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Volunteering for the future – Geospatial excellence for a better living

Automated Building Extraction from Dense LIDAR Data

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MOTIVATION

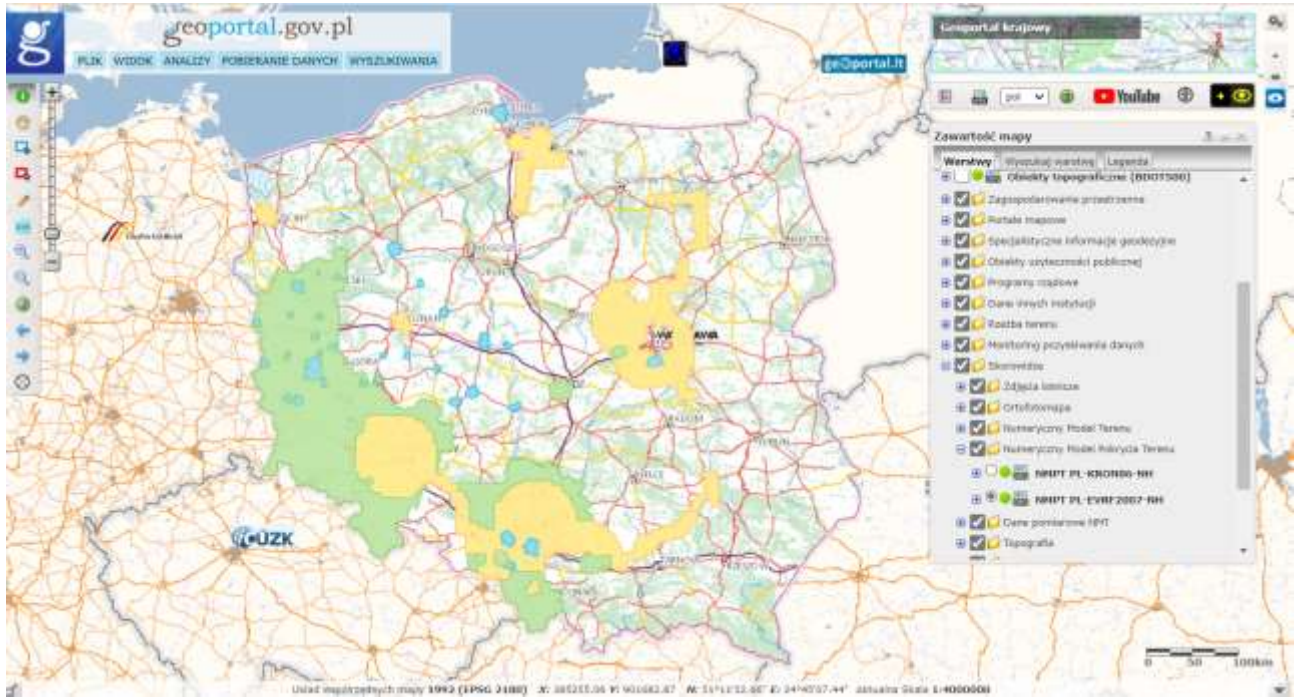
- The Earth is becoming more and more anthropogenic.
- Monitting urbanization and urban sprawl is of utmost importance at global, national and local level.
- Agenda 2030 SDGs - Towards inclusive and sustainable urbanization.
- One of the ultimate aims in photogrammetry is to generate an urban landscape model to show the objects and land cover of an urban area in 2 or 3D.
- The full automation of extracting buildings has been regarded as an active research topic in digital photogrammetry.

Automated Building Extraction from Dense LIDAR Data

- Over the last decade, many research and development efforts have been put into extracting and reconstructing building from images and DEMs data.
- It didn't take long for them to realize the great value in LIDAR data and use LIDAR data in building extraction and reconstruction.
- **The high quality of LIDAR data is reflected in three aspects**:
  - **high accuracy**, a typical LIDAR system can provide data with15 cm vertical accuracy and less than 50 cm horizontal accuracy,
  - **high consistency of the accuracy**, i.e., the accuracy is same everywhere,
  - and **consistency in coverage**, i.e., points are evenly distributed in the covered area.

