Development of New Photogrammetric Software for High Quality Geo-Products and Its Performance Assessment

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Abstract : In this paper, we introduce a newly developed photogrammetric software for automatic generation of high quality geo-products and its performance assessment carried out using various satellite images. Our newly developed software provides the latest techniques of an optimized sensor modelling, ortho-image generation and automated Digital Elevation Model (DEM) generation for diverse remote sensing images. In particular, images from dual- and multi-sensor images can be integrated for 3D mapping. This can be a novel innovation toward a wider applicability of remote sensing data, since 3D mapping has been limited within only single-sensor so far. We used Kompsat-2, Ikonos, QuickBird, Spot-5 high resolution satellite images to test an accuracy of 3D points and ortho-image generated by the software. Outputs were assessed by comparing reliable reference data. From various sensor combinations 3D mapping were implemented and their accuracy was evaluated using independent check points. Model accuracy of 1~2 pixels or better was achieved regardless of sensor combination type. The high resolution ortho-image results are consistent with the reference map on a scale of 1:5,000 after being rectified by the software and an accuracy of 1~2 pixels could be achieved through quantitative assessment. The developed software offers efficient critical geo-processing modules of various remote sensing images and it is expected that the software can be widely used to meet the demand on the high-quality geo products.

Key Words : Geo product, software development, satellite image, mapping, DEM, ortho-image

1. Introduction

Geometric processing of various remote sensing data has been treated as an active research topic in the spatial information industry. The scale of the spatial information industry is expected to consistently increase and this brings close attention to the effective utilization of various remote sensing data. In particular, recent satellite sensor systems provide very high resolution and therefore, it is possible to generate high-precision geo-products from the satellite images. Many studies have demonstrated over the years that from satellite images geo-referencing accuracy of 1~2 pixels or better can be achieved by state-of-the-art photogrammetric techniques (Fraser et al., 2002; Dial et al., 2003; Noguchi et al., 2004; Büyüksalih et al., 2005; Jeong and Kim, 2009; Tong et al., 2010). Further investigations described that sub-meter
accuracy is supported by ultra high resolution of new satellites such as Geoeye-1, WorldView-1 (Eckert, 2009; Fraser and Ravanbaks, 2009). Connectedly, to generate fine and reliable geo-products such as DEMs and ortho-images, high resolution satellite images have been employed with suggestion of new or improved methods. However, many previous studies including the cases listed above were limited to the suggestion of algorithm and several experiments for verification. For the growth and development of the spatial information industry, it is necessary that the proven methods are fully and widely exploited and this can be facilitated through software development and commercialization. Photogrammetric software commercialization is able to lead to wide opportunities for the application of various remote sensing data and provides great advantages in terms of the timely update and cost-reduction. However, there are not many software specialized for photogrammetric processing of satellite images, in particular to meet domestic demand. As domestic products, several products were released (Park, 2004) but mostly they are focused on general image processing functions. They are not specialized in photogrammetric processing for handling high resolution satellite images automatically. The government has discussed ways to vitalize domestic products from 2008 and aimed to controls about 80 percent of domestic market share, but we still depend heavily on the imported products at a high cost. This is mainly due to the lack of domestic products which can be alternatives to the imported products and therefore, the development of reliable domestic software for photogrammetric processing using high resolution satellite image, in particular KOMPSAT-2, can greatly contribute to national spatial information industry.

In this research, we introduce our newly developed photogrammetric software, “3DSuite”, handling various remote sensing data for the production of high quality geo-products. This contains new techniques of an optimized sensor modelling, ortho-rectification and automated DEM generation for diverse remote sensing images. In particular, our software provides geometric integrations between different types of satellite images for 3D point determination, which have not been provided from many existing software. This can be a novel innovation toward a wider applicability of remote sensing data. This software is based on proven techniques developed in-house and the quality of this software is every bit as good as that of high-priced equivalents.

We briefly introduce a framework and characteristics of the developed software and then describe core functions in detail. Several testing processes have been implemented using the software and the outputs are evaluated to verify the software performances. An accuracy of the geometric processing from various remote sensing data is provided and the applicability of the developed software is suggested.

2. Software framework and characteristics

A framework of the developed software is shown in Fig. 1. The software is composed of five modules and each module is organically connected to one another and produces meaningful results.

In “Image” module, functions to input various remote sensing data and their metadata files are carried out. This module supports the majority of high resolution satellite images commonly used and recent aerial images such as airborne digital sensor (ADS) and digital mapping camera (DMC). In “Model” module, initial sensor modelling of inputted images with only the metadata files and precise sensor modelling with ground control points (GCPs) are selectively implemented by definition of users.