LiDAR Feature Extraction Methodologies

2009 Civil Commercial Imagery Evaluation Workshop

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Feature Extraction Methodologies

- Imagery-based analysis is well-established and can be applied to LiDAR intensity images. Most of these approaches utilize intensity values (8-bit) and RGB values of coincident orthophotography to extract features.
- Commercial Offerings
  - PCI Geomatics Geomatica
  - Defiens eCognition
  - ERDAS Imagine
  - Overwatch Feature Analyst
  - ITTVIS ENVI

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Pros/Cons of Imagery Analysis

- + Loads of commercial applications!
- + Well-established exploitation algorithms
- + May require stereo pairs
- - Loss of detail (from point cloud to image)
- - Difficult to assess ‘hard edges’ accurately (due to interpolation process) and understand all relevant vertical obstructions

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Feature Extraction Methodologies

- LiDAR-based feature extraction is an emerging technology that utilizes the spatial characteristics of the point cloud, as well as the attributes of each point.
  - Location (x, y, z)
  - Intensity
  - Return Number (1-4)

- Commercial Offerings
  - Terrasolid Terrascan
  - Merrick MARS® Explorer
  - Overwatch LiDAR Analyst

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Pros/Cons of LiDAR Analysis

- + Provides a very high degree of (3-D) detail
- + Airborne collections can be integrated with terrestrial & mobile datasets
- + Can be used to investigate obscured areas (ex. jungle environment)
- - Difficult to optimize algorithms of increasingly higher point density requirements
- - Typically requires low-altitude flight plan
- - LiDAR data is HEAVY! (difficult to manage very large AOIs)

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Data Processing Workflow

- Reclassify raw LiDAR data into bare-earth and canopy classifications (automated)
- Refine classification of bare-earth surface (manual)
- Compilation (heads-up digitization) of hydrologic features (automated/manual)
- Building Compilation (automated/manual)
- Investigate canopy class to extract additional spatial features

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Derivative Features

- **Bare-Earth & Canopy**
- **Hydrologic Features**
  - **Lakes/Ponds (flat water)**
  - **Streams (single drain)**
  - **Rivers (double drain)**
- **Buildings (planar)**
  - **Roofline polygons**
  - **Building footprint**
  - **Flat, pitched or gabled roof segmentation**
  - **Polygonal vector generation; wire frame models**
- **Planimetrics**
  - **Roadways**
  - **Sidewalks**
  - **Driveways**

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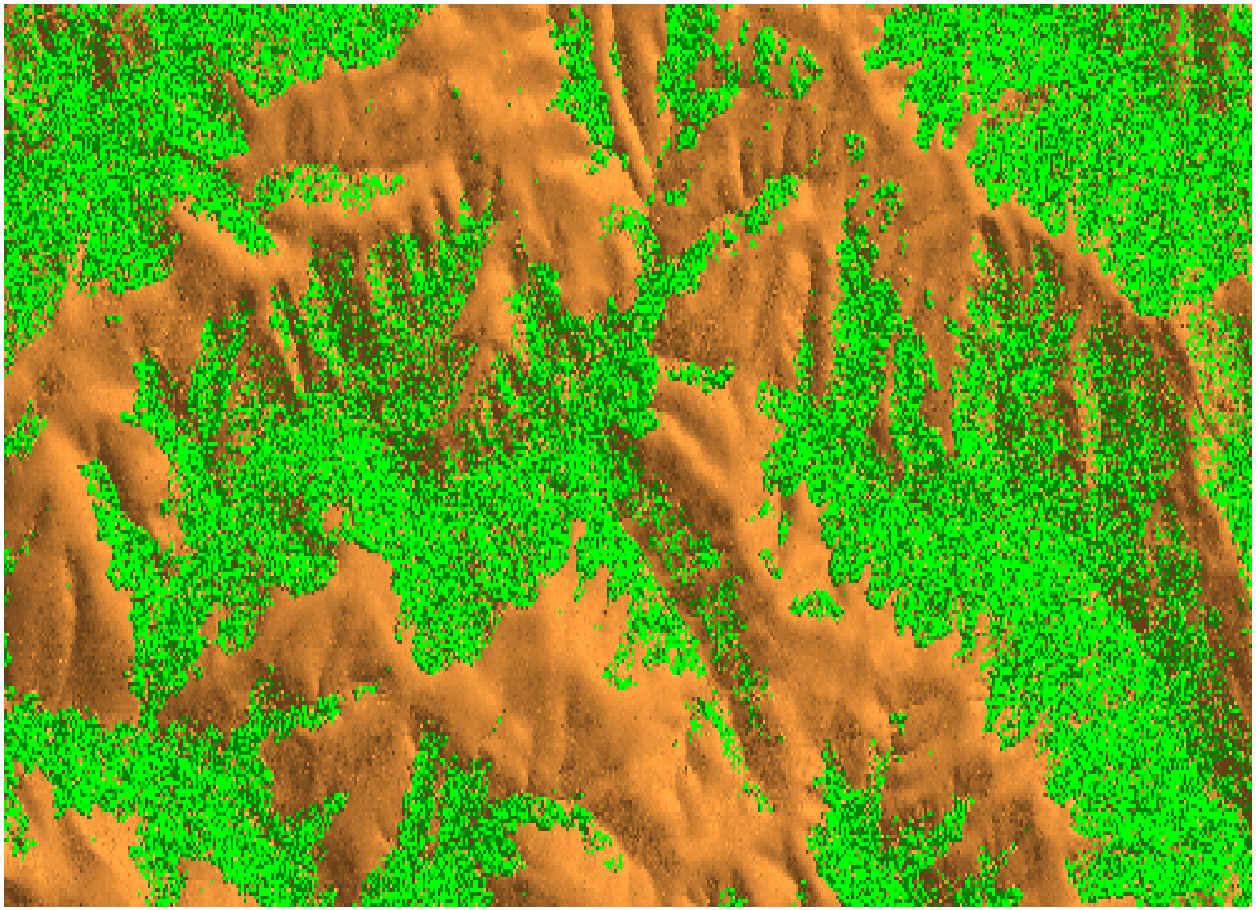
Bare-Earth Extraction



