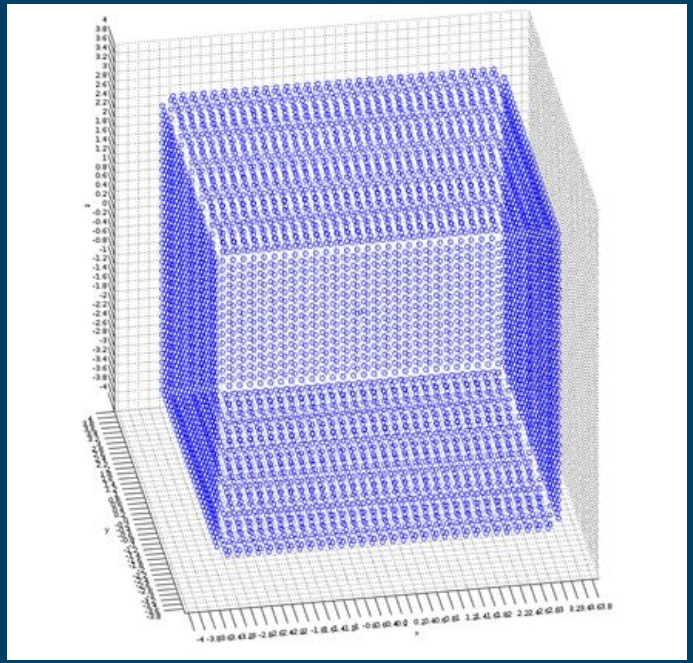
Regular Grid

Sparse grid

- Obstacle
- Free space
- Frontier cell
- Unknown

Neighbors

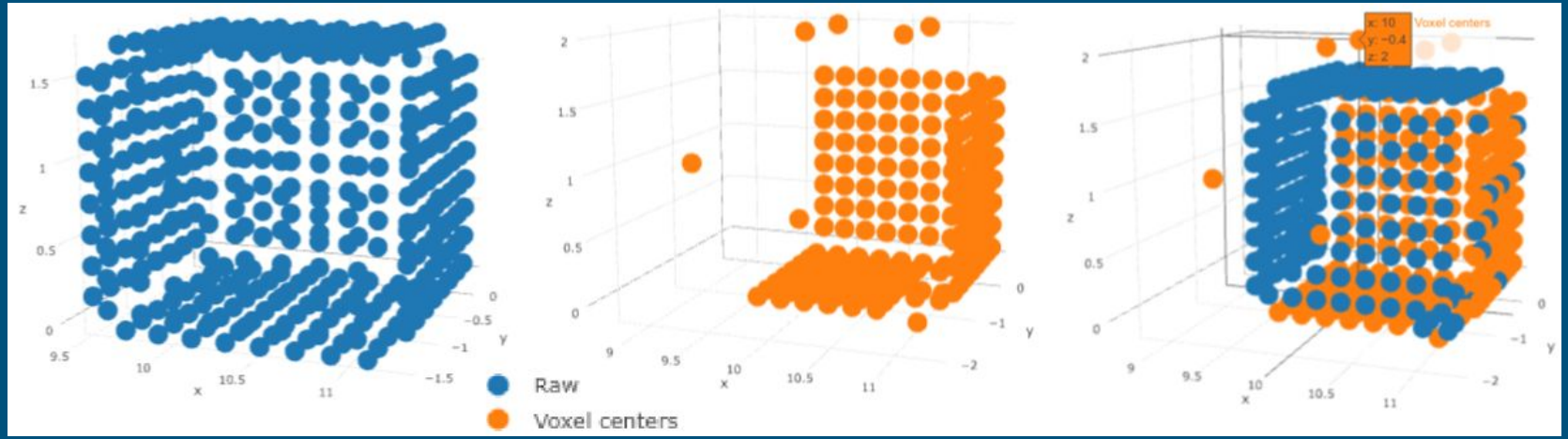
Evaluate for each, variable size cell



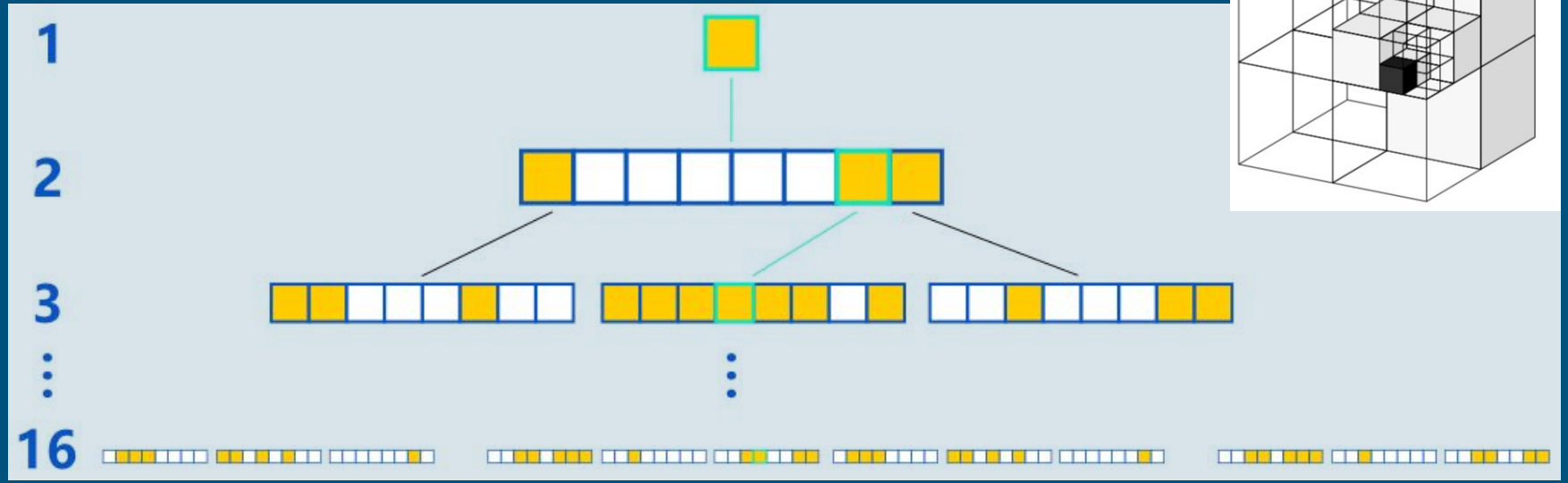
Covers 32 768 maximum resolution cells