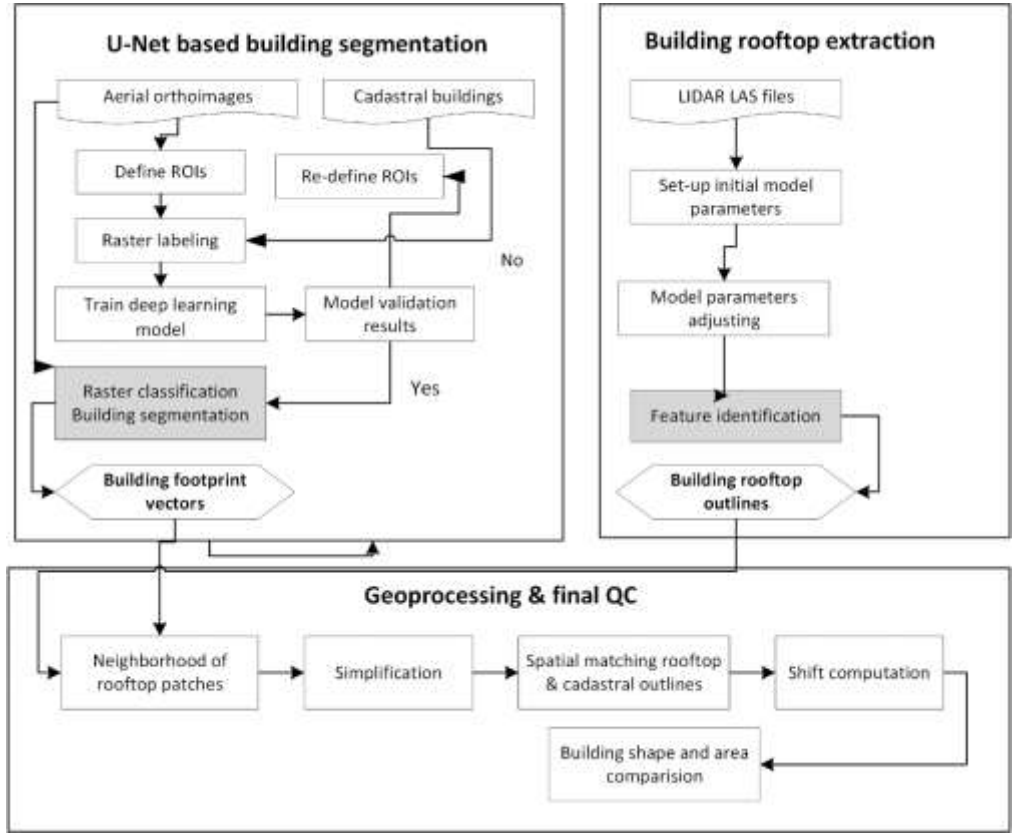
Automated Building Extraction from Dense LIDAR Data – RESEARCH GOAL

The possibilities and limitations of the Polish spatial data updating by remotely extracted buildings from airborne dense LiDAR data.



METHOODOLOGY

- Two-stage, top-down, end-to-end methodology of building rooftop outlines extraction.
  - First - buildings detection and the approximate building outlines determination.
  - Second – geoprocessing to buildings outlines reconstruction, 2D models of the buildings.