Green = Canopy (aka vegetation)

Brown = ground points (aka mass points, model keypoints)

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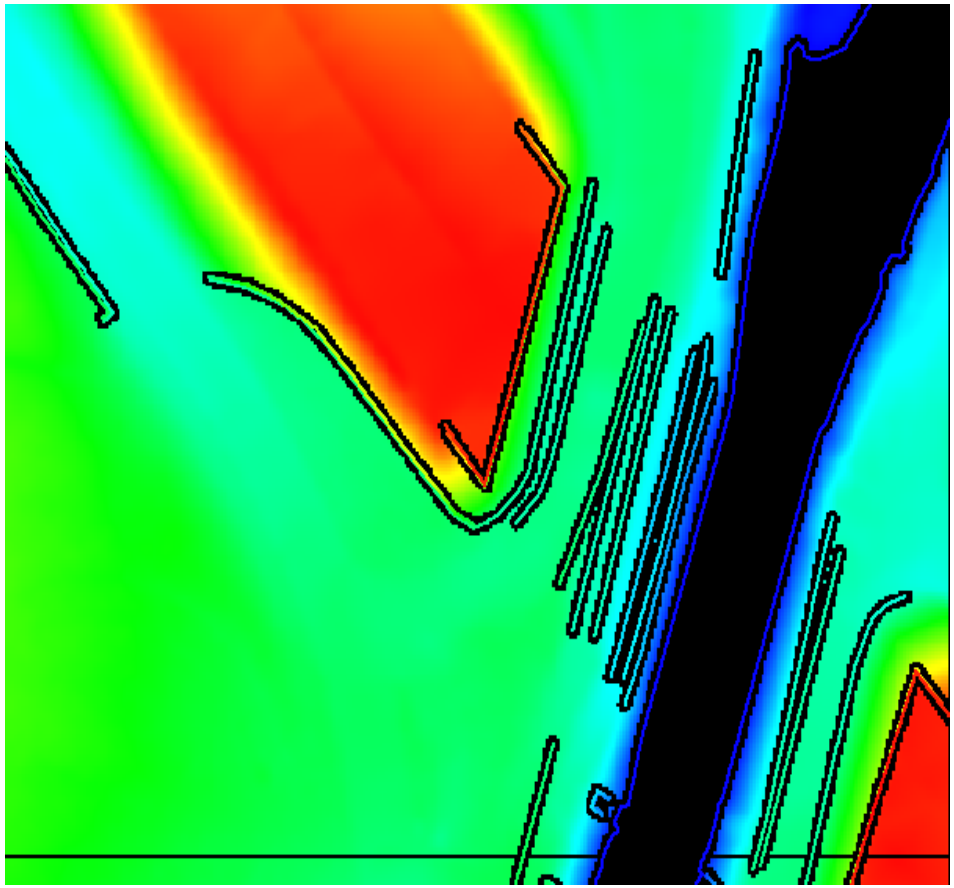
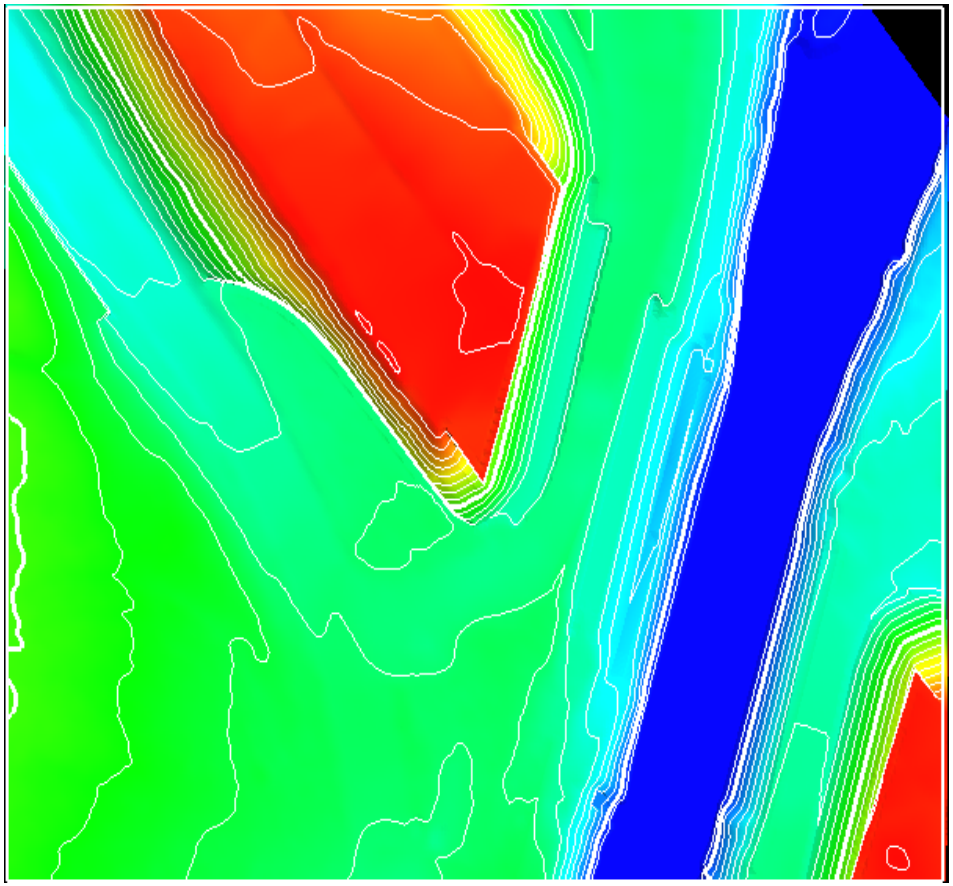
Hydrologic Features



