Automated Mobile Lidar Data Processing Framework for Asset Extraction

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Disclaimer

Michael Olsen   **Ezra Che**

- Drs. Olsen and Che have financial interests in the company EZDataMD LLC, a tech transfer company spun out from OSU. The conduct, outcomes, or reporting of this research could benefit EZDataMD LLC and could potentially benefit us.

- Tech Transfer of Geomatics Research at OSU
  - Exclusive IPs for point cloud processing:
    - **RoME**: road marking extraction and evaluation
    - **Vo-Norvana**: point cloud segmentation
    - **Vo-SmoG**: ground filtering
    - **EZPC**: point cloud data management toolkit
    - **EZVox**: point cloud data processing toolkit
    - **EZFeat:** feature extraction toolkit
    - **RAMBO**: slope stability/terrain modeling/change analysis
    - And MANY MORE!
- Provides a wide range of services
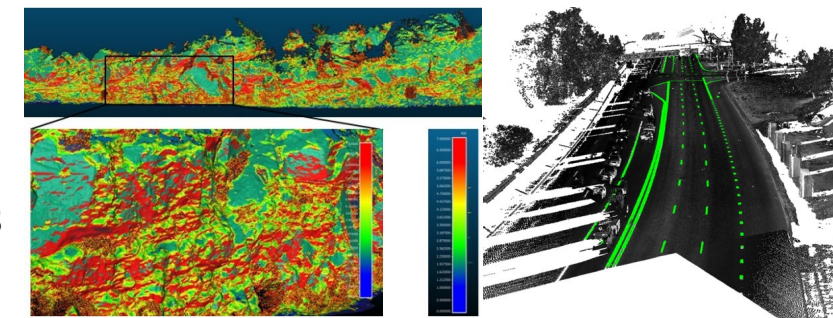 Licensing software
 Consulting services
 Custom development

EZDataMD

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Background

