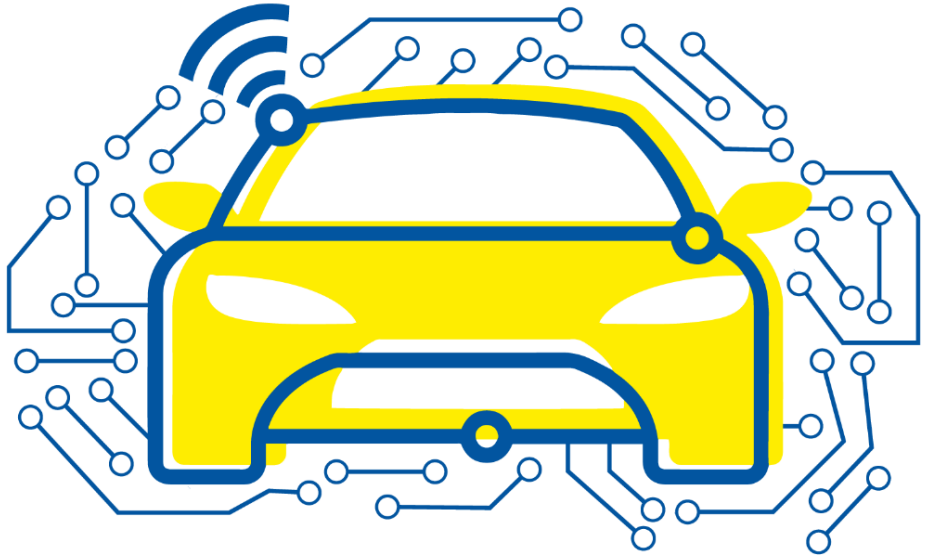
Automated and Connected Driving Challenges

Section 2 – Sensor Data Processing

Point Cloud Occupancy Grid Mapping

Geometric Inverse Sensor Models

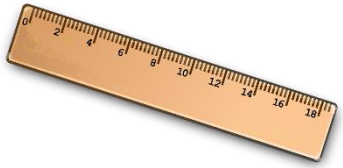


Bastian Lampe

Institute for Automotive Engineering

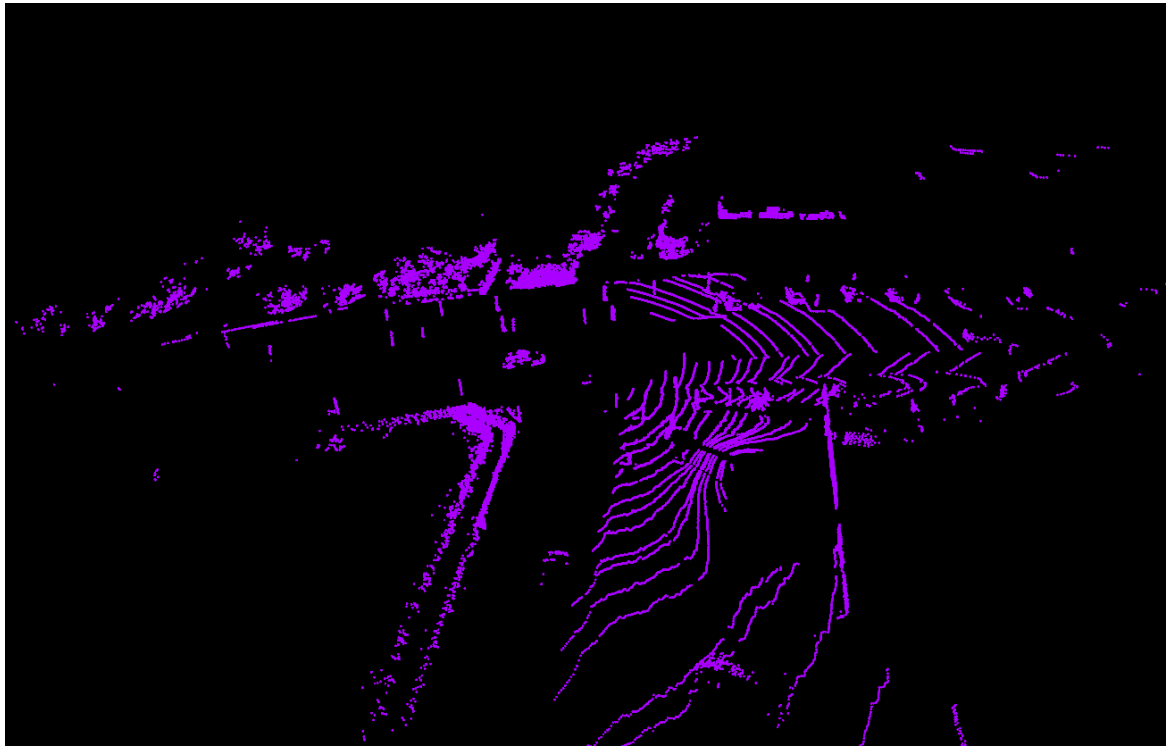
Point Cloud OGM – Geometric ISM

Approach



- **Geometric Inverse Sensor Models** use geometry to derive occupancy information from measurements