DSM w/ breaklines



Tinned DSM w/ contours

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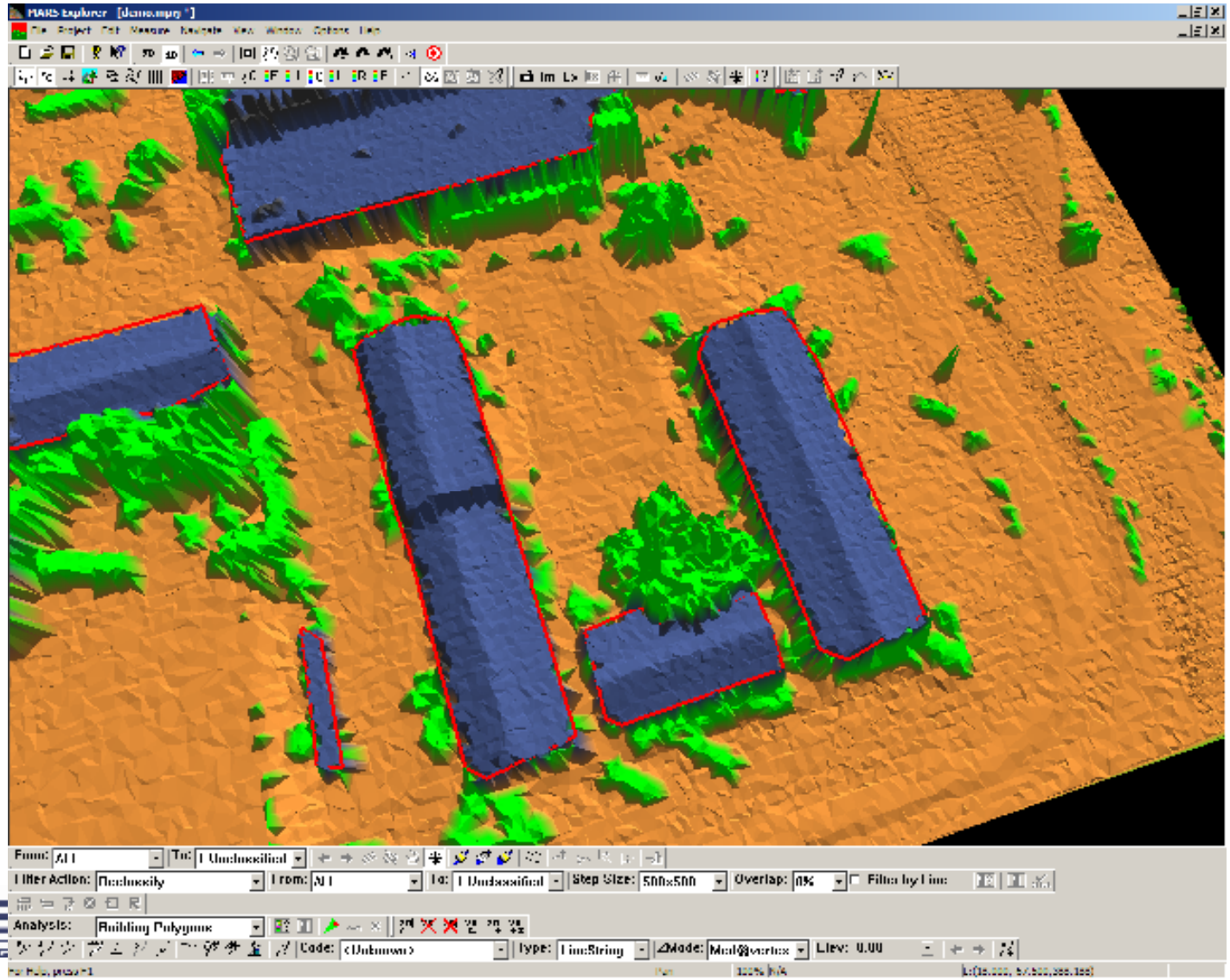
Building Features



