salzburg**research**

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Transformer based 3D Semantic Segmentation of Urban Bicycle Infrastructure

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Motivation

- Cycling is healthy, sustainable, and therefore, desirable
- Good infrastructure can promote cycling
- The bicycle path itself is important
- Question: How do we measure whether it is "good"?
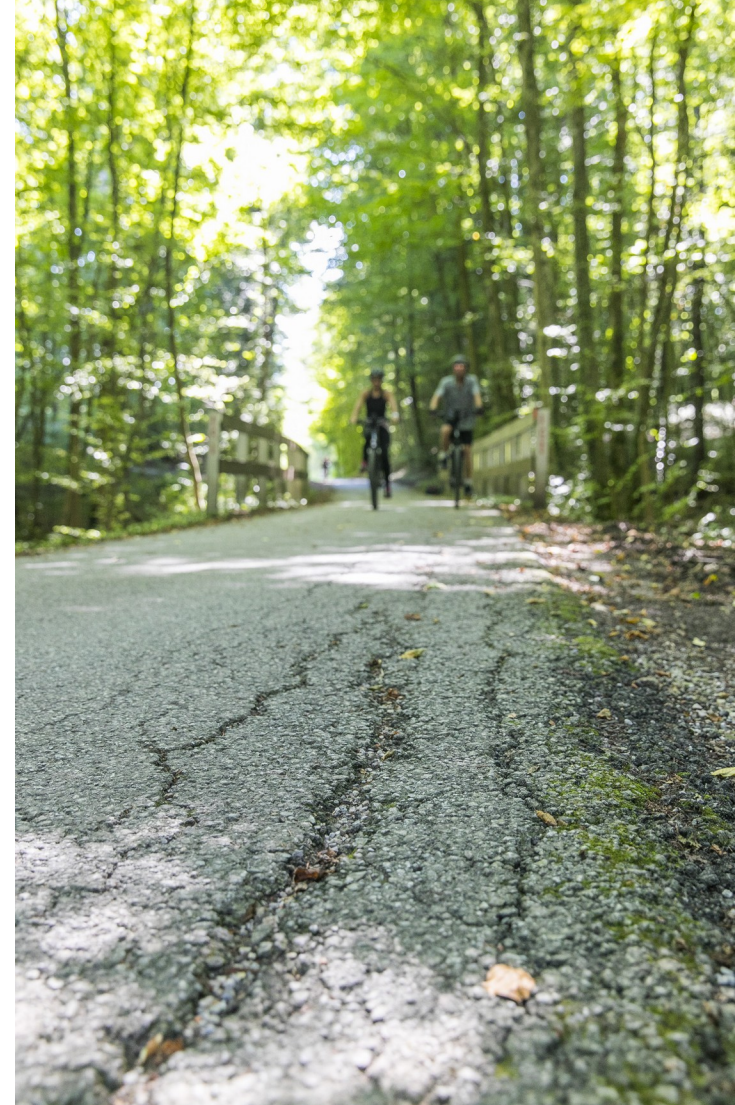
LiDAR & Semantic Segmentation

