Integration Of Multiple Mapping Sensor Data For The Purpose of Creating GIS-Ready 3D Models Of The Built Environment.

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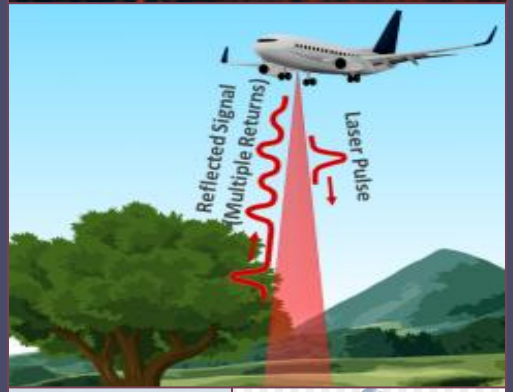

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Introduction

01

Research Back Ground and Motivation

The research is aimed at investigating the different opportunities and challenges in the process of integrating data from multiple sensor for the process of mapping the built environment.

02

Supporting Research

Current research, shows that there is a growing trend in the use of multiple sensor data, such as oblique imagery, mobile laser scanners and other sensors in the process of obtaining data in municipal areas.
(Poli et al, 2017)-Back this.

03

The Need for this Research

This research is necessary because it aims at quantifying the challenges that can be encountered in the process of data integration, but also see how the results can be used in a productive manner in a GIS environment.

04

Goals & Objectives of the Thesis

-The aim of research was to understand the problems that occur in integrating data from different sensors.
-Explored efficient ways of cleaning and classifying data.
-Explore 3D Model LoD that can be obtained.

Literature Review - Overview

Pixel Level/Data Level

This research is based on the Integration of raw data (Point Cloud), into a new ‘robust’ dataset.
Unlike – Feature Level and Decision Level Integration.

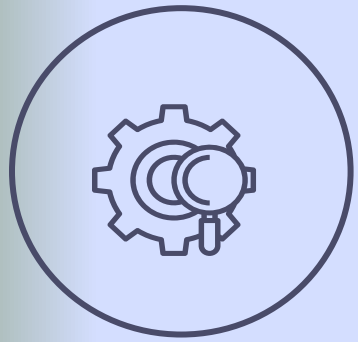
Point Cloud Data Integration

The different methods of Integrating point cloud datasets. (ICP registration and Manual Registration of Point Cloud using Common Details).

GIS-Ready 3D Building Models and LoD

This research also focused on how the point cloud data could be used to creating GIS-Ready 3D models with LoD2 that can be used for various applications.

Methodology



Research Approach :

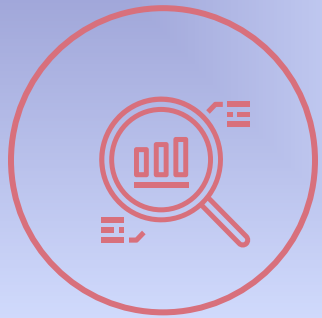
A qualitative and quantitative at understanding the process of data integration.

Methods Used:

ICP and Manual Point Cloud registration.

Point Cloud Filtering and Classification

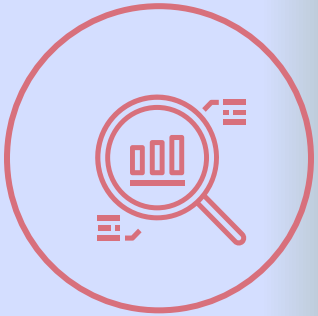
Automatic 3D Modeling.



Excel and Python Based Analysis.

Cloud to Cloud Analysis (RMS values and C2C Distances)

Comparing 3D Models with GE 3D Models.



Comparing the Dimensions of the 3D Models with existing GE Models.

Case Study Area

Area 1: Buildings Around Adderley Street

Area 2: Buildings Around Bree Street

3D Model of this Building is later on Compared with Google Earth Model

Images are sourced from : CoCT –City Map Viewer.

Methodology

Point Cloud Integration

- Manual Alignment of Point Cloud , by means of Common features.
- ICP Alignment .
- Comparison.

Point Cloud Filtering

- Application of Noise Filter and the SOR filter on the integrated Data.

Point Cloud Classification.

