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MICRO UAV FLIGHT PARAMETERS ANALYSIS IN PRODUCING AN ACCURATE LARGE SCALE TOPOGRAPHIC MAP

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ABSTRACT

Unmanned Aerial Vehicles (UAVs) are a type of aircraft that can be remotely operated without requiring the physical presence of a pilot. The latest advancement in technology provides UAVs with the ability to provide accurate positioning and high-resolution images, making it a viable option to collect data for topographic survey works. The positioning of high-resolution images from UAVs can be highly accurate with the application of ground control points (GCPs). Furthermore, optimal flight altitude and overlap can be advantageous for orthophoto, digital surface model, and topographic mapping. Therefore, the present study aims to assess the impact of UAV flight parameters in large-scale topographic mapping. The objectives were (1) to investigate the effect of different numbers of GCP and its configuration on photogrammetric products; (2) to analyse the changes in different altitudes as well as overlap and sidelap percentages in photogrammetric image processing; and (3) to validate the photogrammetric products using the ground survey data and accuracy standards for topographic mapping. The investigation comprised three different numbers of GCP configurations (5 GCP, 6 GCP, and 7 GCP), altitudes (60 m, 80 m, and 100 m), as well as overlap (70%, 80%, and 90%) and sidelap (50%, 60%, and 70%) percentages. Ground Control Points (GCPs) and Check Points (CPs) were established using the Global Positioning System (GPS) via Real Time Kinematic (RTK). The data were obtained using Phantom 3 Pro with different flight parameters, which were processed using the Agisoft and PCI Geomatics software. The final photogrammetric products were analysed through accuracy assessment using Root Mean Square Error (RMSE). The outcomes demonstrated that the combinations tested, 5 GCPs at 80m altitude with 70% overlap and 50% sidelap; 6 GCPs at 60m altitude with 80% overlap and 50% sidelap; and 7 GCPs at 100m altitude with 70% overlap and 60% sidelap were proved to be the most effective in utilizing micro UAV flight parameters. These configurations excelled in creating an accurate, detailed topographic map that met the rigorous accuracy standards of either a 1:600 map scale or a 7.5cm accuracy threshold specified by the American Society of Photogrammetry and Remote Sensing (ASPRS) for digital geospatial data's positional accuracy. The outcome of this study can be used by any private or government agencies, including local authorities, to conduct mapping works at their respective area of interest.

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TABLE OF CONTENTS

CHAPTER 1
INTRODUCTION

1.1 Research Background

Unmanned Aerial Vehicles (UAVs) are a type of aircraft that can be remotely operated using a ground-based controller without requiring the need of a pilot (Czapiewski, 2022; Barba et al., 2019). Recent years have witnessed the extensive use of UAVs for various purposes, including for surveying and engineering works in the commercial industry (Ahmed et al., 2022) as well as for crop monitoring, quantifying volume change, and natural landform mapping (Liu & Zheng, 2018; Liu et al., 2018; Villanueva & Blanco, 2019; Flores-de-santiago, 2020). Such extensive usage, along with the rapid technological advancement, subsequently prompted the emergence of more UAVs of varied designs, sizes, and functions to meet the increasing usage demand (Fang et al., 2021; Mohd Noor et al., 2018).

The increasing demand for UAVs usage is believed to stem from its capability of giving accurate positioning and high-resolution images as compared to satellite imaging, which can be an advantage for topographic survey works (Saad & Tahar, 2019; Karamuz et al., 2020; Abdulrahaman et al., 2020; Colomina & Molina, 2014; Lee et al., 2018). Aside from the ease to operate, UAVs are capable of capturing clear, high-resolution images without much distortion from environmental factors, making it a preferred option for engineering surveys in producing topographic mapping (Azmi et al., 2014; Tan & Li, 2019). Such advantage is imperative as any information obtained from topographic mapping is based on the reality of the ground and its surrounding at a certain point of location that can be used by numerous parties, such as private personnel, government agencies, and even the military (Zuo et al., 2022). Previously, the acquisition of data for topographic mapping was done using conventional technology, such as total station and would be represented in 2-dimension (2D) maps. However, the current photogrammetry technology allows UAVs with high-resolution images to produce topographic mapping, allowing for a faster and more convenient data acquisition process (Saifizi et al., 2020). Additionally,