Derivative Features

- **Infrastructure**
  - **Transmission Lines**
  - **Pipelines**
  - **Storage Tanks**
- **Topographic Data**
  - **Depression Contours**
- **Street 'Furniture'**
  - **Street Light**
  - **Power/Telco Pole**
  - **Median**
  - **Fire Hydrant**
  - **Antenna(s)**

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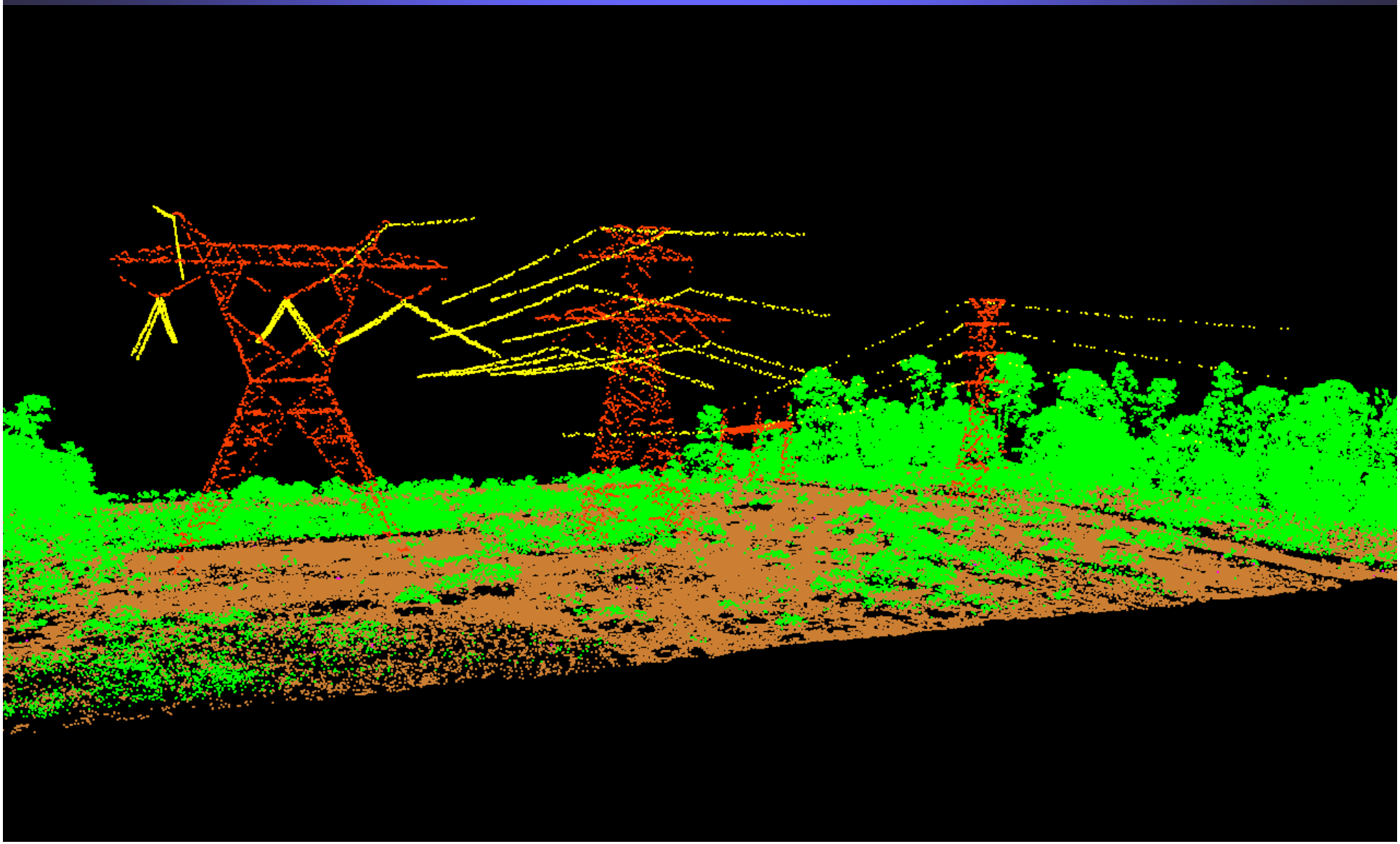
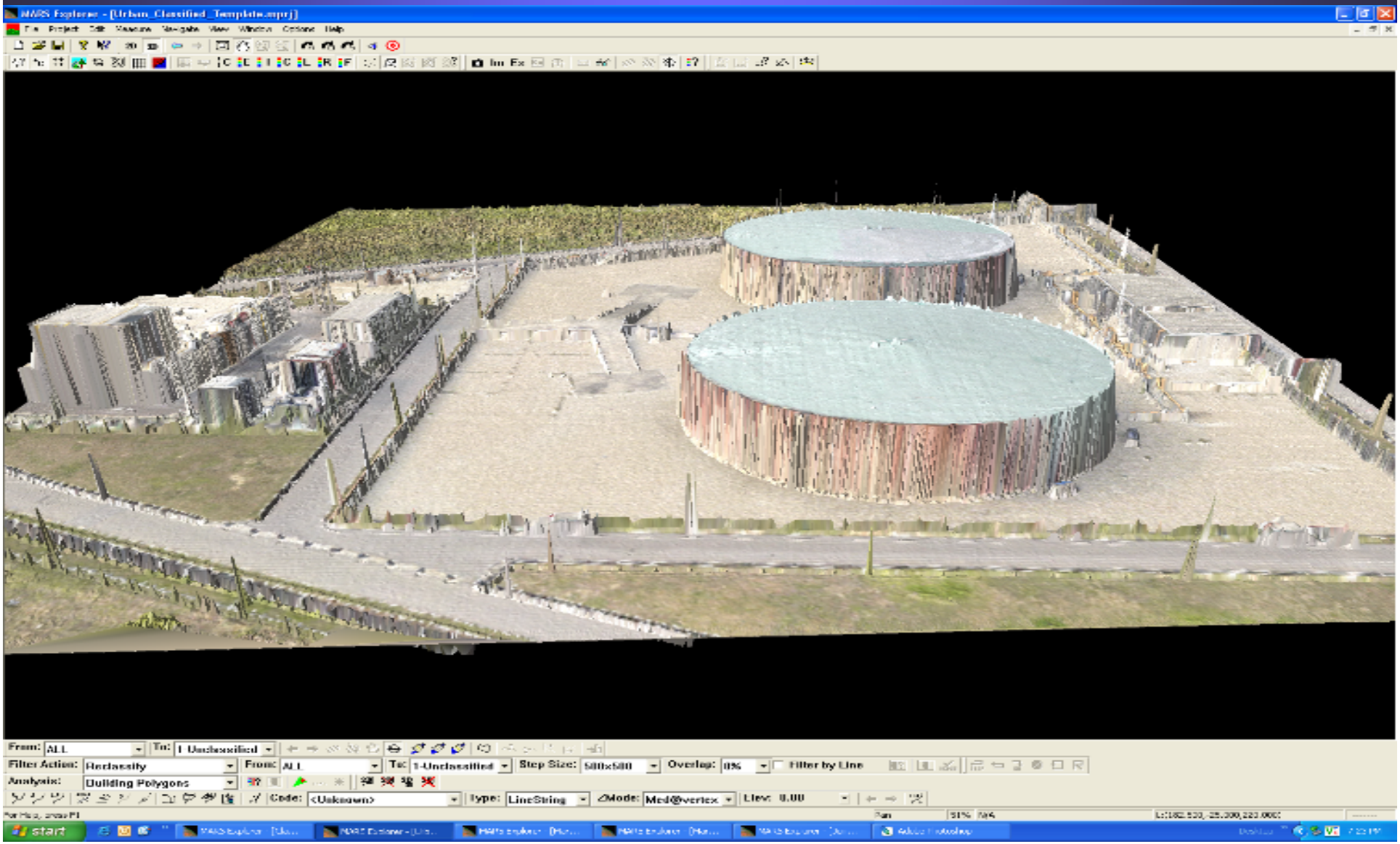
Utility Infrastructure



