Occupancy Grid Updates for Autonomous Driving

Course 4, Module 2, Lesson 3

UNIVERSITY OF TORONTO
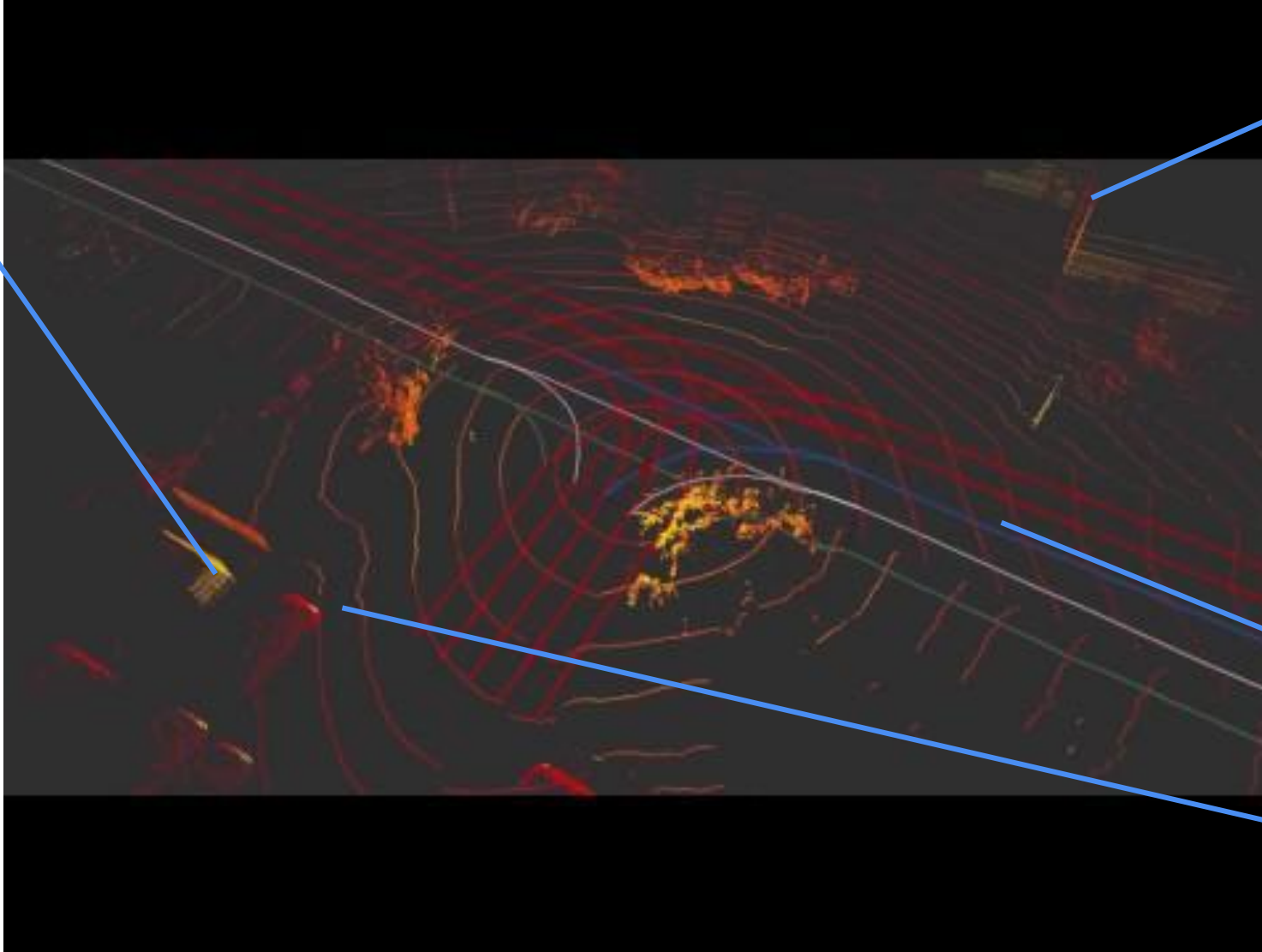FACULTY OF APPLIED SCIENCE & ENGINEERING

Learning Objectives

- Requirement for converting 3D lidar data to 2D data suitable to be used by occupancy grid
  - Set of filters required for 3D lidar data
  - 3D to 2D projection
  - Tuning the occupancy grid for the task of autonomous driving