- The geomatics research team from Oregon State University (OSU) has completed several research projects with ODOT and other funding agencies (e.g., PacTrans, NSF) focused on leveraging mobile lidar data in a variety of applications
  - Road roughness assessment (ODOT SPR744)
  - Point cloud segmentation and classification (NSF)
  - Road marking evaluation (ODOT SPR799)
  - Sight distance analysis (PacTrans)
  - Rockslope stability analysis (ODOT SPR809)
  - Curb ramp assessment (PacTrans, ODOT SPR844)
  - **Bike lane and crosswalk inventory (ODOT SPR850, in progress)**
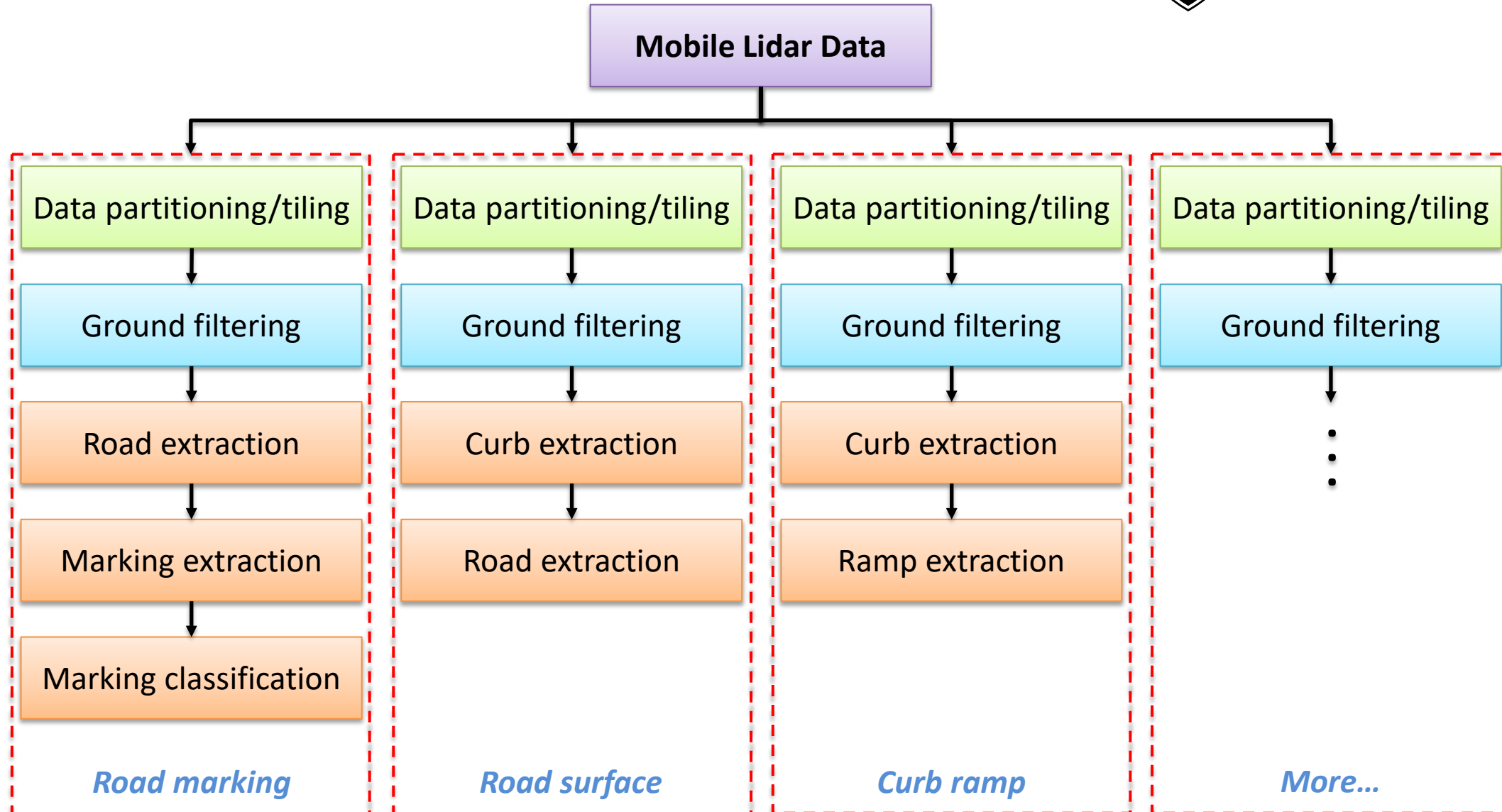 - **Road characterization and feature extraction framework (ODOT SPR866, in progress)**
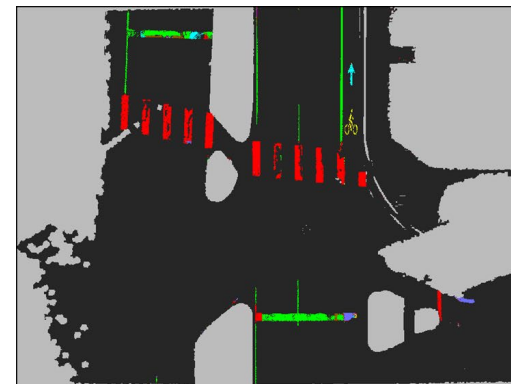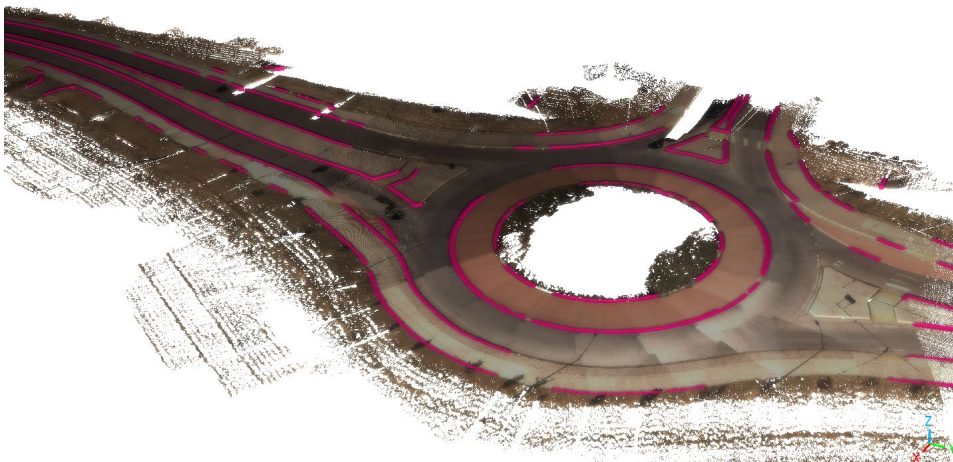
Straight arrow   Right arrow   Bike symbol
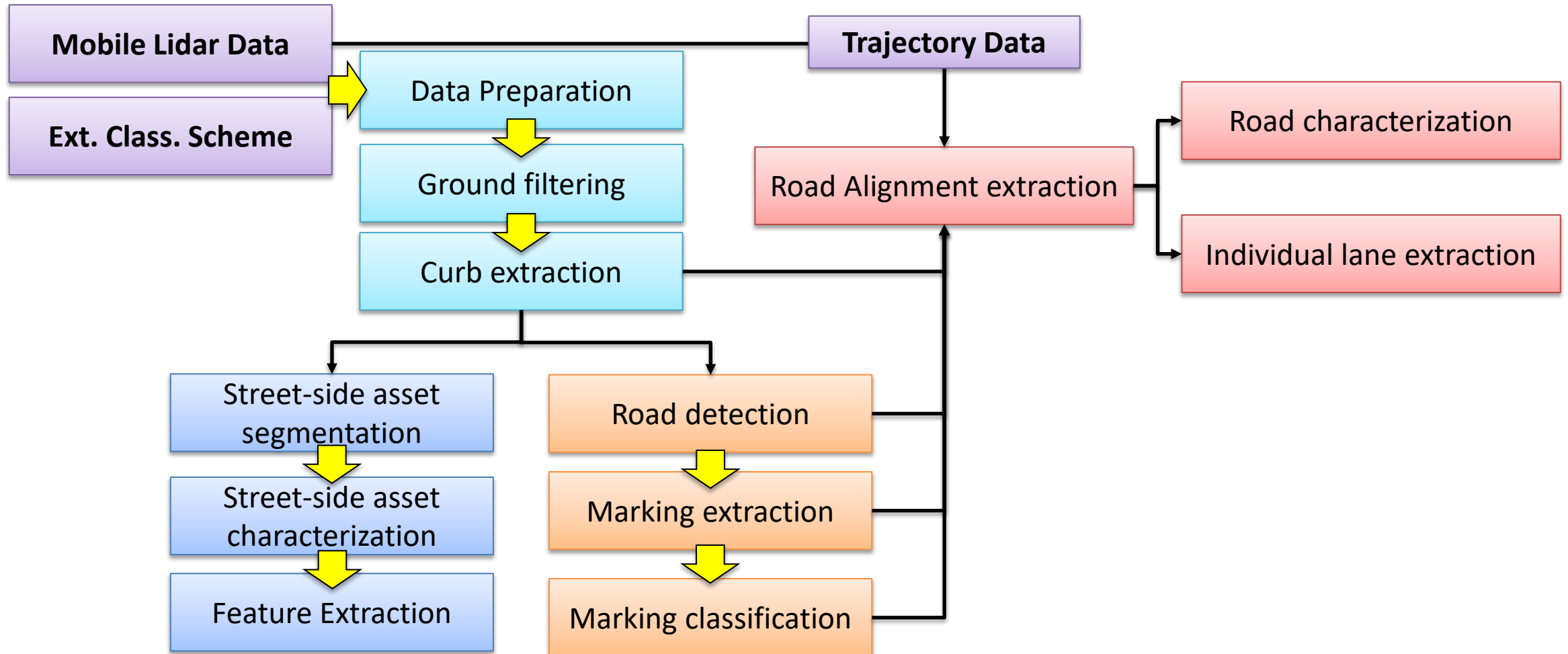Lane markings   Crosswalk   Road surface
Unclassified
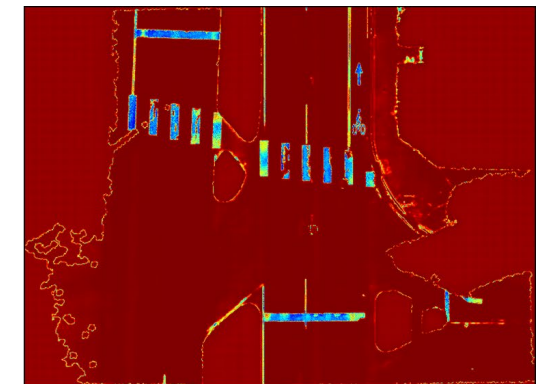
Uncertainty
High
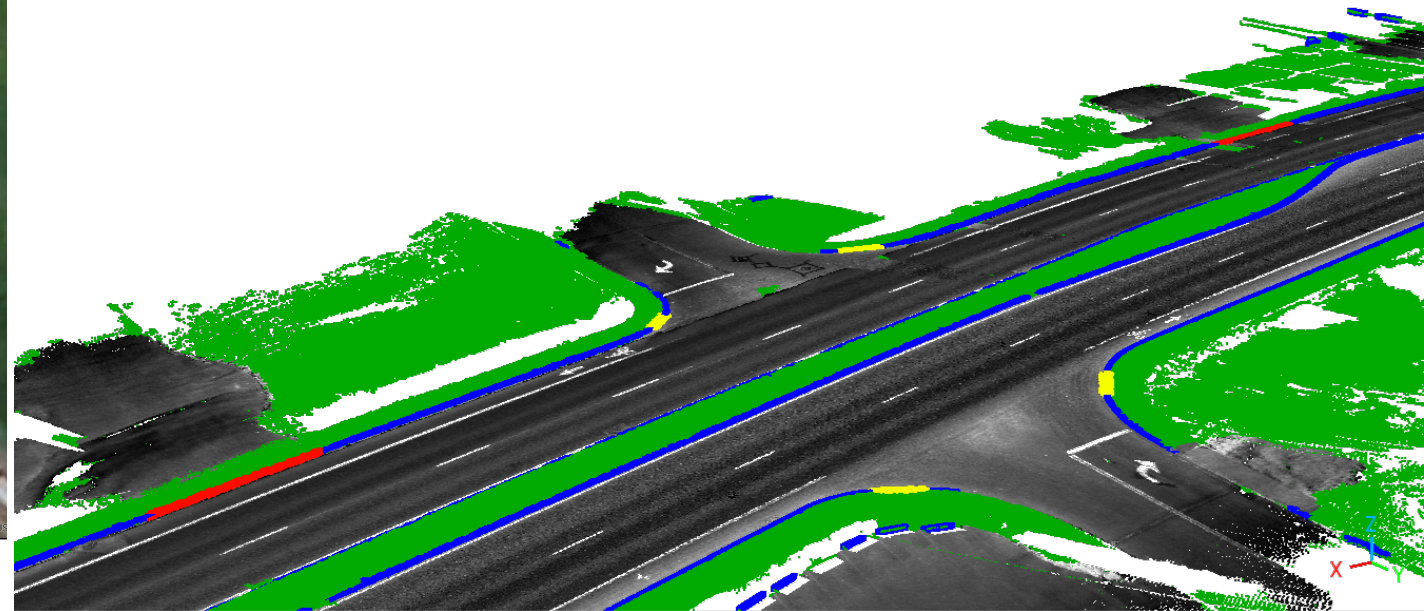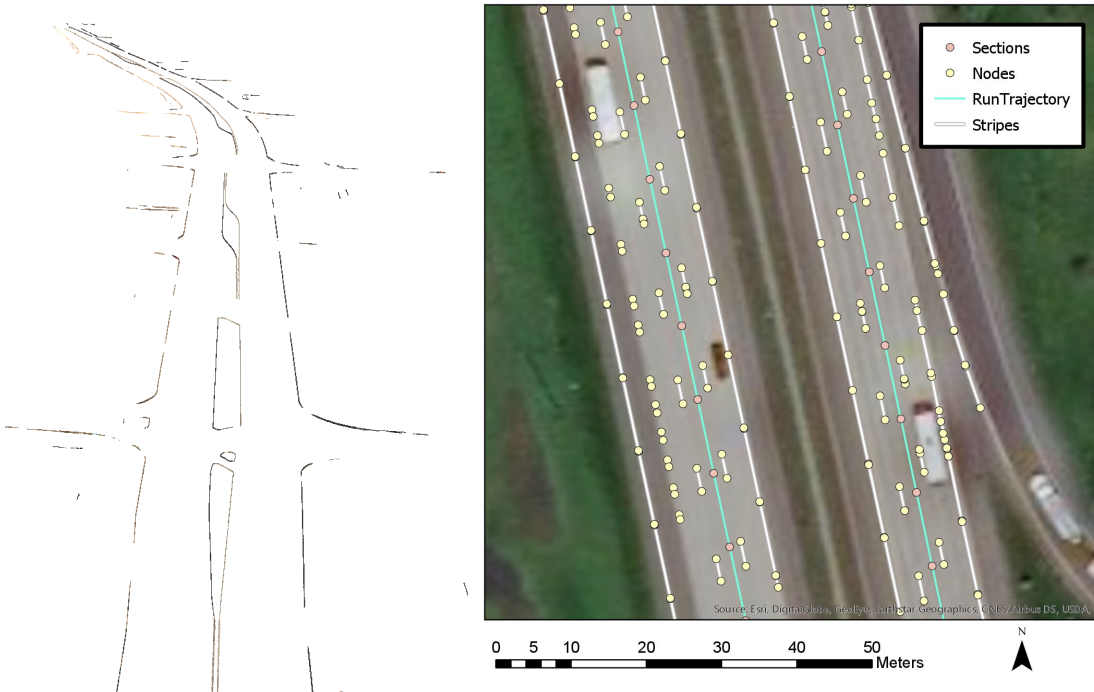low

