Machine-Learning Classification of Aerial Photogrammetric 3D Point Clouds

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Key words: Cadastre; Cartography; Digital cadastre; Education; Engineering survey; Geoinformation/GI; Implementation of plans; Land management; Mine surveying; Photogrammetry; Quantity surveying; Remote sensing; Spatial planning; Young surveyor

SUMMARY

Objectives:

Pix4D presents a powerful method to extract per-point semantic class labels from photogrammetry data. Labelling this kind of data is important for tasks such as environmental modelling, object classification, and scene understanding. Unlike previous point cloud classification methods that rely exclusively on geometric features, we show that incorporating the color information from each pixel value into geometry yields a significant increase in accuracy in detecting semantic classes.

Results:

We tested our classification method on three real-world photogrammetry datasets (buildings, cadastrial, ankeny village) generated with Pix4Dmapper with varying point densities, focusing on five class labels: buildings, roads, high vegetation, human-made objects, ground.

The color features algorithm merged with the geometry algorithm significantly improves the overall classification results with high computational efficiency, making our approach suitable for interactive applications.

Conclusions:

There are several directions that we would like to explore to increase accuracy and decrease computational complexity. First, we would like to explore the possibility to use auto-context

information to train a second classifier to take into account class labels of the neighboring points.

Secondly we would like to combine point cloud and image classification.

We plan to implement an incremental training method, giving users the possibility to classify their data and visualize and correct errors manually. Then, we will offer the possibility to include their datasets into our training data to improve the classifier quality. As the amount of training data increases we will be able to provide more accurate classifiers and also to train specialized ones. For example, we could provide a selection of classifiers for indoor and outdoor scenes, and for different seasons and scales.

Significance:

We believe that photogrammetry and machine learning techniques will revolutionize today's workflows and to enable many new ones. In the end, it will allow the conversion of raw image input to 3D reality models with attributed semantic information.

That means, instead of having operators inspecting and measuring 3D reality models manually, they will directly receive automatically-generated answers to questions like:

What is the total road surface area in your area of interest?

What is the amount and distribution of roofs that are suitable for solar cell coverage?

How many cars are in a parking lot?

Answering these very specific questions will make workflows feasible that allow photogrammetric processing being connected directly to GIS databases to update their vectorized information automatically based on collected drone data.