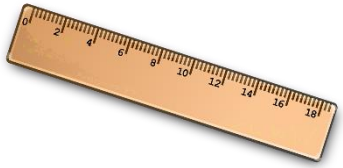
- For each **point cloud** received from sensor:
  1. Eliminate **ground points**



Images: pixabay, ika

Point Cloud OGM – Geometric ISM

Approach



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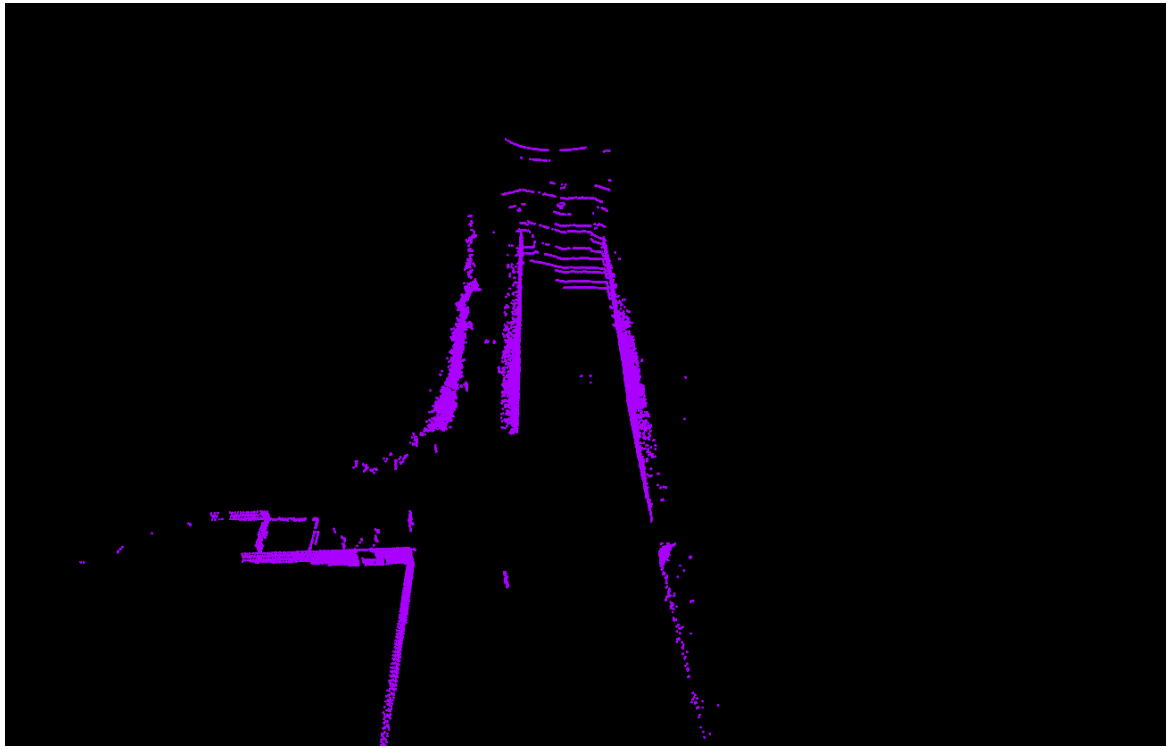