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Typical Workflow

Proposed Framework

Data Formats

- Point Cloud vs GIS linework/layer/geodatabase
  - Using point cloud to save as much information as possible
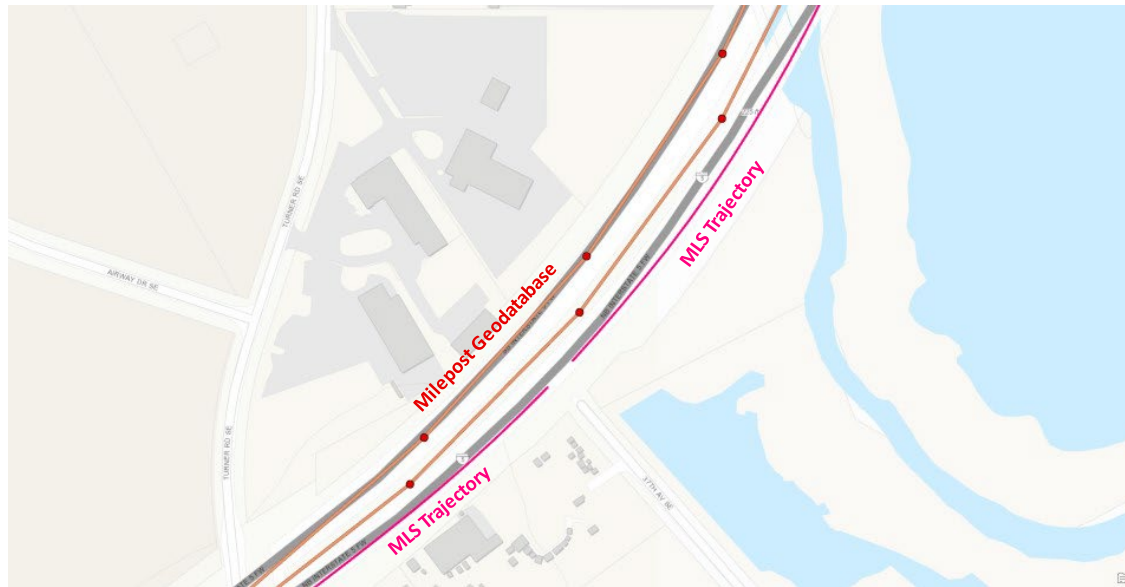 - Exporting GIS data products for specific applications/analysis
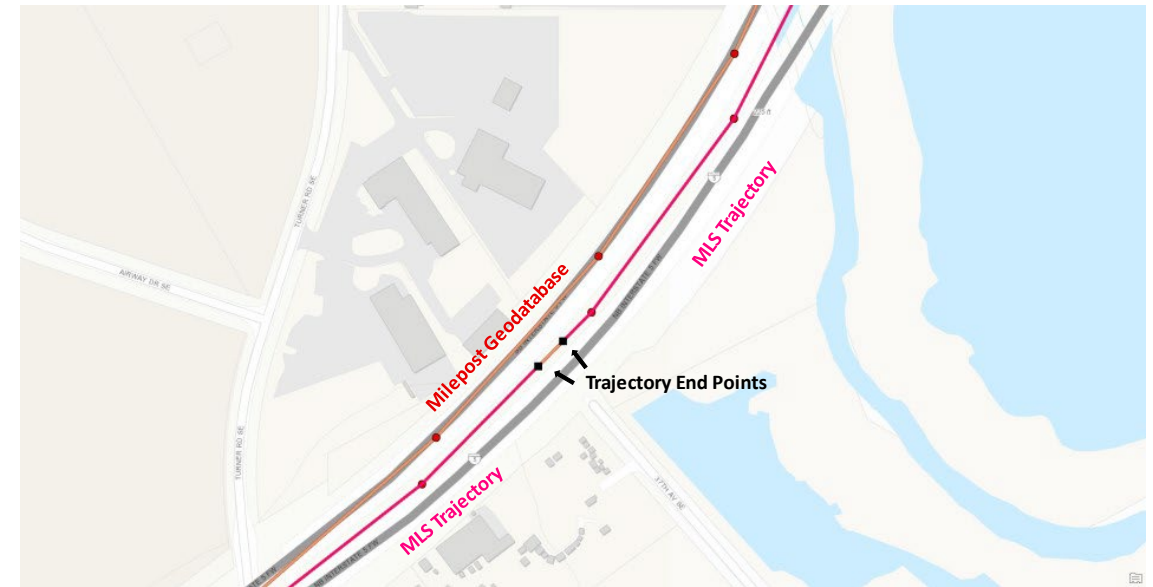
Data Management/Organization

- Lidar Data Milepost Indexing
  - Improves data findability
  - Support more geospatial analyses

Visuallization of the misalignment between the MLS trajectory and polylines generated from the lower accuracy milepost geodatabase
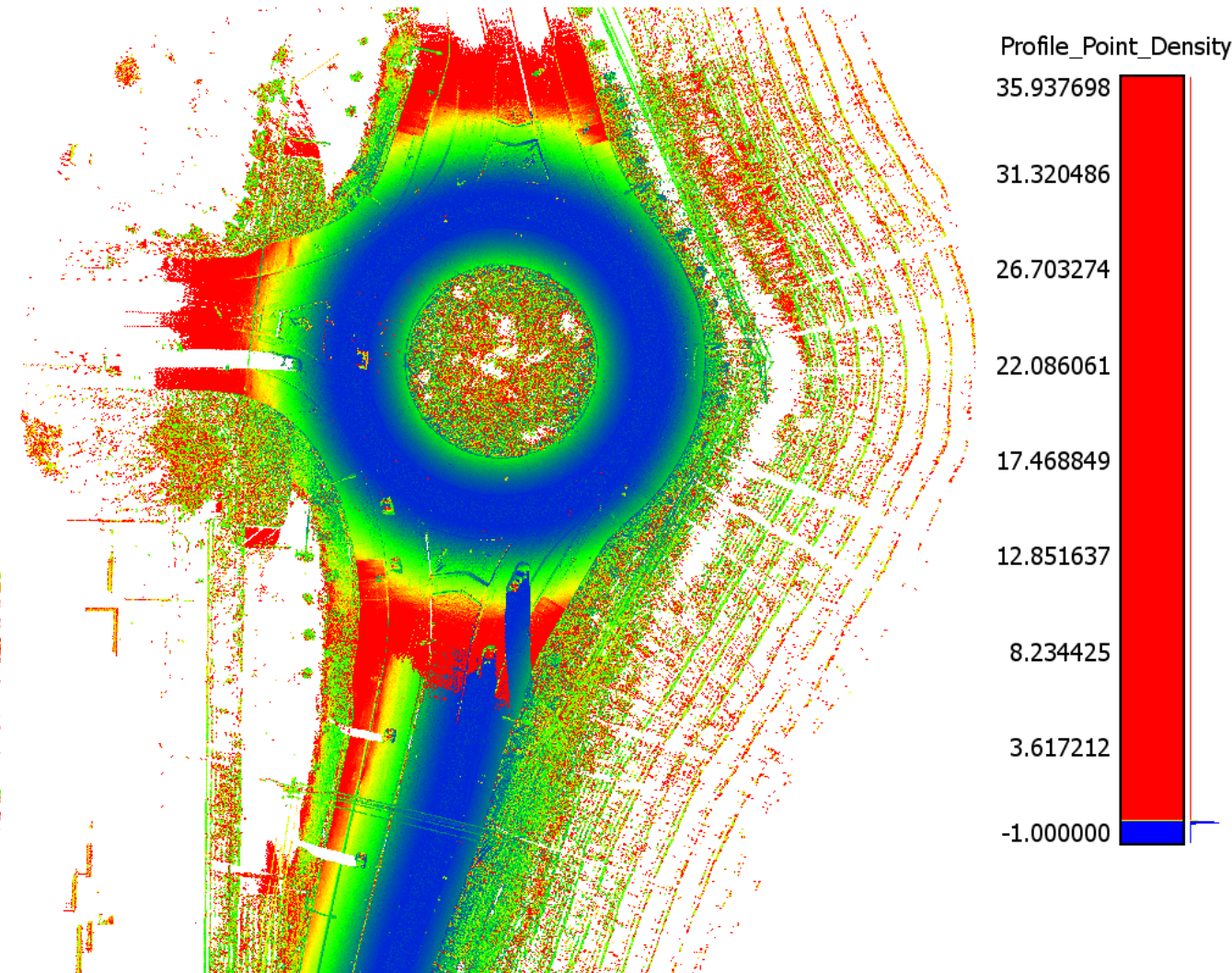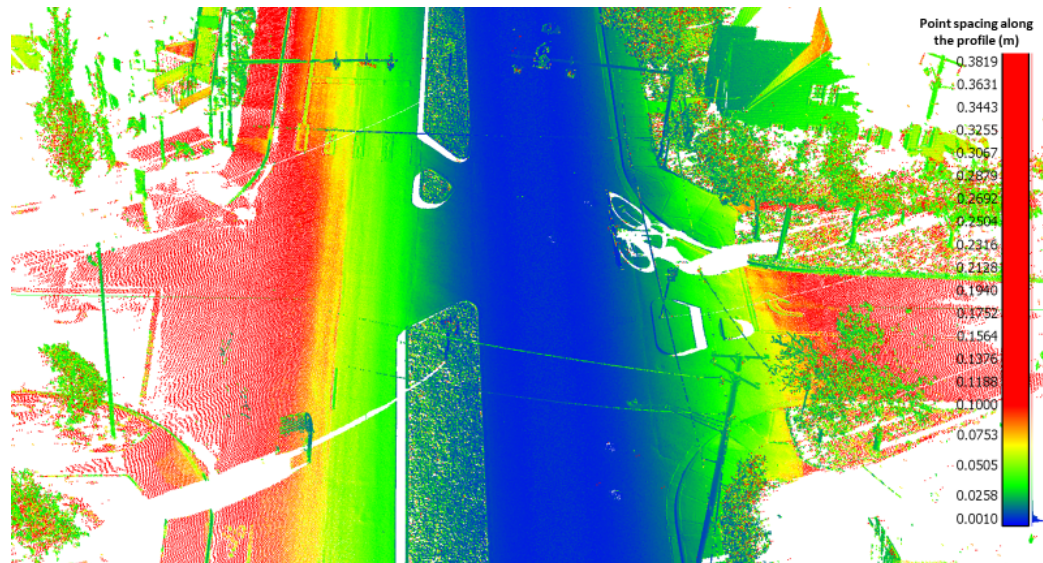

Alignment between the MLS trajectory and the milepost geodatabase

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Data QA/QC

- Estimating point spacing
  - Efficient QA/QC
  - On Scan Pattern Level
  - Indicate Data Quality
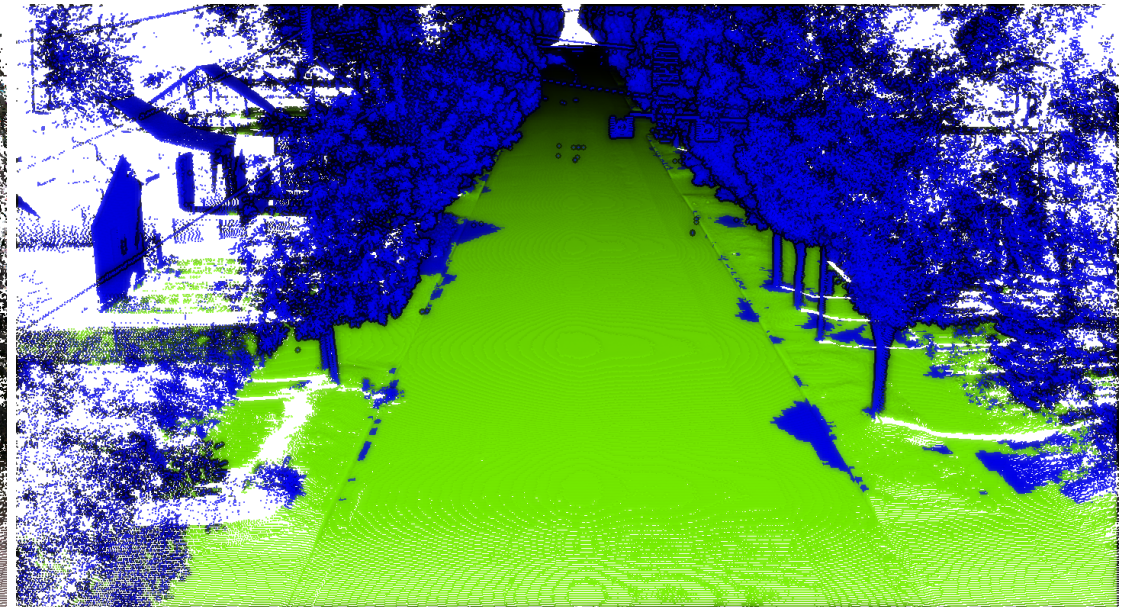 - Guide Parameter Setting
 - Indicate Confidence

