Geometric Processing Techniques for Urban Aerial Laser Scan Data

Viva Presentation

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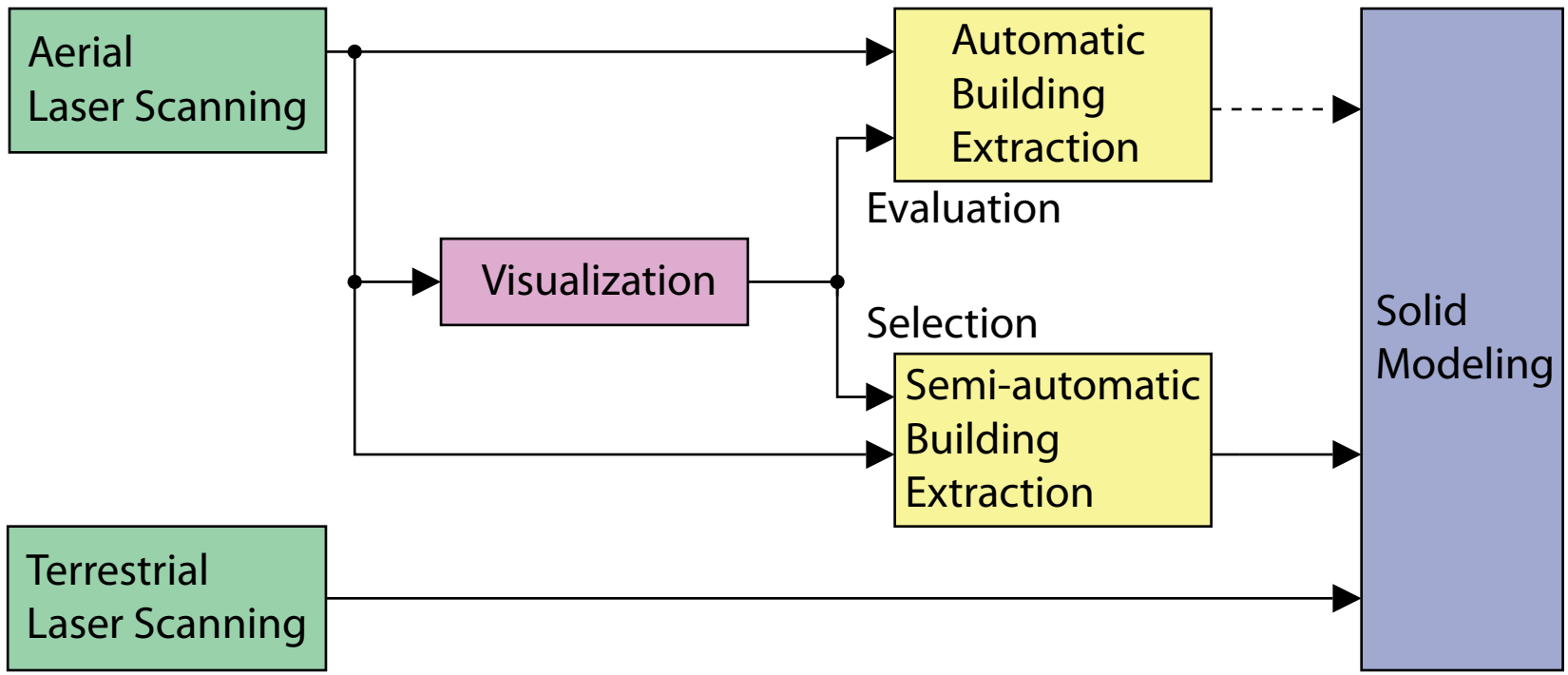
Overview