Filtering of 3D LIDAR

Objects above car height

Downsampling

reduce # of points of a lidar scan

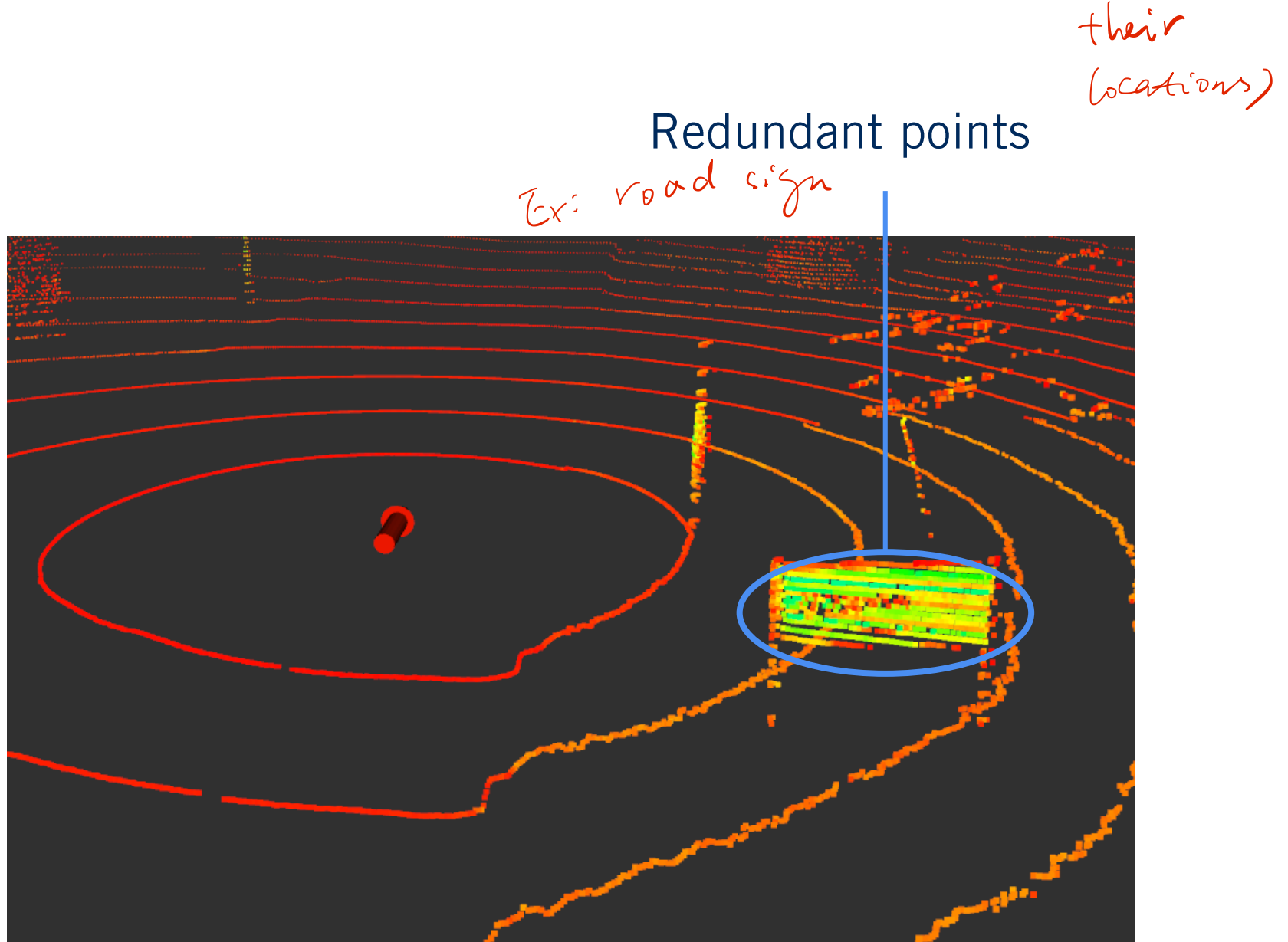Do not want to label the drivable surface occupied