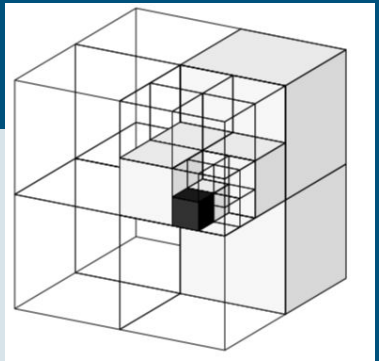
Has up to 6 148 neighbours

Neighbors - Evaluate for each, variable size cell



Neighbors - Find tree depth to find node size





Architecture

Frontier points

Waypoint sequence

Trajectory

Data storage

Sensors & platform

Getting to the frontier

Breaking down the path

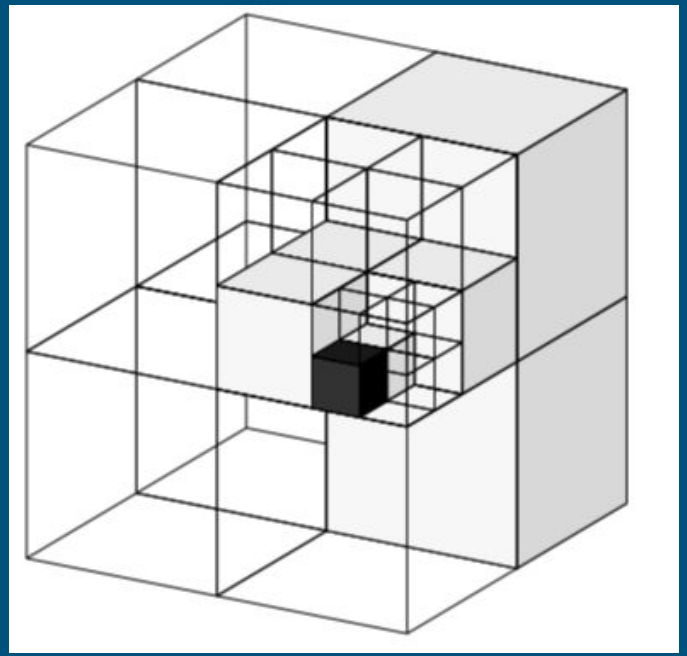
Lazy Theta *

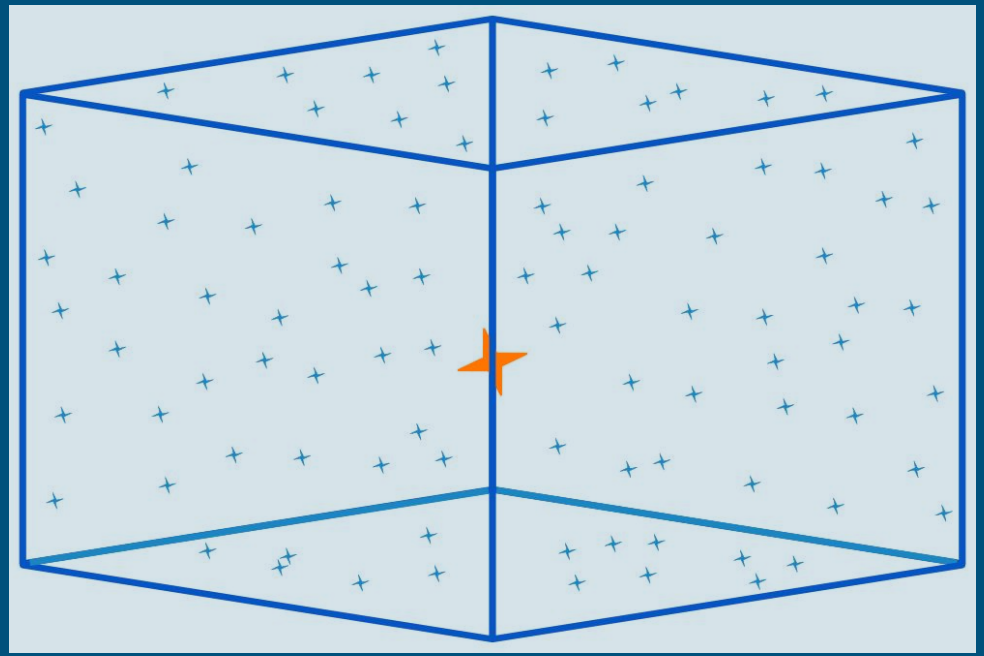
From games to robotics

World representation requirements:

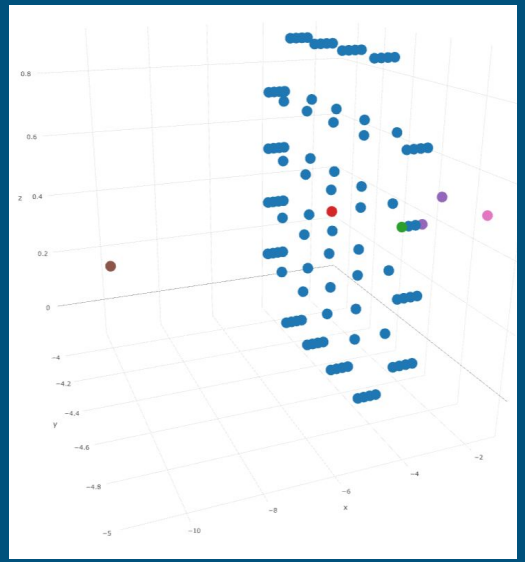
- Random access
- Cell size
- Cell identification

