Automated Extraction of Buildings from Aerial LiDAR Point Cloud and Digital Imaging Datasets - Preliminary Results

Pankaj Kumar (UTM, Malaysia),
Alias Abdul Rahman (UTM, Malaysia), and
Gurcan Buyuksalih (BIMTAS, Turkey)

Outline

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Introduction

- An accurate information about location and dimension of building features is important.
- Traditionally, buildings are delineated based on manual or semi-automated reconstruction.

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Introduction

- LiDAR technology provides rapid, continuous and cost effective method to acquire 3D information.
- LiDAR data records a number of attributes which can be useful for extracting various features.

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Problem statement

- Most of the building extraction methods require manual intervention.
- Developed methods are associated with misclassification of roads, vehicles, trees, etc. along with building objects.
- There is a need to develop an automated and operational approach for extracting building objects.

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Automated approach

- We present an automated approach for extracting building objects from integrated aerial LiDAR and digital imaging datasets.
- LiDAR data provides to distinguish between high and low rise objects while digital image helps to filter out vegetation.
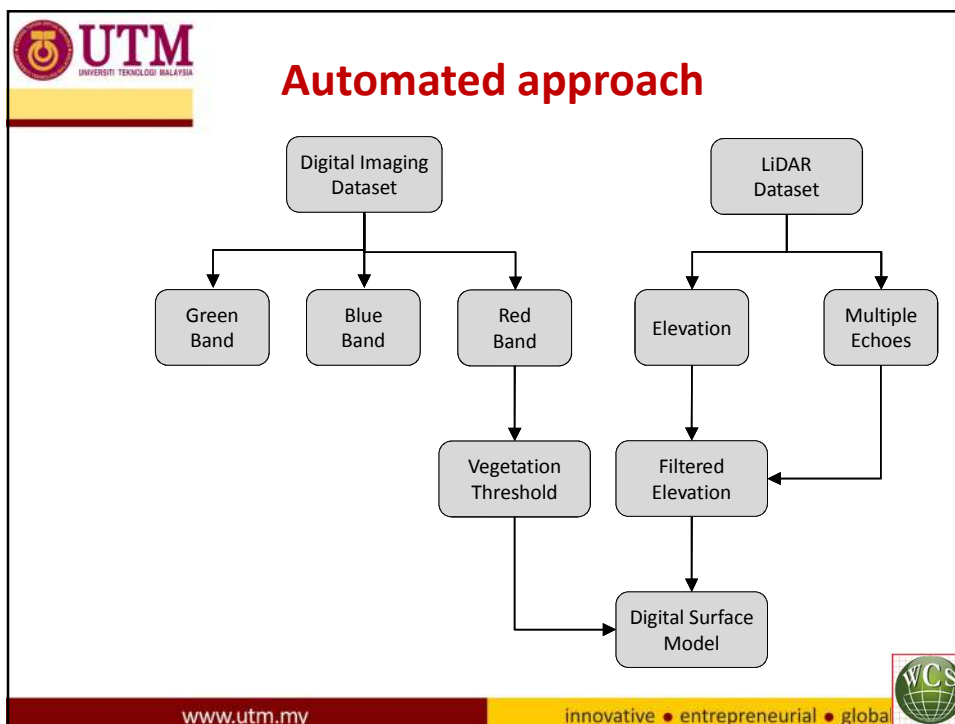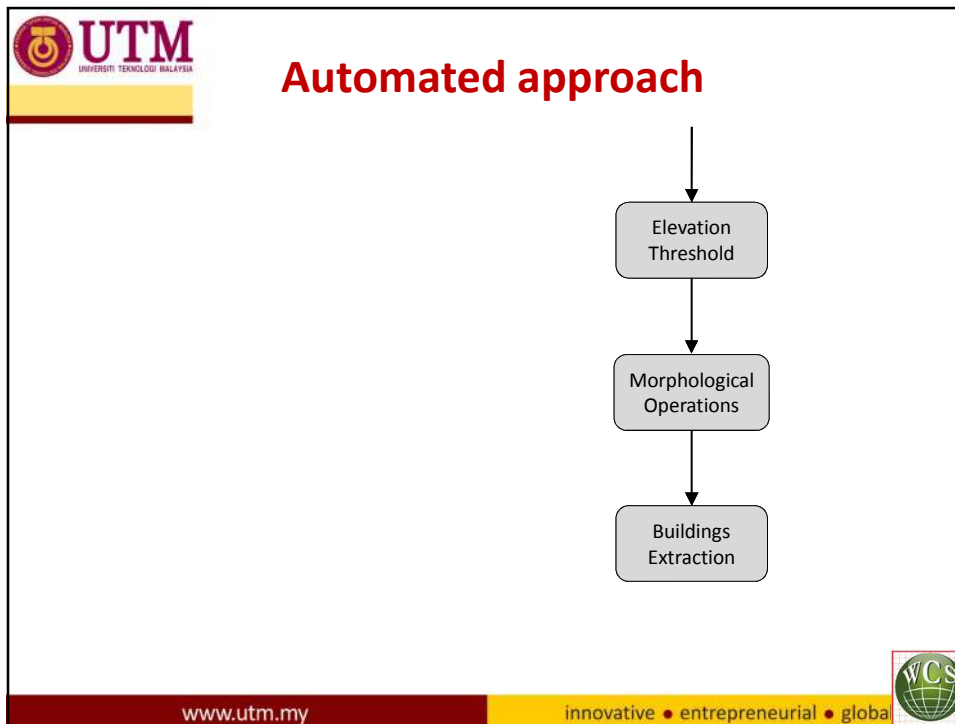
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Automated approach