Ground plane (will come from perception)

Dynamic objects (relying on perception to identity)

Downsampling

- Up to ~1.2 million points per second
- Removal of redundant points
- Improves computation

Redundant points

their
(locations)

Ex: road sign

Removal of overhanging objects

- Removing all Lidar points that are above a given threshold of the height limit of the car
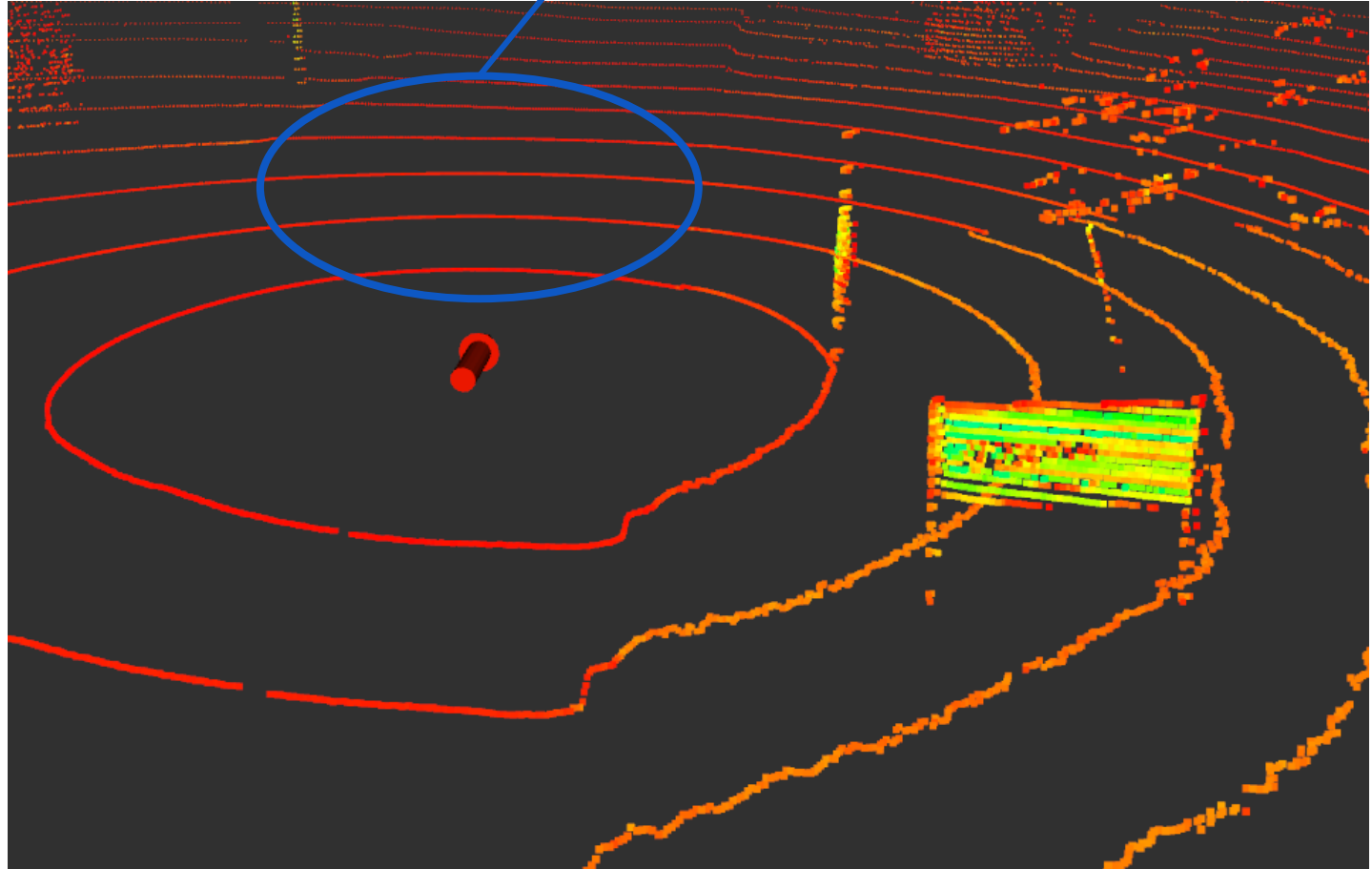
Removal of ground plane