Lazy Theta * - Cell Identification

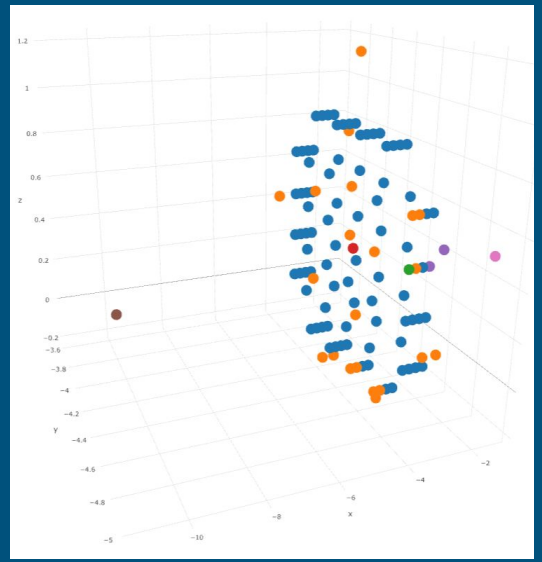




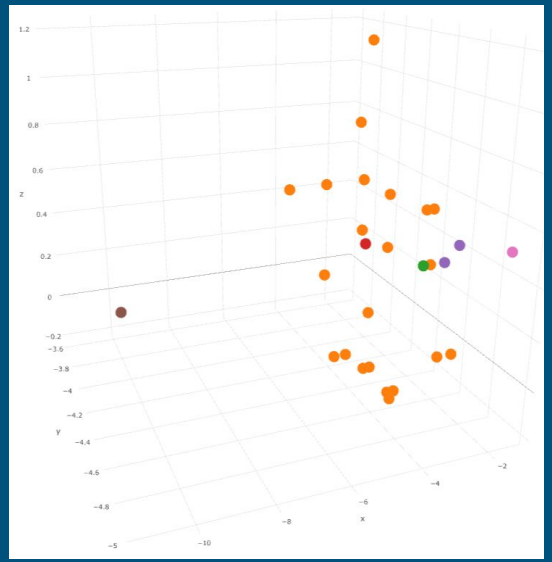
Lazy Theta * - Neighbours sparse grid



Neighbours using regular grid.

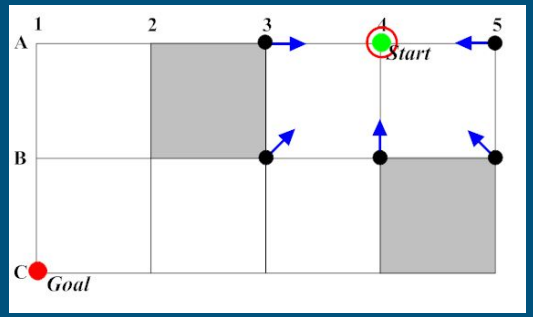


Neighbours using both regular and sparse grid.



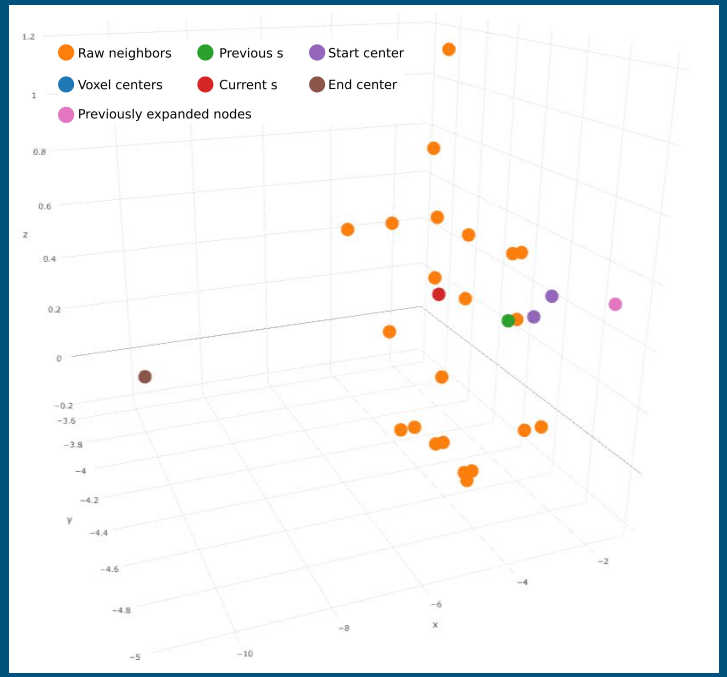
Neighbours using sparse grid.