Images: pixabay, ika

Point Cloud OGM – Geometric ISM

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- For each **point cloud** received from sensor:
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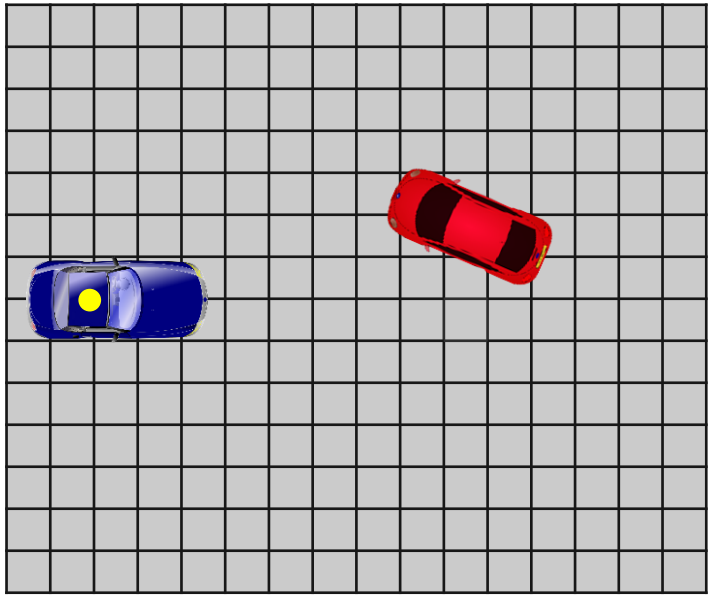
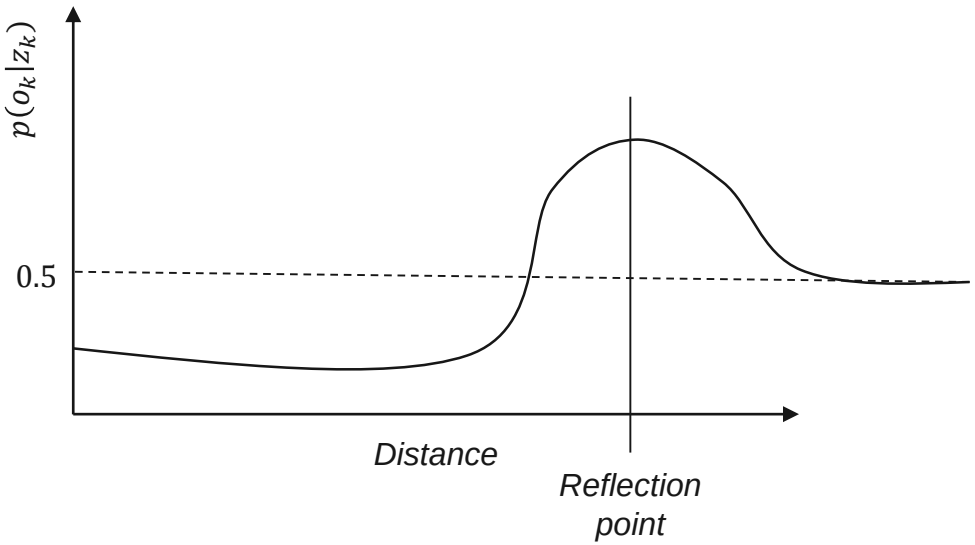
  2. For all **obstacle points** k in point cloud:
     - Estimate occupancy probabilities of cells using **inverse sensor model** $p(o_k|z_k)$