- LiDAR well-established in road maintenance

- Semantic Segmentation: Class per Point instead of Bounding Boxes in Object Detection
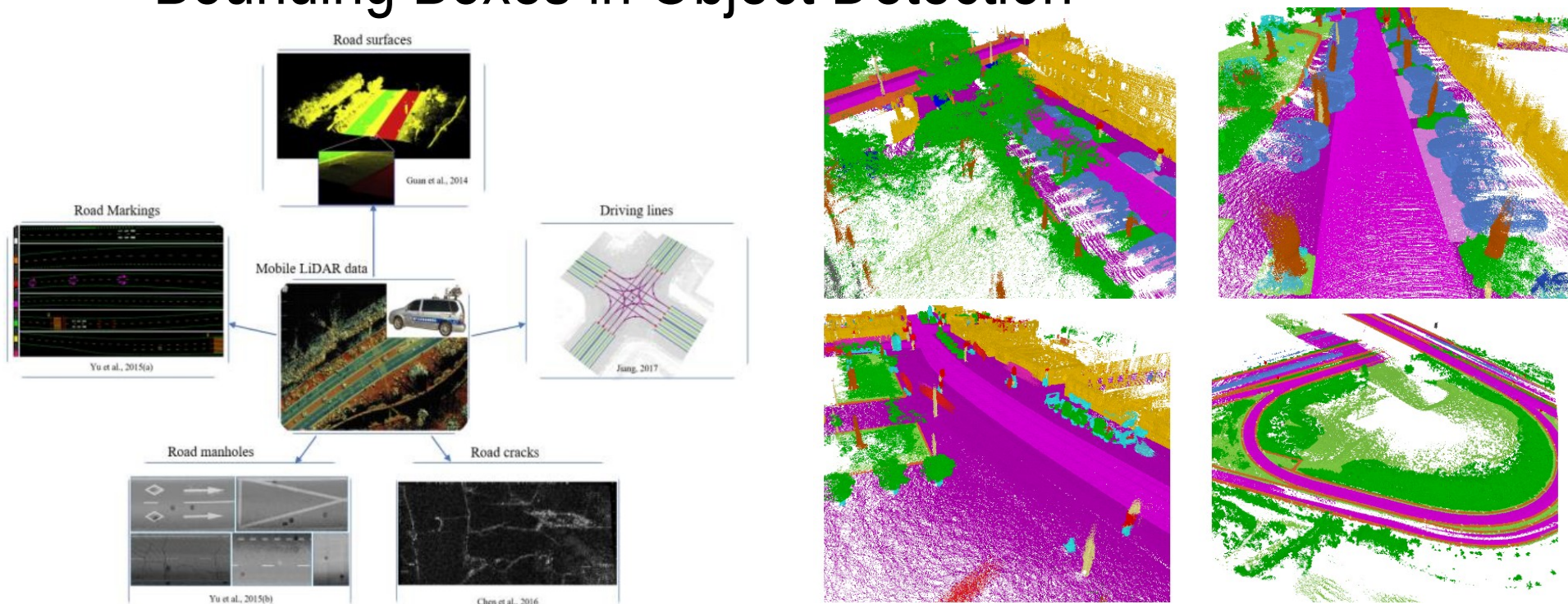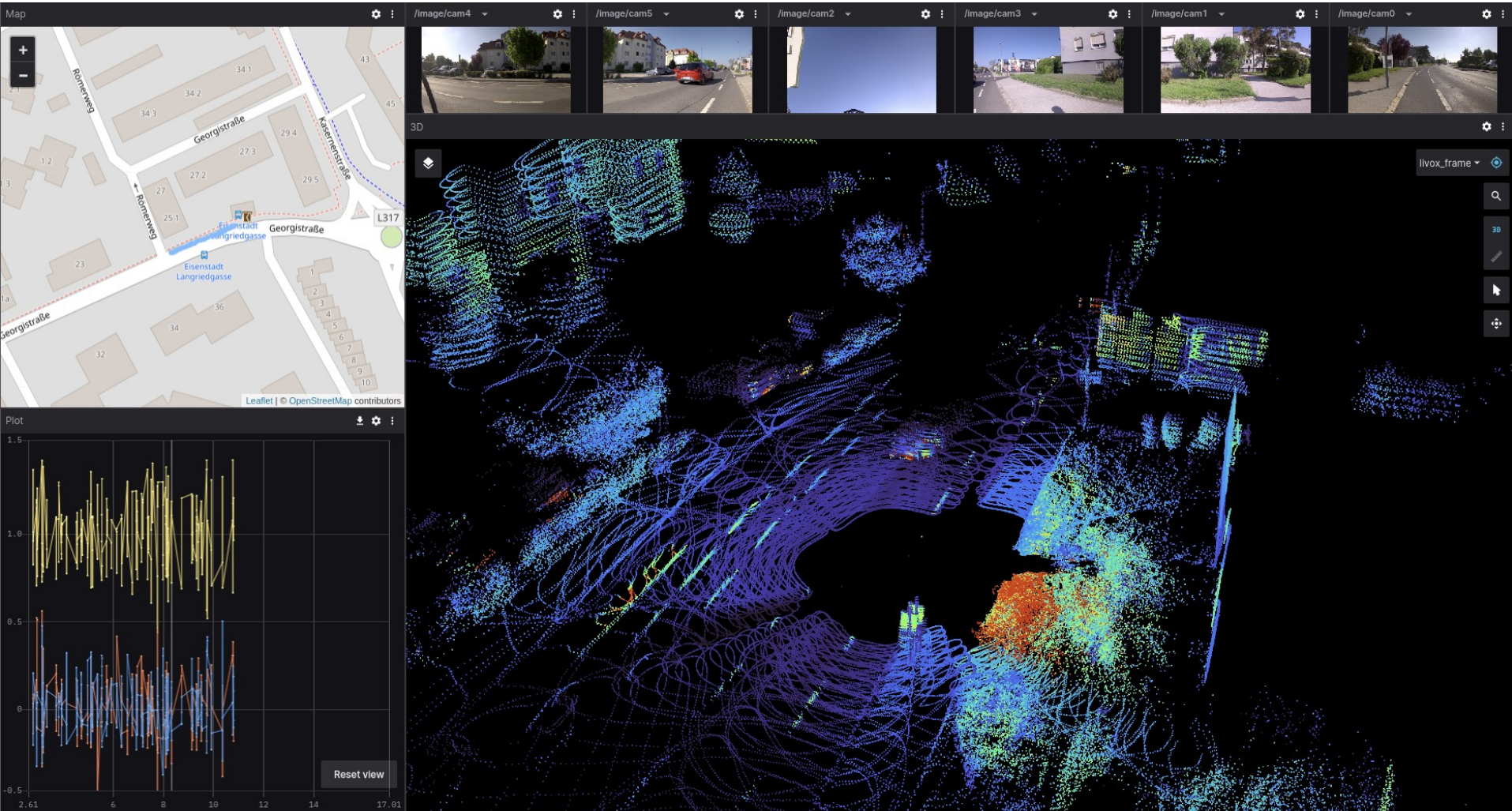