Lazy Theta * - Iteration samples

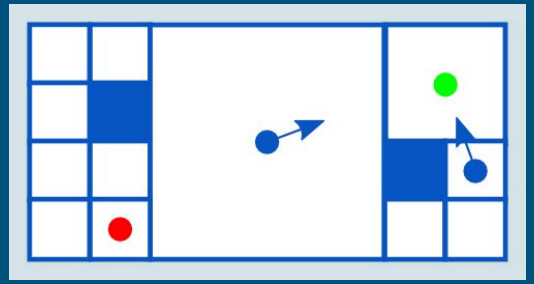


Alex J. Champandard,
AiGameDev Lazy Theta*,
Faster Any-Angle Path Planning

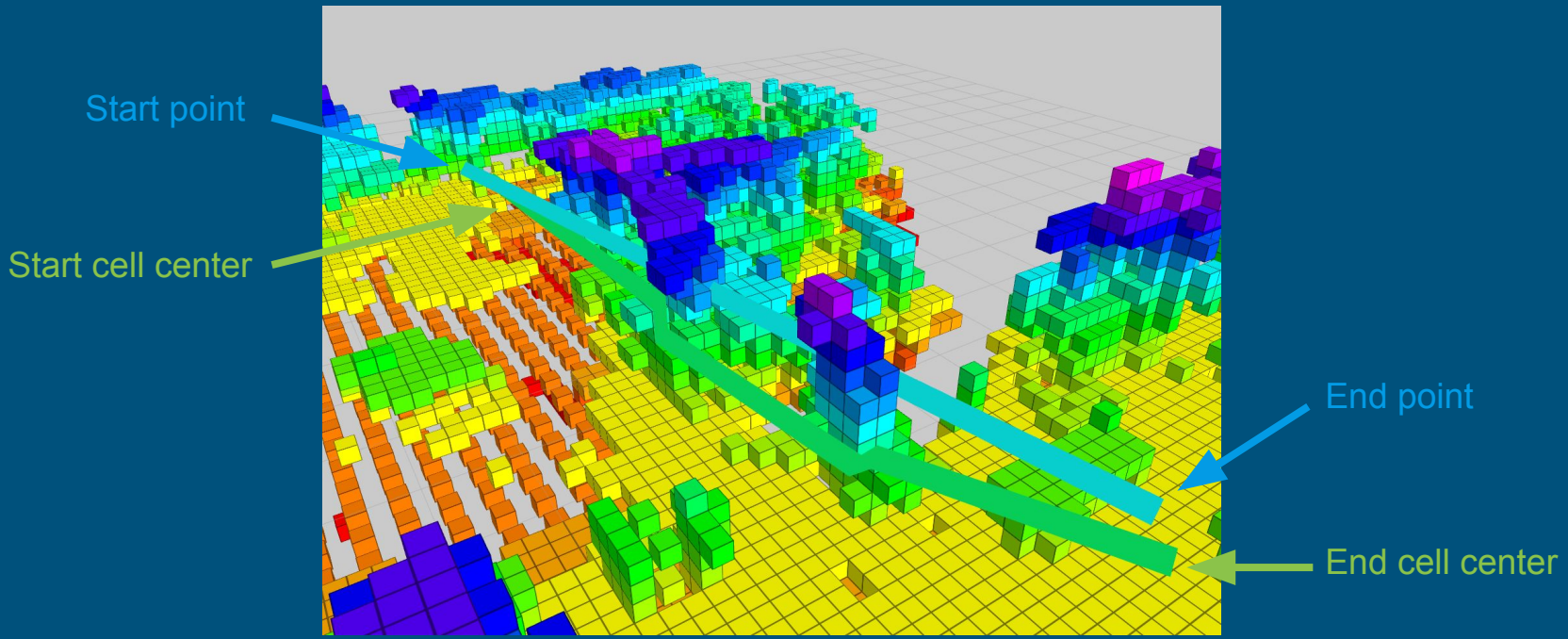
3D



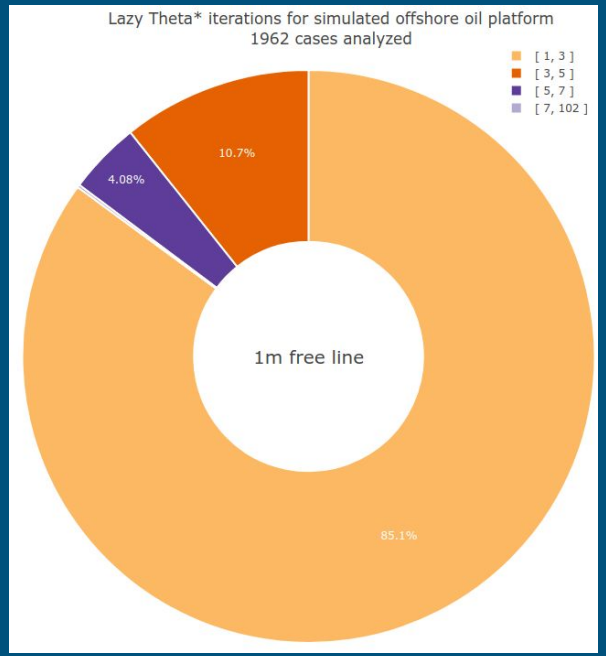
Sparse grid

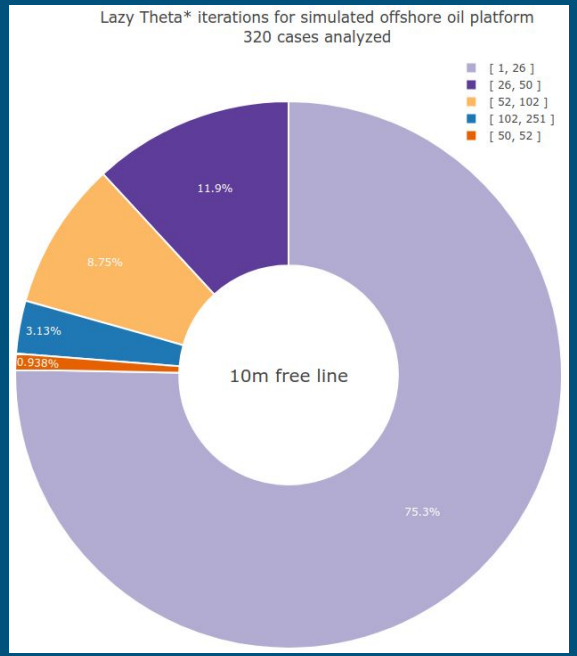


Lazy Theta * - Path result



