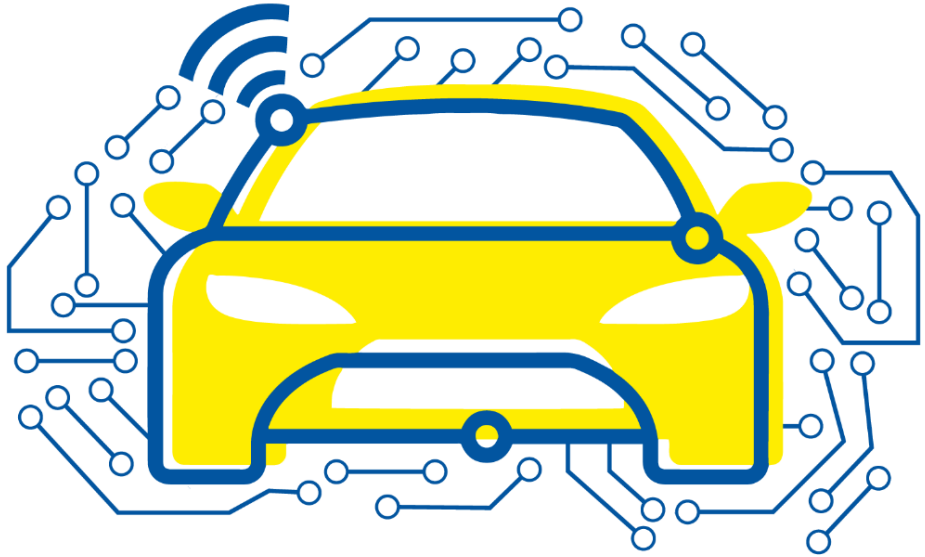
Automated and Connected Driving Challenges

Section 2 – Sensor Data Processing Algorithms

Semantic Image Segmentation

Introduction



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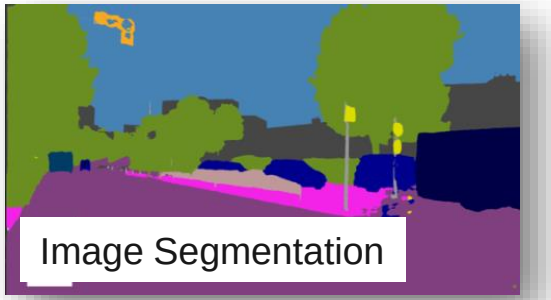
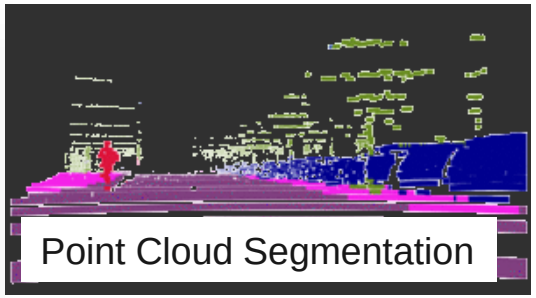
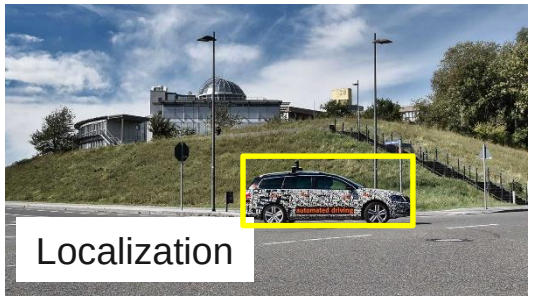
Semantic Image Segmentation - Introduction

