MATCHING OF HIGH RESOLUTION OPTICAL DATA TO A SHADED DEM

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One of the first essential steps in the analysis of satellite imagery is the orthorectification of the images. Normally, satellite data are delivered geocoded with varying accuracy. Orthorectification without ground control points (GCPs) using only the ephemeris and attitude data provided by the satellite operator provides an absolute accuracy of about 20 m to 1 km (depending on the satellite). For most applications like change detection this accuracy is not sufficient. For this purpose, accuracy in sub-pixel range is necessary. The orthorectification accuracy can be improved by measuring precise GCPs. However, often there is no possibility to measure precise GCPs in situ or through precise maps. An alternative method to obtain GCPs is a matching of the satellite image to a previously orthorectified image. If none of these reference data are available, no correction can be made. In this paper, a method to obtain GCPs from an existing digital elevation model (DEM) is described and assessed. Since at least the SRTM DEM is available worldwide, DEMs can serve as a valuable additional source for the generation of GCPs. Furthermore, several planned and ongoing missions will increase the availability and accuracy of DEMs or stereo imagery respectively, e.g. ALOS, Tandem-X, etc.

In the first part of the paper, the method is described: From the existing DEM a shaded model is generated. To reach a maximum of similarity of image and DEM, the shaded model is calculated by trying to simulate the conditions that were prevailing during the image acquisition. Therefore, the same viewing angle as in the satellite image is used as well as the same sun incidence and elevation angles as during the image acquisition. This shaded model is then used as reference image for a hierarchical intensity based matching as described in (Lehner and Gill, 1992) and the resulting matching points are used as GCPs. A similar approach is presented in (Leprince, 2007), where – in contrast to this paper – a frequency based matching was used to extract GCPs.

In the second part of the paper, an analysis of the performed tests is made. DEMs from different sources and different test areas are used. For a test area located in Yemen three

different DEMs are available. Additional to the SRTM-DEM, a DEM is calculated from an IKONOS stereo pair and another DEM is calculated from an ALOS/PRISM triplet. The feasibility of the method is demonstrated depending on the source and resolution of the DEMs and the character of the landscape of the respective test area.

It is shown that the presented method can provide a very useful additional source of GCPs for orthorectification purposes. Since the absolute accuracy of the GCPs depends on the accuracy of the used DEM, absolute subpixel or even pixel accuracy can not be reached in case of very high resolution images. However, a sufficient accurate coregistration of different images to a DEM can be realized which is necessary e.g. for change detection.

References:

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