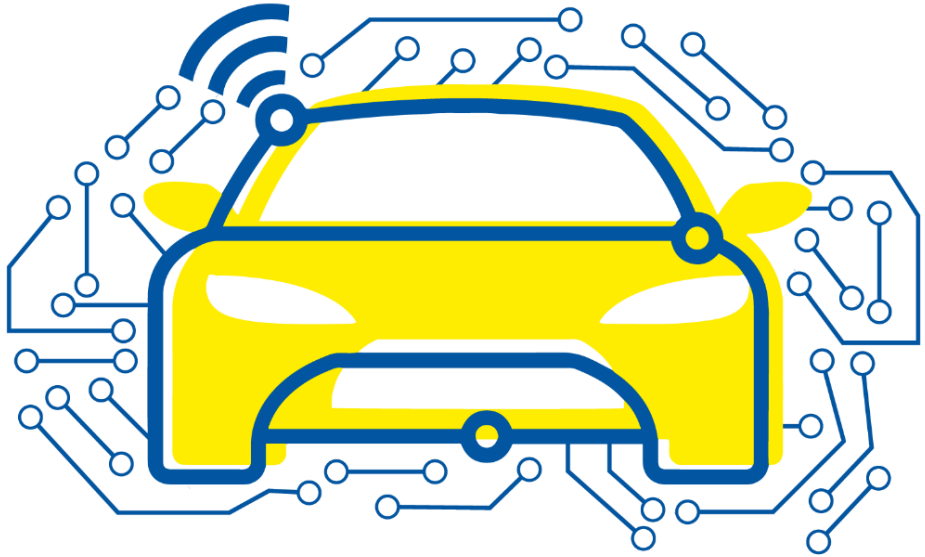
Automated and Connected Driving Challenges

Section 2 – Sensor Data Processing

Semantic Point Cloud Segmentation

Boosting Performance



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Semantic Point Cloud Segmentation – Boosting Performance

Data Augmentation

- Large ground truth datasets are expensive
- Use data augmentation to artificially increase the size of the dataset and make it **more diversified**

- Automatic annotations are only annotated within a FOV of the camera

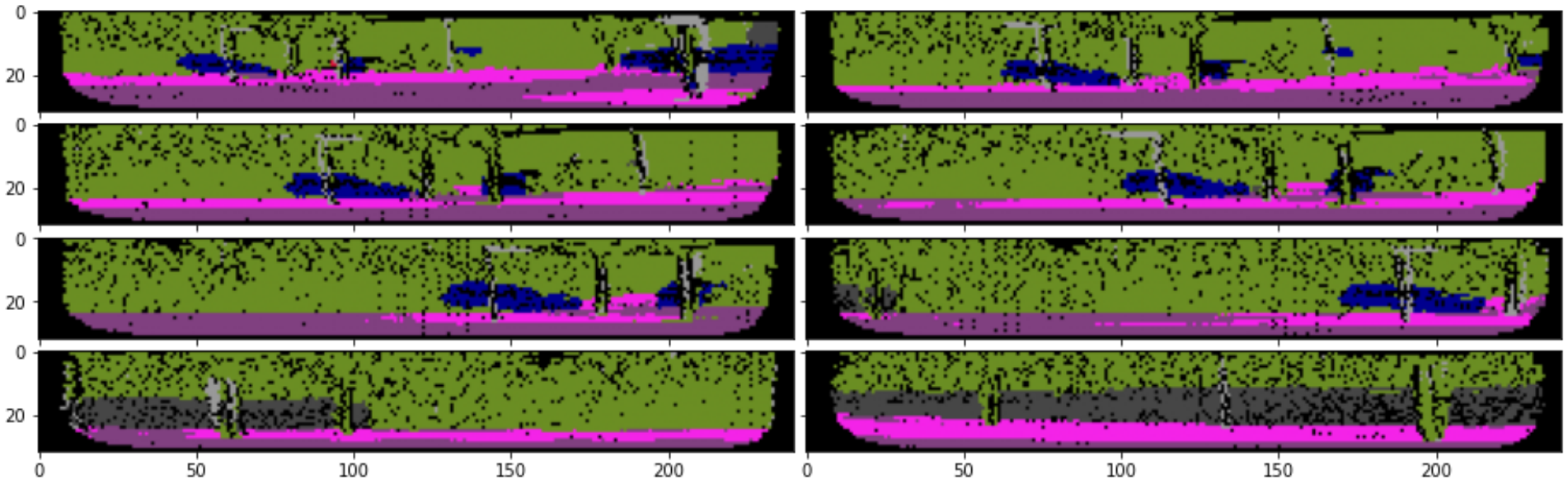
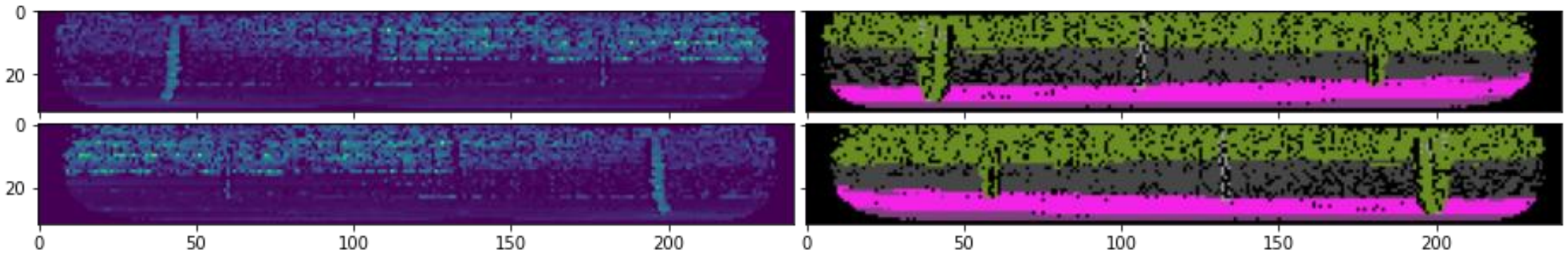


