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Detection of Infrastructural Changes in Satellite Images – Screening and Detailed Analysis

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Change detection is the process of identifying differences in the state of an object or phenomenon by observing it at different times. It plays an important role in different civilian and military applications. In many applications a huge amount of data has to be processed with respect to relevant changes. We propose a two-stage approach consisting of screening in low-resolution RADARSAT data and a detailed analysis in high-resolution optical images (IKONOS, QUICKBIRD).

In a first step the two RADARSAT images with a size of 17 km x 14 km and a resolution of 6.25 m by 6.25 m per pixel are registered automatically. For this purpose we use a technique based on straight lines and contour sequences matching. Screening of changes will be performed to determine regions of interest (ROIs). An entropy measure, a modified Kullback-Leibler-Divergence (KLD), operating on local histograms, gives hints for arbitrary changes.

In a second step the ROIs determined in the first step will be selected in the high-resolution optical images for further processing. Like the RADARSAT images the IKONOS and QUICKBIRD images have to be registered in advance. We start our investigations with images taken under nearly the same flight conditions and aspect angles. Thus a fine-registration of the images is possible in most cases. The main focus of our investigations is urban terrain. Linear structures of man made objects are used for the matching process. Especially in non flat topography and different aspects the ortho-rectification of the images has to be performed.

Before performing change detection it is necessary to separate changes of interest from changes caused by differences in data acquisition parameters (e. g. aspect, resolution, displacements due to topography variations and different aspects) by pre-processing

the data. As pre-processing the images are normalized concerning radiometric properties, and shadow areas are determined. Segmentation is applied to the images for different purposes. One is the exclusion of regions which are of minor interest (e. g. vegetation areas, water areas) or to focus the detailed analysis to specific areas of interest like rivers if bridges are in the focus. Another aspect of the investigations is the extraction of buildings, roads and tanks in refineries. For these objects structural descriptions are obtained. An important function in the change detection process is the evaluation of differences in the signature of corresponding objects. This difference can be built on pixel level or on higher levels of abstraction. We have focussed our investigation on the structural level. A matching on a structural level is more failure tolerant against geometrical shifts. We have tested a distance measure based on segment features to match objects. Geometrical shifts of buildings or other elevated objects were compensated registering corresponding objects separately.

The analysis could be supported by GIS information (e. g. DTM, vector maps). Further investigations deal with such context information to exclude rural areas from urban areas or to focus the analysis like vehicles on roads.