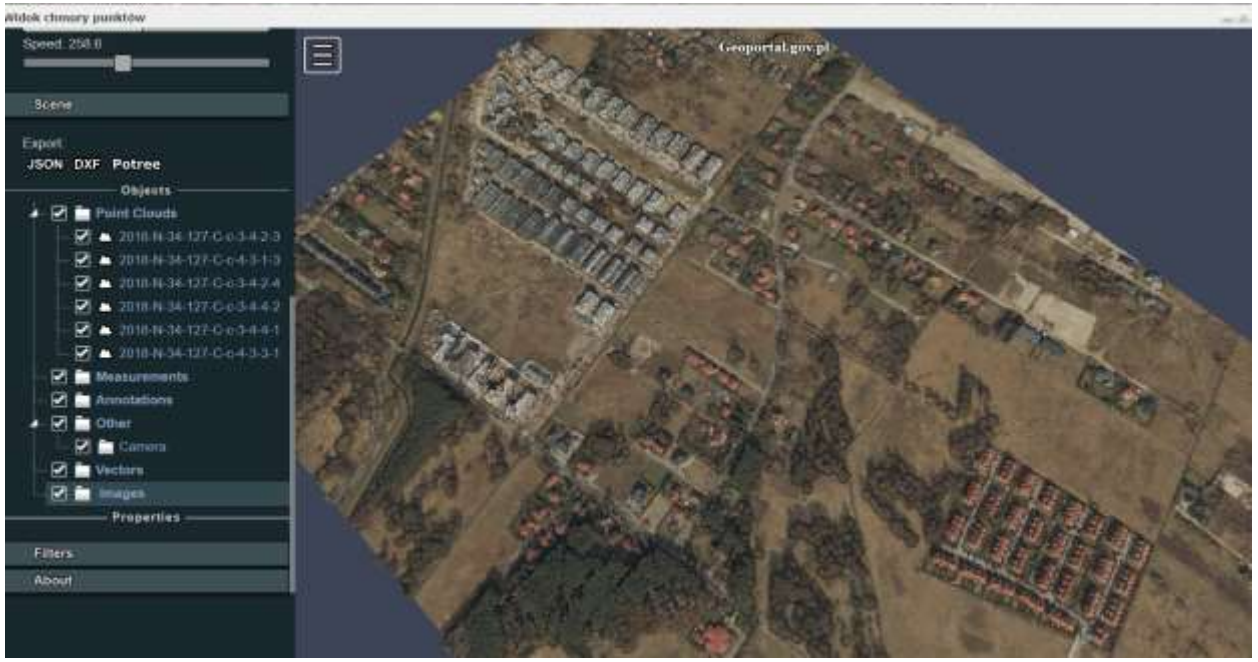
STUDY AREA

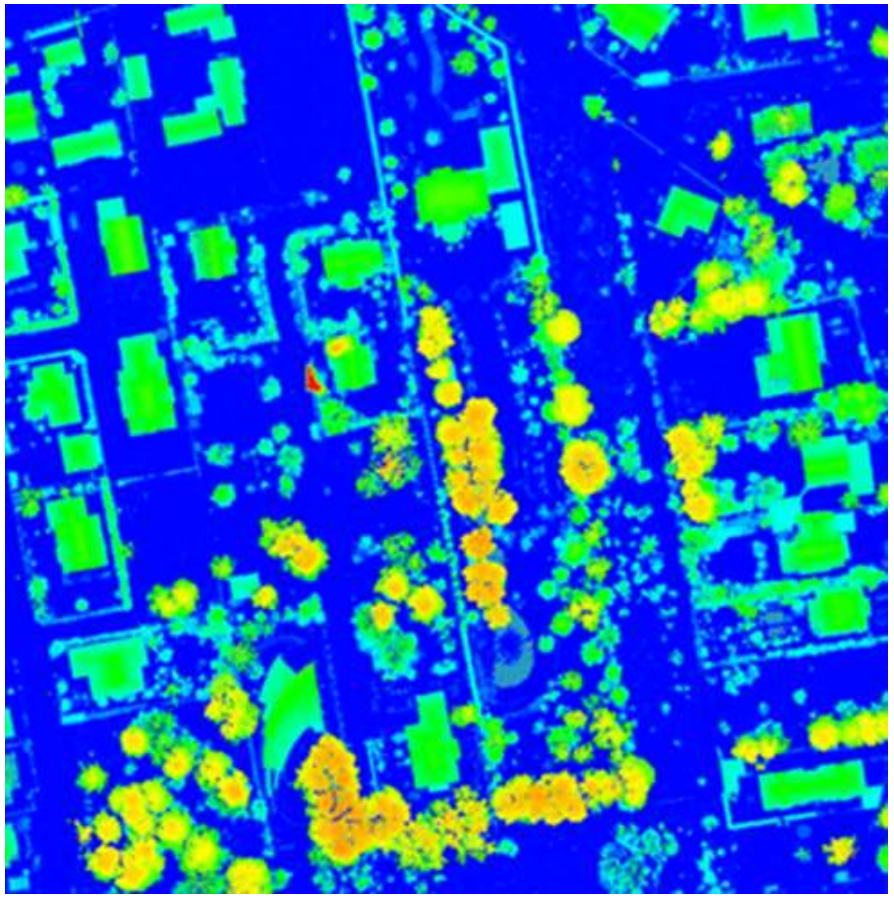
Residential district on the outskirts of Warsaw, diverse building architecture:

- multi-slope roofs,
- dormers and the accompanying vegetation.

DATA USED

- Dense classified point clouds (12 points per 1 m^2).
- Buildings data from the Warsaw cadastre.