Ground Filtering

- Ground Filtering:
  - Separate ground and non-ground points
- Vo-SmoG (Award-winning, Martin Isenburg Best Paper, 3D Geoinfo 2021)
  - Flexibility for fine-tuning and batch processing
 - Versatile for different types of data and scenarios

Curb Extraction

- Serve as road boundary (and bike lane boundary)
- Provide road alignment information
- Support modeling of the raised median
- Help curb ramp localization
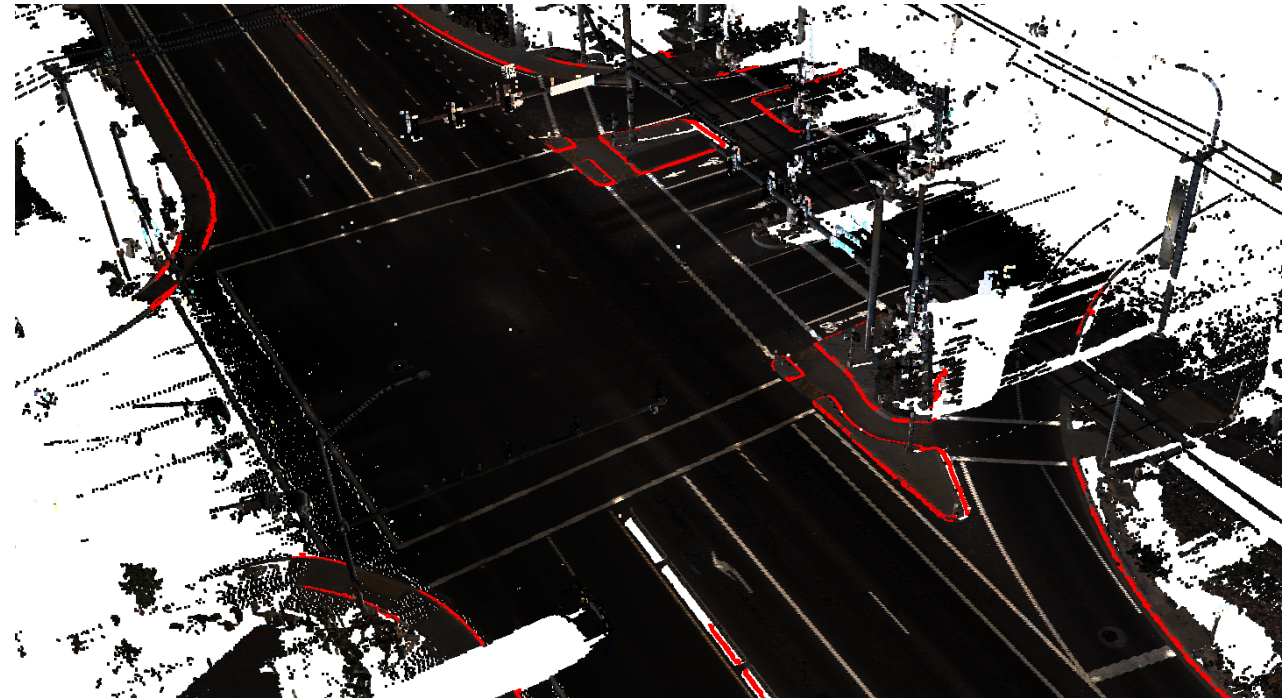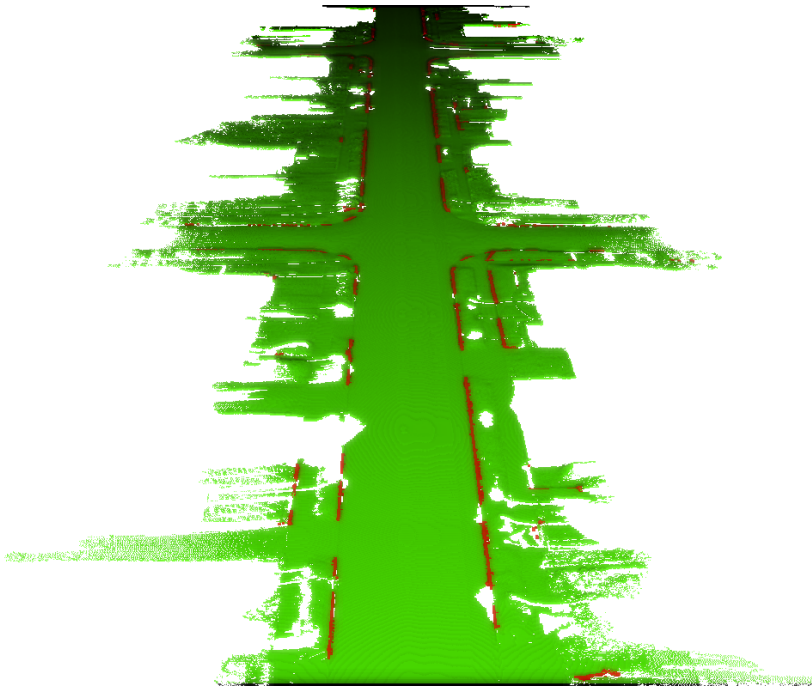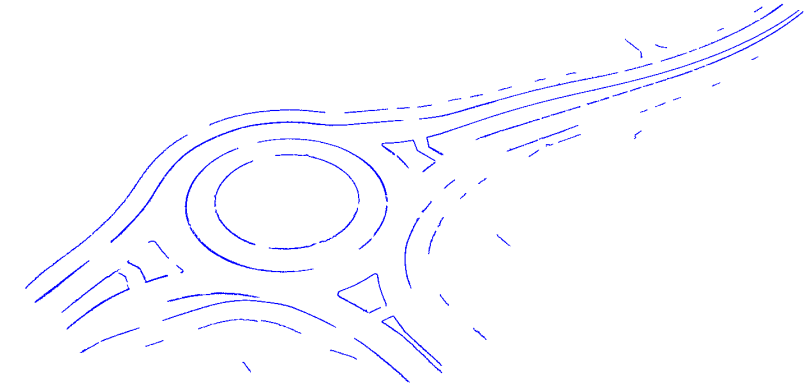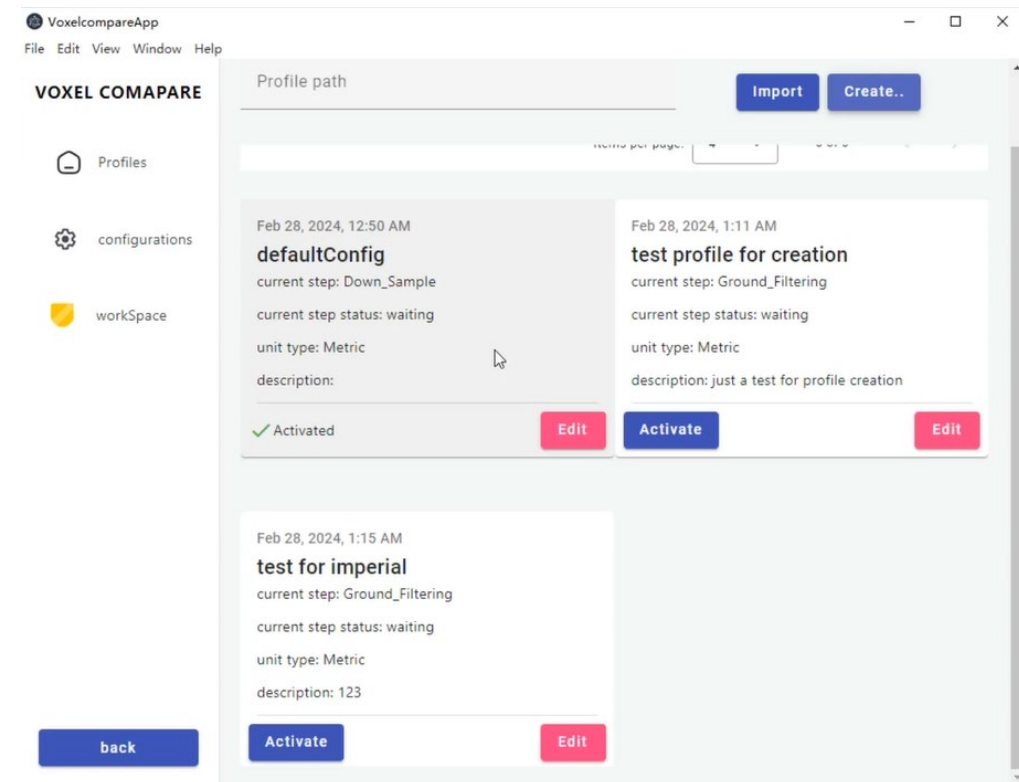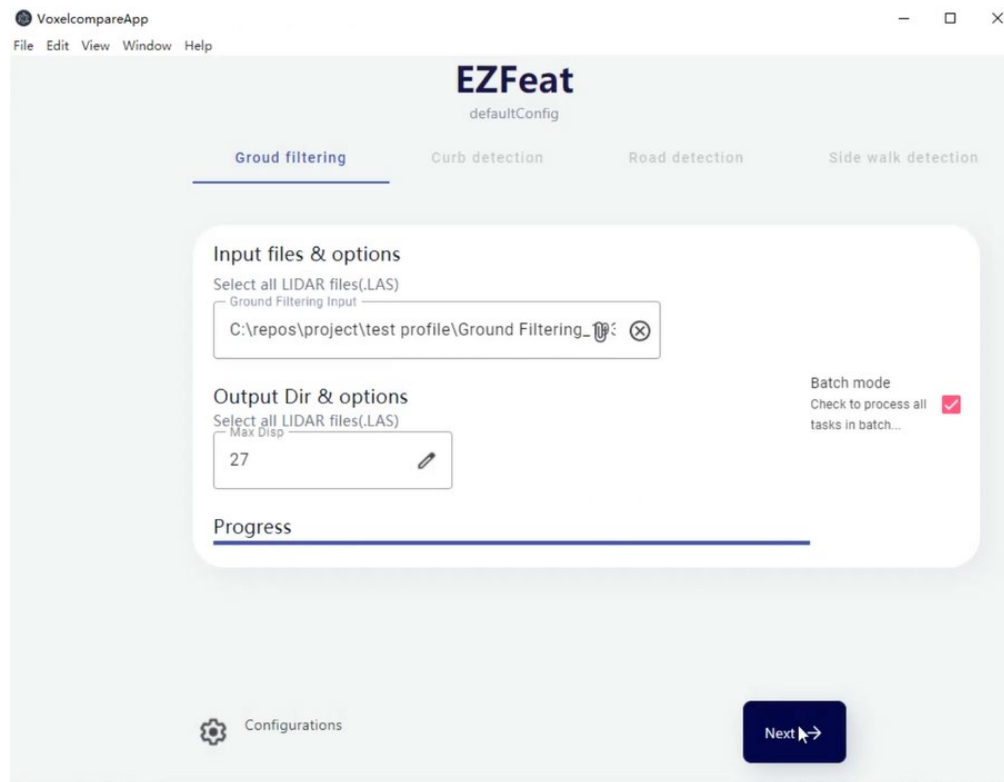
Road Detection