Utility Infrastructure



Defense & Intelligence Features

- **Under-Canopy Feature Detection**
  - **Buildings (planar analysis)**
  - **Lines of communication (roadways); trails**
  - **'Full-spectrum' exploitation!**
- **Gaseous Effluent**
  - **'Off-gassing' from drug lab operations**
- **Hydrocarbon Detection**
  - **May indicate the presence of motorized vehicles**
- **Integration of LWIR (Thermal Imaging)**
  - **Coincident thermal signatures can help identify vehicles and structures**

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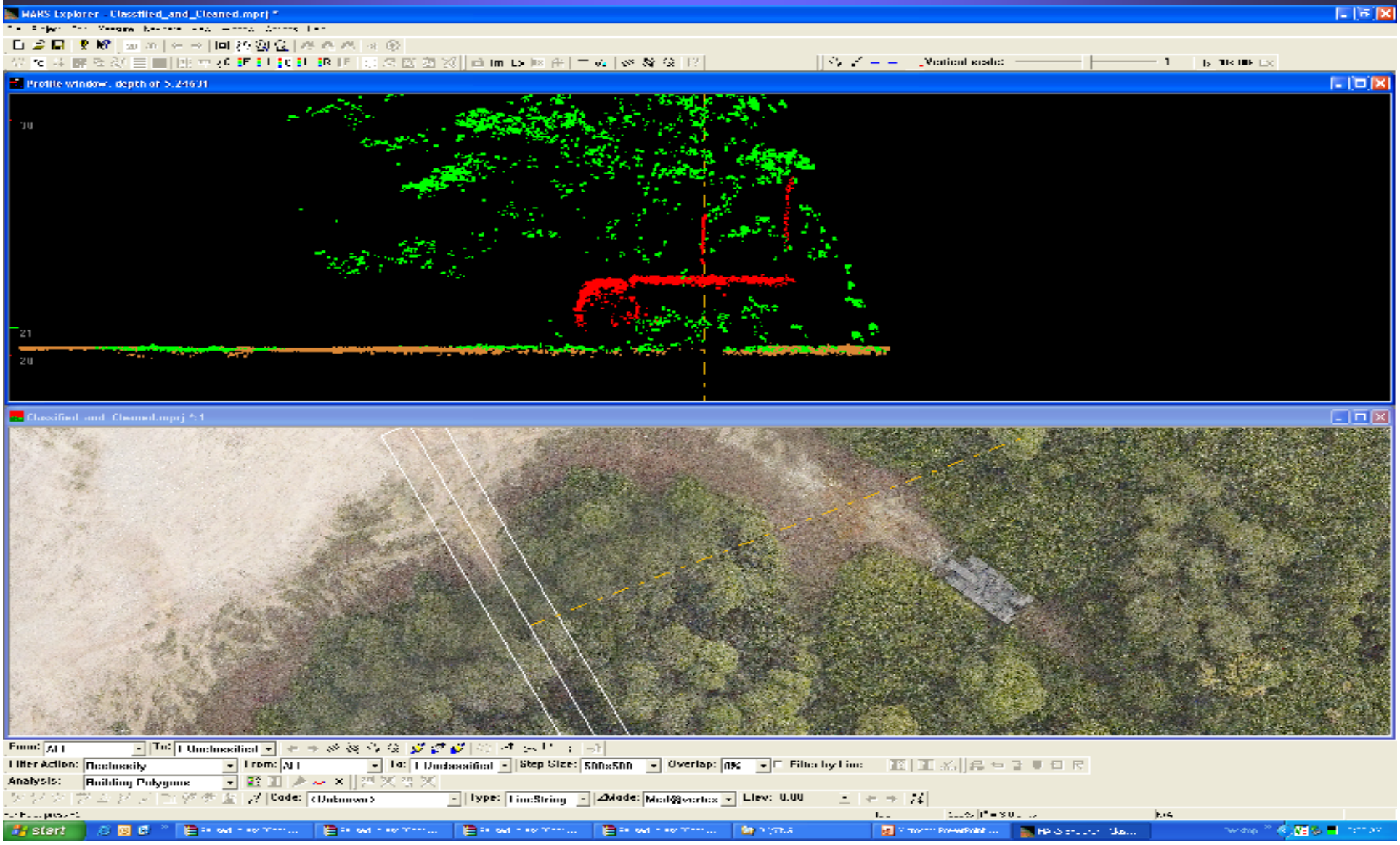
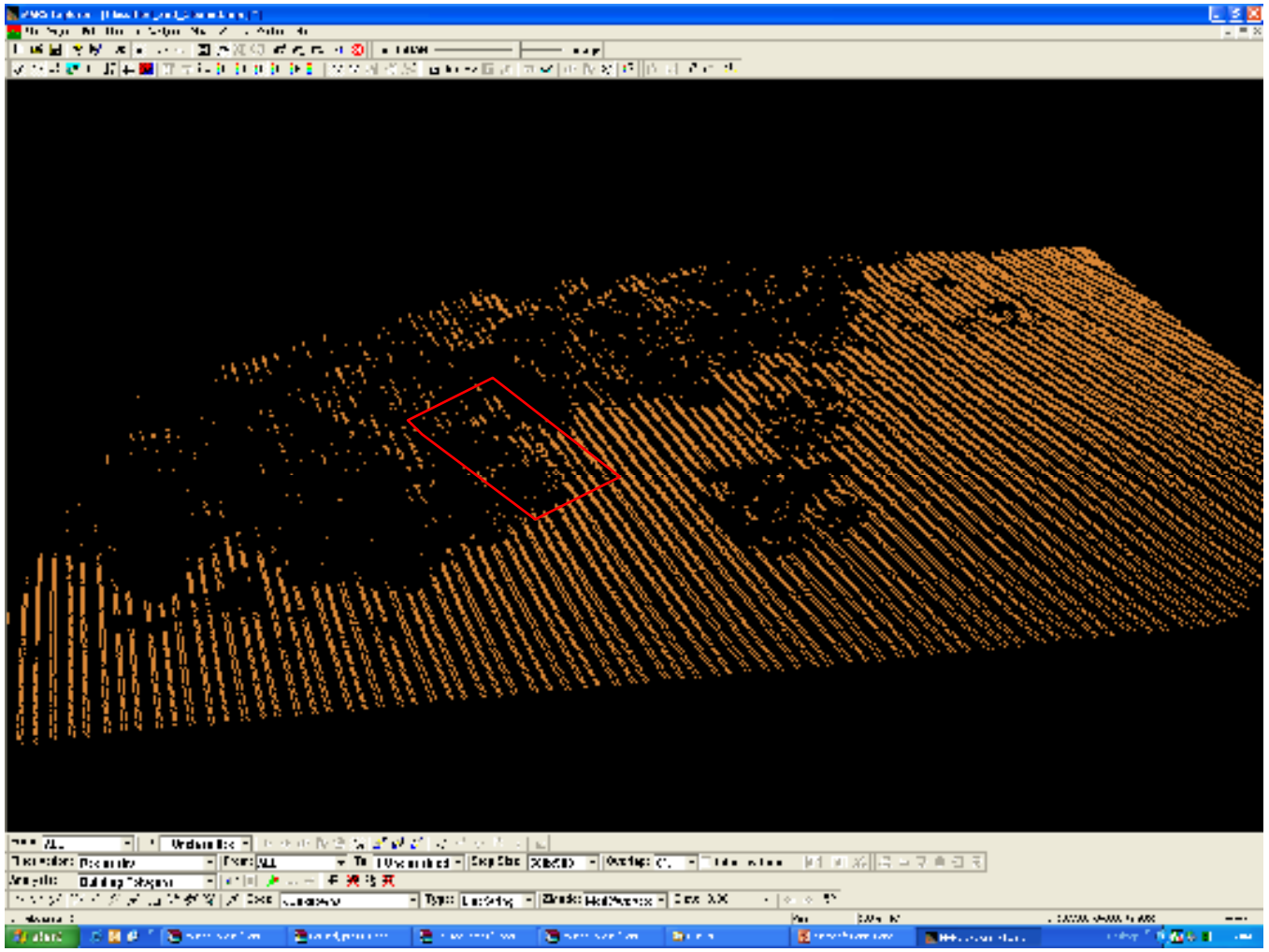
Under-Canopy Features