Image: ika

Semantic Point Cloud Segmentation – Boosting Performance

Data Augmentation

- Left-Right Flipping



Intensity Map

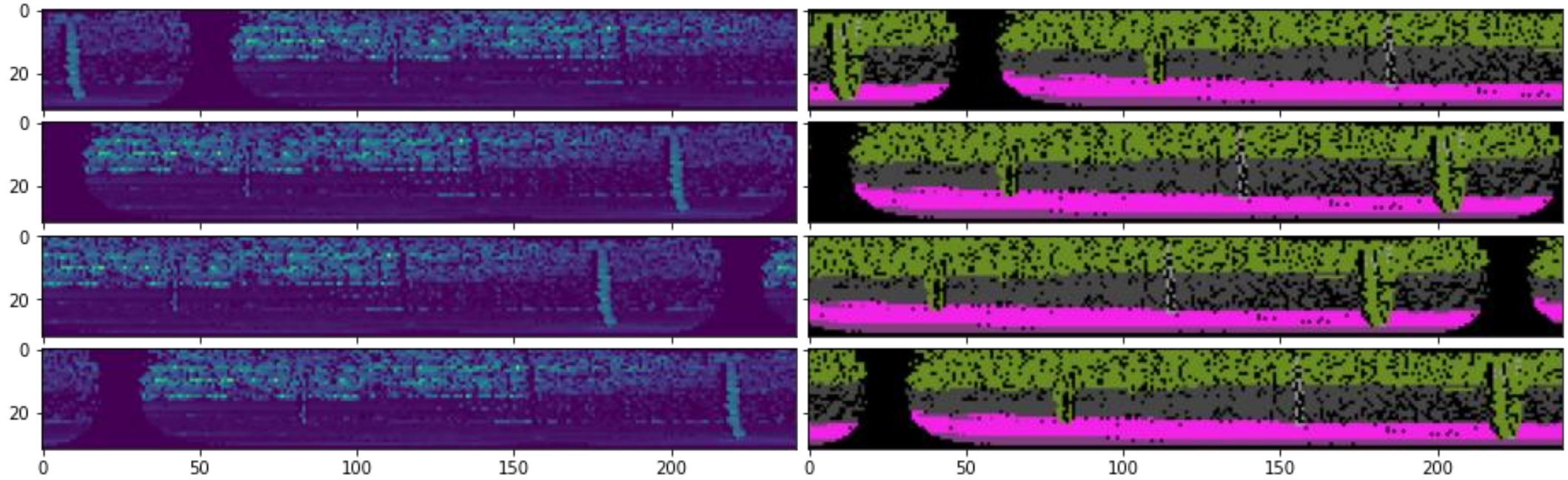
Segmentation Map

Source: ika

Semantic Point Cloud Segmentation – Boosting Performance

Data Augmentation

- Left-Right Shifting



Intensity Map

Image: ika

Segmentation Map

Semantic Point Cloud Segmentation – Boosting Performance

Class Imbalance

- Dataset usually show **class imbalance**
- Classes with large surfaces are **relatively frequent** (e.g. Road, Building, Vegetation)