- Improved VROOM algorithm
  - Only point cloud data needed
  - Not rely on road boundary (e.g., curbs)
  - Able to cope with driveway, curves, etc.
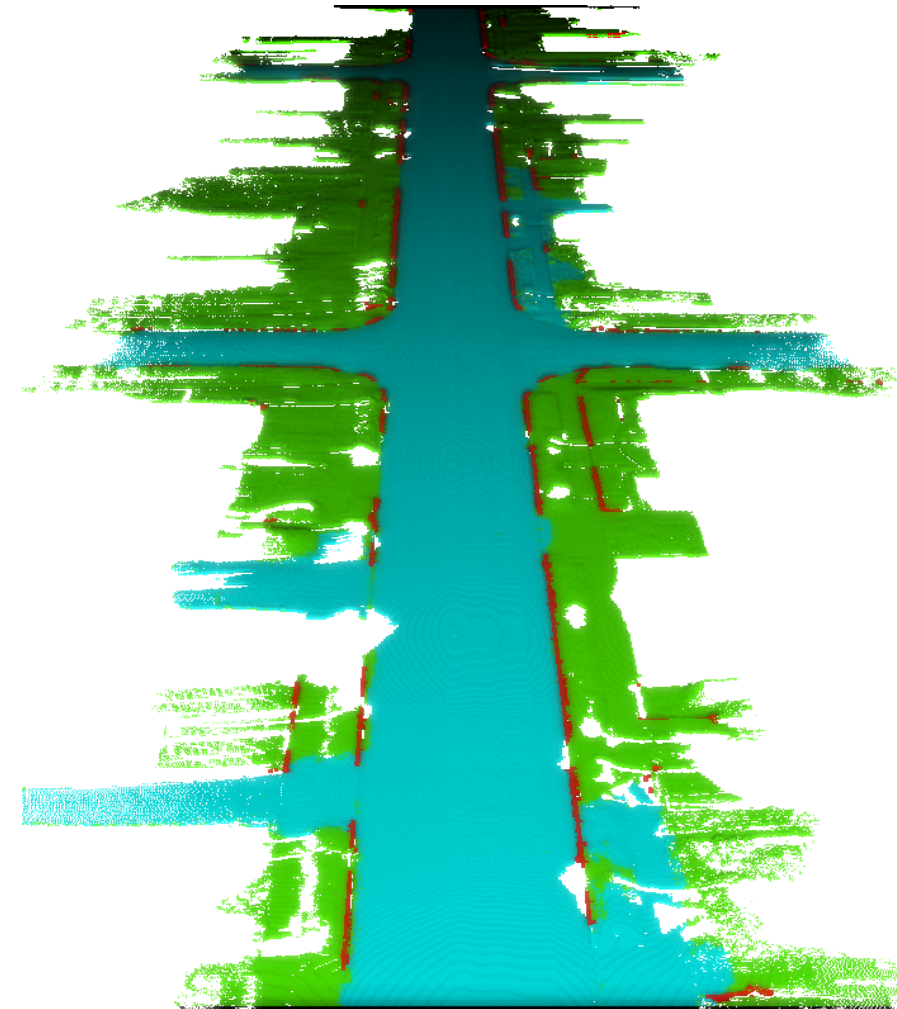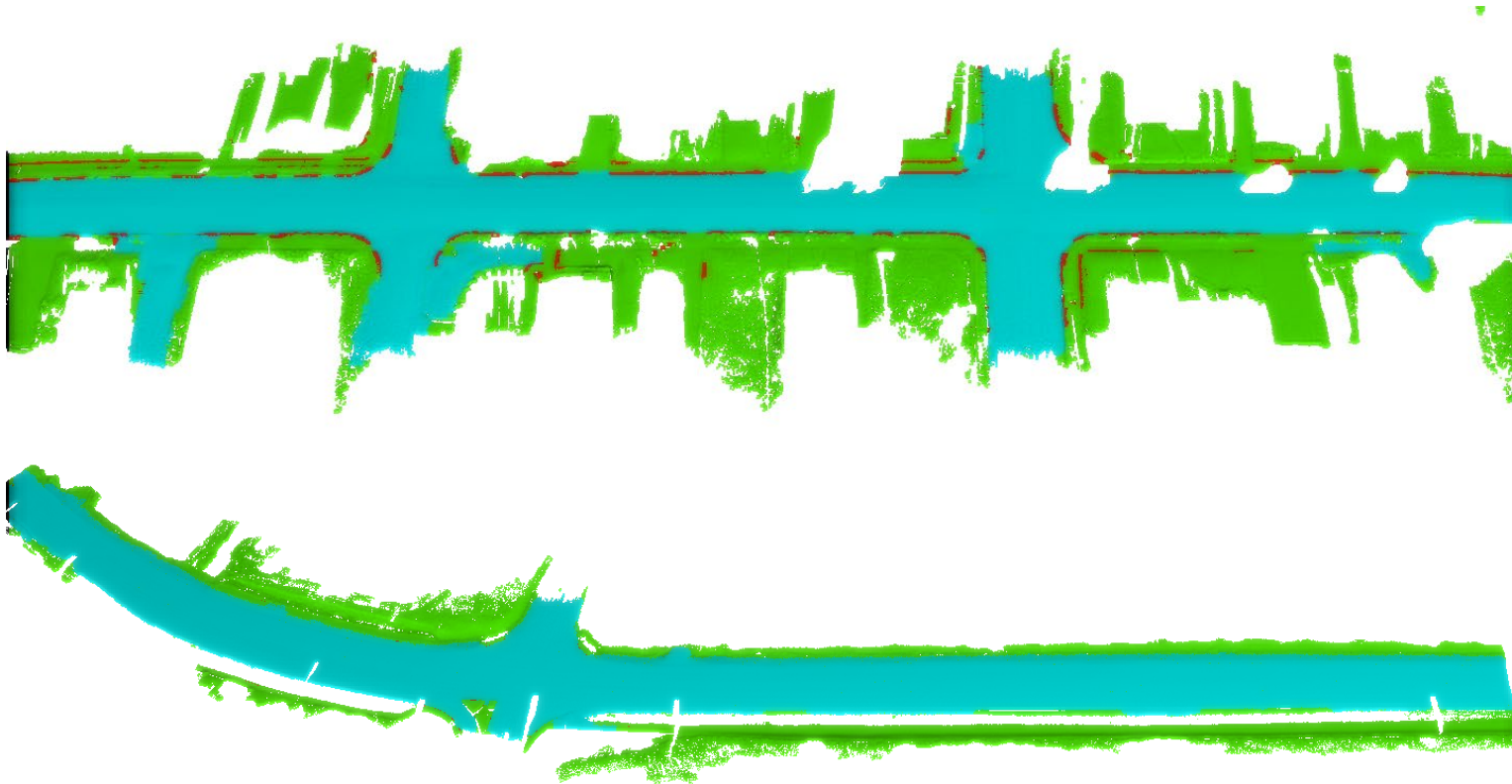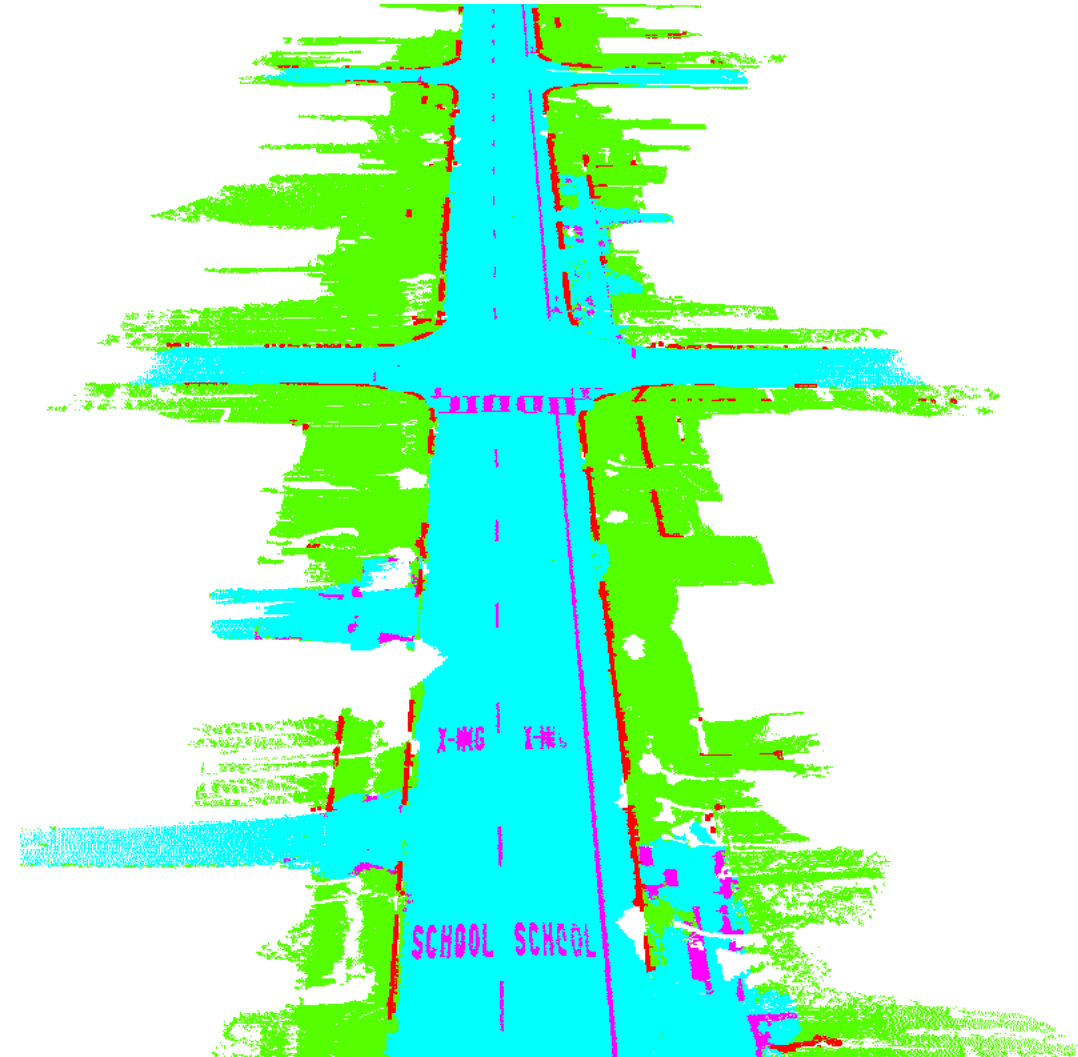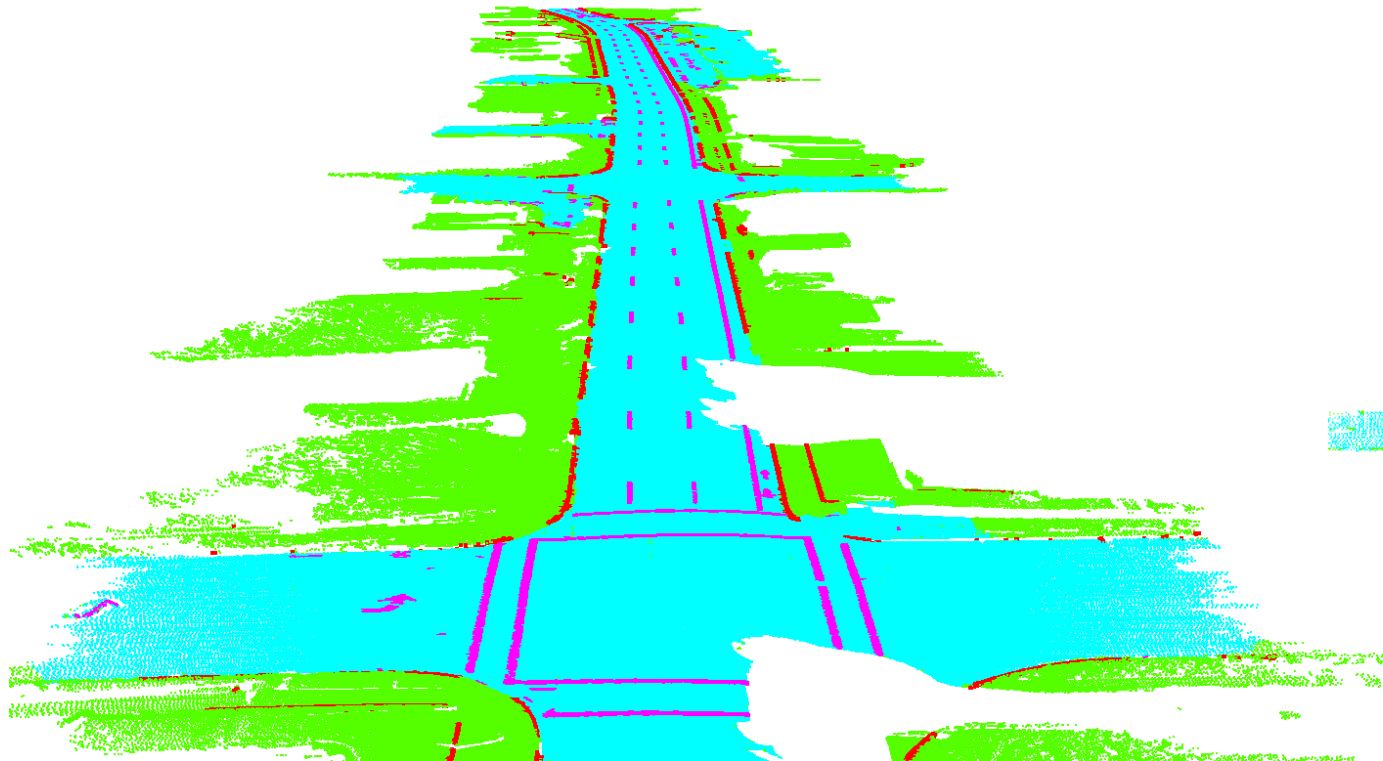
Prototype GUI

