INTISARI

Penggunaan metode fotogrametri dengan teknologi *Unmanned Aerial Vehicle* (UAV) dalam kegiatan pemetaan dan pengukuran volume *overburden* semakin banyak diterapkan di industri pertambangan. Namun, salah satu faktor yang memengaruhi akurasi hasil pengukuran adalah jumlah dan distribusi *Ground Control Point* (GCP) yang digunakan pada proses triangulasi udara. Proyek ini mengevaluasi pengaruh jumlah dan distribusi GCP terhadap tingkat akurasi pengukuran volume *overburden* serta membandingkan hasilnya antara metode fotogrametri dan GNSS RTK.

Proyek akhir ini dilakukan di PT Putra Perkasa Abadi Jobsite PT Bukit Asam Tbk, Sumatera Selatan, menggunakan enam variasi jumlah GCP (0, 1, 2, 4, 5, dan 6 GCP) serta pengujian distribusi merata dan tidak merata pada penggunaan 2 GCP, dengan 7 *Independent Check Point* (ICP) pada setiap pengolahannya. Pengolahan data dilakukan menggunakan SFM-MVS *Photogrammetry*, sementara perhitungan volume dilakukan menggunakan metode *Cut and Fill*, dengan *boundary* dari hasil pengukuran GNSS RTK sebagai acuan permukaan model DTM. Validasi akurasi volume dilakukan melalui perhitungan CE90 dan LE90 hasil triangulasi udara serta selisih volume dibandingkan dengan hasil pengukuran RTK.

Analisis hasil menunjukkan bahwa jumlah 6 GCP menghasilkan akurasi terbaik dengan selisih volume terkecil sebesar 3,76%. Untuk perhitungan ketelitian geometrik didapatkan nilai CE90 0,0344 meter dan LE90 0,0510 meter. Meskipun demikian, penggunaan minimal 4 GCP dengan distribusi merata sudah mampu menghasilkan akurasi volume yang baik dengan selisih volume 6,31% serta memenuhi acuan Badan Informasi Geospasial (BIG, 2021). Sebaliknya, tanpa GCP (0 GCP) menghasilkan selisih volume tertinggi mencapai 8.571,45% dengan CE90 sebesar 6,1055 meter. Selain jumlah, distribusi GCP juga memengaruhi akurasi. Penggunaan 2 GCP dengan distribusi merata mampu menurunkan selisih volume hingga 6,83%, dibandingkan 316,70% pada distribusi yang tidak merata. Maka, penggunaan minimal 4 GCP dengan distribusi merata dapat direkomendasikan untuk meningkatkan ketelitian pengukuran volume *overburden* menggunakan metode fotogrametri, di mana jumlah dan distribusi GCP yang merata berperan penting dalam menghasilkan pengukuran yang akurat dan efektif.

Kata kunci: UAV fotogrametri, *Ground Control Point* (GCP), *overburden*, volume, akurasi horizontal, akurasi vertikal

ABSTRACT

The use of photogrammetry with Unmanned Aerial Vehicle (UAV) technology in mapping and measuring overburden volumes has become increasingly common in the mining industry. However, one of the factors affecting measurement accuracy is the number and distribution of Ground Control Points (GCPs) used in the aerial triangulation process. This project evaluates the influence of the number and distribution of GCPs on the accuracy of overburden volume measurements and compares the results between the photogrammetry method and GNSS RTK.

This final project was conducted at PT Putra Perkasa Abadi, Jobsite PT Bukit Asam Tbk, South Sumatra, using six variations in the number of GCPs (0, 1, 2, 4, 5, and 6 GCPs), as well as testing both uniform and non-uniform distributions for the 2-GCP configuration, with 7 Independent Check Points (ICPs) in each processing scenario. Data processing was carried out using SFM-MVS photogrammetry, while volume calculations employed the Cut and Fill method, with boundaries from GNSS RTK measurements serving as the reference for the DTM surface model. Volume accuracy validation was performed using CE90 and LE90 calculations from aerial triangulation results and by comparing the volume differences with RTK measurements.

The analysis results show that the configuration with 6 GCPs produced the highest accuracy, with the smallest volume difference of 3,76%. For geometric accuracy, CE90 and LE90 values were 0,0344 meters and 0,0510 meters, respectively. Nevertheless, using at least 4 GCPs with a uniform distribution already provided good volume accuracy, with a volume difference of 6,31%, meeting the standards of the Geospatial Information Agency (BIG, 2021). In contrast, the 0-GCP configuration resulted in the largest volume difference, reaching 8,571.45%, with a CE90 of 6.1055 meters. Besides quantity, GCP distribution also affected accuracy. Using 2 GCPs with a uniform distribution reduced the volume difference to 6.83%, compared to 316,70% with a non-uniform distribution. Therefore, the use of at least 4 uniformly distributed GCPs is recommended to improve the accuracy of overburden volume measurements using the photogrammetry method, where both the number and uniform distribution of GCPs play an important role in producing accurate and effective measurements.

Keywords: *UAV photogrammetry, Ground Control Point (GCP), overburden, volume, horizontal accuracy, vertical accuracy*