GENERATION OF DENSE 3D POINT CLOUDS USING A SMALL QUADCOPTER

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The disruptive technology of small and light-weight Unmanned Vehicle Systems (UVS) is changing geomatics applications and creating new and innovative opportunities for measuring and modeling outdoor and indoor environments. UVS' compliment, and in many cases replace, total stations and laser scanners, and operate as flexible mobile survey systems. A small aerial quadcopter has been used to capture oblique highly overlapped video images. The video images captured from the onboard camera were reconstructed based on an incremental structure from motion bundle adjustment approach. Dense multi-image matching was used to generate a 3D point cloud representing the surface of the mapped area from the oblique video images, while the position and orientation of the image frames were also estimated in the process. The photogrammetrically-generated dense digital surface model was co-registered and compared to an existing 3D building model. The paper presents the methodology and the obtained results and accuracies.

La technologie perturbatrice des petits et légers systèmes de véhicules aériens sans pilote (UVS) transforme les applications de géomatique et crée de toutes nouvelles occasions innovatrices de mesurer et modéliser les environnements extérieurs et intérieurs. Les UVS complémentent et, dans certains cas, remplacent les tachéomètres électroniques et les lecteurs laser et fonctionnent comme des systèmes d'arpentage mobiles flexibles. Un petit quadcoptère a été utilisé pour capter des images obliques vidéo à grand recouvrement. Les images vidéo captées par la caméra à bord ont été reconstruites selon une structure incrémentielle à l'aide d'une compensation par faisceaux du mouvement. On a utilisé la correspondance d'images multiples denses pour créer un nuage de points tridimensionnel représentant la surface de la région cartographiée à partir des images vidéo obliques. La position et l'orientation des images étaient aussi estimées en cours de processus. Le modèle de surface numérique dense créé par photogrammétrie a été co-enregistré et comparé à un modèle tridimensionnel existant des bâtiments. Cet article présente la méthodologie utilisée ainsi que les résultats et précisions obtenus.

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1. Introduction

At the 2004 ISPRS Congress, only two papers using Unmanned Aerial Systems (UAS) for geomatics were presented. At the 2008 ISPRS Congress, five technical sessions (20 papers plus) were held, while at the 2012 ISPRS Congress in Melbourne, around 50 UAS-related papers were presented in nine sessions. Remotely piloted mobile mapping systems are becoming the technological impetus for revolutionizing three dimensional geospatial data acquisition and 3D mapping, and causing a paradigm shift in the field of geomatics [*Colomina and Molina* 2014]. The ever-increasing use of small and light-weight Unmanned Vehicle Systems (UVS) are changing the geomatics applications and creating new and innovative opportunities for measuring and modeling outdoor and indoor environments. UVS' compliment, and in many cases replace, total stations and laser scanners, and operate as flexible mobile survey systems. Miniaturization technologies and micro-electromechanical systems (MEMS) have radically reduced the size and weight of many components and electronic systems, leading to the development of unmanned aerial and ground mapping systems of smaller scale and lower cost. However, ''lighter, smaller, simpler and cheaper'' does not mean simpler processing software systems. Actually, highly sophisticated

dx.doi.org/10.5623/cig2014-406 GEOMATICA Vol. 68, No. 4, 2014 pp. 319 to 330