- Batch process mobile lidar data
- Fine-tuned default parameters
- Save intermediate results

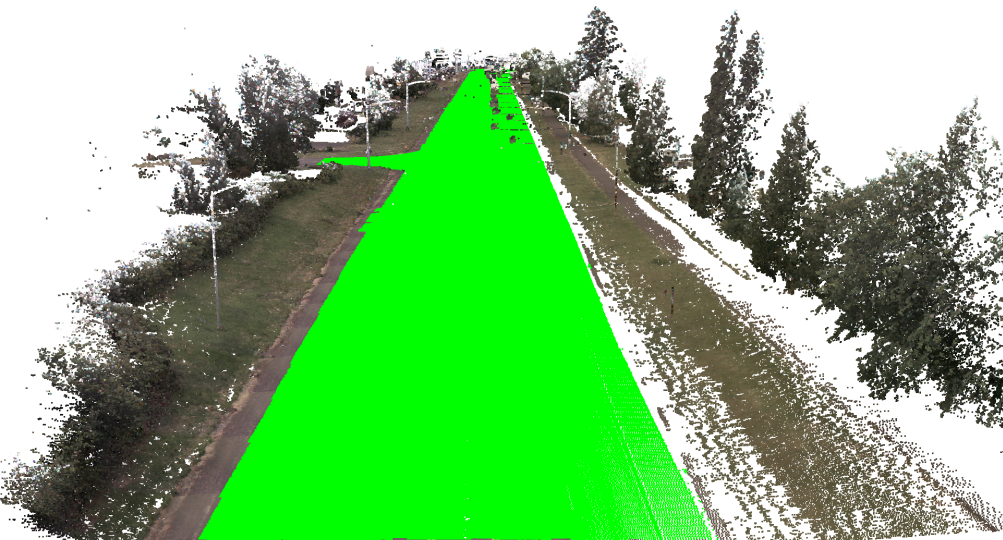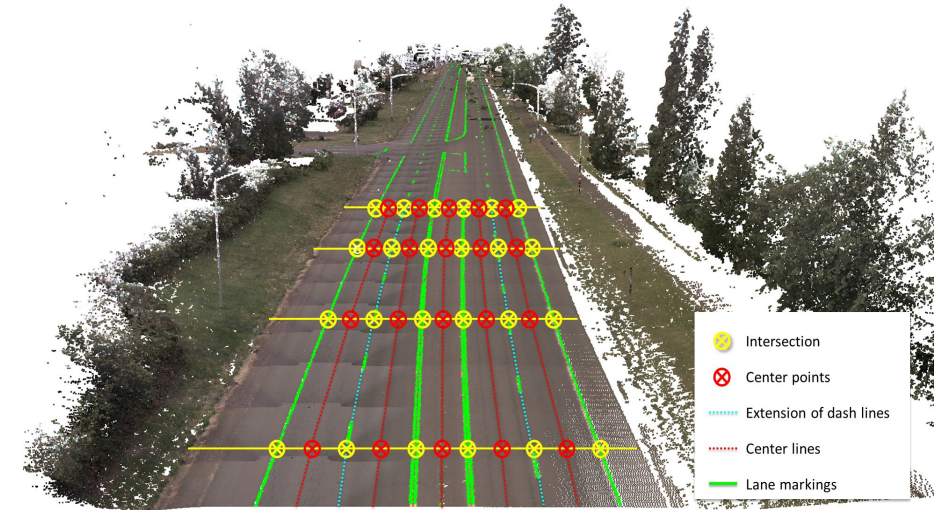# Road Marking Extraction