Image Source: Ma et al., 2018, Mobile Laser Scanned Point-Clouds for Road Object Detection and Extraction: A Review   Image Source: Behley et al. 2019, SemanticKITTI: A Dataset for Semantic Scene Understanding of LiDAR Sequences
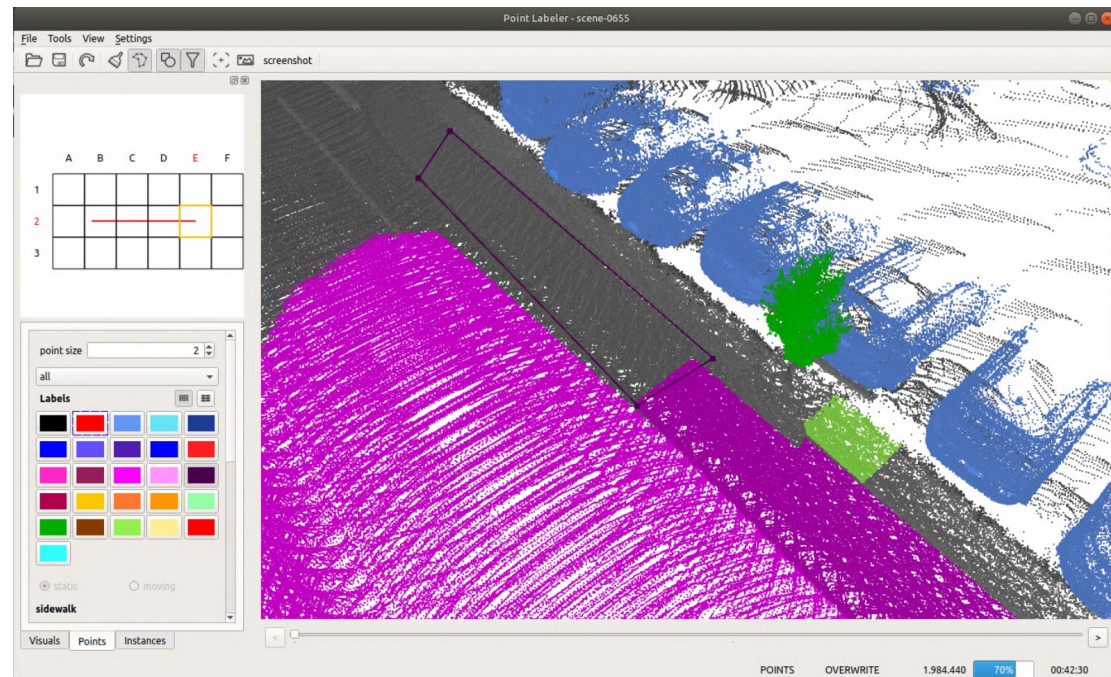
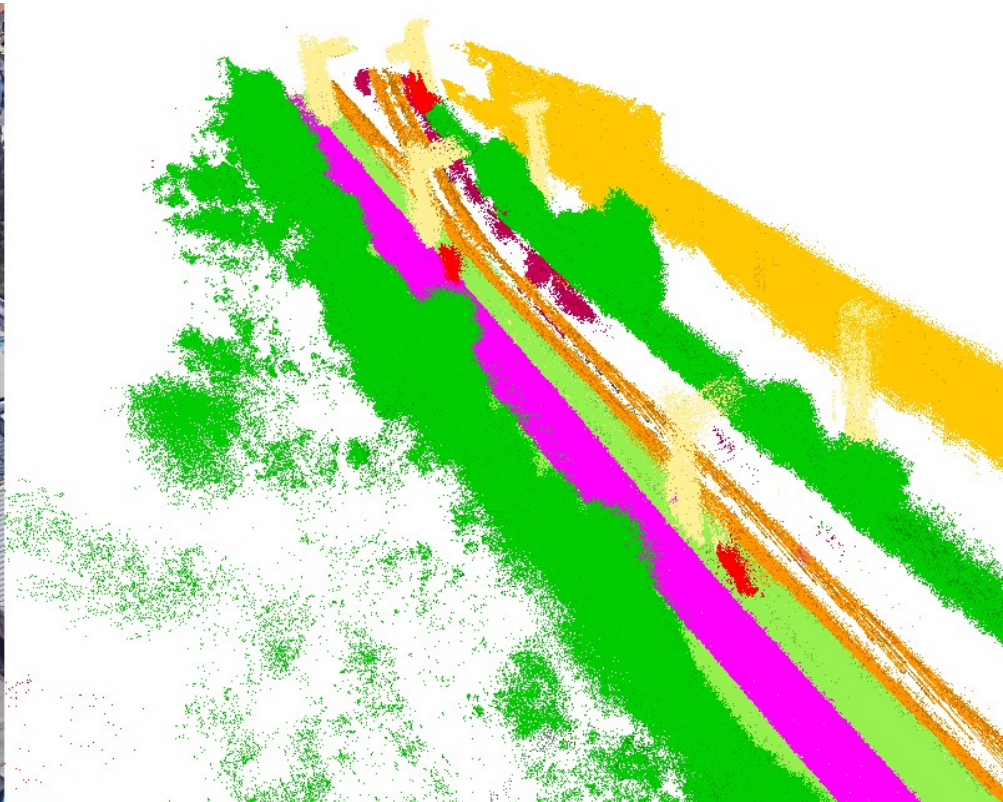# Holoscene X Sensor Bicycle

