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Experimental evaluation of ALS point cloud ground extraction over different land cover in the Małopolska Province

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The paper presents an evaluation of different terrain point extraction algorithms for Airborne Laser Scanning (ALS) point clouds. The research area covers eight test sites in the Małopolska Province (Poland) with varying point density between 3-15points/m^2 and surface as well as land cover characteristics.
In this paper the existing implementations of algorithms were considered. Approaches based on mathematical morphology, progressive densification, robust surface interpolation and segmentation were compared. From the group of morphological filters, the Progressive Morphological Filter (PMF) proposed by Zhang K. et al. (2003) in LIS software was evaluated. From the progressive densification filter methods developed by Axelsson P. (2000) the Martin Isenburg's implementation in LAStools software (LAStools, 2012) was chosen. The third group of methods are surface-based filters. In this study, we used the hierarchic robust interpolation approach by Kraus K., Pfeifer N. (1998) as implemented in SCOP++ (Trimble, 2012). The fourth group of methods works on segmentation. From this filtering concept the segmentation algorithm available in LIS was tested (Wichmann V., 2012).
The main aim in executing the automatic classification for ground extraction was operating in default mode or with default parameters which were selected by the developers of the algorithms. It was assumed that the default settings were equivalent to the parameters on which the best results can be achieved. In case it was not possible to apply an algorithm in default mode, a combination of the available and most crucial parameters for ground extraction were selected. As a result of these analyses, several output LAS files with different ground classification were achieved.
The results were described on the basis of qualitative and quantitative analyses, both being in a formal description. The classification differences were verified on point cloud data. Qualitative verification of ground extraction was made on the basis of a visual inspection of the results (Sithole G., Vosselman G., 2004; Meng X. et al., 2010). The results of these analyses were described as a graph using weighted assumption. The quantitative analyses were evaluated on a basis of Type I, Type II and Total errors (Sithole G., Vosselman G., 2003).
The achieved results show that the analysed algorithms yield different classification accuracies depending on the landscape and land cover. The simplest terrain for ground extraction was flat rural area with sparse vegetation. The most difficult were mountainous areas with very dense vegetation where only a few ground points were available. Generally the LAStools algorithm gives good results in every type of terrain, but the ground surface is too smooth. The LIS Progressive Morphological Filter algorithm gives good results in forested flat and low slope areas. The surface-based algorithm from SCOP++ gives good results in mountainous areas - both forested and built-up because it better preserves steep slopes, sharp ridges and breaklines, but sometimes it fails to remove off-terrain objects from the ground class. The segmentation-based algorithm in LIS gives quite good results in built-up flat areas, but in forested areas it does not work well.

Bibliography:
Axelsson, P., 2000. DEM generation from laser scanner data using adaptive TIN models. International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences XXXIII (Pt. B4/1), 110– 117
Kraus, K., Pfeifer, N., 1998. Determination of terrain models in wooded areas with airborne laser scanner data. ISPRS Journal of Photogrammetry & Remote Sensing 53 (4), 193–203
LAStools website http://www.cs.unc.edu/∼isenburg/lastools/ (verified in September 2012)
Meng, X., Currit, N., Zhao, K., 2010. Ground Filtering Algorithms for Airborne LiDAR Data: A Review of Critical Issues. Remote Sensing 2, 833-860
Sithole, G., Vosselman, G., 2003. Report: ISPRS Comparison of Filters. Commission III, Working Group 3.

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Sithole, G., Vosselman, G., 2004. Experimental comparison of filter algorithms for bare-Earth extraction form airborne laser scanning point clouds. ISPRS Journal of Photogrammetry & Remote Sensing 59, 85-101
Trimble, 2012 http://www.trimble.com/geospatial/aerial-software.aspx (verified in November 2012)
Wichmann, V., 2012. LIS Command Reference, LASERDATA GmbH, 1-231
Zhang, K., Chen, S.-C., Whitman, D., Shyu, M.-L., Yan, J., Zhang, C., 2003. A progressive morphological filter for removing non-ground measurements from airborne LIDAR data. IEEE Transactions on Geoscience and Remote Sensing, 41(4), 872–882