- Small surface objects are **relatively rare** (e.g. Person, Two Wheeler, Car)

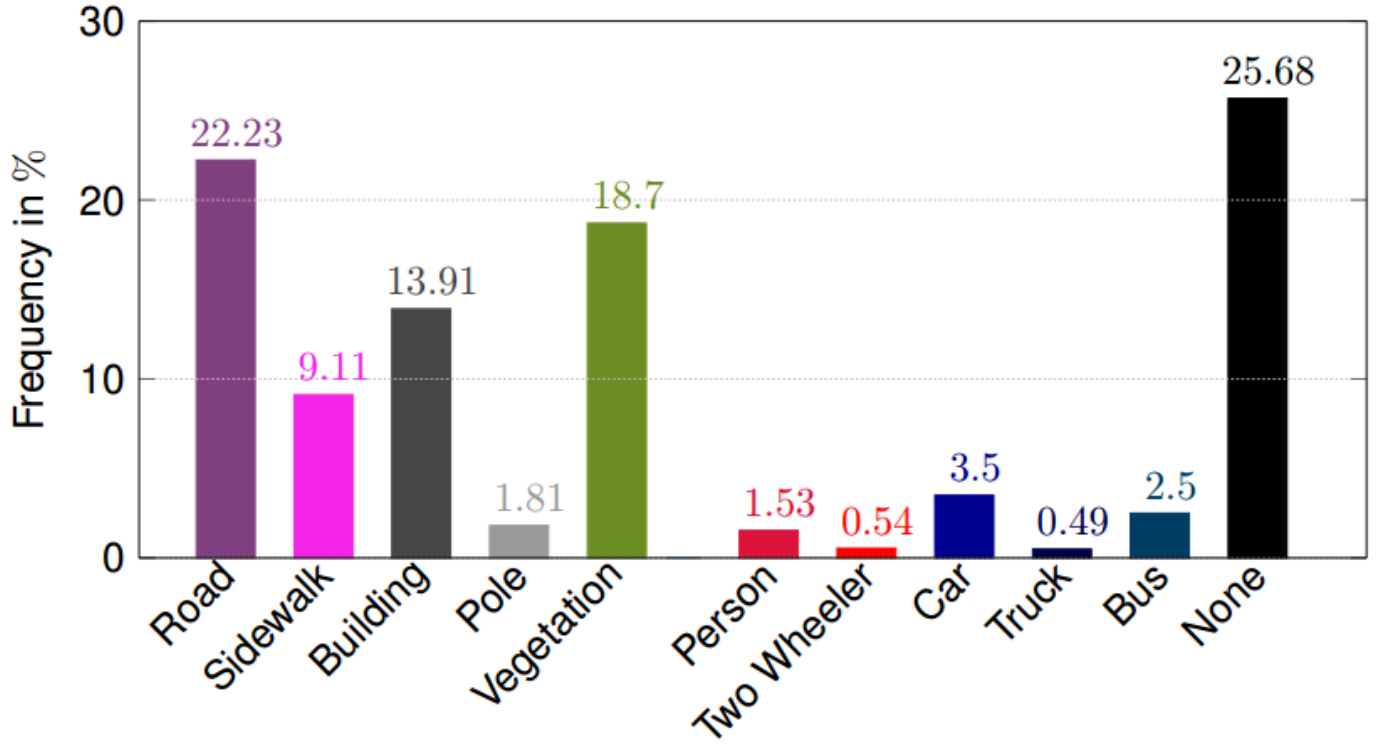


Image: ika

Semantic Point Cloud Segmentation – Boosting Performance

Focal Loss

- **Categorical Cross-Entropy**
  - Standard loss function for classification

$$CE = -\sum_{i}^{C} t_i \log(p_i)$$

- **Focal Loss**
  - Tackles the problem of **class imbalance**
  - Adds a **modulating factor** to the Cross-Entropy

$$FL = -\sum_{i}^{C} (1 - p_i)^{\gamma} (\mathrm{t_i} \log(p_i))$$

  - with $\gamma \in \mathbb{R}$ a tunable factor that regulates the loss magnitude of instances with low predicted probability

