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# Automatic detection of potential non-conformities in the LPIS

Warsaw University of Technology (WUT) Institute of Photogrammetry and Cartography
Remote Sensing and GIS Laboratory

Joint Research Canter, Institute of Protection and Security of the Citizen, Agriculture Unit
I-21020 Ispra (VA) Italy

## Introduction

In the case of LPIS, as in any geographic information system (GIS), in order to ensure a valid decision process, the underlying vector/image data must be both current and of appropriate accuracy to guarantee the robustness of the results obtained and relevance of the decisions taken. In general, the process of ensuring the data is current and consistent with 'the real world' is referred to as the update process. An important issue is to have comprehensive real data-based information about the currency and quality of the system, in order to recognize and understand the weaknesses and required improvements of the geospatial data.

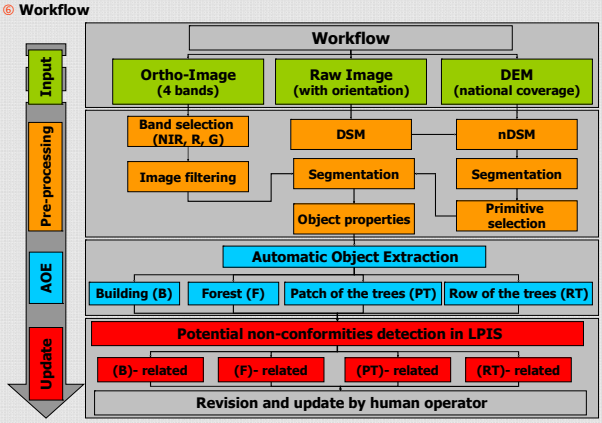
In the LPIS context, an anomaly can be an obvious error, observed when data does not comply with the applicable LPIS model, caused by incorrect mapping or data processing. Failures created while modeling of the 'real world', generated by incomplete and extensive mapping or processing, will be respectively called omission and commission errors. Finally, the dynamic and local oriented anomalies, caused by change of 'real world' condition (terrain change), are driven by outdated data in the system. On the other hand, when the concept is applied to 'real world' changes, brought about by a change in policy goals and consequently in the Regulations, this could potentially generate a mass of anomalies, which are not caused by mapping, data processing or terrain changes.

## Objectives

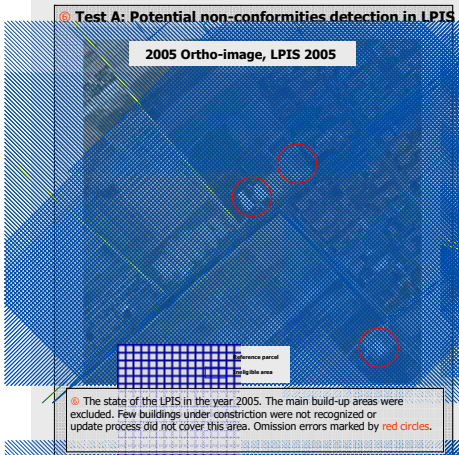
Thus the anomaly evidence might become a powerful instrument to monitor and maintain the quality of the LPIS system. Natural landscape features surrounding or containing the reference parcels (forests, hedges, etc.) and continuous anthropogenic landscape features were the two main sources of anomalies detected (Grandgirard D., Zielinski R., 2008). The objective of the study was to develop a new automatic method for selected non-conformities detection in the LPIS system to support the systematic update process based on up-to-date ortho-imagery.

The new method proposed is based on the image object analysis using the image content with the digital surface model. The preliminary results presented here are based on the real dataset.

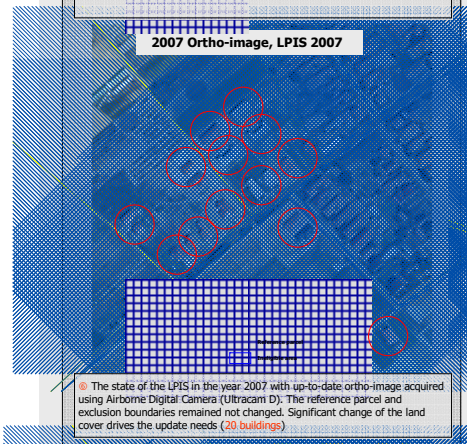
## Workflow



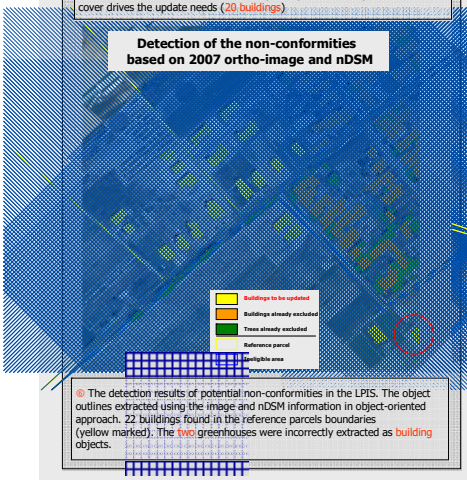

## Test A: Potential non-conformities detection in LPIS




The state of the LPIS in the year 2005. The main build-up areas were excluded. Few buildings under constriction were not recognized or update process did not cover this area. Omission errors marked by red circles.