Data Example

Data Processing

- Extract & match frames of 5 LiDARs

- Combine into single frame using Point Cloud Library

- Align single frames using KISS-ICP

- Label data using SemanticKITTI Labeling tool
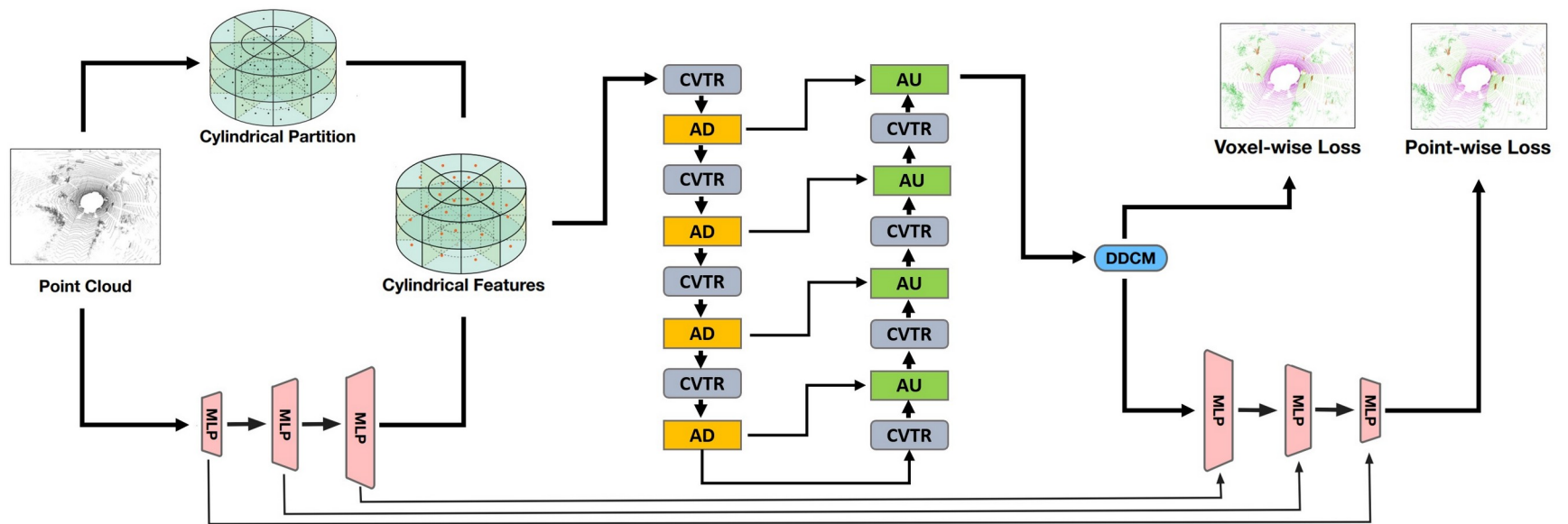
Labeled Data

