VIDEO-BASED MOBILE MAPPING SYSTEM USING SMARTPHONES

A. Al-Hamad [a], A. Moussa[a] and N. El-Sheimy [a]

Dept. of Geomatics Engineering, Schulich School of Engineering, University of Calgary, 2500 University Dr. NW , Calgary, Alberta, Canada T2N 1N4 - (amalhama, amelsaye, elsheimy)@ucalgary.ca

ISPRS Technical Commission I Symposium 2014

KEY WORDS: Close Range Photogrammetry, Mobile Mapping System, Smartphones, MEMS, Epipolar Geometry, Bundle Adjustment.

ABSTRACT:

Last two decades have witnessed a huge growth in the demand for geo-spatial data. This demand has encouraged researchers around the world to develop new algorithms and design new systems in order to obtain reliable sources for this data. Mobile Mapping Systems (MMS) are of the main sources for mapping and Geographic Information Systems (GIS) data. MMS integrate various remote sensing sensors, such as cameras and LiDAR, along with navigation sensors to provide the 3D coordinates of points of interest from moving platform (e.g. cars, air planes, etc.). Although MMS can provide accurate mapping solution for different GIS applications, the cost of these systems is not affordable for many users and only large scale companies and institutions can benefits of MMS systems.

In the last few years, Micro Electrical Mechanical Systems (MEMS) sensors have witnessed a massive development in terms of the used technologies and manufacturing. The low cost of these sensors encourages various cellular phone manufacturers to use these sensors inside their phones to make it smarter for many applications. Nowadays, smartphones are becoming more sophisticated with a lot of capabilities and various sensors types. For example, current smartphones are equipped with GPS receivers, high resolution image and video cameras, MEMS inertial sensors and powerful computing processors. Smartphones are considered the most widespread platform which contain all of these technologies and available for normal users. All of these developments in smartphones encourage the researches around the world to develop new creative applications and services beyond the traditional voice calls and SMS so that users can exploit its maximum benefits in their daily life activities. In this paper, smartphones will be used as a platform for mapping applications. Using its GPS receiver, Inertial Measurement Unit (IMU), magnetometers and camera sensors, smartphones can be considered an ideal platform which contains all navigation and remote sensing sensors required for any MMS. However, the main challenge of using smartphones for mapping applications is their poor sensors accuracy which needs an external update source to improve its performance.

In this research work, video camera will be used to record a synchronized video with GPS, IMU and magnetometers measurements inside the smartphone. Current smartphones digital video cameras can be used for various mapping application (e.g. the resolution of Samsung Galaxy S4 video camera is 1920x1080 pixels). In contrast to a digital image camera, large overlapping area between images can be guaranteed between used images in mapping solution. The paper presents a new algorithm for selecting the best set of images from the captured video with a certain overlapping area between each two consecutive chosen images for coordinate estimations. The Exterior Orientation Parameters (EOPs) of the selected images will be calculated initially using the different navigation sensors measurements of the smartphone. In addition to a set of points matched automatically between images, epipolar geometry constraints are used to correct the initial EOPs values. These corrected values are used in bundle adjustment software to estimate the final mapping solution.

The main objective of this paper is to propose a new very low cost MMS with reasonable accuracy using the available sensors in smartphones and its video camera. Interest point's detection, points matching, blunders detection and removal are done automatically in the proposed system. Using the smartphone video camera instead of capturing individual images makes the system easier to be used by non professional users since the system will automatically extract the highly overlapping and non blurry frames out of the video without the user intervention.