- Difficult to estimate due to several complications
    - Differing road geometries
    - Curbs, lane boundaries
    - Don't want to miss small objects

mixed together with the ground plane

Lidar Points Impacting Ground Plane

Ground plane Classification

- Utilize segmentation to remove points of road elements
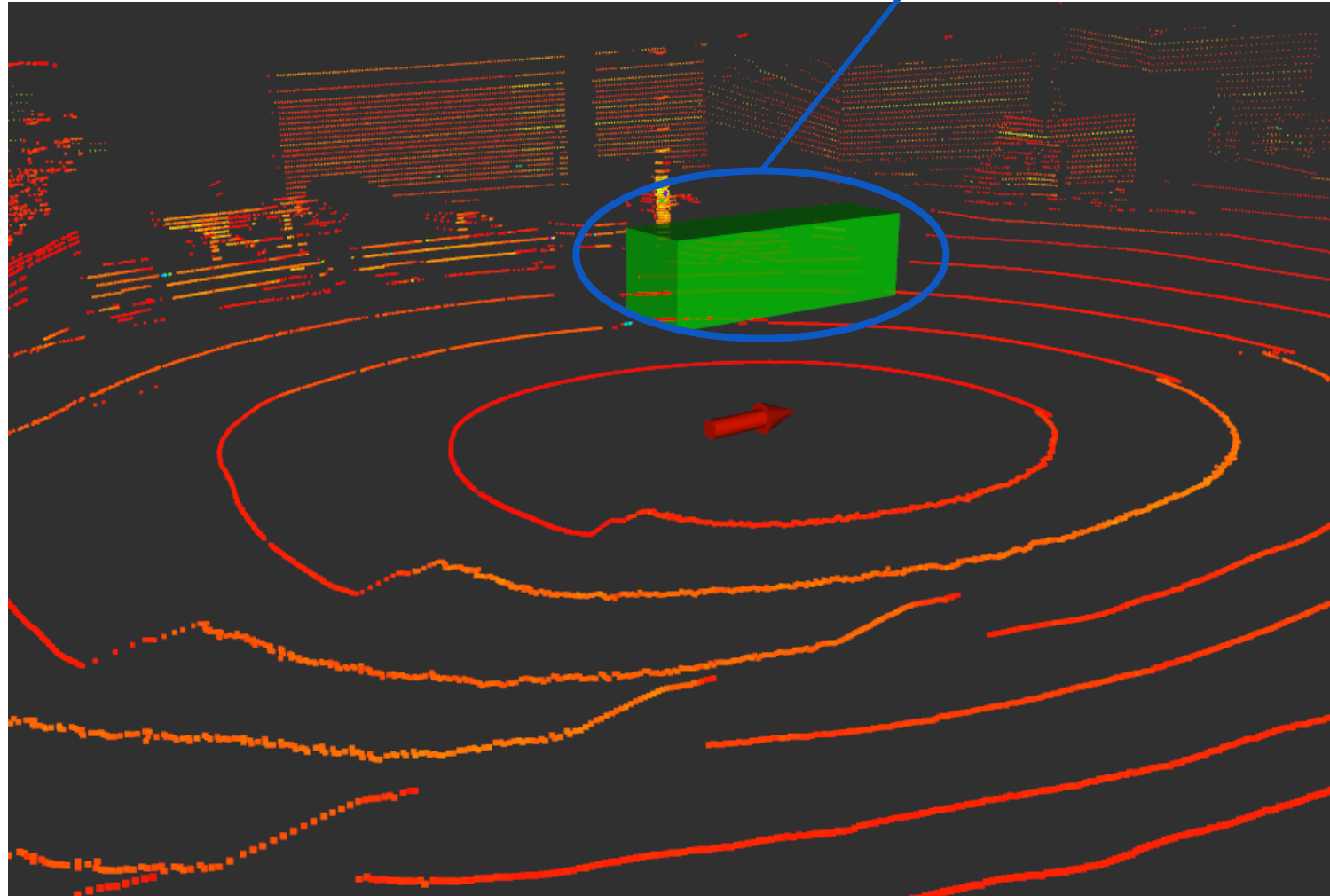- Keep points from no drivable surfaces

