USING GEOMETRIC ACCURACY OF TERRASAR-X DATA FOR IMPROVEMENT OF DIRECT SENSOR ORIENTATION AND ORTHO-RECTIFICATION OF VHR OPTICAL SENSOR DATA

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Orthorectification of high and very high resolution (VHR) optical satellite data using direct sensor orientation still needs ground control information to reach absolute geometric accuracy in pixel or sub-pixel range. This is mainly due to the insufficient knowledge of the sensors attitude and thermal influenced mounting angles, which leads to errors between 5 m and several hundred meters. In addition precise digital elevation models (DEM) are necessary to achieve a high geometric accuracy. Ground control information can be obtained by several means: e.g. measuring GPS points in situ, measuring points in topographic maps or using reference images already orthorectified together with height informations from a suitable DEM. In all cases the identification of the ground control points in the images to be rectified is an additional challenge, which requires careful selection and measurement. In the case of reference images automatic image matching procedures can be applied to extract tie points with very high correlation coefficients to improve the sensor orientation parameters, which leads to RMSE values in the sub-pixel range. Additionally from the large amount of tie points extracted by the automatic matching process also points can be selected, which serve as independent check points for quality assurance tasks. The usage of reference orthoimages as ground control information has been shown to be very precise with an overall accuracy of around half pixel size (Müller et al 2007). The drawback is that up to now optical reference images are in most cases not easily available. Especially for very high resolution data with pixel sizes of 2.5 m and better, only few areas around the world are covered by orthoimages and reach this high geometric precision to serve as a reference.

Since mainly distances are measured, the geometry of radar data from space borne sensors is not much dependant on the attitude of the satellite due to the spherical waves which are emitted from the radar antenna. Especially the data of the German TerraSAR-X mission show a very high geometric accuracy of the data. The geocoding accuracy is therefore mainly influenced by the DEM quality. Since the geometric accuracy is better than 1 m in the Single

Look Slant Range Complex (SSC) mode, the same accuracy can be reached in the Enhanced Ellipsoid Corrected (EEC) mode when the data are rectified using a precise DEM. In order to combine the high geometric potential of TerraSAR-X with the necessary improvements of the exterior orientation parameters of VHR optical sensors several investigations are shown in this paper. The main focus is in taking the radar data as ground control source for the improvement of the geometric accuracy of orthorectified optical data. Since radar and optical data contents show a very different behavior, a simple correlation technique is not applicable. Tie points can therefore be found either by manual point measurements or by multimodal image registration techniques like Mutual Information and Cluster Reward Algorithms (Suri et al 2008). We show the usage of all three methods for the purpose of finding ground control (tie points) in TerraSAR-X images as reference and use this information for the orthorectification of optical data from IKONOS and ALOS-PRISM. The resulting images are compared with check points for their geometric properties. Due to the different nature of the images the tie points and check points are mainly taken from relatively flat rural areas including streets. Urban areas and forested areas are not well suited for the process due to the different object geometries in the data of these areas.

References:

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