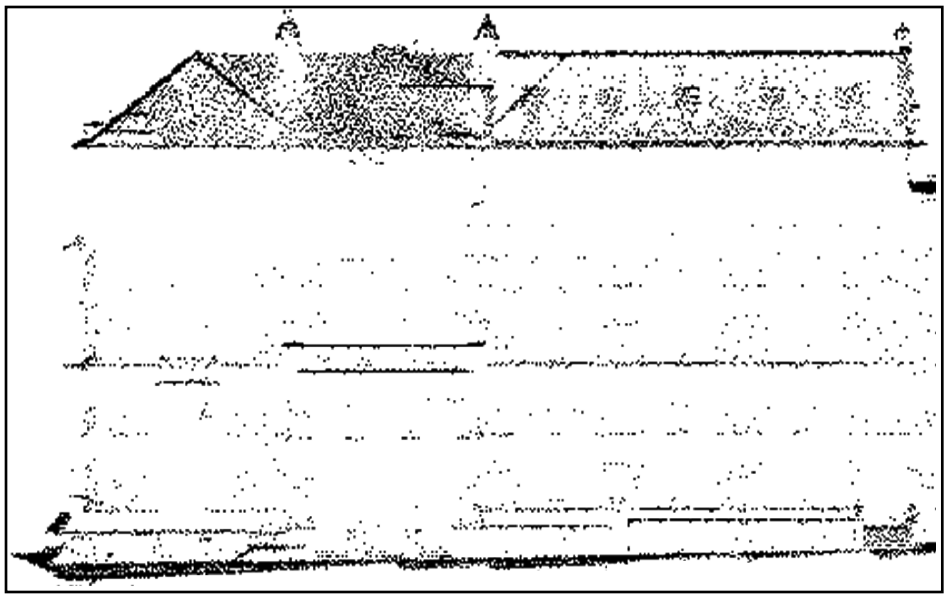
Major Contributions

- Urban ALS Flight Paths
- Occlusion Images
- Engineering Models

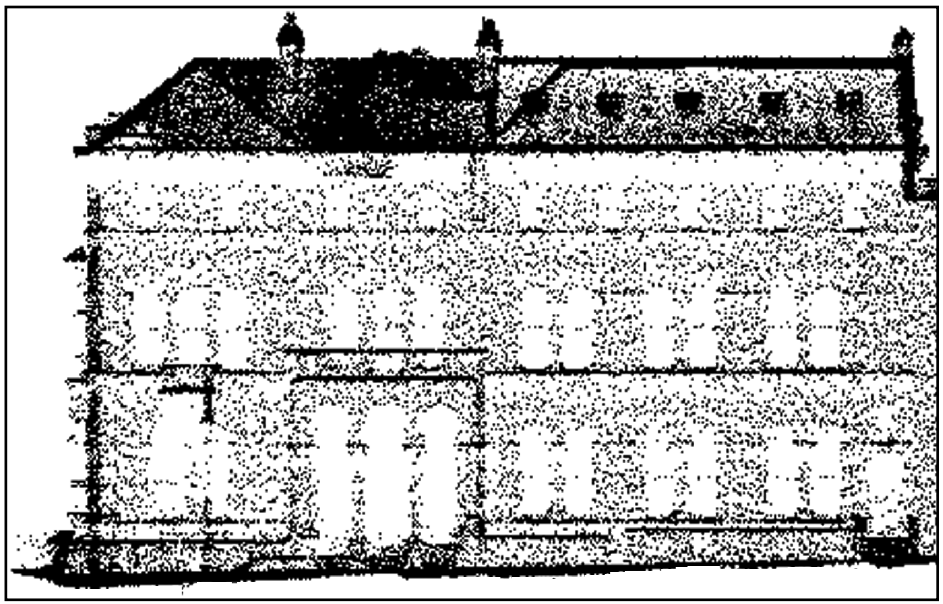
Minor Contributions

- Automatic Building Extraction
- Flight Path Model
- Missing Echoes