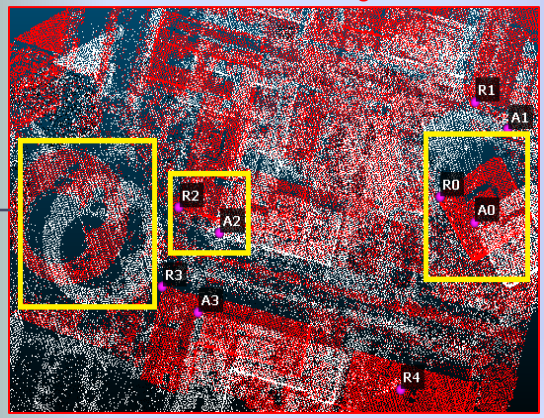
- Python based Point Cloud Classification .
- Cloud Compare Classification.
- ArcGIS Cloud Classification.
- LasTools Classification

3D Modelling

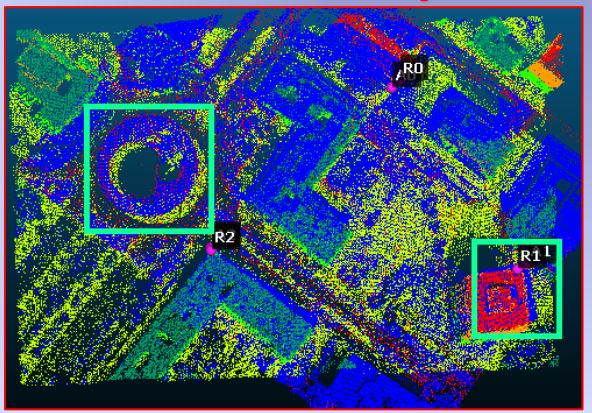
- Point Cloud Based –Plane Fitting 3D Modeling In ENVI.
- Creation of LoD2 Models that are GIS Ready.
- Comparison of 3D Models with Google 3D Models.

Point Cloud Alignment Results.