Removal of Dynamic Objects

Dynamic Object (Car)

Removal of Dynamic Objects

Remove 3D bounding
+ threshold

Removal of Dynamic Objects Improvement

- Not all vehicles are dynamic, so they should be included
- History of dynamic object location can be used to identify parked vehicle
- The dynamic objects are identified from the previous LIDAR frame
- Predicted future location improvement

perception needs to use

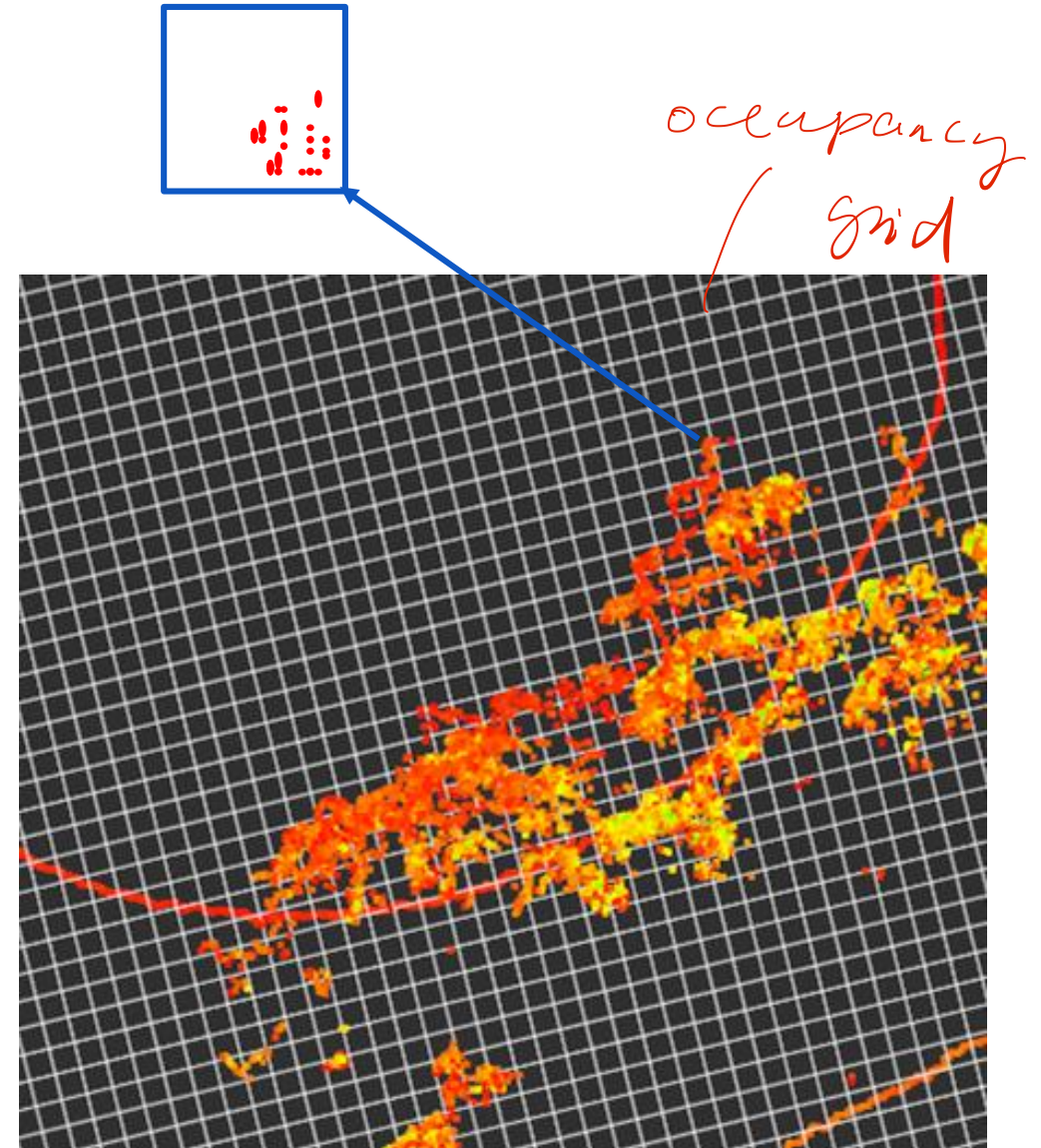*due to computation time of perception stack*