Images: ika
Sources: Elfes 1989, Thrun et al. 2000, Nuss et al. 2016

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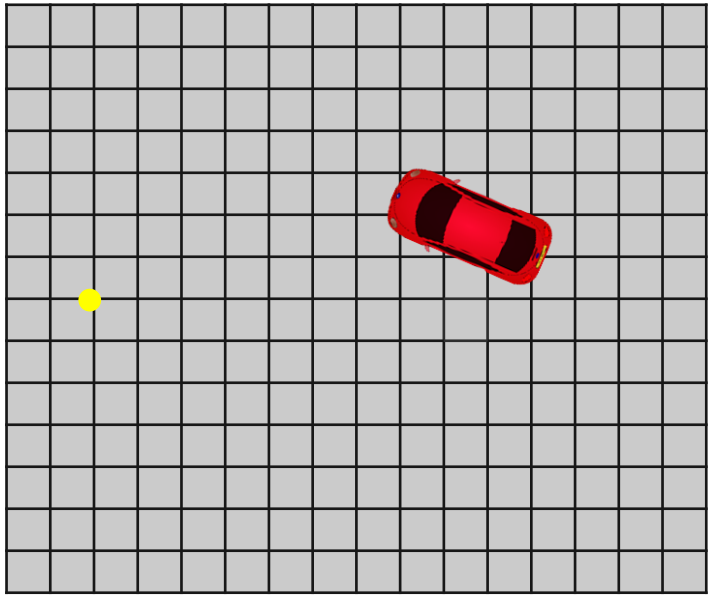
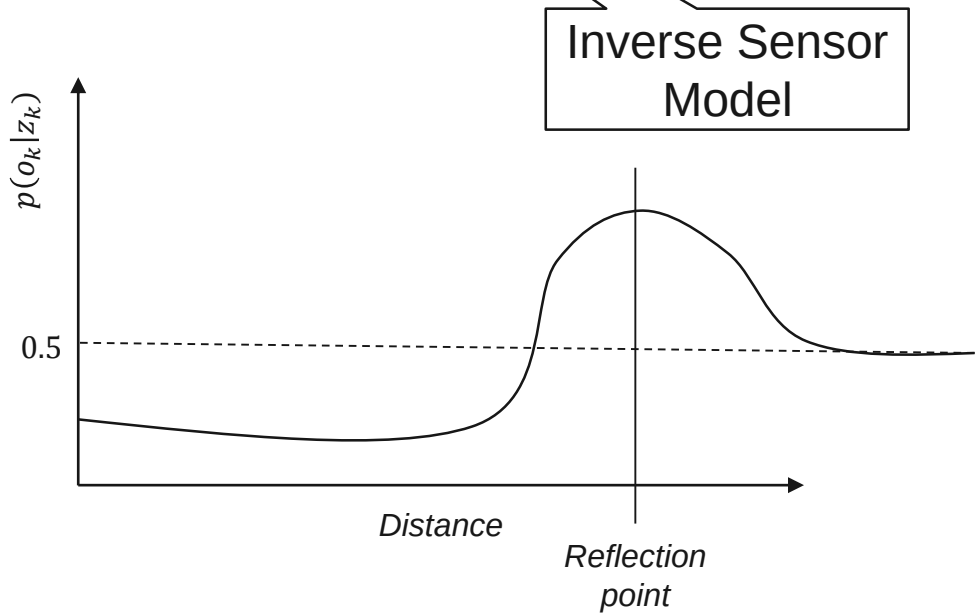
     - **Combine** occupancy probabilities **with previous probabilities** $p(o_{k-1})$ using *binary Bayes filter*

Binary Bayes Filter:

$$p_k(o) = \frac{p(o_k|z_k) \cdot p(o_{k-1})}{p(o_k|z_k) \cdot p(o_{k-1}) + p(\bar{o}_k|z_k) \cdot p(\bar{o}_{k-1})}$$





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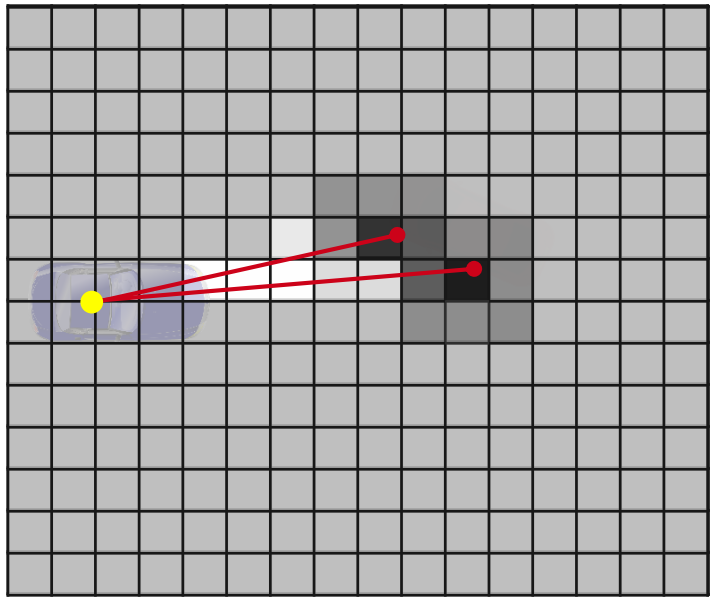