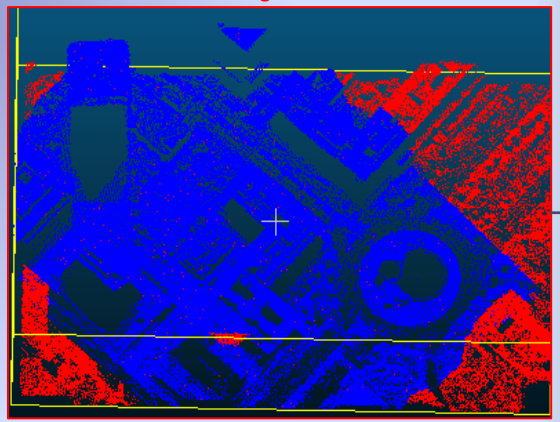
Point Cloud Manual Alignment

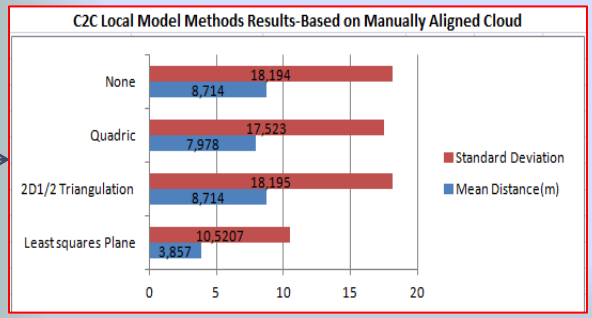


Point Cloud Manual Progress



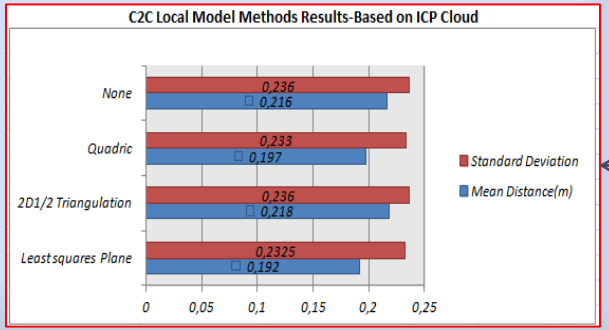
ICP Registration





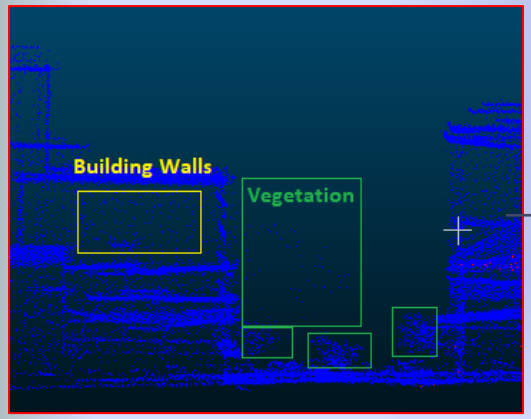
	Manual Alignment	ICP Alignment
1	1,543	1,190
2	0,948	0,656
3	0,603	0,372

No of Iterations	Overlap	Final RMS(m)
10	30%	0,079
20	30%	0,074
50	30%	0,006
100	30%	0,006
150	30%	0,006
200	30%	0,006

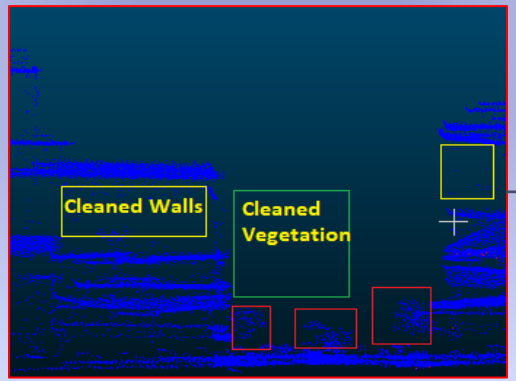


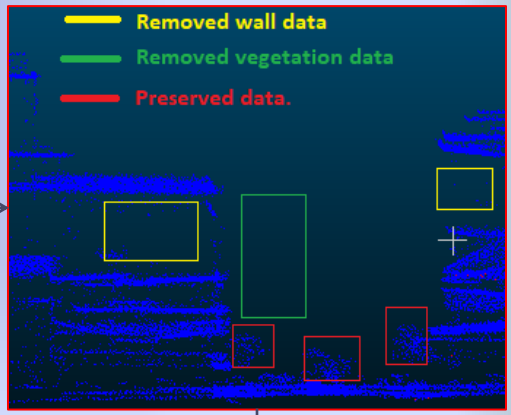
Point Cloud Filtering Analysis and Results