MODEL PARAMETERS

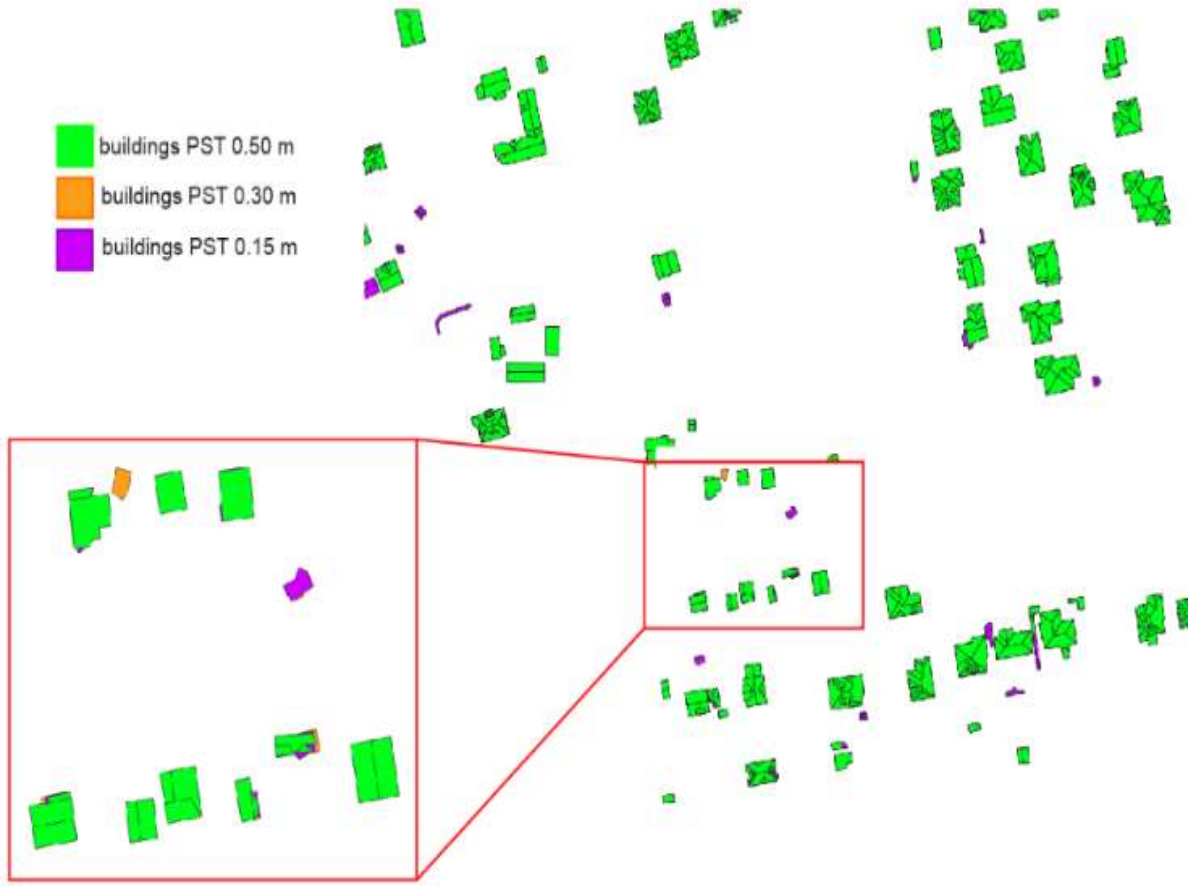
Min. building area - 10 m^2.

Near Ground Filter Width - 5 m.

The Buildings Points Range - 1.5 m.

The Plane Surface Tolerance (PST) – 0.5 m.

