

LAMPIRAN

LAMPIRAN 1. Perhitungan Persamaan 1

- Perhitungan 4.2 metode *fotogrametri* persamaan 1

$$T = \frac{D.V}{t} \quad T = \frac{1,180 \times 23.574}{1000} = \mathbf{27.818 \text{ ton}}$$

Keterangan :

T = Total tonase *Stockpile*

D = Densitas (kg/m³)

V = Total volume *Stockpile* (m³)

t = 1000 kg/Mg (metric ton)

- Perhitungan 4.3 metode *RTK* persamaan 1

$$T = \frac{D.V}{t} \quad T = \frac{1,180 \times 24.213}{1000} = \mathbf{28.572 \text{ ton}}$$

Keterangan :

T = Total tonase *Stockpile*

D = Densitas (kg/m³)

V = Total volume *Stockpile* (m³)

t = 1000 kg/Mg (metric ton)

LAMPIRAN 2. Perhitungan persamaan 2

- Perhitungan 4.4 persamaan 2

1. Perbandingan tonase survei

$$\text{Persentase perbedaan (\%)} = \frac{\text{Tonase fotogrametri} - \text{Tonase RTK}}{\text{Tonase RTK}} \times 100 \%$$

$$\text{Persentase perbedaan (\%)} = \frac{27.818 - 28.572}{28.572} \times 100\% = \mathbf{2,6 \%}$$

LAMPIRAN 3. Perhitungan RMSE

#Label	X/Easting	Y/Northing	Z/Altitude	Error_(m)	X_error	Y_error	XY_Error	Z_error	X_est	Y_est	Z_est
GCP 1	264624.019	9769068.404	47.359	0.022055	0.009366	0.01991	0.00048413	-0.001503	264624.0284	9769068.424	47.357497
GCP 2	264556.36	9769054.574	42.138	0.014383	0.006919	-0.012392	0.000201434	-0.002332	264556.3669	9769054.562	42.135668
GCP 3	264586.134	9769123.569	42.313	0.004346	0.000345	0.003491	1.23061E-05	0.002565	264586.1343	9769123.572	42.315565
GCP 4	264640.405	9769032.212	40.149	0.019983	-0.016623	-0.011014	0.000397632	0.001296	264640.3884	9769032.201	40.150296
#Total error				0.016669	0.010149	0.013072		0.001997			
RMSE				Error_(m)	X_error	Y_error	r_Error	Z_error			
				0.01667	0.020299	0.026143	0.01654919	0.001997			

$$RMSE_y = \sqrt{\frac{\sum_{i=1}^n (Xdata_i - Xcek_i)^2 + (Ydata_i - Ycek_i)^2}{n}}$$

$$RMSE_z = \sqrt{\frac{\sum_{i=1}^n (Zdata_i - Zcek_i)^2}{n}}$$

LAMPIRAN 4. Volume Metode RTK



DTM CUT AND FILL VOLUME REPORT

Aug 20, 2024

First DTM: bedding1.dtm
 Second DTM: stokpile_121_1baru.dtm
 Upper DTM object ID: 1
 Upper DTM trisolation ID: 1
 Lower DTM object ID: 2
 Lower DTM trisolation ID: 1

Boundary file: bdry_stpl.str
 Boundary string: 1
 Number of segments: 1
 Density: 1.180

DTM Extents

	X Minimum	X Maximum	Y Minimum	Y Maximum	Z Minimum	Z Maximum
Bedding1.dtm	264541.813	264674.839	9769017.440	9769122.505	39.660	42.864
Stokpile 121 1baru.dtm	264544.527	264657.165	9769017.986	9769121.746	39.734	50.396

Volumes

Cut Vol	Cut Area	Fill Vol	Fill Area	Nett Vol	Nett Tonnage	Common Area
338.324	1651.287	24551.884	5500.794	24213.561	28572.002	0.000