‘Footprint’ Detection

Vehicle was detected by finding the rectangular “hole in the ground” after the bare earth surface was generated.



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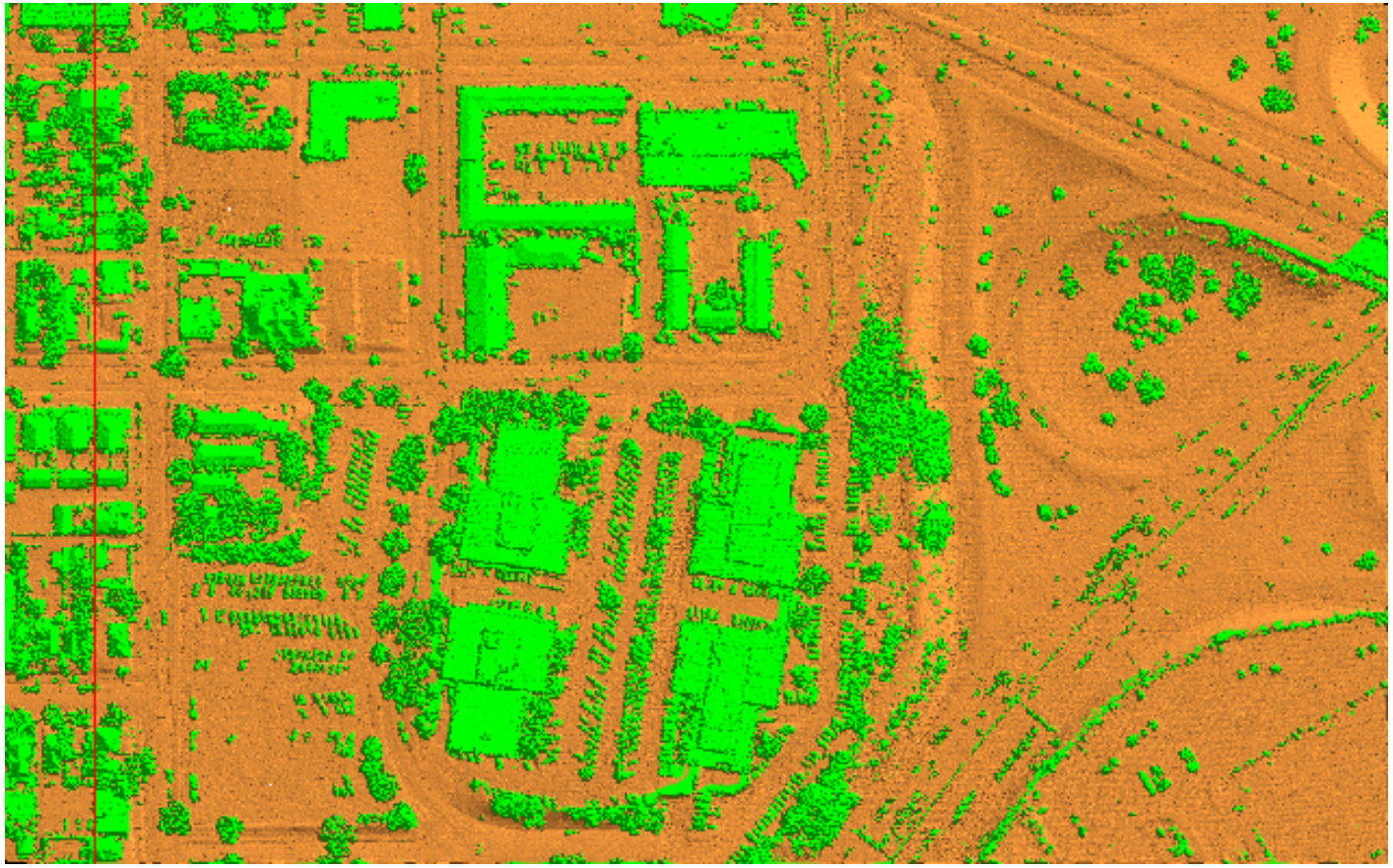
Classified Data



