Detection of buildings through multivariate analysis of spectral, textural, and shape based features

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INTRODUCTION: In recent publications, numerous methods for automated reconstruction/registration of buildings from stereo imagery have appeared (cf. e.g. Niederöst, 2003; Süweg, 2003). A common characteristic of these methods is the requirement of an existing approximate position (AP) of the building to be registered. In the present work, we develop a method for producing such APs based on sets of true colour (RGB) or colour-infrared (CIR) aerial imagery in combination with prior registrations from a GIS database.

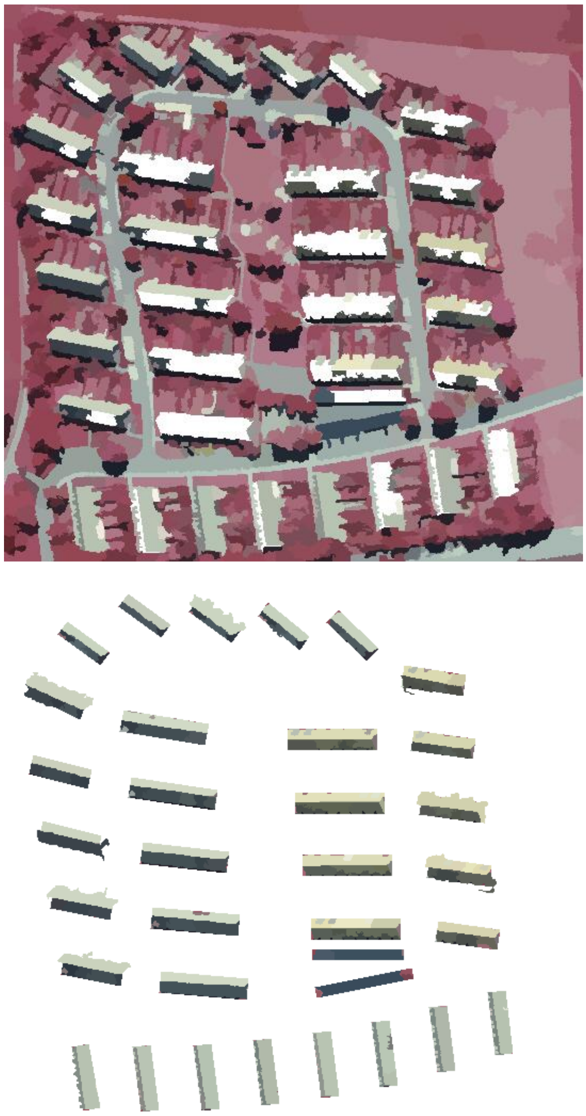
The primary intention with the work is to support the automated update of the GIS database. At the current stage of the project, the main goal is to produce a dataset where as much as possible of the "non building" area is masked out.

METHOD: The prior registrations from the GIS database are used to derive a training dataset for a multivariate classifier. The training dataset is pulled from a post processed version of the imagery, which is first segmented using the EDISON segmentation algorithm (Christoudias et al, 2002). The original 3 channel dataset is then extended to a 20 channel feature vector for each segment by computing a vegetation index and a set of shape and textural parameters. The *a priori* assumption is that the vegetation index and texture indices will help remove vegetated background, while the shape based indices will help remove road segments.

A multipart detection algorithm is utilized; the first part discriminates buildings from background by thresholding in the Mahalanobis distance from each feature vector to the set of feature vectors in the training set; the second part is a tree based method (cf. Breiman et al, 1984). The synergistic use of two (and potentially more) methods is desirable as both methods are at the limit of their descriptive power in our case: the Mahalanobis metric is affected by the fact that some components of the feature vector are far from being normal distributed; the tree based method is limited due to the small size of the input data set.

RESULTS & DISCUSSION: In general, the tree classification routine matches the input data very well, with a misclassification below 3% in all cases. The complexity of the datasets is, however reflected in the number of terminal nodes of the classification trees, which falls in the range 20–50, with the CIR cases in the lower end. This (expected) tendency of better separability in the CIR case is also reflected in the Mahalanobis discrimination step.

A sample result is shown in the figure. The upper panel shows the segmented image, with the training dataset overlaid in white (the sample is from a CIR photo, so vegetation is shown in red). The lower panel shows the result of the algorithm. The assumption that vegetation and roads could be detected from vegetation index and shape respectively, seems to hold. The major task for further work is now to get a more reliable evaluation of the existing buildings, allowing us to decide directly whether the prior registrations should be kept or should be updated.



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