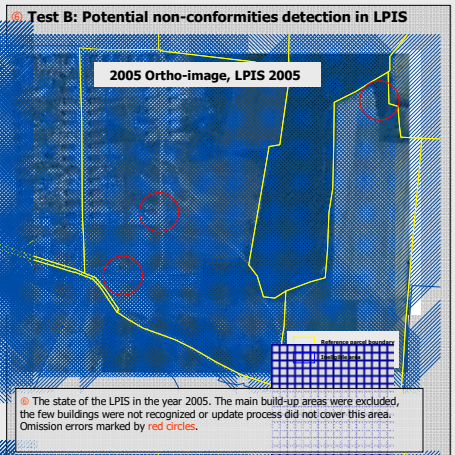



The state of the LPIS in the year 2007 with up-to-date ortho-image acquired using Airborne Digital Camera (Ultracam D). The reference parcel and exclusion boundaries remained not changed. Significant change of the land cover drives the update needs (20 buildings)

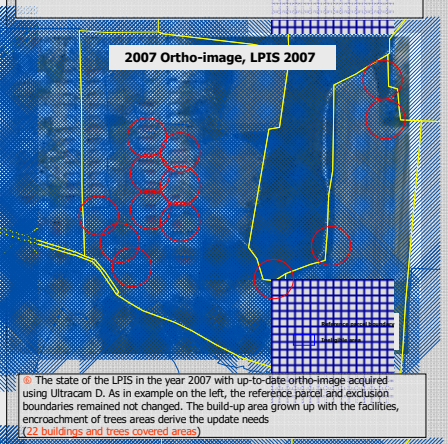



The detection results of potential non-conformities in the LPIS. The object outlines extracted using the image and nDSM information in object-oriented approach. 22 buildings found in the reference parcels boundaries (yellow marked). The two greenhouses were incorrectly extracted as building objects.

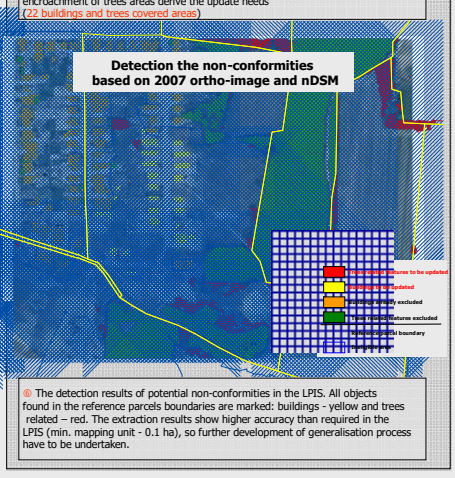
## Test B: Potential non-conformities detection in LPIS




The state of the LPIS in the year 2005. The main build-up areas were excluded, the few buildings were not recognized or update process did not cover this area. Omission errors marked by red circles.




The state of the LPIS in the year 2007 with up-to-date ortho-image acquired using Ultracam D. As in example on the left, the reference parcel and exclusion boundaries remained not changed. The build-up area grown up with the facilities, encroachment of trees areas derive the update needs (22 buildings and trees covered areas)




The detection results of potential non-conformities in the LPIS. All objects found in the reference parcels boundaries are marked: buildings - yellow and trees related – red. The extraction results show higher accuracy than required in the LPIS (min. mapping unit - 0.1 ha), so further development of generalisation process have to be undertaken.

## Methods

The method developed is based on object-oriented image analysis using the image content with the normalized Digital Surface Model (nDSM). Main stapes of the process are:

- The raw image data with the orientation parameters for the photogrammetric block solution are used for automatic matching and extraction of the DSM.
  The nDSM is created based on the DSM and the national DEM.
- Height based nDSM segmentation.
- Objects merging and primitives selection.
- Image filtering (NIR, R, B) and the Mean-Shift segmentation is performed for selected primitives.
- Refinement and final object extraction, based on object properties including the vegetation index and height information.
- Export the final results of extraction (4 object types).
- The GIS analysis, potential non-conformities detection in LPIS.

## Key summary

The LPIS systematic update processes based on the new ortho-images carried out by Member States are mostly done using manual photo-interpretation method and qualified human recourses.
The parcel-by-parcel LPIS revision, in the range of new ortho-coverage, is an effective method of update but very expensive and time consuming.

Proposed workflow might significantly speed up the update process by providing the information about objects within the reference parcel boundaries, which caused potential non-conformities.

Moreover, the information resulting from the object extraction process provide several helpful attributes given per reference parcel (e.g. object types, number of object within one reference parcel, total area, etc.), that might indicate the importance of update for every parcel.

However, high correctness and completeness coefficients of the object outline extraction is a key component of the proposed workflow.
Additional parameters (e.g. texture) for object extraction have to be investigated to assure the correctness of results.

Regarding the ranking of the most common anomalies found in the LPIS (Grandgirard D., Zielinski R., 2008), presented method covers more than 50% of all possible objects types causing problems.

Grandgirard, D. & R., Zielinski, (2008), Land Parcel Identification System (LPIS) Anomalies Sampling and Spatial Pattern: Towards convergence of ecological methodologies and GIS technologies, EUR 23484 EN – ISBN 978-92-79-09701-0, pp84