

ABSTRAK

STUDI KOMPARATIF PENGARUH VARIASI PRESISI HORIZONTAL DAN VERTIKAL PADA UAV-PPK TERHADAP AKURASI ORTOFOTO DAN DTM

(Studi Kasus : Area Pit Tambang Batubara)

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Pemetaan tambang terbuka memerlukan metode yang efisien dan akurat mengingat perubahan topografi yang terjadi secara cepat. Metode UAV *Post Processing Kinematic* (PPK) menawarkan solusi dengan menghasilkan posisi presisi tinggi tanpa ketergantungan penuh pada *Ground Control Point* (GCP), namun pengaruh parameter *horizontal precision* dan *vertical precision* terhadap kualitas model fotogrametri belum banyak dikaji. Penelitian ini bertujuan menganalisis pengaruh variasi parameter presisi horizontal dan vertikal terhadap akurasi ortomosaik dan *Digital Terrain Model* (DTM) pada area tambang terbuka, dengan data *Terrestrial Laser Scanner* (TLS) sebagai data referensi karena memiliki ketelitian tinggi dan umum digunakan pada pengukuran topografi tambang. Skenario pengolahan meliputi penggunaan parameter *horizontal-vertical precision*, tanpa parameter tersebut, penggunaan parameter dan GCP, serta tanpa parameter dan GCP. Pengolahan foto udara dilakukan menggunakan metode *Structure from Motion - Multi View Stereo* (SfM - MVS), sedangkan perbandingan *point cloud* menggunakan algoritma *Multiscale Model to Model Cloud Comparison* (M3C2). Uji akurasi dilakukan berdasarkan CE90 dan LE90 mengacu pada SNI 8202:2019, serta analisis selisih volume hasil UAV-PPK terhadap TLS. Hasil penelitian menunjukkan rata-rata jarak M3C2 *point cloud* UAV terhadap TLS berada pada rentang 0,021 - 0,128 m, dengan nilai terkecil pada penggunaan parameter presisi horizontal dan vertikal. Nilai LE90 berada pada rentang 0,701 - 0,792 m sehingga memenuhi interval kontur 1 meter, sedangkan nilai CE90 berada pada rentang 0,225 - 0,499 m dan memenuhi ketelitian peta dasar skala 1:1000. Seluruh skenario menghasilkan selisih volume di bawah batas toleransi industri sebesar 2%, dan uji statistik menunjukkan tidak terdapat perbedaan signifikan antara rata-rata jarak maupun estimasi volume UAV-PPK terhadap TLS. Berdasarkan hasil tersebut, penggunaan parameter *horizontal precision* dan *vertical precision*, dan jika dikombinasikan dengan GCP, mampu menghasilkan akurasi geometrik dan estimasi volume yang mendekati data referensi.

Kata kunci : M3C2, Presisi Horizontal - Vertikal, UAV-PPK, Volume

ABSTRACT

COMPARATIVE STUDY ON THE EFFECT OF HORIZONTAL AND VERTICAL PRECISION VARIATIONS IN UAV-PPK ON THE ACCURACY OF ORTHOPHOTO AND DTM

(Case Study: Coal Mine Pit Area)

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Open-pit mine mapping requires efficient and accurate methods due to the rapid topographic changes occurring within the mining area. The Unmanned Aerial Vehicle Post-Processing Kinematic (UAV-PPK) method offers a solution by providing high-precision positioning without full dependence on Ground Control Points (GCPs). However, the influence of horizontal precision and vertical precision parameters on the quality of photogrammetric models has not been widely investigated. This study aims to analyze the effect of variations in horizontal and vertical precision parameters on the accuracy of orthomosaics and Digital Terrain Models (DTMs) in an open-pit mining area, using Terrestrial Laser Scanner (TLS) data as reference data due to its high accuracy and common application in mine topographic surveys. The processing scenarios included the use of horizontal-vertical precision parameters, processing without these parameters, processing with precision parameters and GCPs, as well as processing without precision parameters and GCPs. Aerial photo processing was conducted using the Structure from Motion – Multi View Stereo (SfM-MVS) method, while point cloud comparison was performed using the Multiscale Model to Model Cloud Comparison (M3C2) algorithm. Accuracy assessment was carried out based on CE90 and LE90 according to SNI 8202:2019, along with volume difference analysis between UAV-PPK and TLS results. The results showed that the average M3C2 distance between UAV and TLS point clouds ranged from 0.021 to 0.128 m, with the smallest value obtained from the scenario using horizontal and vertical precision parameters. LE90 values ranged from 0.701 to 0.792 m, fulfilling the 1 meter contour interval requirement, while CE90 values ranged from 0.225 to 0.499 m, meeting the accuracy standard for 1:1000 base maps. All processing scenarios produced volume differences below the industrial tolerance limit of 2%, and statistical tests indicated no significant differences in either average point cloud distance or volume estimation between UAV-PPK and TLS data. Based on these findings, the use of horizontal precision and vertical precision parameters, particularly when combined with GCPs, was able to produce geometric accuracy and volume estimation results closely matching the reference data.

Keywords: *Horizontal - Vertical Precision, M3C2, UAV-PPK, Volume*