- with t_i as the ground truth label (as one-hot encoding) and p_i as probability/confidence for each class i in C (set of all classes)

Semantic Point Cloud Segmentation – Boosting Performance

Summary

- **Data Augmentation**
  - Artificially increase the size of the dataset

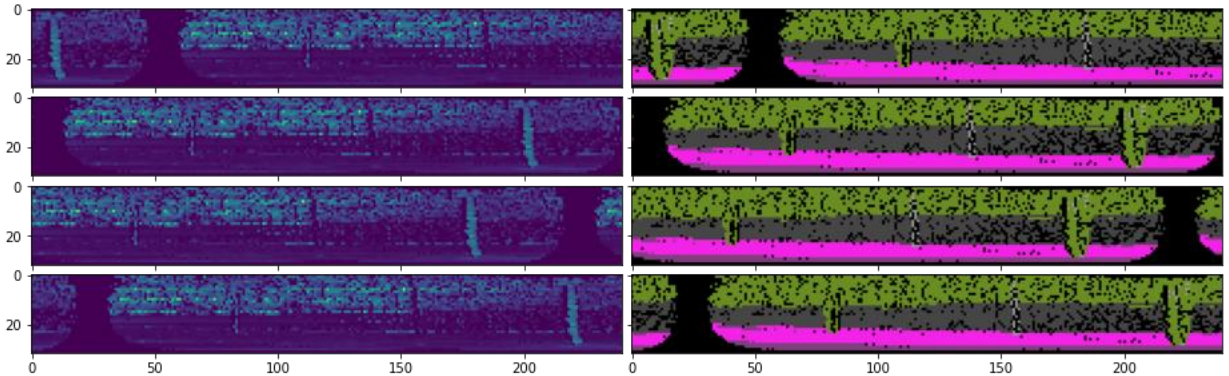


Image: ika

- **“Focal Loss” as Loss Function**
  - Accounts for class imbalance during the training

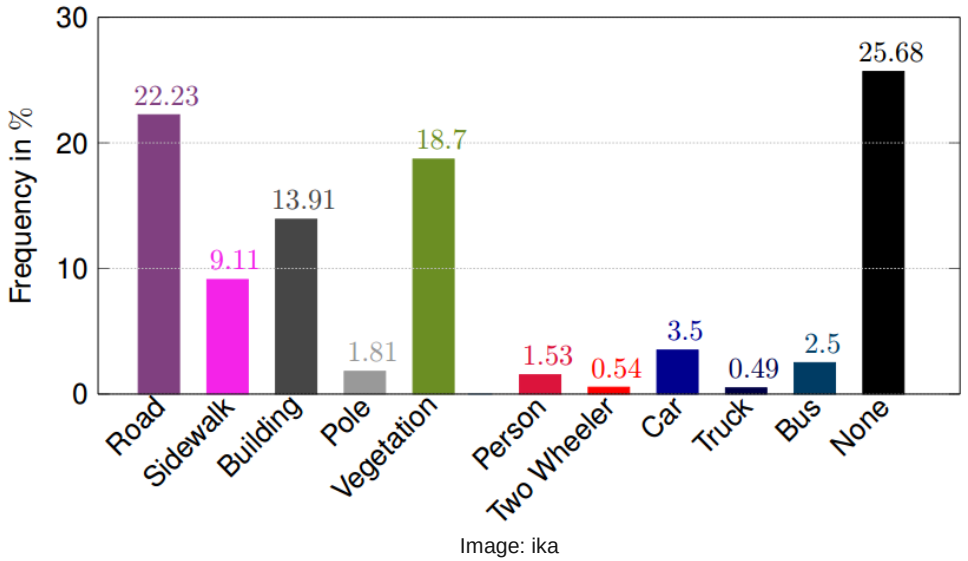


Image: ika