- EZFeat/RoME
  - Marking detection and classification
  - Bike lanes & crosswalk inventory
  - More in Dr. Olsen's presentation!
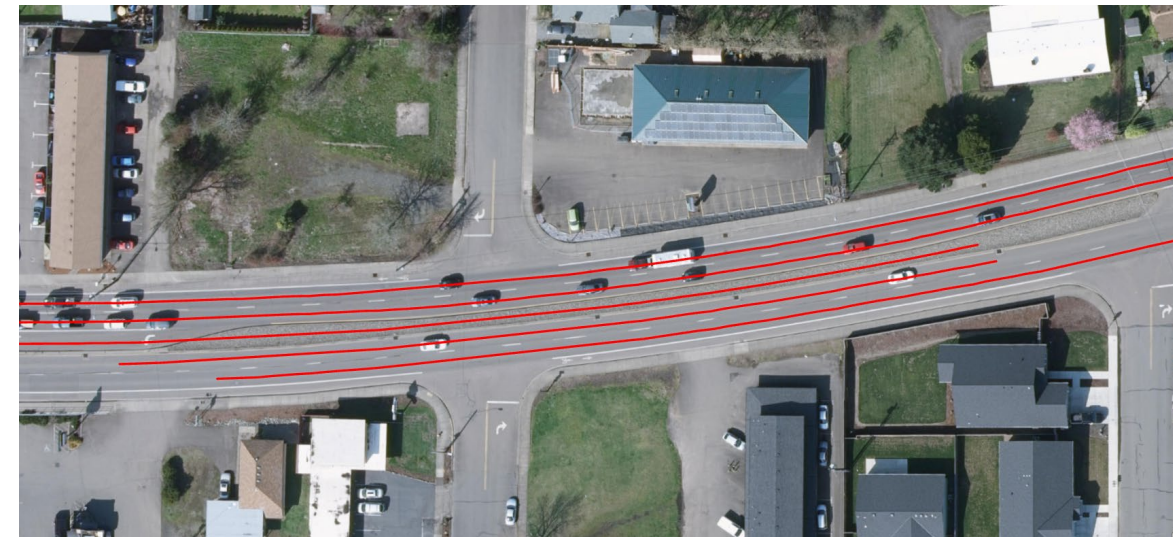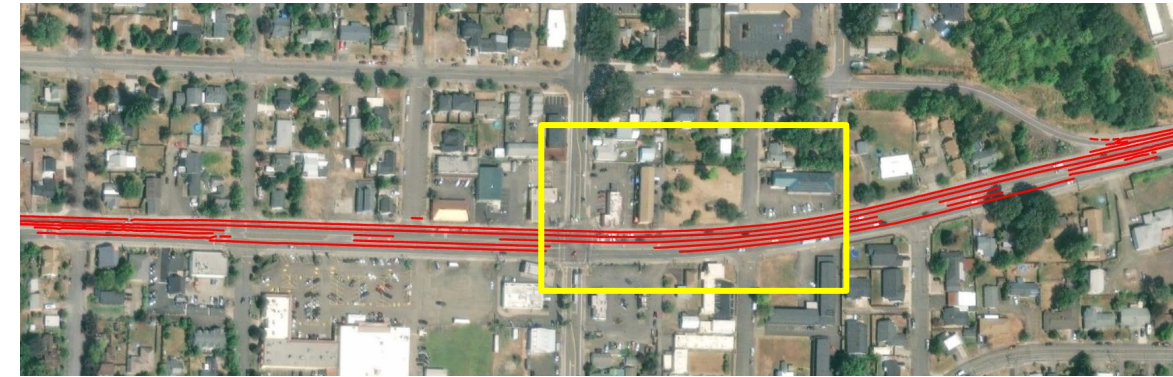

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Road Alignment Extraction

- Road detection
- Marking extraction
- Cross section extraction
- Center points extraction

Intersection
Center points
Extension of dash lines
Center lines
Lane markings
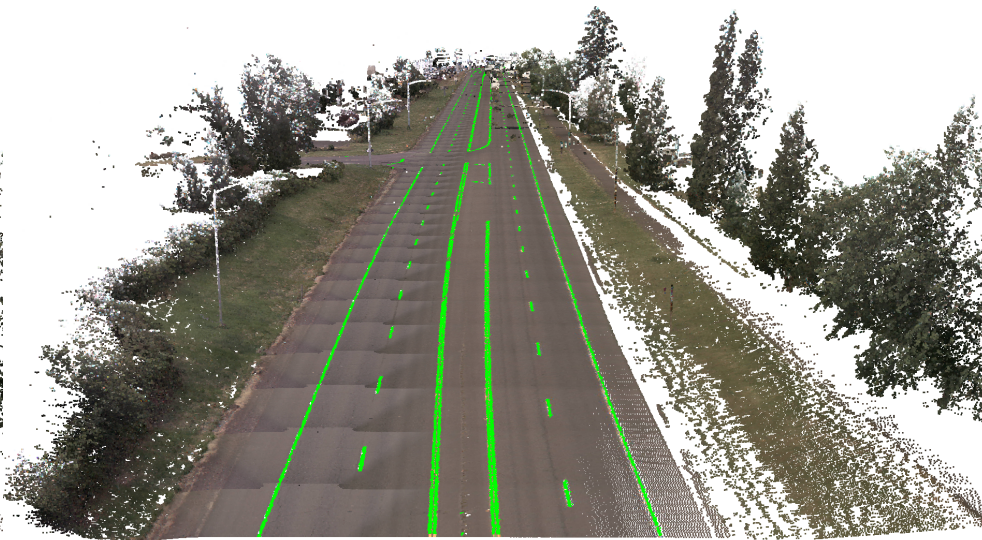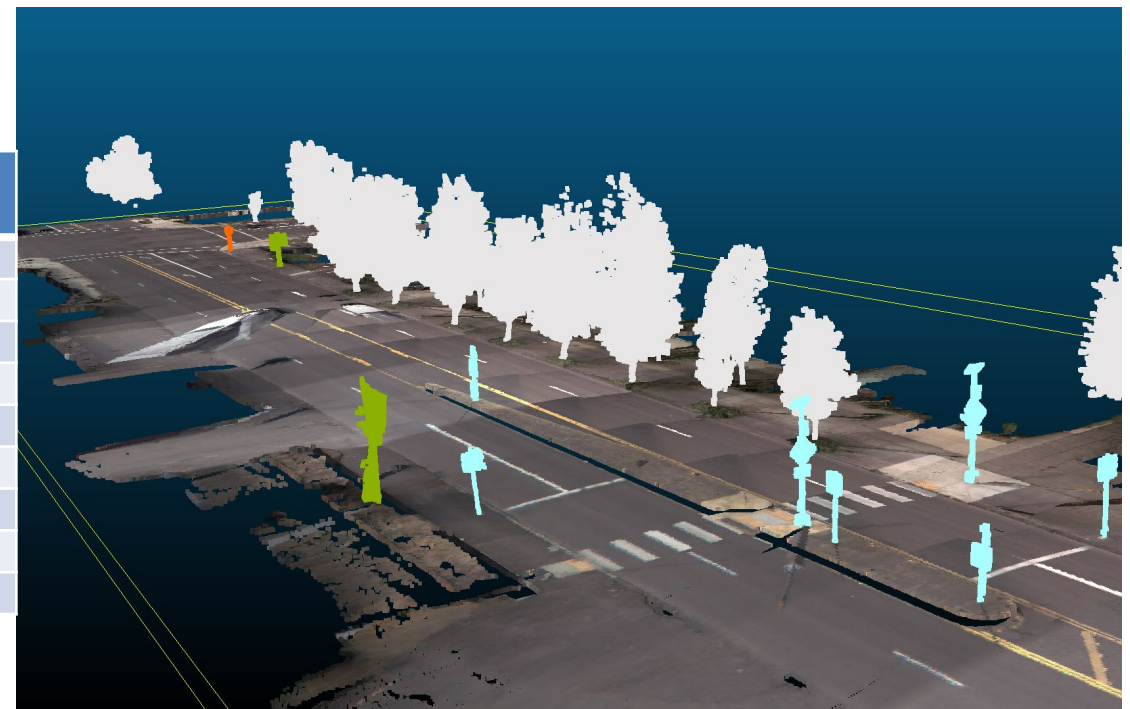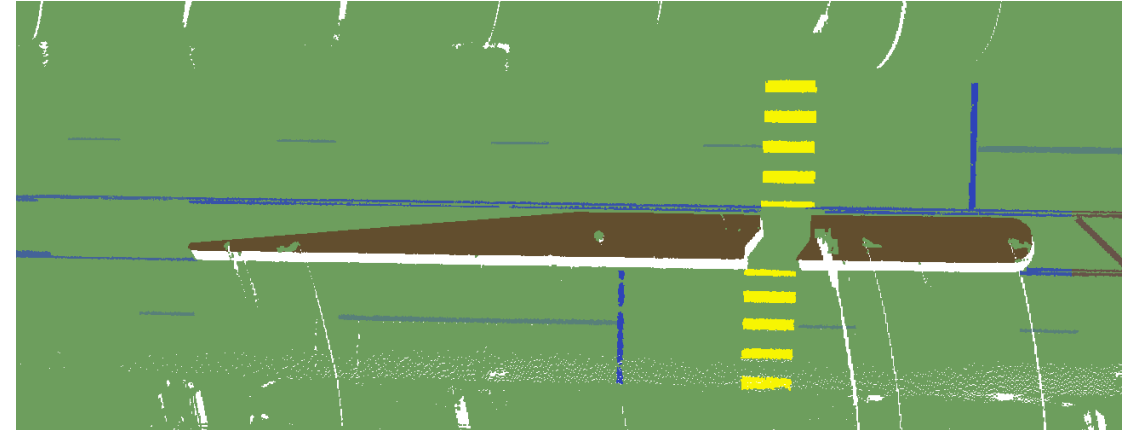
Road Characterization

