GeoDPA'24
23.-25. April 2024
in Oldenburg
International Conference on Geoinformation Data, Processing and Applications

# TIAS: An aerial traffic infrastructure dataset to study transportation in urban environments

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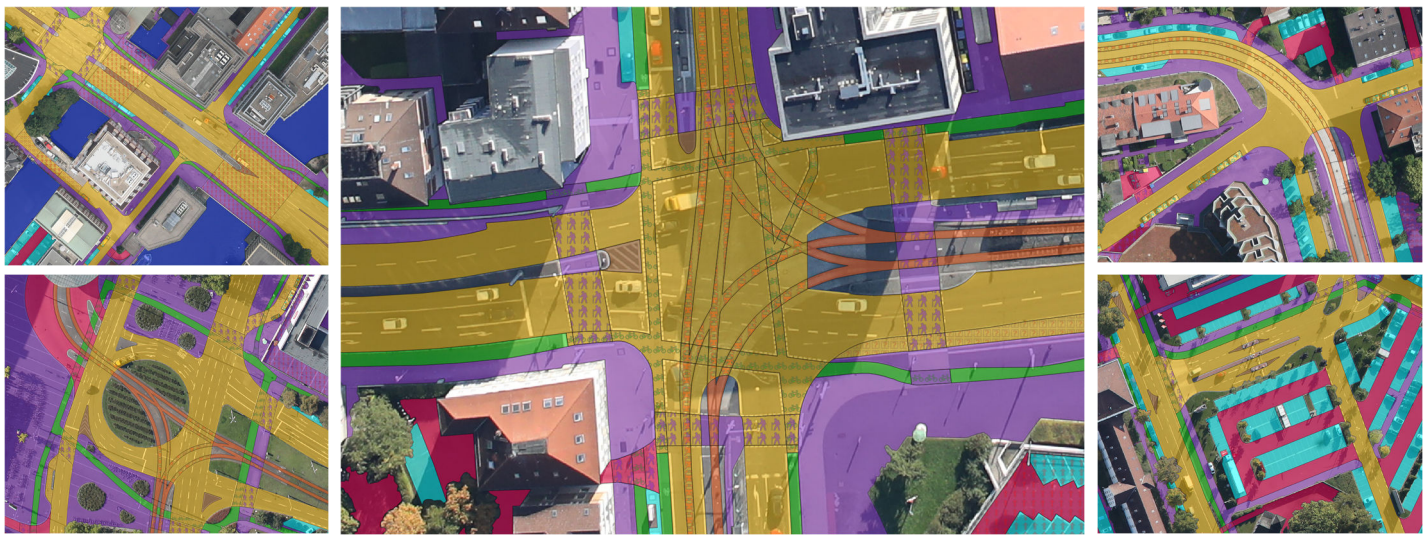
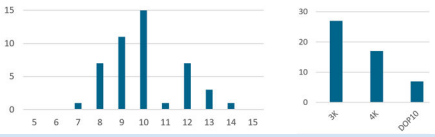



## Motivation

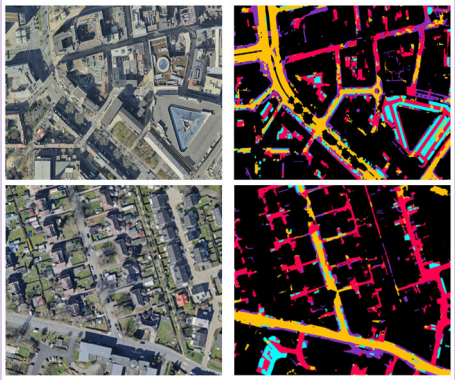
TIAS is a novel dataset consisting of **aerial images** and high quality **labels of traffic areas**. This dataset accurately reflects urban scenarios from a transportation perspective by providing detailed, fine-grained labels. The dataset enables the reconstruction of traffic networks for motorized vehicles, bicycles, pedestrians, and rail traffic, with applications such as the identification of hazardous areas (e.g., for automated vehicles and traffic safety analysis) or distribution analysis of traffic areas.

The datasets consists of **51 annotated images** acquired over the **German cities** Berlin, Brunswick, Hamburg, Landsberg, Kaufbeuren and Munich. 45 images are captured by DLR's 3k and 4k camera systems with varying **resolution between 7 – 14 cm**, the other 6 images are DOP10 images with a resolution of 10 cm.

**Resolution & sensor system frequency distribution:**




**First results of the AI-based segmentation:**



## Dataset details

The traffic areas within TIAS are classified into nine classes: **parking area, road, access way, footway, bikeway, railroad bed, keep-out area, road shoulder,** and **water.**

To preserve the topological nature of the transportation network, attributes indicate whether areas are:

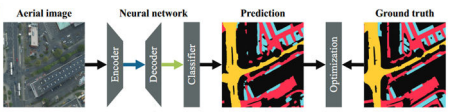
- **shared** by two or more traffic participants
- **elevated** (e.g. bridges)
- under **construction**
- **difficult** to recognize for the annotator.

Additionally, the attribute "**unsure**" provides a confidence with which an object of a given class is annotated.

## AI-based segmentation of traffic areas

To perform the **semantic segmentation of the nine classes**, we train a **Dense-U-Net-201** model. This architecture consists of a U-Net that uses a DenseNet backbone in both its encoder and its decoder. The decoder has more layers than normal U-Nets, such that it learns to extract fine-grained details from the low-resolution feature maps and the higher resolution skip-connections. The resulting masks are generally smooth and homogeneous.

**Illustration of the network architecture:**




## Conclusion & Future work

TIAS enables the use of aerial images to:

- study the **interaction between traffic participants** in urban environment
- extract the **topology of transportation** networks
- **capture temporary changes** in the topology due to constructions sides.

Selected applications supported by TIAS:

- **VMo4Orte:** input data for microscopic modeling of parking search traffic.
- **MoDa:** spatial disaggregation of charging demand and additional infrastructure based on parking spaces
- **Third-party collaboration**: analysis of cycling infrastructure and crash statistics to derive measures for improved safety

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