Publicly Available Data Set

- 9486 labeled point clouds

- ~4.5 km of bicycle paths labeled

- SemanticKITTI like data structure

- Available at: https://osf.io/yqrd3/

Model Architecture

Model Training

- Identical for original Cylinder3D and adapted AttentiveCylinder3D

- Adam used

- Temperature Annealing used to alter SoftMax

- Final Results (mean intersection over union):

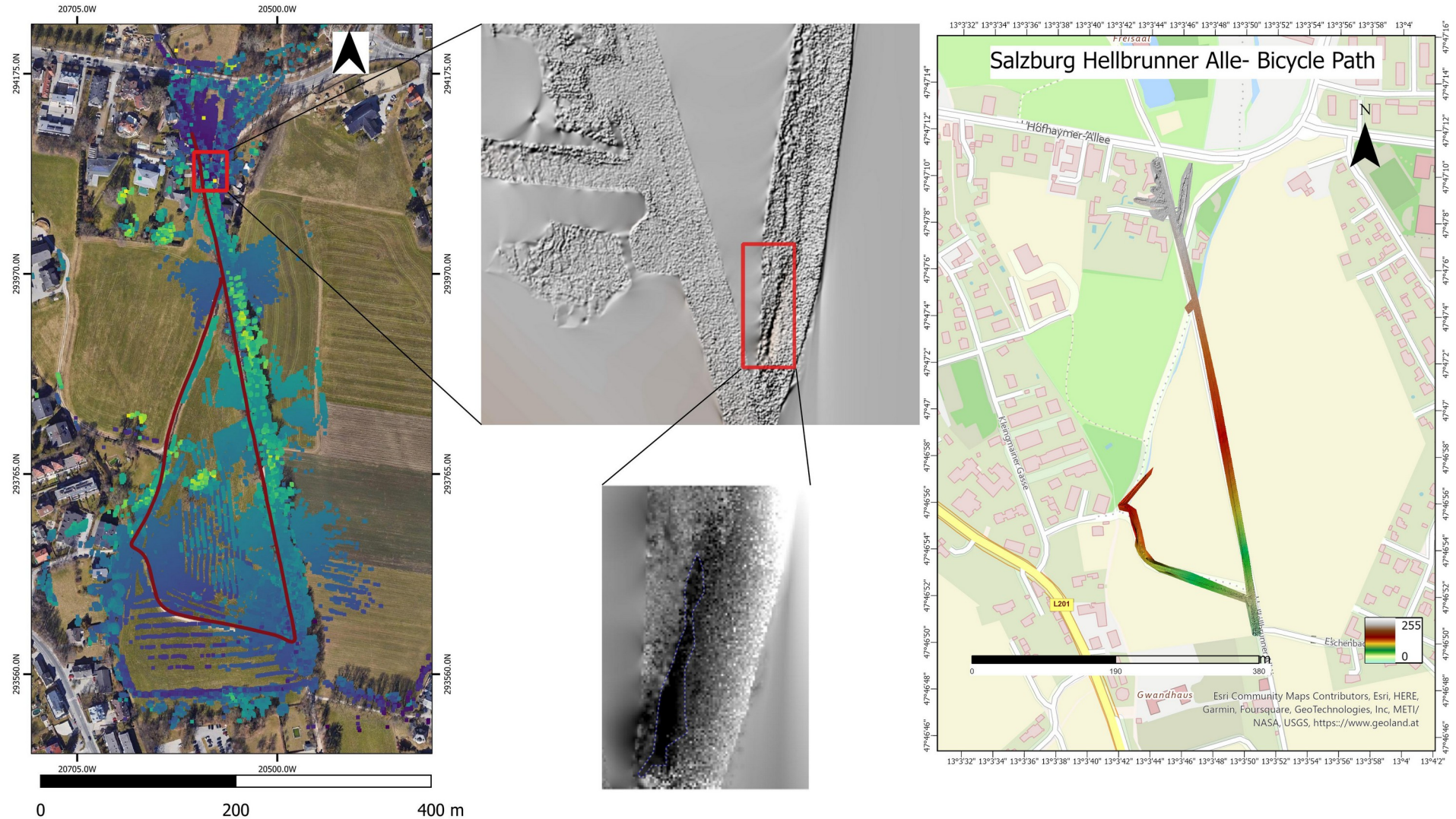|	Road	Vegetation	Terrain	Building	Average
Data set share	11.53 %	29.93 %	21.99 %	2.58 %	66.03 % (Sum)
Cylinder3D	60.23 %	**68.77 %**	48.61 %	58.00 %	58.90 %
AttentiveCylinder3D	**61.32 %**	68.49 %	**50.57 %**	**66.37 %**	**61.69 %**