LAMPIRAN 5. Volume Metode Fotogrametri



DTM CUT AND FILL VOLUME REPORT

Aug 13, 2024

First DTM: bdry_drone1.dtm
Second DTM: 90_rev.dtm
Upper DTM object ID: 1
Upper DTM trisolation ID: 1
Lower DTM object ID: 1
Lower DTM trisolation ID: 1

Boundary file: bdry_drone1.str
Boundary string: 50
Number of segments: 1
Density: 1.180

DTM Extents

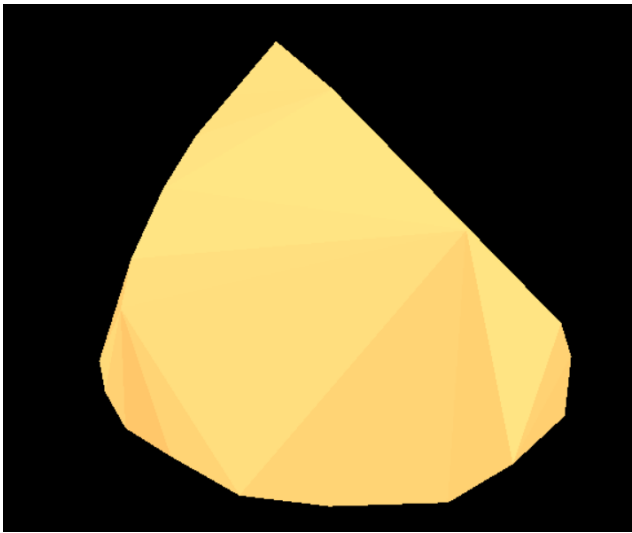
	X Minimum	X Maximum	Y Minimum	Y Maximum	Z Minimum	Z Maximum
Bdry Drone1.dtm	264554.253	264647.937	9769023.975	9769118.516	40.198	42.773
90 Rev.dtm	264543.952	264665.018	9769022.980	9769128.234	39.719	49.093

Volumes

Cut Vol	Cut Area	Fill Vol	Fill Area	Nett Vol	Nett Tonnage	Common Area
9.235	235.271	23583.968	5851.637	23574.733	27818.185	0.000

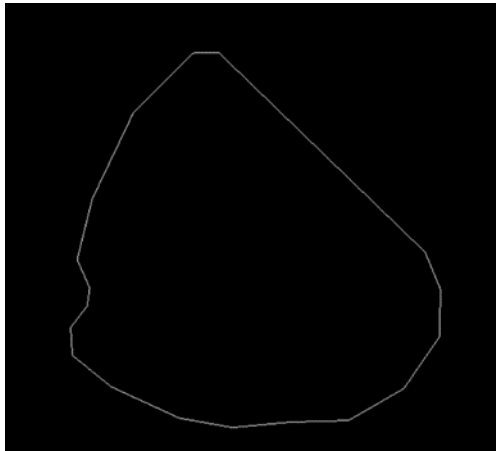
LAMPIRAN 6. Bedding (Alas) dan Boundary

-bedding(alas)