Urban ALS Flight Paths I



Single Flight Strip



Multiple Flight Strips

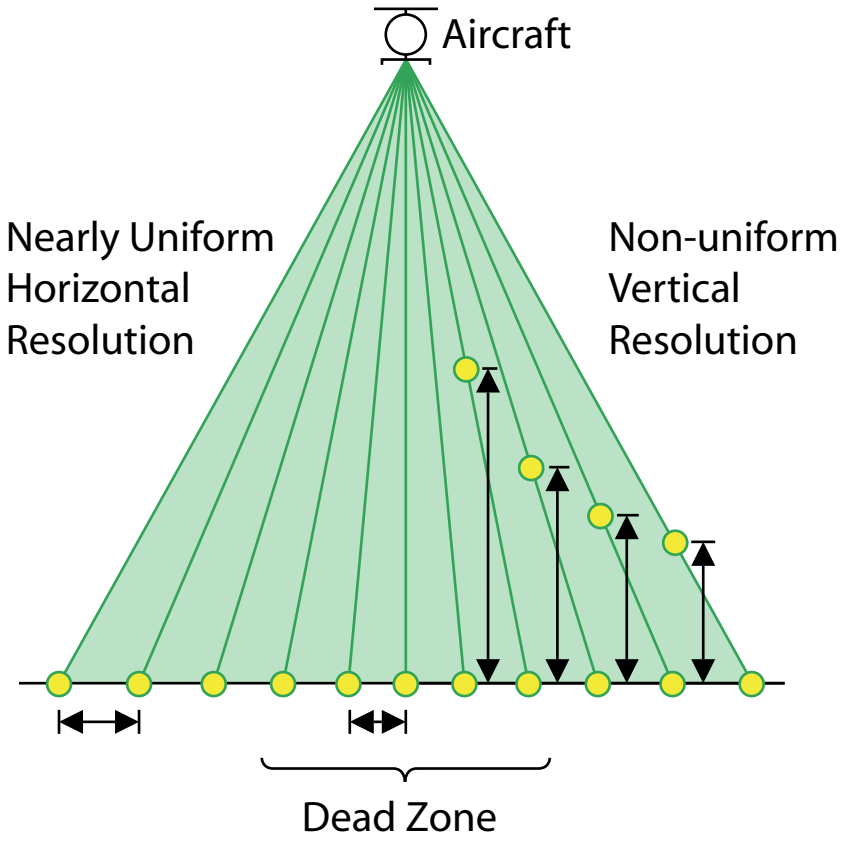
Problems

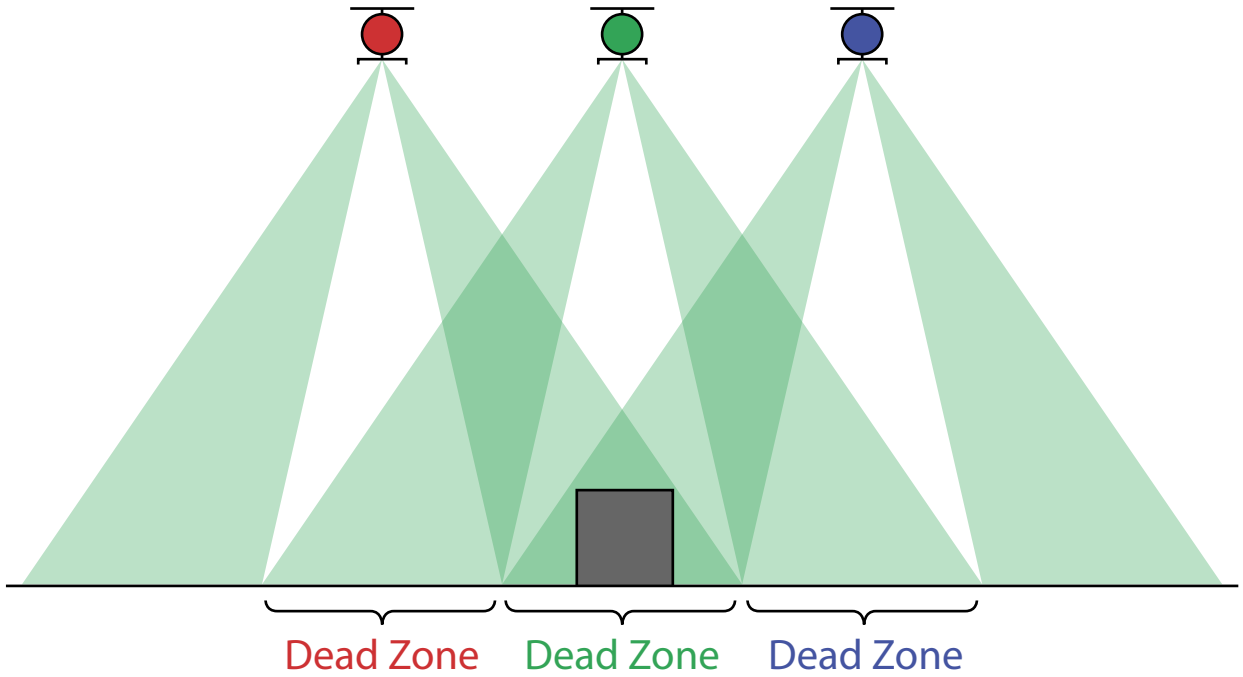
- Irregular sampling resolution
  - "Dead zone"
- Street shadows
  - Self-shadows
- Missing facade data