Example Result
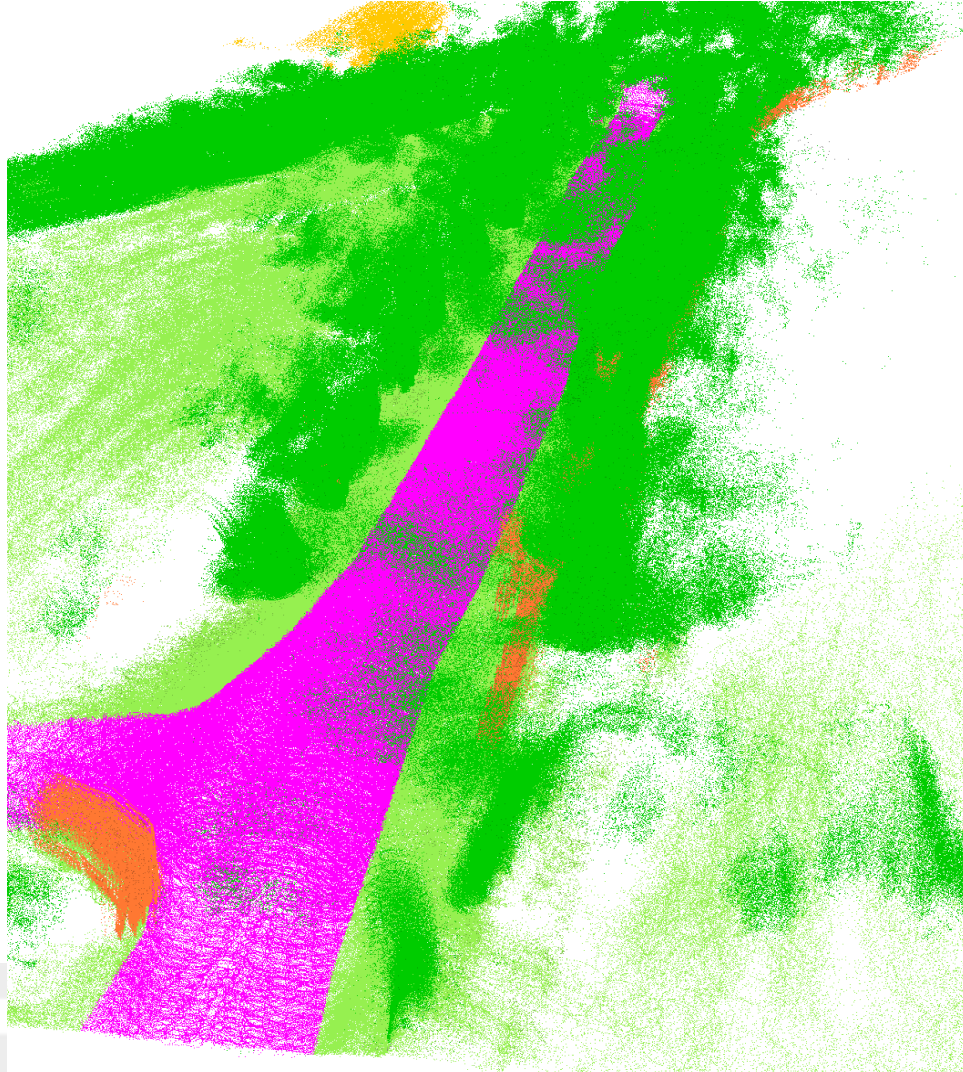
Hand Labeled Ground Truth

Segmented by AttentiveCylinder3D

Outlook: Roughness Evaluation

Contact

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FROM DATA TO VALUE