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## Building reconstruction

LiDAR data is natural for the extraction of buildings



## From Airborne Laser Data to Spatial Information: Object Reconstruction and Accuracy Analysis

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## Building extraction

- Three tasks:
  - Detection
  - Reconstruction
    - Boundary estimation
    - Shape reconstruction
  - Verification

The emphasis of this work is on the accuracy of the reconstruction



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## Extraction of buildings from LiDAR

Laser systems sample the surface—  
where is the actual building boundary?

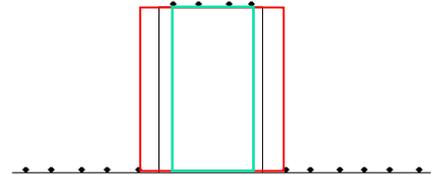


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## Building extraction

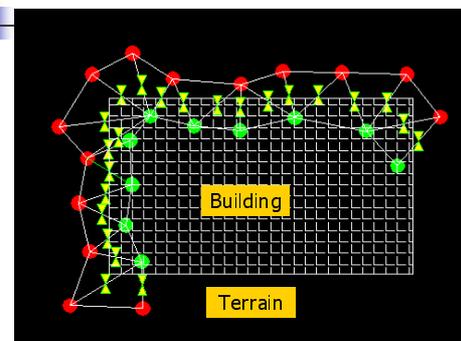
- Three tasks:
  - Detection
  - Reconstruction
    - Boundary estimation
    - Shape reconstruction
  - Verification

Accuracy analysis is studied via simulation



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## Boundary estimation



## Simulator

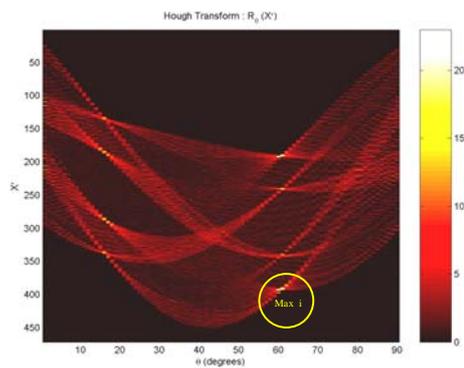
- Offers flexibility in:
  - Scanning patterns
  - Density
  - Flying altitude
  - Placement of objects within the swath
- Such flexibility is not available with real data

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## Analysis via synthetic data - motivation

- Provide quantitative and statistical analysis.
  - Examine the influence of:
    - Shape and orientation of the buildings
    - height
    - Location within the swath
    - density
- on the extraction

## lines extraction Hough Transform



## Boundary points

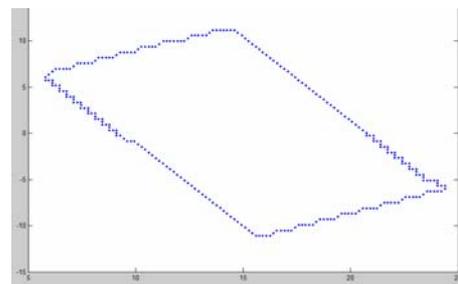


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## Height influence on location and dimensions

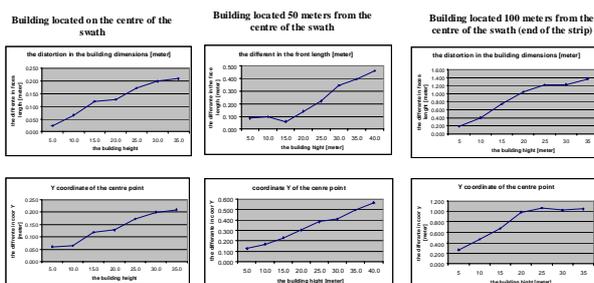


Figure 4.1, (left) the distortions in the length of the building, (right) the displacements in the building position.