Solutions

- Multiple flight strip overlap
  - Wide scan angle
- Flight track orientation

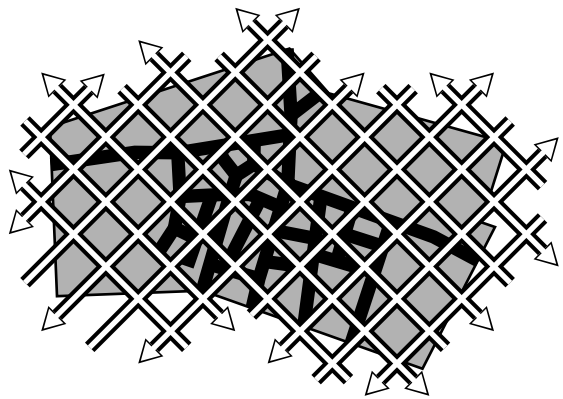
Urban ALS Flight Paths II

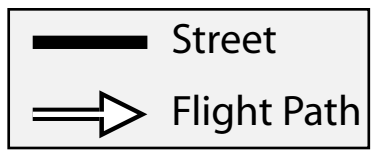




- Poor vertical sampling beneath the aircraft
- Fairly uniform horizontal sampling

- Multiple flight strip overlap compensates for "Dead Zones"
- Dublin flight path