Unfiltered Point Cloud

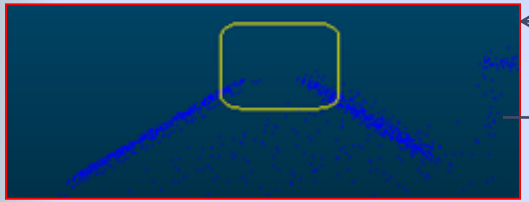


SOR Filter Errors

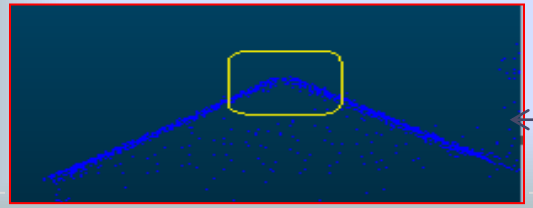




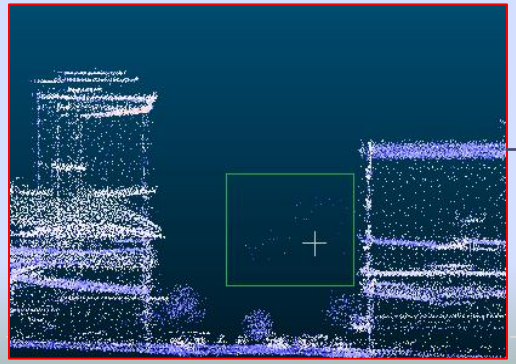
Over filtered data



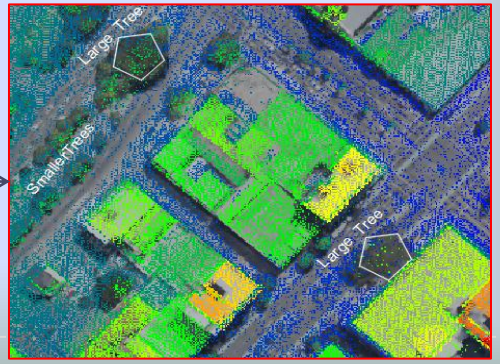
Corrected



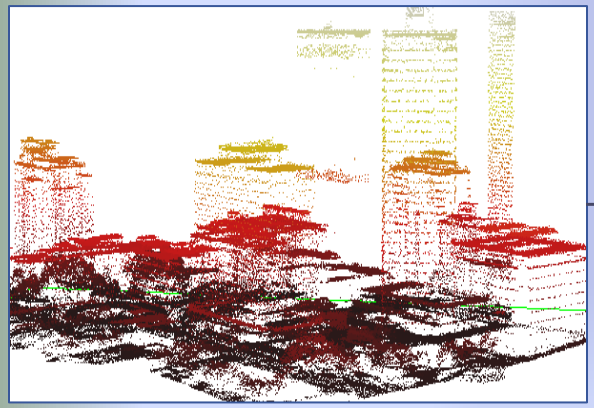
Noise Filter Results

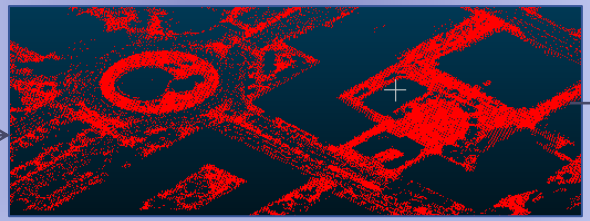


Filtering Quality Control + Results



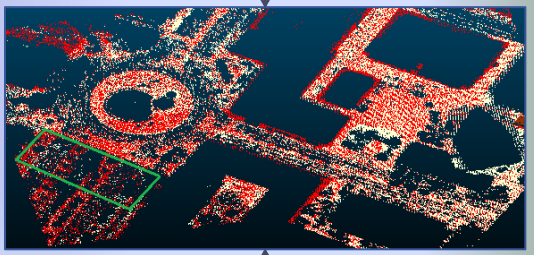
Point Cloud Classification Results

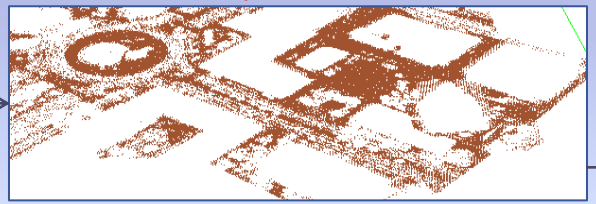




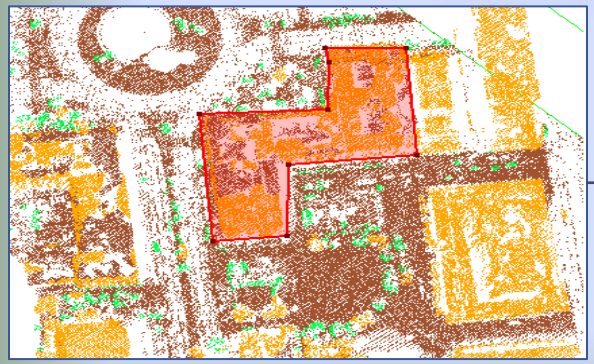
Cloud Compare – Ground Class

Point Cloud Alignment RMS Comparison.