- Road Alignment from Markings
- Horizontal & Vertical Curve
    - Segmentation
    - Identification
    - Characterization
    - MORE in Sahar's presentation!
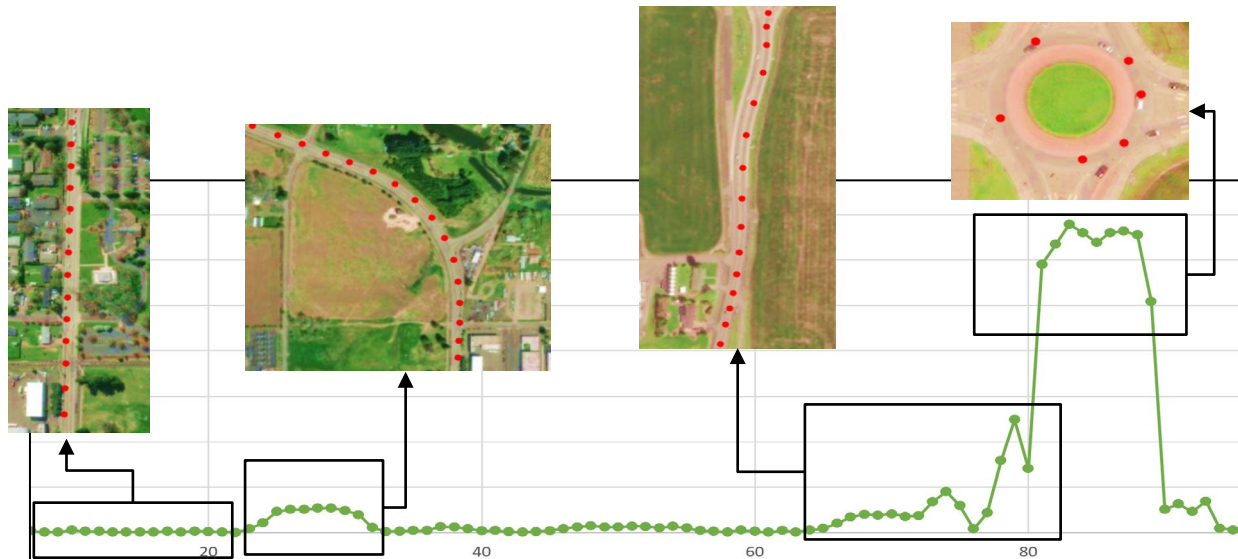
Data Annotation

- Extended Class Scheme
  - Compatible with LAS Specification
  - Ground objects
    - Ground
    - Road
    - Markings
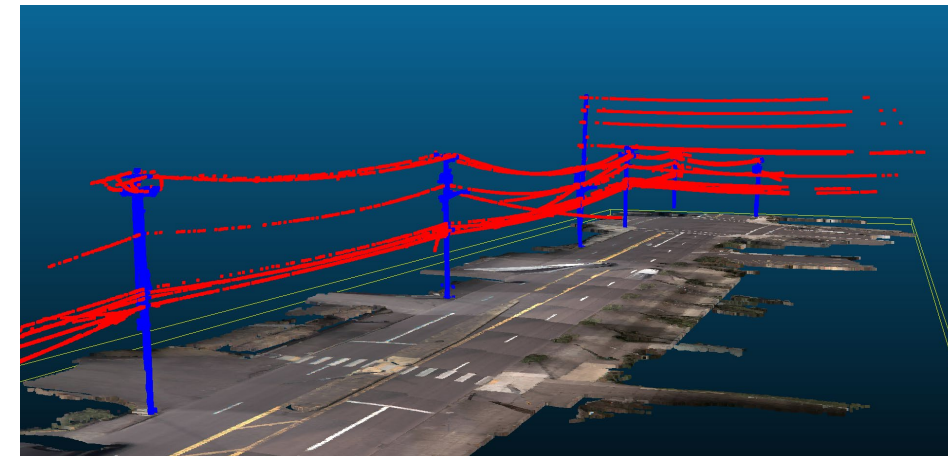   - Various classification

Extended Class ID	Extended Class Meaning	LAS Class ID	LAS Class Meaning
000000	Created, Never Classified	0	Created, Never Classified
100000	Unknown/unclassified	1	Unclassified
200000	Unspecified ground	2	Ground
200100	Sidewalk	2	Ground
200200	Curb ramp	2	Ground
110000	Road surface	11	Road Surface
110100	Road marking	11	Road Surface
110110	Lane marking	11	Road Surface
110120 – 119999	Other markings	11	Road Surface

Data Annotation

- Street-side Assets
 - More complicated
    - Not necessarily one-to-one matching
    - Different classes depending on the applications
- Assign Priority for sub-classes
  - Examples
    - Overhead structure
      - Sign, Traffic light, others
    - Pole-like object
      - Sign, Traffic light, Streetlight, others
- Label Editing Tool
  - Change classification ID
  - Change classification priority
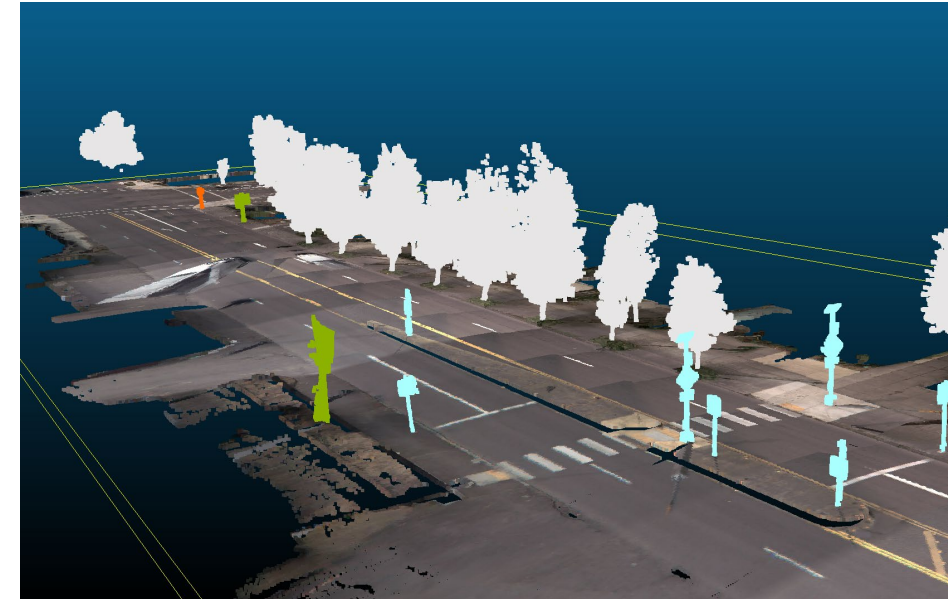
Street-side Asset Extraction

- Vo-Norvana Segmentation
  - Non-ground points only
  - Obtain individual objects
- Object Characterization
  - Dimension (height, footprint)
  - Linearity
  - Orientation
  - Shape
  - Slice shape distribution
- Object Classification
  - Machine learning
  - Flexible with labeling strategy

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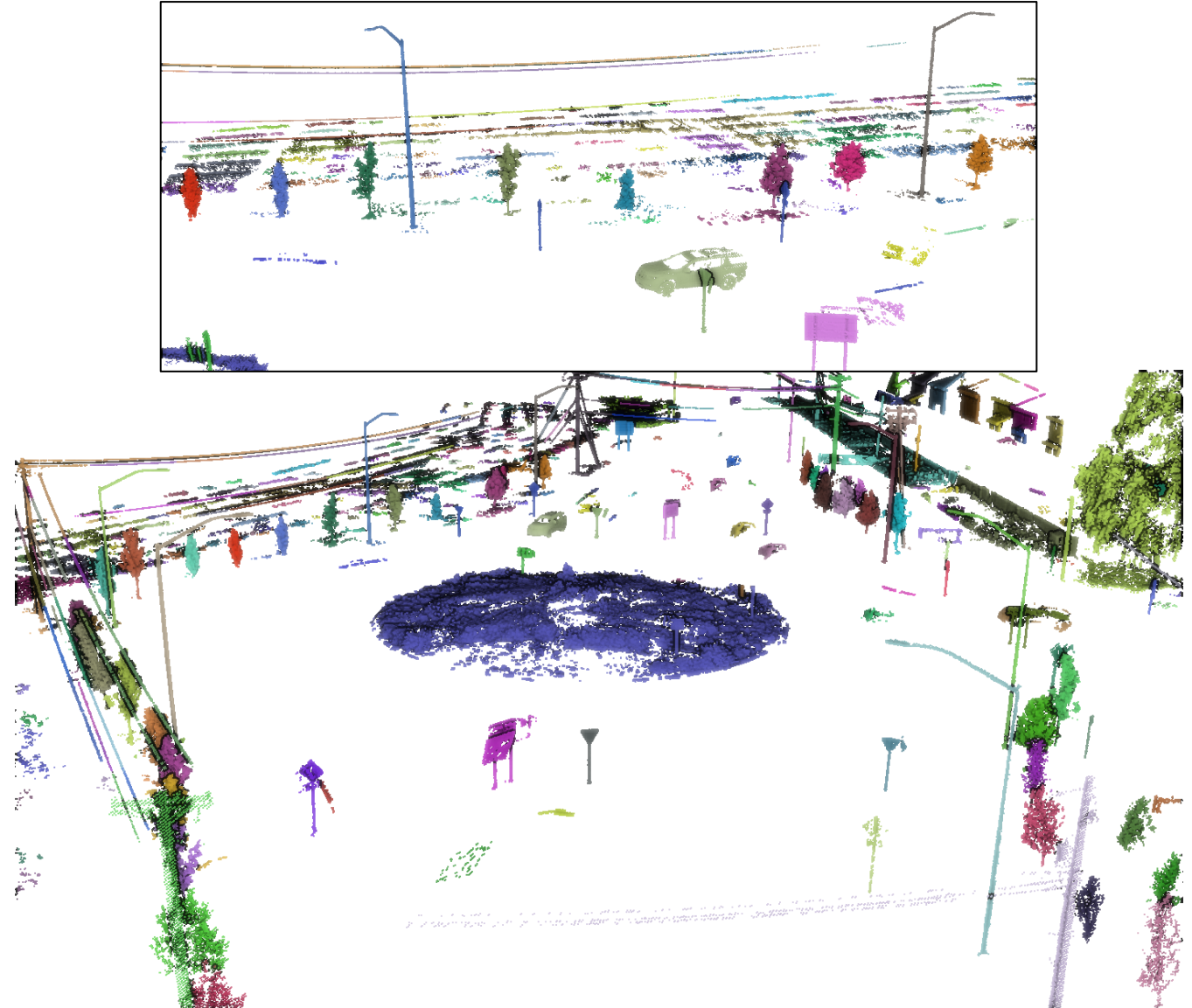
THANK YOU!

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