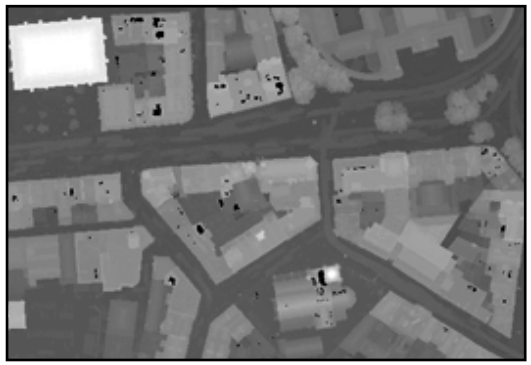




Occlusion Images I

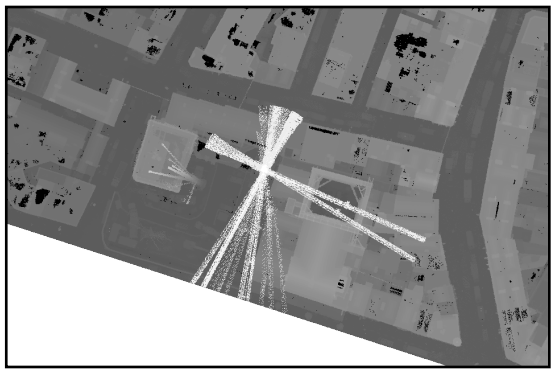
Problems

- Direct visualization of measurements

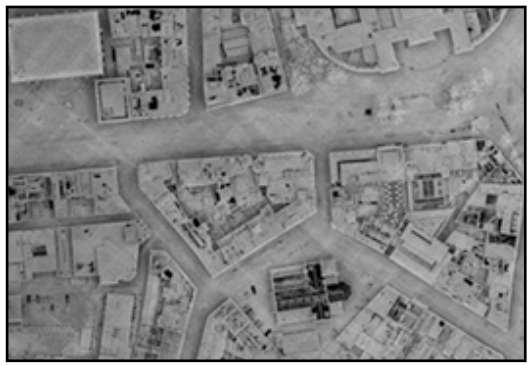


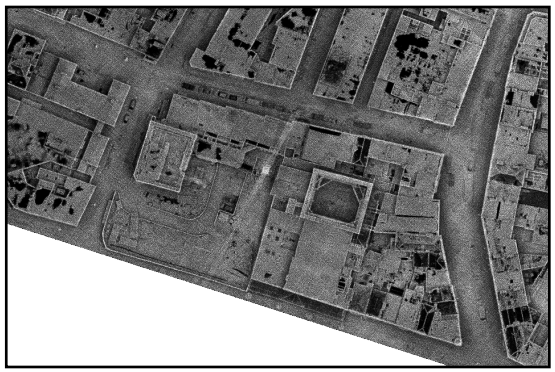
- Moving objects

Elevation Image



- Overhanging objects





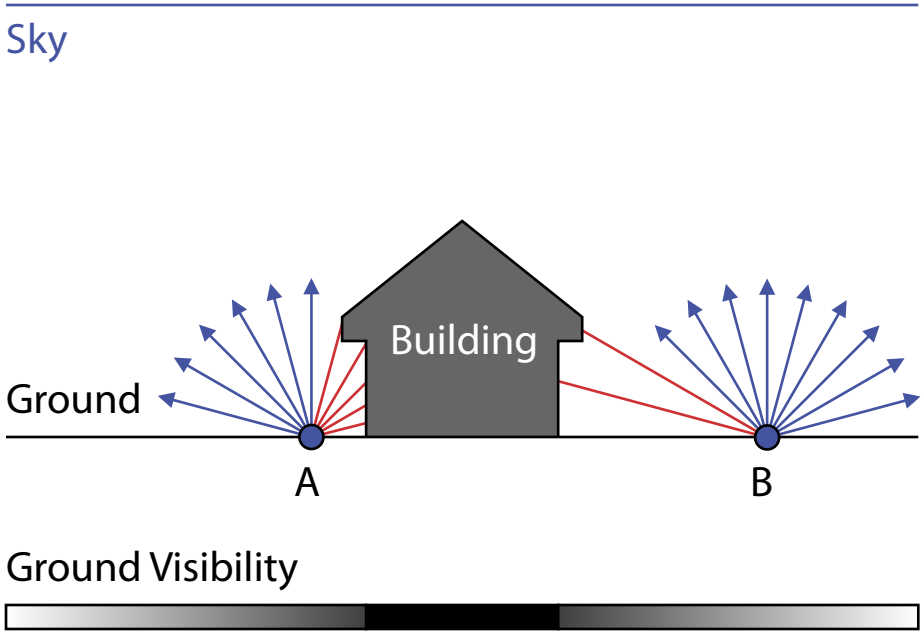
Occlusion Image

Solutions

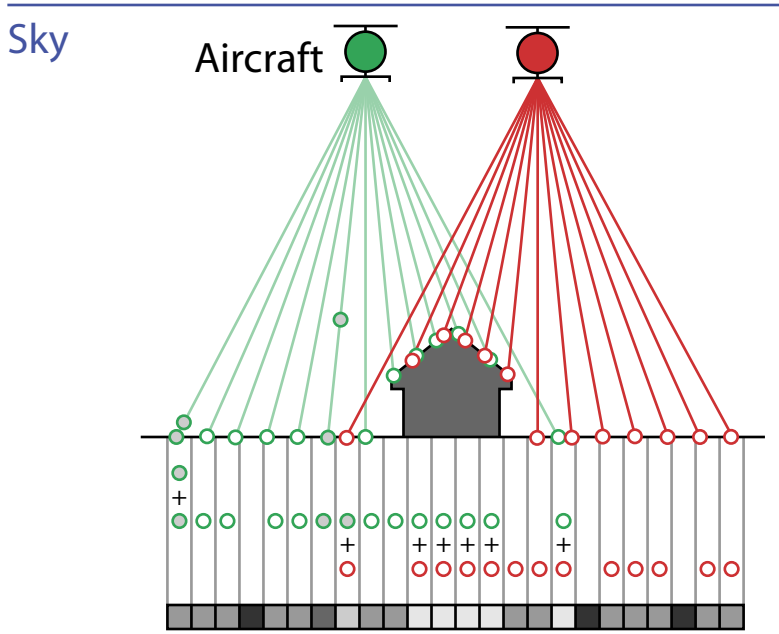
- Visualize patterns
- Treat ALS points as visibility samples