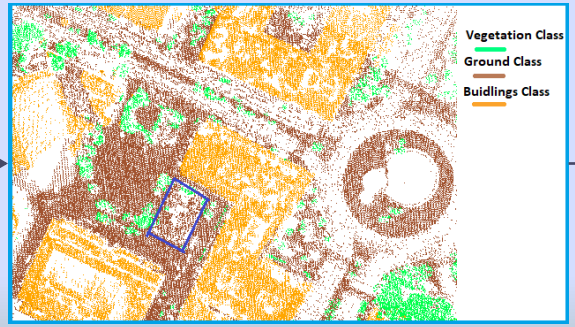


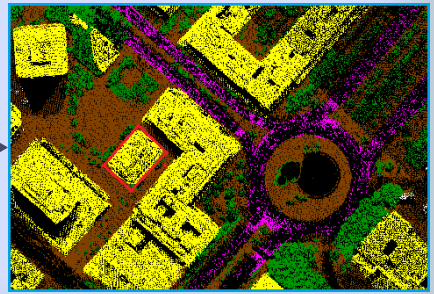


LasTools Ground Class



Classification Errors-Editing

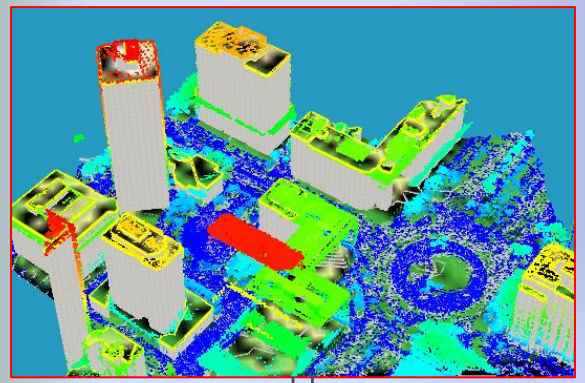




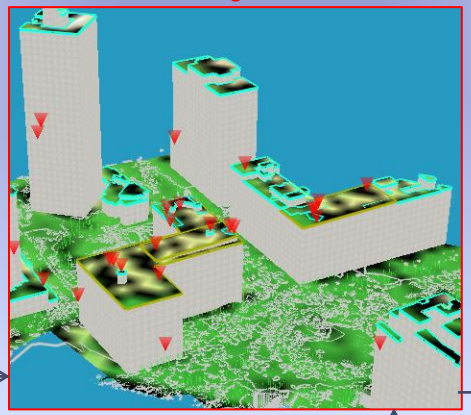
Final Cloud Classification.

Point Cloud 3D Modelling Results

3D Models Creation

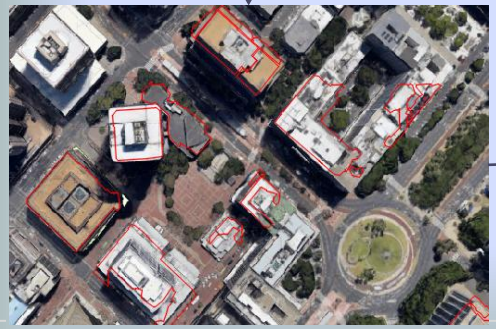


3D Modeling Corrections

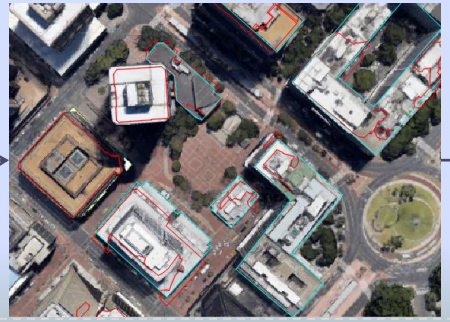


3D Models in 3D Scene

3D Modelling Errors



3D Modelling Corrections



The Final 3D Models were compared to Google Earth 3D Models.(Building Belongs to Area 2).

Application Domain and Additional Information

The 3D Models that were obtained in This research can be used in a variety of Applications in a GIS environment Such as :

-Town Planning (Height Restrictions)
-Cadastral Applications -3D Cadastre (Registration of rights)-This Link Contains an example. (https://3d.bk.tudelft.nl/news/2016/03/21/3DKadaster.html)
-Energy Related Applications-Solar Potential
-Visualization Related Applications (BIM)

The Different Levels of Detail in 3D Modelling

3D Models Compared to Google Earth Models

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Adeleke, A., 2018. *Web-Based GIS Modelling Of Building integrated Solar Photovoltaic System For The City Of Cape Town*. PhD. University of Cape Town.

2 (Ahmad Fuad, Yusoff, Ismail and Majid, 2018)
Ahmad Fuad, N., Yusoff, A., Ismail, Z. and Majid, Z., 2018. COMPARING THE PERFORMANCE OF POINT CLOUD REGISTRATION METHODS FOR LANDSLIDE MONITORING USING MOBILE LASER SCANNING DATA. *ISPRS - International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, XLII-4/W9, pp.11-21.

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Poli, D., Moe, K., Legat, K., Toschi, I., Lago, F. and Remondino, F., 2017. USE OF VERTICAL AERIAL IMAGES FOR SEMI-OBLIQUE MAPPING. *ISPRS - International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, XLII-1/W1, pp.493-498

QUESTIONS

THANK YOU !

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