



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


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Outline


- Introduction
- Problem statement
- Automated approach
- Buildings extraction
- Concluding remarks
- Future work

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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.

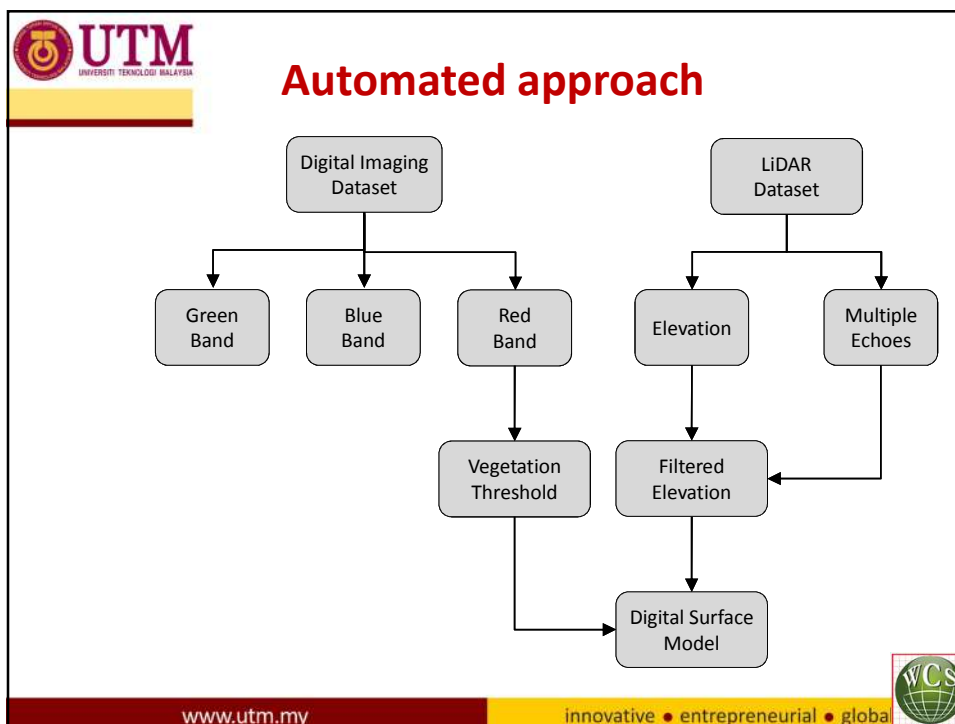


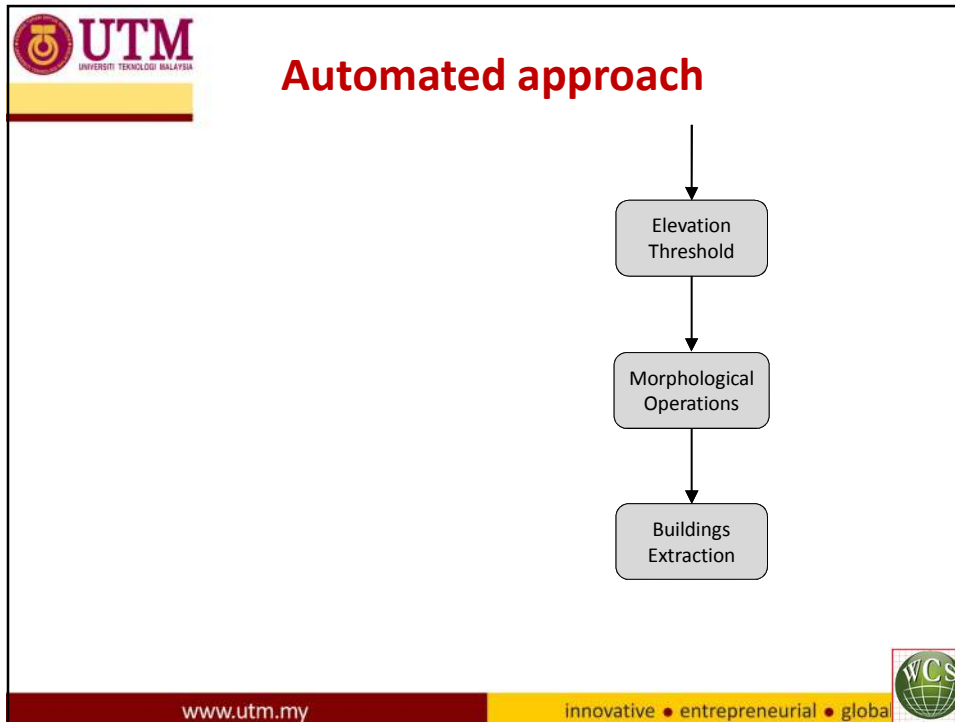
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 **Automated approach**

- 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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- The slide is titled 'Experimentation' and features the UTM logo at the top left. It contains a bulleted list of experimental details. At the bottom, it includes the website 'www.utm.my', the motto 'innovative • entrepreneurial • global', and the WCS logo.
- We tested our automated approach on aerial LiDAR and digital image datasets of Istanbul city covering 89.76 km².
 - 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





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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.





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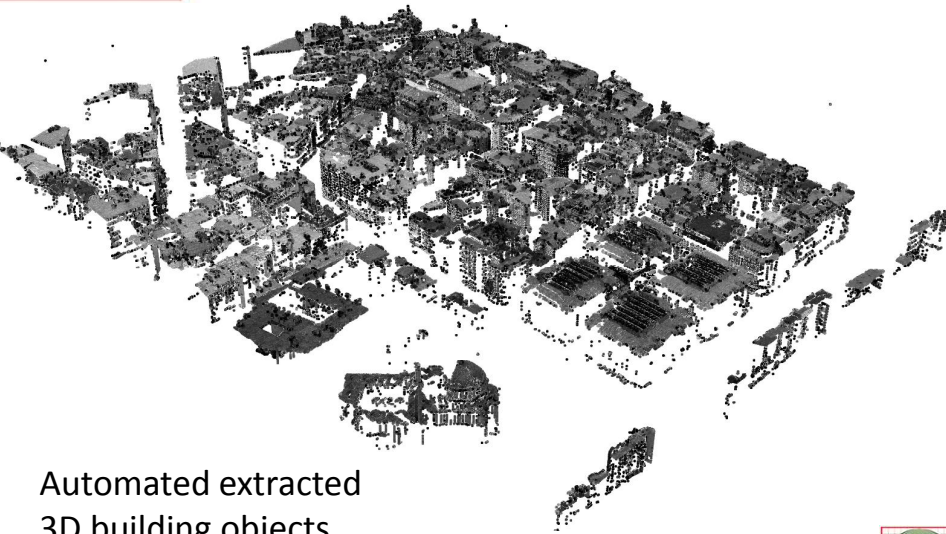
Experimentation – automated extracted 2D buildings




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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!

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