Occlusion Images II

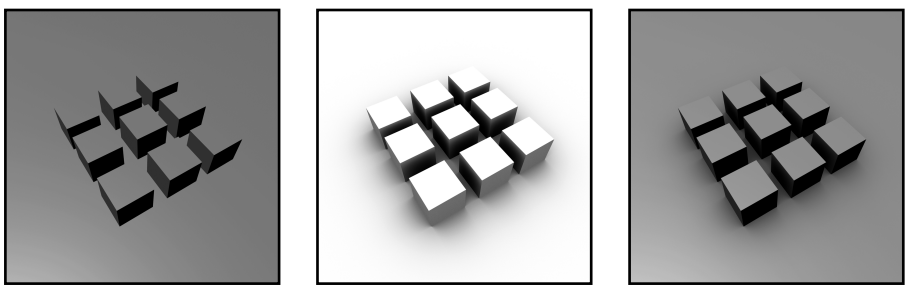
- Occlusion patterns
  - Visibility is proportional to clear sky views



- Accumulate visibility at pixels
  - Point samples treated as visibility from aircraft

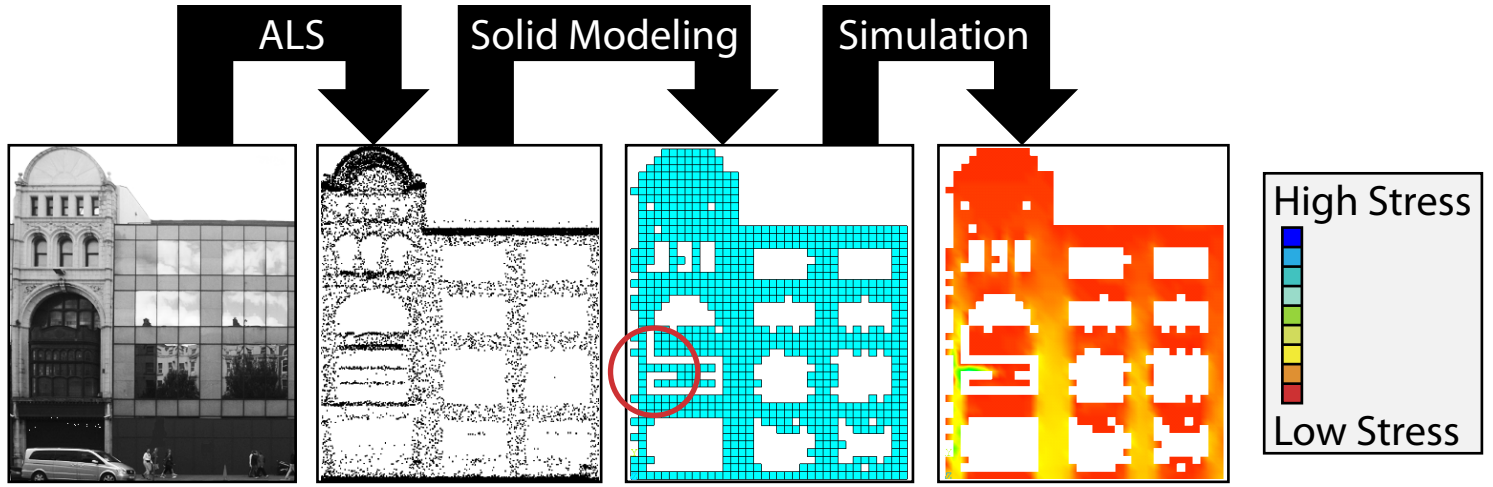


- Ambient Occlusion



Local Illumination | Occlusion | Combined

Engineering Models I



Problems

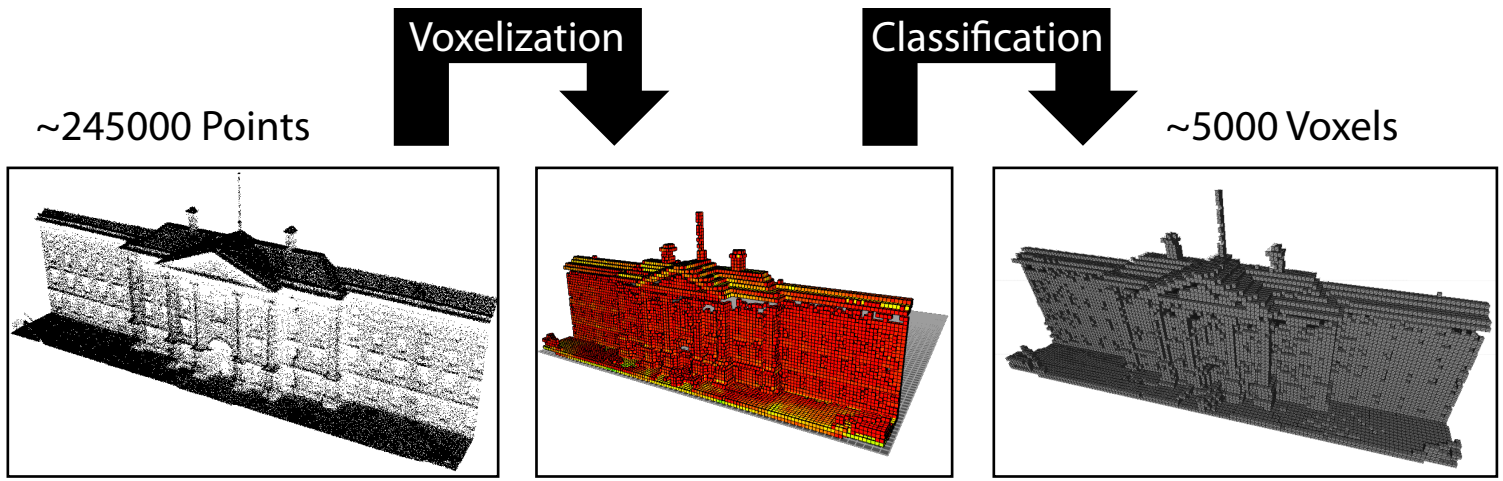