Green = Canopy (aka high vegetation)

Brown = ground points (aka mass points)

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Future Trends

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Terrestrial (Ground-Based) Laser Scanning

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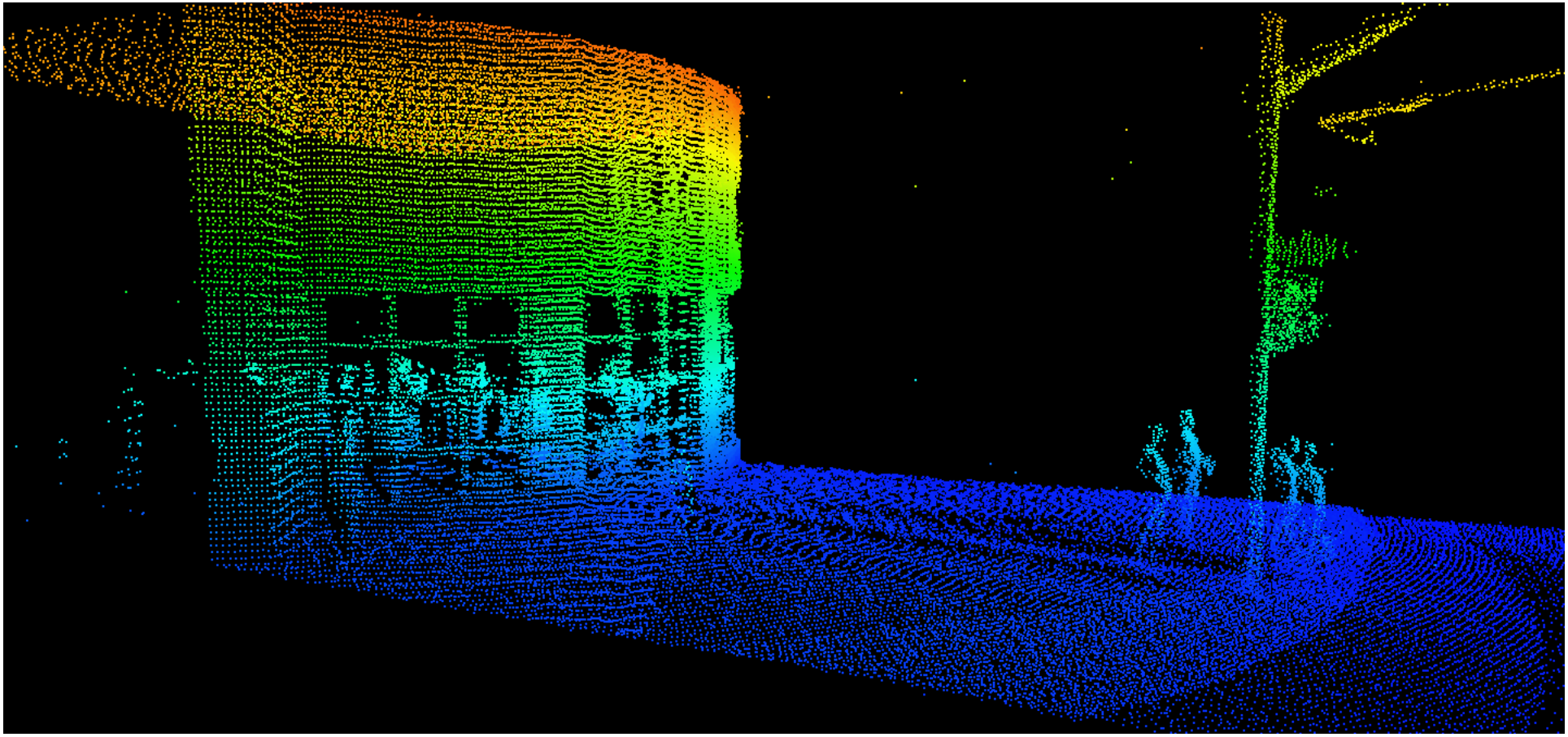
Mobile Scanning



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Questions?
Comments?

THANKS for your attendance!

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