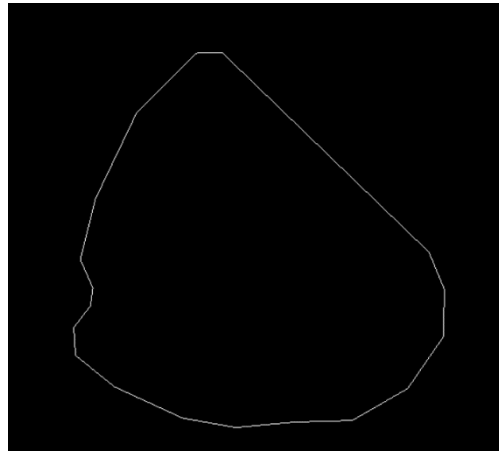


- boundary

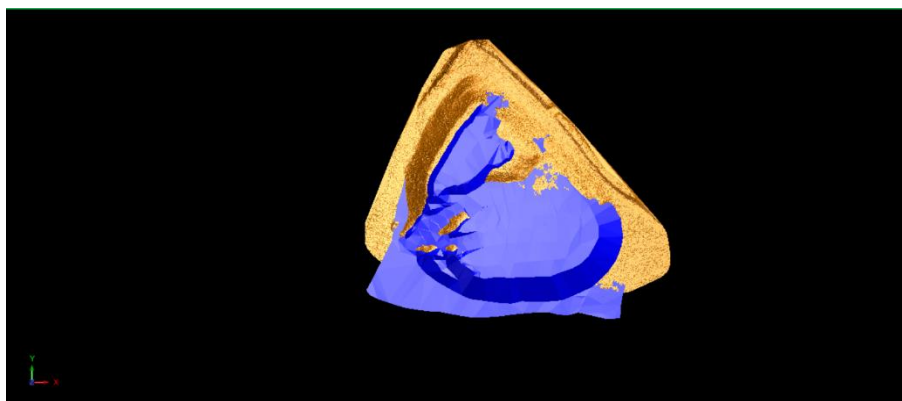
(Boundary *RTK*)



(Boundary *Drone*)



LAMPIRAN 7. Overlay Data *RTK* dan *UAV*



warna emas data *UAV* dan Warna Biru data *RTK*

LAMPIRAN 8. Data foto udara



LAMPIRAN 9. Data GPS Geodetic

X	Y	Z
264635.247	9769146.575	42
264634.452	9769145.779	42
264633.041	9769144.189	42
264633.152	9769142.537	42
264631.876	9769142.327	42
264631.876	9769142.327	42
264631.458	9769141.277	42
264631.458	9769141.277	42
264632.703	9769140.575	42
264632.405	9769139.39	42
264632.886	9769138.289	42
264634.352	9769137.023	42
264636.411	9769135	42
264637.468	9769133.449	42
264639.974	9769132.203	42
264639.974	9769132.203	42
264641.329	9769131.079	42
264643.431	9769129.677	42
264646.433	9769127.679	42
264646.433	9769127.679	42
264649.966	9769126.069	41
264650.665	9769125.148	41
264650.665	9769125.148	41
264653.601	9769123.315	42
264656.381	9769121.982	42
264656.381	9769121.982	42
264659.835	9769122.138	42
264663.781	9769124.873	42
264666.092	9769127.72	42
264667.116	9769129.675	42
264667.52	9769131.17	42
264668.885	9769131.647	42
264668.885	9769131.647	42
264668.183	9769135.136	42
264668.878	9769135.577	42
264668.878	9769135.577	42
264669.412	9769137.134	42
264671.114	9769138.261	42
264671.353	9769140.314	42
264670.097	9769144.528	42
264668.147	9769147.642	42
264668.147	9769147.642	42