- How to create geometric models used in engineering simulations from ALS data?
  - Each building wall as separate model
- Triangulation does not handle openings and is not volumetric
  - ALS data is fairly sparse

Solutions

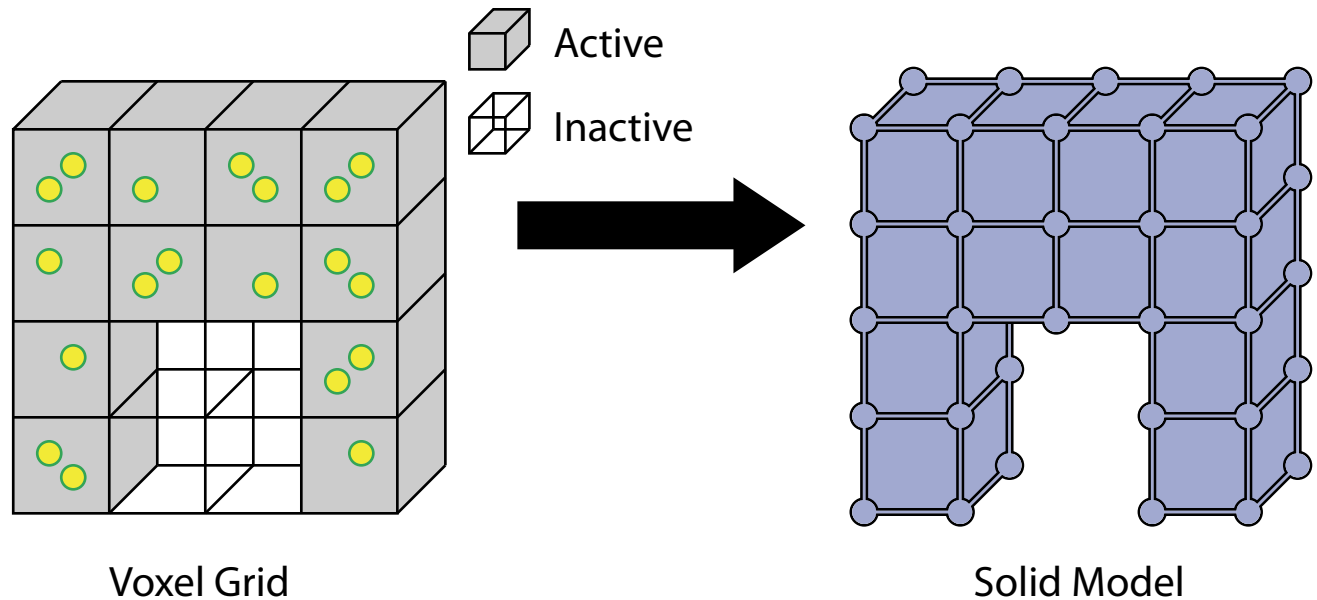
- Create voxel grid and convert to solid model
  - Voxels are volumetric
  - Simple and robust
  - Requires verification