95% completeness in comparison with building cadastral data

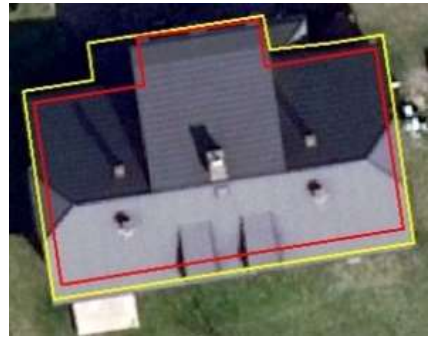


GEOPROCESSING

GEOPROCESSING

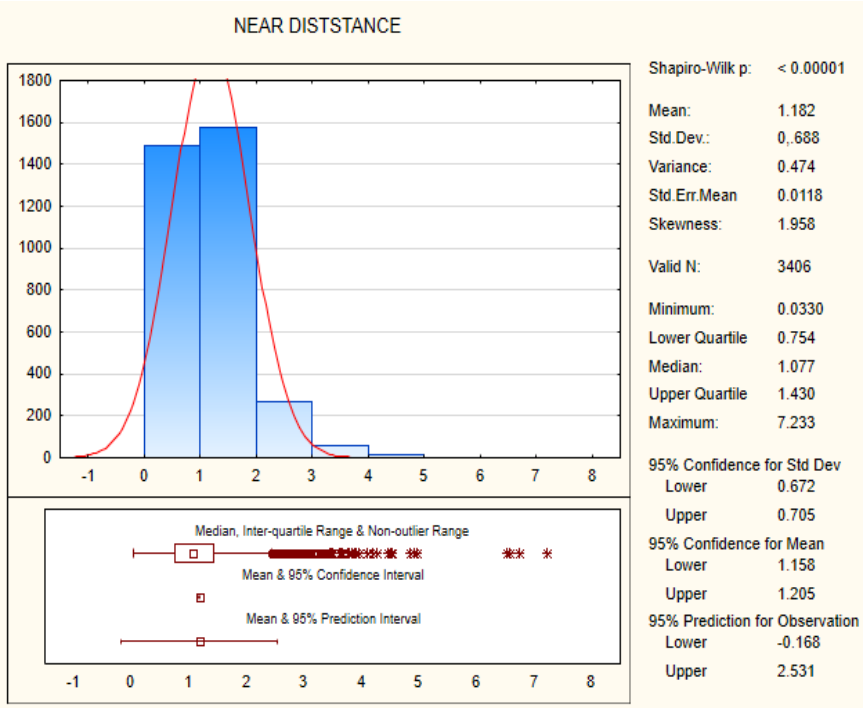
building the rooftop outline extracted from LAS data

corrected and simplified rooftop outline

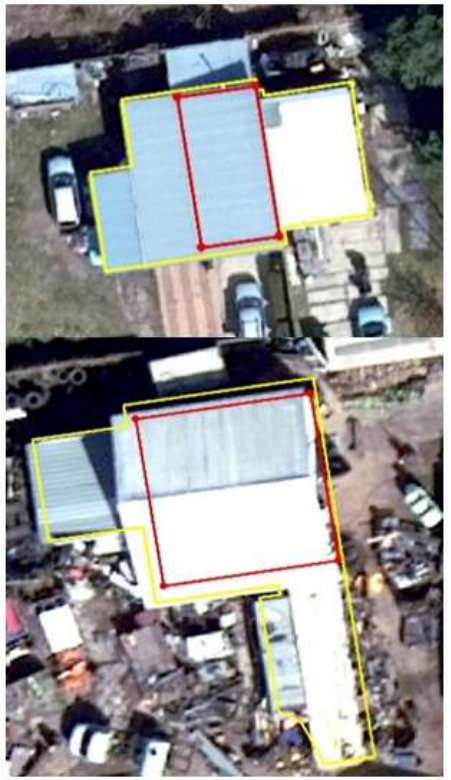


shift in building outlines (yellow line) and building footprints from cadastral data (red line)

RESULTS



- Roof overhead showed an average shift of 1.18 m (with STD equal to 0.688).
- The dispersion index (VMR) of the shift value (near distance) amounted to 0.4, indicating a binomial distribution (under dispersion).
- Less than 5.6% of the edge points of the building outlines (190 out of 3406) were perceived as outliers, the near distances between corresponding edges in the compared datasets were greater than 2.44 m.



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RESULTS

- 28 out of 263 analyzed cadastral buildings contained two outlines derived from LiDAR data processing.
- The highest differences in building area were observed for attached single-family houses.
- The Shape index (SHI) indicates the similarity between cadastral building outlines and LiDAR outline shapes irrespective of their areas.

Automated Building Extraction from Dense LIDAR Data

RECOMENDATIONS

Posibilities:

- The automatically extracted building outlines:
  - feed topographic data,
  - be successfully used when planning the cadastral modernization.
- Up-to date information of building location is of high importance in spatial planning and crisis management.

Limitations:

- Roof/ground outline – elaborate reducing algorthm.

Thank you for the attention

Further reading: Wierzbicki, D.; Matuk, O.; Bielecka, E. Polish Cadastre Modernization with Remotely Extracted Buildings from High-Resolution Aerial Orthoimagery and Airborne LiDAR. *Remote Sens.* **2021**, 13, 611. https://doi.org/10.3390/rs13040611