Lazy Theta * - Batch testing





Future work

Heuristics

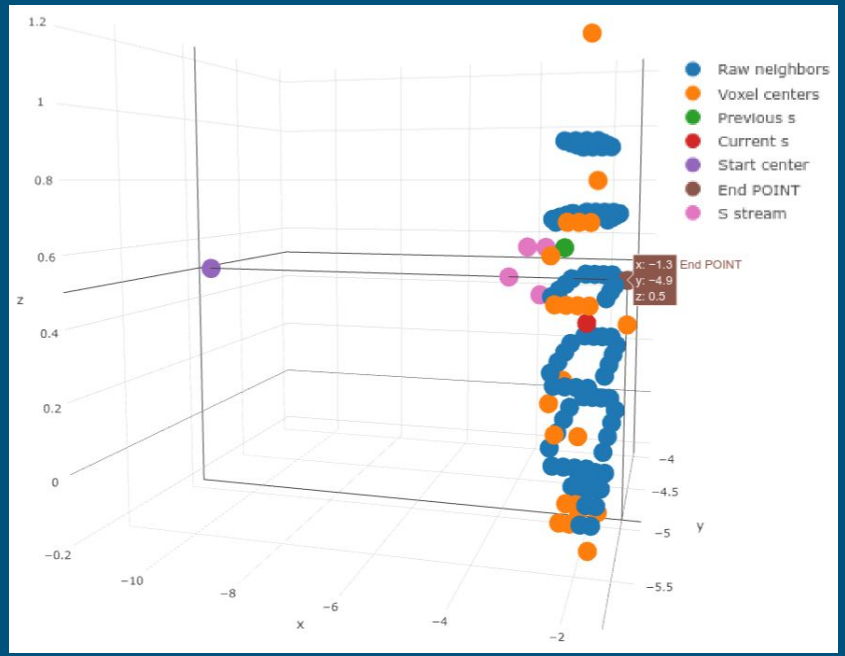
Putting all together

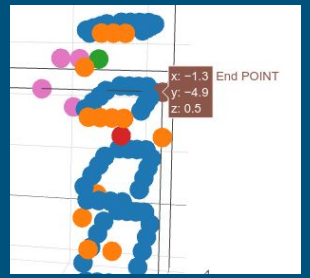
Experimental testing

Thank you!

Questions?

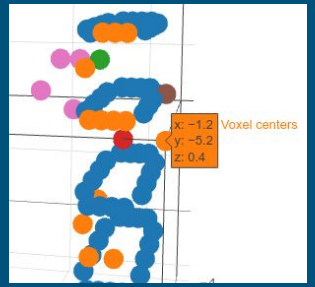
Lazy Theta * - Destination mismatch





End Point.

VS



Center of cell where end point is.