Engineering Models II

- Create voxel grid and classify voxels as {Active} or {Inactive}



- Create solid model from connected {Active} voxels



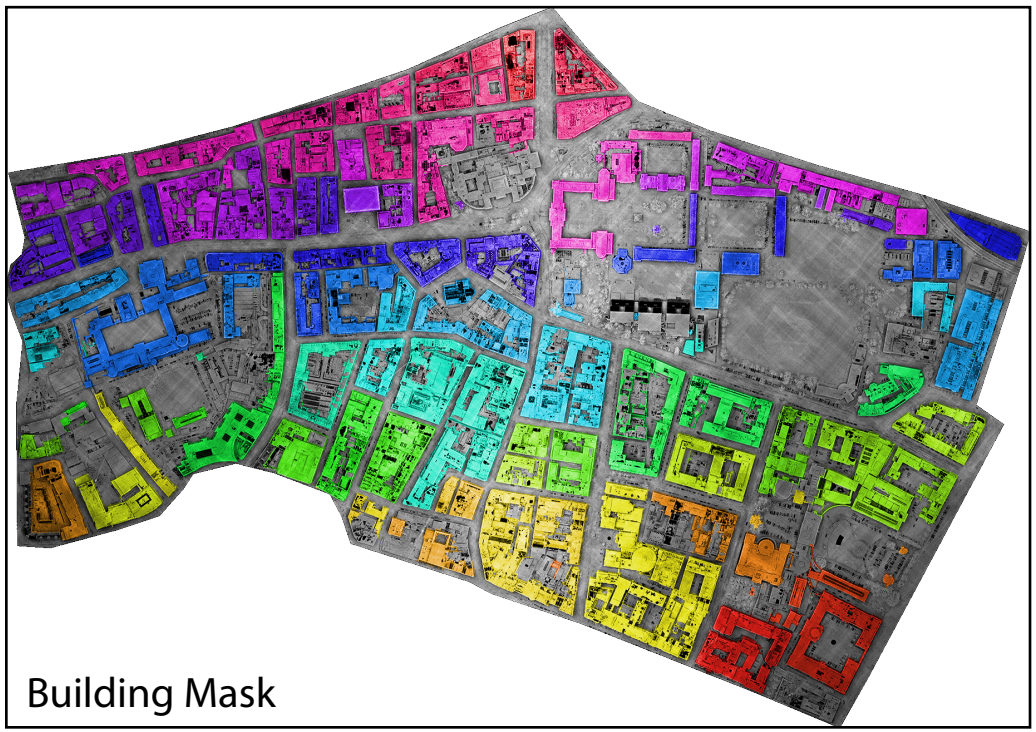
Building Extraction I

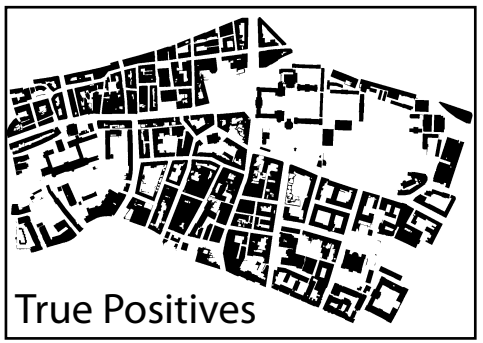
Problems

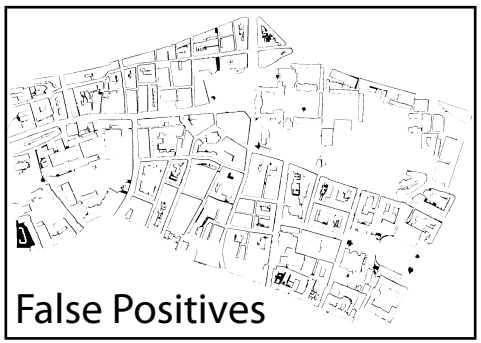
- How to extract points acquired on buildings?
- Densely built-up urban regions

Solutions

- Identify building outlines through points sampled on walls
- Use image processing to identify building interiors
- ~82% of buildings detected


Building Mask


True Positives


False Positives


False Negatives

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