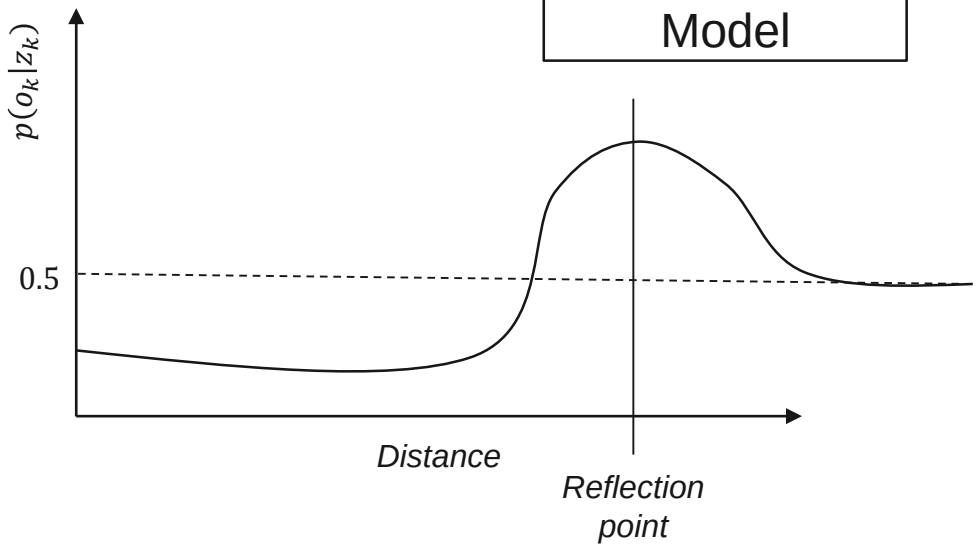

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Point Cloud OGM – Geometric ISM

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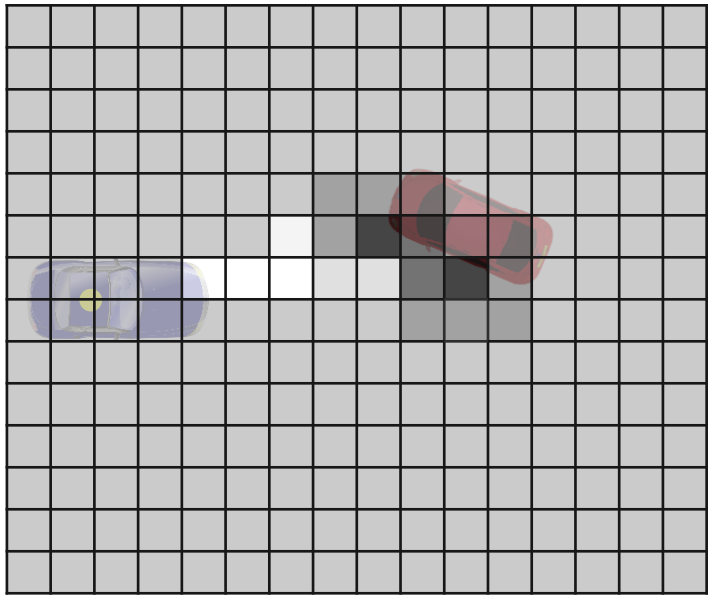
- For each **point cloud** received from sensor:
  1. Eliminate **ground points**
  2. For all **obstacle points** k in point cloud:
     - Estimate occupancy probabilities of cells using **inverse sensor model** $p(o_k|z_k)$
     - **Combine** occupancy probabilities **with previous probabilities** $p(o_{k-1})$ using *binary Bayes filter*
  3. Combine **measurement grid map** with previous grid map using *binary Bayes filter*



Binary Bayes Filter:

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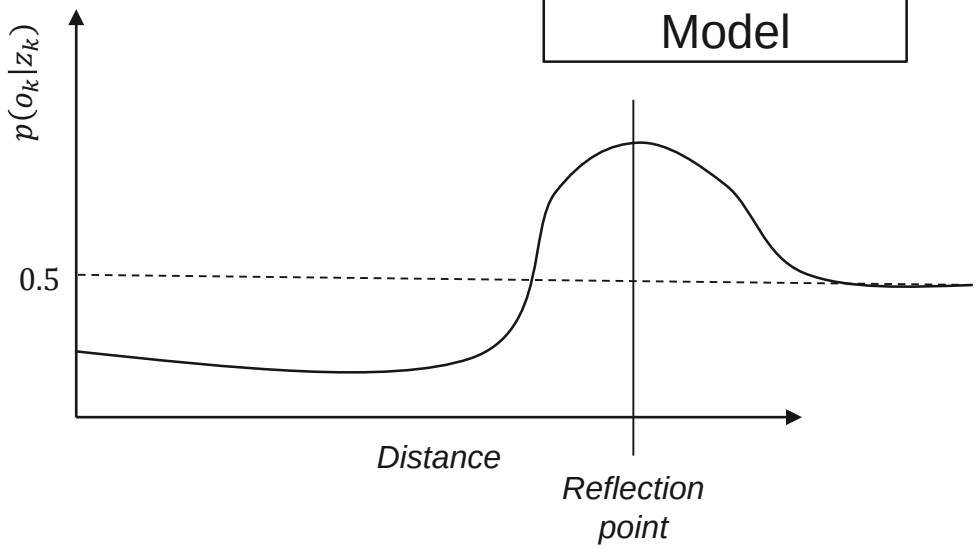
Inverse Sensor Model



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