- Our approach utilises various LiDAR and digital image attributes to automatically extract building objects.
- The parameters used in the approach are empirically estimated and requires minimal user intervention.

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Automated approach

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Automated approach

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┌──────────────┐
│  Elevation   │
│  Threshold   │
└──────────────┘
      ↓
┌──────────────┐
│ Morphological│
│  Operations  │
└──────────────┘
      ↓
┌──────────────┐
│  Buildings   │
│  Extraction  │
└──────────────┘
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Experimentation

- We tested our automated approach on aerial LiDAR and digital image datasets of Istanbul city covering 89.76 km^2.

- LiDAR data consists of around 2.6 million points with 0.18 m spacing.

- Digital image consists of 3 bands (i.e. red, blue & green) with ground sampling distance of 0.1 m.

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Experimentation

multi-spectral image

Experimentation

- Empirically estimated threshold value (T_1 = 130) was used to remove vegetation from red band image.

- Multiple reflected points were filtered out to retain single reflection points belonging to buildings, roads and other solid objects.

- DSM was generated from the maximum elevation value of filtered points with 0.1 m cell size.

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Experimentation

- Vegetation was removed from the generated DSM.

- Empirically estimated threshold value ($T_2 = 45$) was used to remove ground level objects from the filtered DSM.

- To remove noise and complete shapes, morphological operations were applied.

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Experimentation

- Morphological opening and closing operations were applied using 3x3 matrix element.

- Finally, contour boundary of each extracted building object is identified and then LiDAR points inside each boundary were estimated to provide 3D model.

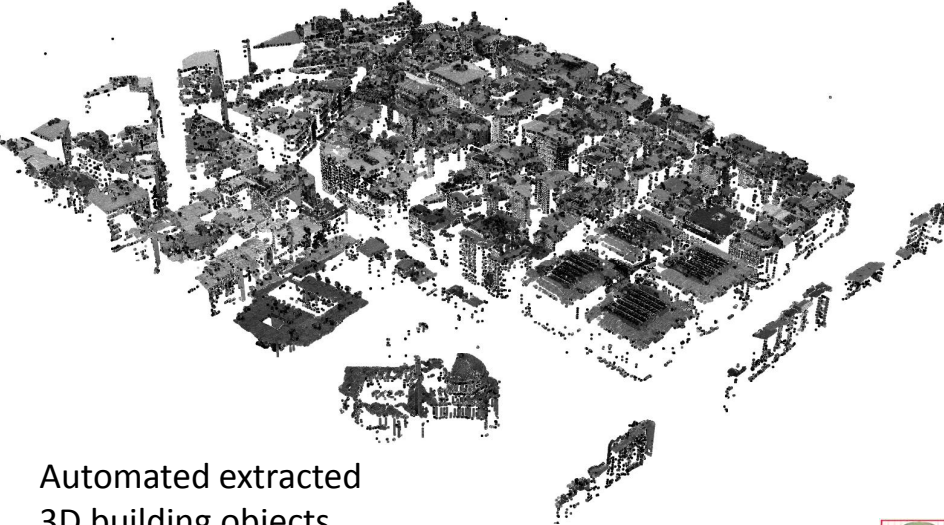www.utm.my   innovative ● entrepreneurial ● global

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Experimentation – automated extracted 2D buildings

Experimentation

Automated extracted 3D building objects

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Concluding remarks

- Our automated approach was able to successfully extract the building objects.
- Some of the road sections were extracted as false positive.
- Multiple echo attribute was useful in filtering single and multiple reflection points.

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Concluding remarks

- The use of red band provided to remove vegetation while LiDAR elevation attribute was helpful in distinguishing building objects.
- Morphological operations were useful in removing noise and completing shapes.

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Future work

- The use of near infra red band would be more efficient in removing vegetation.
- LiDAR intensity attribute would be used to differentiate terrain objects.
- Normalized Differential Surface Model (NDSM) values can be more useful in removing ground level objects.

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Future work

- Inclusive use of morphological operations.
- Need to validate the extraction results.
- Development of comprehensive approach for automated and operational extraction.
- Something for 3D cadastre? . . .

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Thank you!

pankajkumar@utm.my
alias@utm.my
gbuyuksalih@yahoo.com