LIDAR points of the car
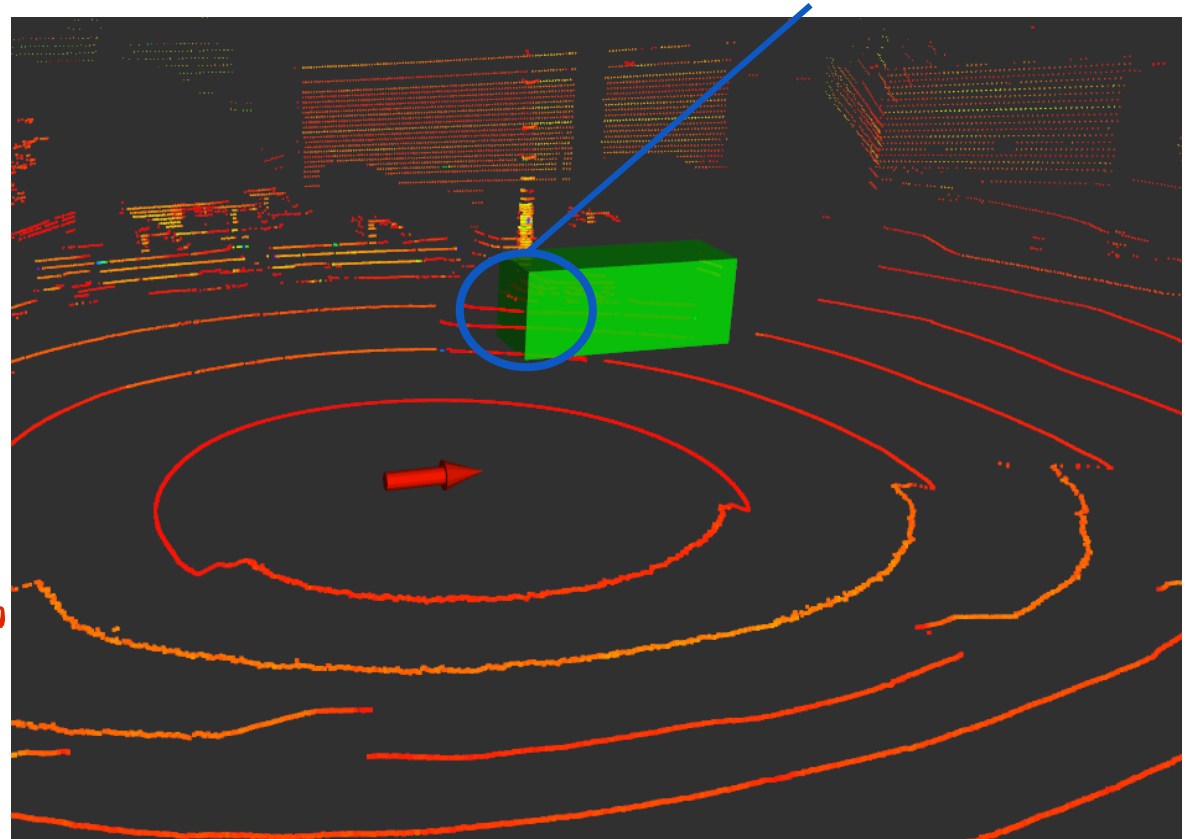
Projection of LIDAR Onto a 2D Plane

Simple solution:

- Collapse all points by Zeroing the Z coordinate

- Sum up the number of LIDAR points in each grid location
  - More points indicated greater chance of occupation of that grid cell

used as measure of the occupancy belief

occupancy grid

Summary

- Set of filters required for 3D lidar data
    - Downsampling
    - Transforming 3D lidar data into a 2D belief map
    - Tuning a occupancy grid for autonomous driving
    - Removing lidar above the vehicle
- Ground plane removal
- Removal of dynamic object