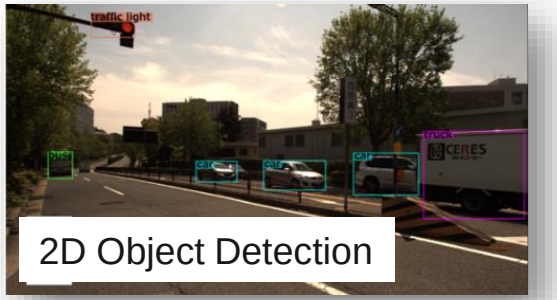
Computer Vision Approaches

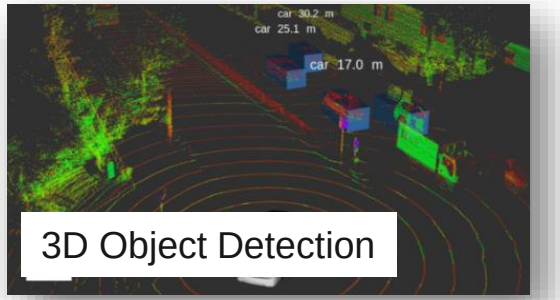


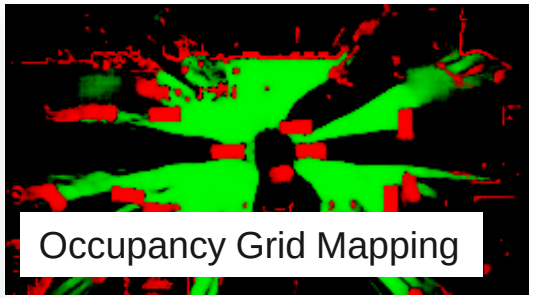




Single Object







Multi Objects

Images: fka, ika, IEEE Access

Semantic Image Segmentation - Introduction

Motivation

Image: Cityscapes

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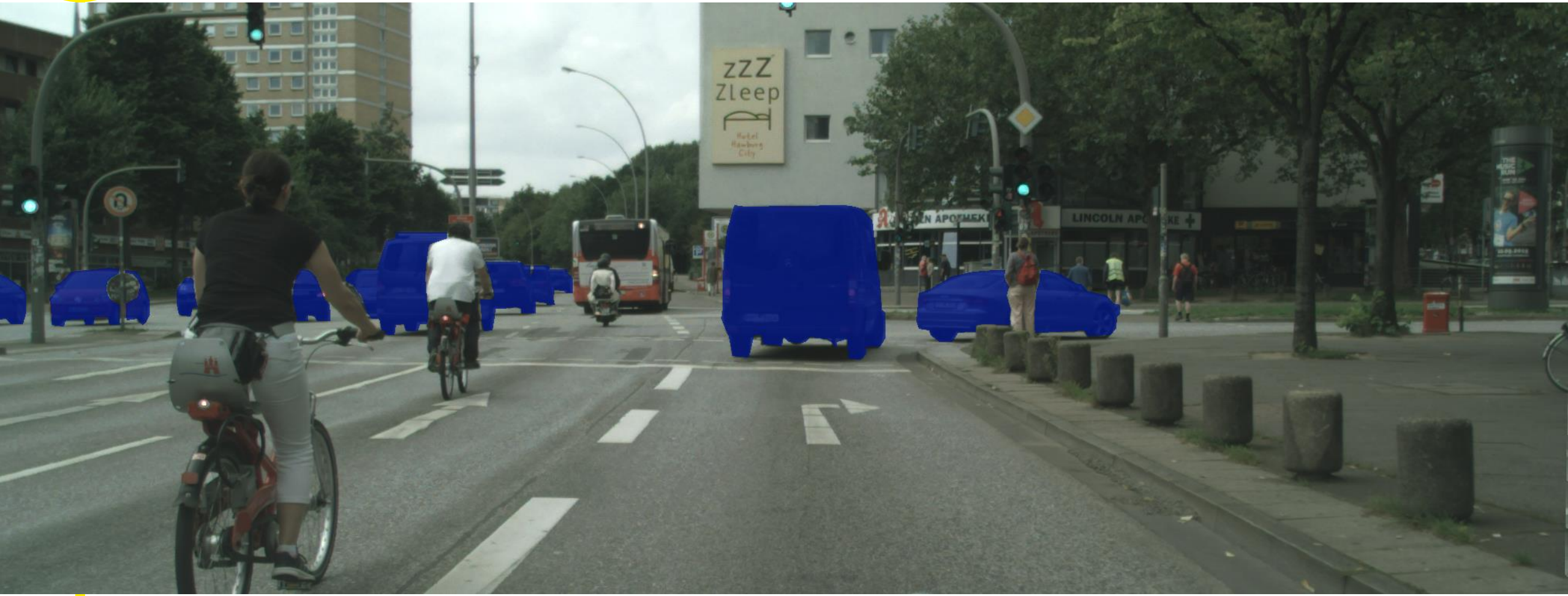

Image: Cityscapes

Semantic Image Segmentation - Introduction

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Semantic Image Segmentation - Introduction

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Image: Cityscapes

Semantic Image Segmentation - Introduction

Overview

- **Goal**: Given a camera image, assign a class from a fixed set of classes to each pixel of that image
- Fixed set of **classes**:
  - Road
  - Sidewalk
  - Pedestrian
  - Rider
  - Car
  - Bus
  - Motorcycle
  - …
- **Classification** task for every single pixel of the camera image
- **Scene Understanding**