## Vertices extraction

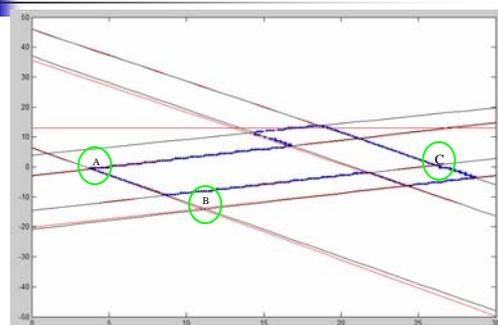
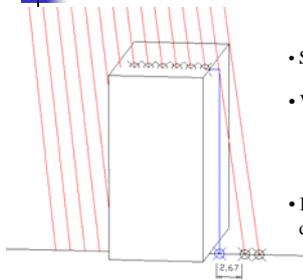


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## Adding virtual points



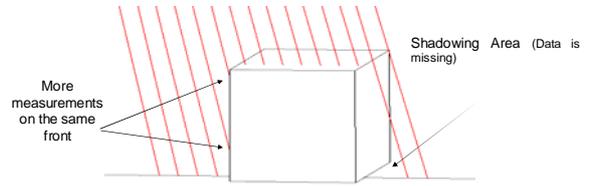
- Shadowing gap 3m
- With **virtual point (blue)**, border is estimated at mid distance between the **virtual point** and the closest roof point.
- Doing so improves the accuracy in determining the building outline.

Inserting the virtual point in the Shadowing gaps

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## Scanning and shadowing effect



region of shading and points on a face of building

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## CONCLUSIONS

- Accuracy of information derived from LiDAR data is influenced by several factors.
  - Scanning system related
  - Scanned objects related
    - The accuracy varies between objects
    - Dependency on such geometric properties as: location within the swath, orientation, and height.

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## Improvement by adding virtual points

Distance from the flight line 100 [m]	Lx [m]	Ly [m]	[m] Cx	Daz [deg]
Average	0.64	1.13	0.00	0.87
STD	0.24	0.19	0.04	1.14

Extracted values without virtual point

Distance from the flight [m] line 100	Lx [m]	Ly [m]	[m] Cx	Daz [deg]
Average	0.14	0.20	-0.04	-0.20
STD	0.04	0.14	0.01	0.25

Extracted values with virtual point

**An Ly offset decrease from 1.13m to 0.2m.**

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# The End

# Thank You

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## CONCLUSIONS (cont.)

- Adding virtual points improves significantly the accuracy of the reconstruction.
- Based on experiments, the results show that the geometric parameters must be taken in account in both flight planning and data processing levels.

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## Building Reconstruction

- Segmentation
- Segments handling and plane extraction
- Topology
- Line and vertices extraction
- Building reconstruction
- Results verification



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## Building reconstruction result

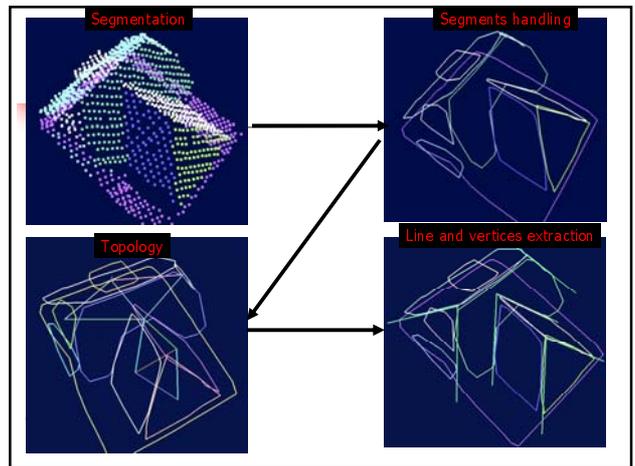
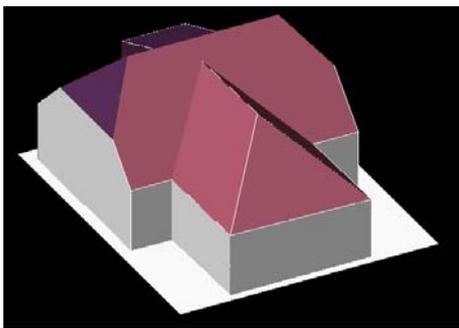


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## Results verification

