Integrating UAV point clouds and imagery: an application for informal settlement mapping

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Abstract:

The quick rise in the popularity of Unmanned Aerial Vehicles (UAVs), also known as drones or Remotely Piloted Aircraft Systems (RPAS), is quite evident in the geospatial community. One of the main reasons is their ability to provide dense point clouds and very high resolution imagery in a flexible and potentially cheap way. But how can geo-informatics exploit the complementary information from both sources? In this presentation, we illustrate how to make use of geometric information from the point cloud and radiometric information from the orthomosaic for a difficult classification task – namely the classification of an informal settlement in Kigali, Rwanda. The dense and complex settlement is the target of a governmental project to improve the neighbourhood, which requires detailed spatial information over a limited study area. We discuss how to extract features from both data formats obtained by a UAV in 2015, and illustrate how a combination can be used to successfully identify thematic classes such as buildings, terrain, and vegetation in the area. Furthermore, we discuss how advanced machine learning algorithms such as Support Vector Machines (SVMs) can be altered to take into account the different statistical characteristics of these heterogeneous features. SVMs make use of kernels to separate the thematic classes in a hyperdimensional space, which has proven successful for a number of remote sensing applications. However, the same kernel parameters are defined for all features. Through Multiple Kernel Learning (MKL), various kernels can be constructed which better describe the different groups of features (such as those from the point cloud versus the imagery) and then combined into a single kernel for the SVM. A comparison of different feature-grouping methods and MKL algorithms illustrates that combining 2D and 3D features through MKL achieves classification accuracies over 90%. A illustrative example of the resulting classification is presented in Figure 1. In sum, we discuss how to use state-of-the-art feature extraction and classification techniques to interpret UAV data for a societally relevant application: the classification of informal settlements.

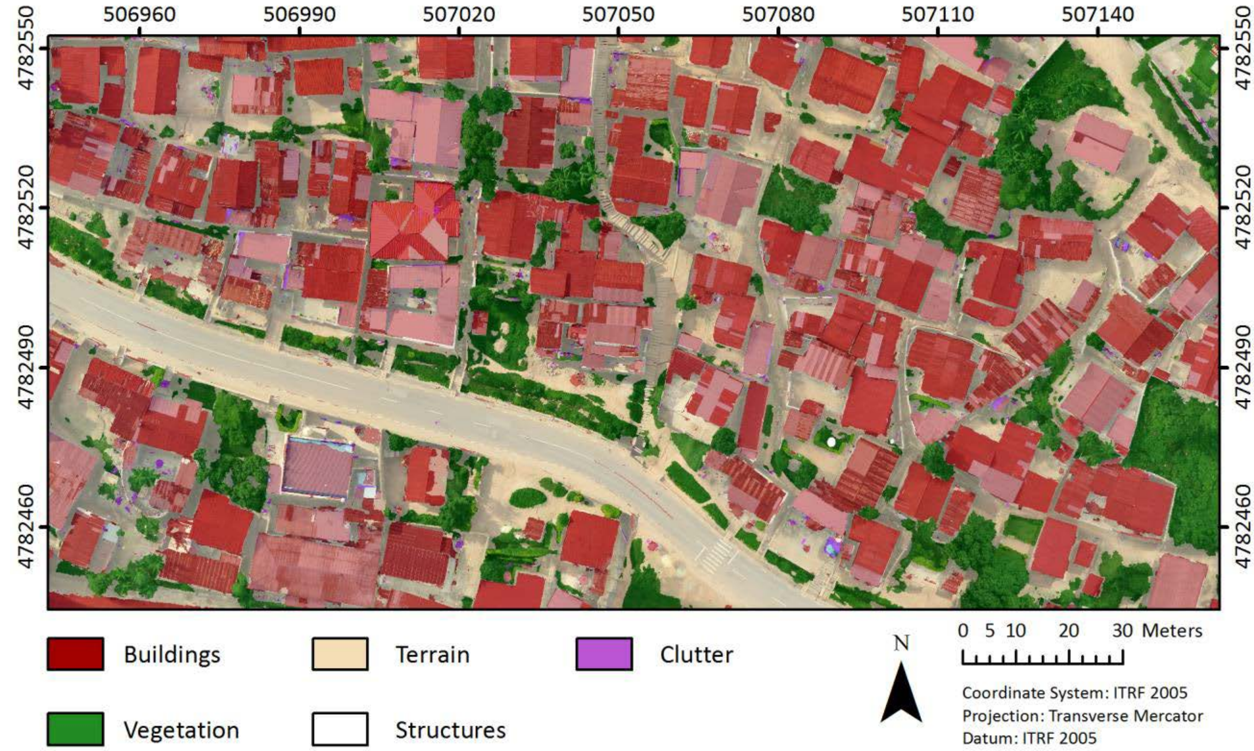

Figure 1: *Classification result overlaying the UAV orthomosaic of an informal settlement. The classification result was obtained by combining 2D features from the imagery with 3D features from the point cloud through Multiple Kernel Learning and Support Vector Machines.*