ORTHORECTIFICATION AND DSM GENERATION WITH ALOS-PRISM DATA IN URBAN AREAS

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ABSTRACT

The Japanese satellite ALOS carries the Prism three line scanner instrument which provides high resolution panchromatic optical images. These images of about 2.5 m ground sampling distance are acquired in the same orbit in nadir and respectively 23.8° forward and backward directions. Based on these images high resolution digital elevation models (DEM) in ground sampling distances of about 2.5 to 10 m can be derived. Due to the three-ray geometry of the sensor these DEM can be calculated independently for three image pairs (forward-nadir, nadir-backward and forward-backward) which allows a better elimination of outliers produced by the DEM generation algorithms beyond a simple statistical approach. Photogrammetric standard algorithms and dense stereo algorithms derived and adjusted from computer vision applications are used for the derivation of the DEM and compared to each other. Using the high resolution DEM produced the generation of a so called true ortho image will be possible. In many cases ortho images are generated using a DEM with a much coarser resolution than the image. In such ortho images vertical objects seen in images not acquired from nadir direction will get projected wrongly to the ground. In contrast using a DEM of the same or better resolution as the imagery allows the generation of a so-called true ortho image which represents the correct nadir view. But due to the large stereo angles of ±23.8° and due to steep vertical walls and narrow streets in urban areas there are many areas of the city which can not be seen in two or more of the images. In this case no height can be derived from the images for such areas. Based on the generated DEM – which is effectively a digital surface model (DSM) – a digital terrain model (DTM) can be derived using appropriate filtering and classification operations. A DTM is a representation of the ground surface with all elevated objects eliminated. Due to the missing object information the approach used in this work eliminates all elevated objects smaller than a given radius. In an urban situation this means mostly buildings, bridges, single trees and small groves get removed from the DSM to generate the DTM. Additionally to the DSM an occlusion mask is created. This mask marks areas in the DSM which can

only be seen in one or none of the images and for which no height information could be derived. Using this occlusion mask the DSM can be filled with values from the DTM. In contrast the filling of occluded areas in the true ortho images needs some more sophisticated approaches. These will be presented and discussed for typical urban situations. In summary a system for the generation of high resolution digital surface models from three ray images, the derivation of digital terrain models for the ground level and the deduction of the true ortho image will be presented and discussed.