Image: Cityscapes

Semantic Image Segmentation - Introduction

Main Challenges

- **Class** ambiguity
  - Only fixed set of classes possible, but “unlimited” type of objects/surfaces
- Class **imbalance**
  - Overrepresented classes: **road**, **sidewalk**, **building**
  - Underrepresented classes: **person**, **truck, bicycle**
- Expensive **datasets**
  - High manual effort for labeling
- **Camera images**
  - Glare, reflection, distortion, illumination…

Images: Berkely Deep Drive

Semantic Image Segmentation - Introduction

Approaches

- Traditional Computer Vision:
  - **Clustering**
    - k-Means Clustering on the RGB Domain
    - E.g. cluster all greenish areas - Grass Class
  - **Conditional Random Fields**
    - Probabilistic modelling method
    - Interpret the image as a graph and model the segments

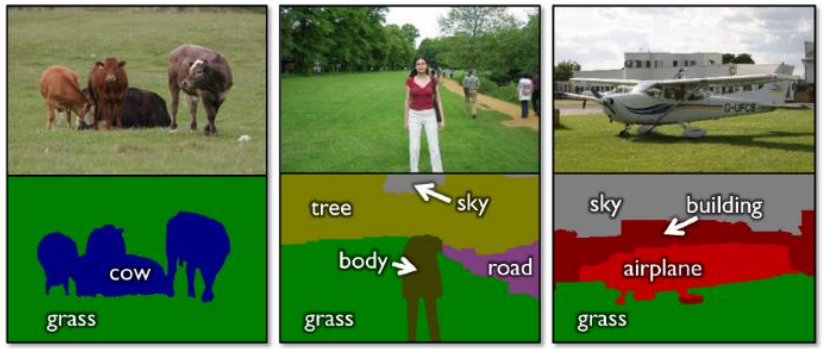

Image: Springer

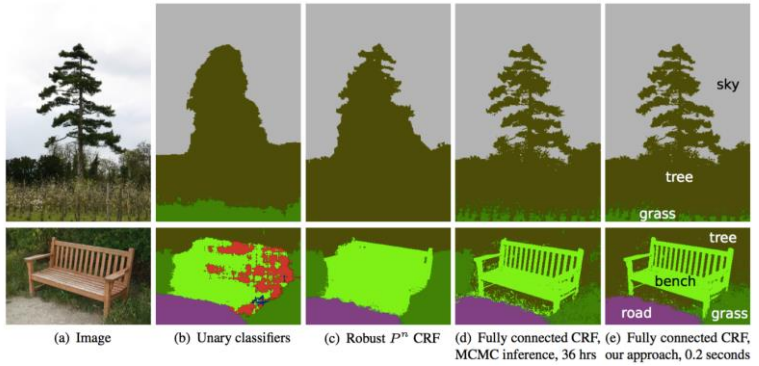

Image: arxiv

- **Deep Learning based Computer Vision:**
  - Large scale dataset with manual annotations
  - Train Convolutional Neural Networks
  - E.g. U-Net Architectures, Deeplab

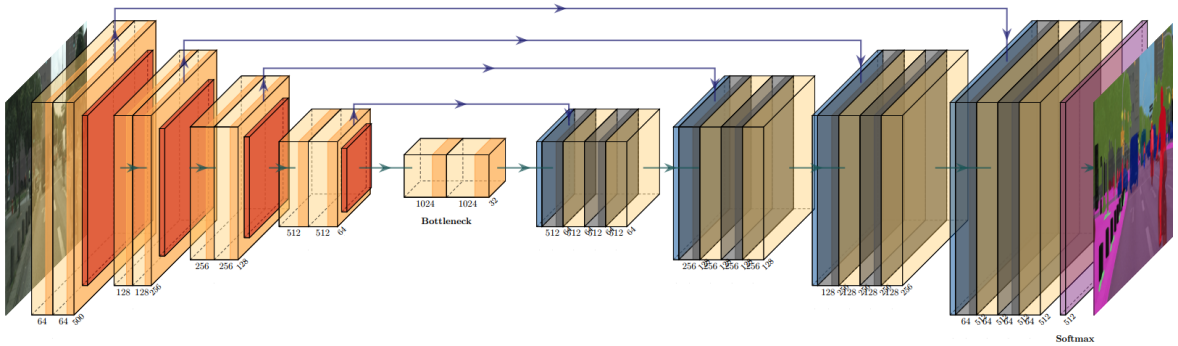

Image: ika, PlotNeuralNet

Semantic Image Segmentation - Introduction

Summary

- Popular **Computer Vision** approach for scene understanding
- Assign a **semantic class** to each pixel of the camera image
- **Challenges** include class ambiguity, class imbalance and visual phenomena (glare, reflections, …)
- Modern approaches rely on **Deep Neural Networks** and **large datasets**

Source: Cityscapes