LAMPIRAN 10. Spesifikasi *DRONE DJI AIR 2S*

Spesifikasi	
Pesawat	
Bobot Lepas Landas	595 g
Dimensi (P×L×T)	Saat Dilipat: 180×97×77 mm Saat Dibuka: 183×253×77 mm
Jarak Diagonal	302 mm
Kecepatan Naik Maks	6 m/dtk (Mode S) 6 m/dtk (Mode N)
Kecepatan Turun Maks	6 m/dtk (Mode S) 6 m/dtk (Mode N)
Kecepatan Maks (dekat permukaan laut, tanpa angin)	19 m/dtk (Mode S) 15 m/dtk (Mode N) 5 m/dtk (Mode C)
Service Ceiling Maks Di Atas Permukaan Laut	5.000 m
Waktu Penerbangan Maks	31 menit (diukur saat terbang pada 19,4 kph dalam kondisi tidak berangin)
Waktu Melayang Maks (tanpa angin)	30 menit
Jarak Penerbangan Maks	18,5 km
Ketahanan Kecepatan Angin Maks	10,7 m/dtk (Skala 5)
Sudut Kemiringan Maks	35° (Mode S) Bagian Depan: 30°, Belakang: 20°, Kiri: 35°, Kanan: 35° (Mode N)
Kecepatan Sudut Maks	250°/dtk (Mode S) 90°/dtk (Mode N) 60°/dtk (Mode C)
Suhu Operasional	32° hingga 104° F (0° hingga 40° C)
GNSS	GPS+GLONASS+GALILEO
Frekuensi Operasi	2,400-2,4835 GHz, 5,725-5,850 GHz
Daya Pemancar (EIRP)	2,400-2,4835 GHz: < 30 dBm (FCC); < 20 dBm (CE/SRRC/MIC) 5,725-5,850 GHz: < 30 dBm (FCC), < 14 dBm (CE), < 29 dBm (SRRC)
Rentang Akurasi Melayang	Vertikal: ±0,1 m (dengan Vision Positioning), ±0,5 m (dengan GNSS Positioning) Horizontal: ±0,1 m (dengan Vision Positioning), ±1,5 m (dengan GNSS Positioning)
Penyimpanan Internal	8 GB (7,2 GB penyimpanan yang tersedia)
Gimbal	
Rentang Mekanik	Miring: -135° hingga +45° Roll: -45° hingga +45° Pan: -100° hingga +100°
Rentang yang Terkendali	Miring: -90° hingga 0° (pengaturan standar), -90° hingga +24° (pengaturan diperpanjang)
Stabilisasi	3-sumbu (miring, roll, pan)
Kecepatan Kendali Maks (miring)	100°/dtk

Rentang Getaran Sudut	±0,01°
Sistem Penginderaan	
Maju	Rentang Pengukuran Presisi: 0,38-23,8 m Kecepatan Penginderaan Efektif: ≤15 m/dtk FOV: 72° (horizontal), 58° (vertikal)
Mundur	Rentang Pengukuran Presisi: 0,37-23,4 m Kecepatan Penginderaan Efektif: ≤12 m/dtk FOV: 57° (horizontal), 44° (vertikal)
Selanjutnya	Rentang Pengukuran Presisi: 0,34-28,6 m Kecepatan Penginderaan Efektif: ≤12 m/dtk FOV: 63° (horizontal), 78° (vertikal)
Ke Bawah	Rentang Pengukuran Sensor Inframerah: 0,1-8 m Rentang melayang: 0,5-30 m Rentang Sensor Penglihatan Melayang: 0,5-60 m
Lingkungan Operasi	Permukaan non-reflektif, dapat dilihat dengan reflektivitas difus >20%; Pencahayaan yang memadai dengan lux >15
Kamera	
Sensor	KMOS 1 inci Piksel efektif: 20MP
Lensa	FOV: 88° 35 mm Format Setara: 22 mm Apertur: f/2.8 Rentang Pemotretan: 0,6 m hingga ∞
ISO	Video: 100-3200 (Otomatis), 100-6400 (Manual) Video-10bit: 100-800 (Otomatis), 100-1600 (Manual) Foto: 100-3200 (Otomatis), 100-12800 (Manual)
Kecepatan Rana Elektronik	1/8000-8 dtk
Ukuran Gambar Maks	20MP (5472×3648, 3:2; 5472×3078, 16:9)
Mode Fotografi Tetap	Tunggal: 20MP Burst: 20MP Automatic Exposure Bracketing (AEB): 20MP, 3/5 Frame dengan Step 0.7EV Jangka waktu: 20MP 2/3/5/7/10/15/20/30/60 detik SmartPhoto: 20MP Panorama HDR: Vertikal (3×1): kurang lebih 3328×8000 piksel (L×T) Lebar (3×3): kurang lebih 8000×6144 piksel (L×T) Panorama 180° (3×7): kurang lebih 8192×3500 piksel (L×T) Sphere (3×8+1): kurang lebih 8192×4096 piksel (L×T)
Resolusi Video	5,4K: 5472×3078 24/25/30fps 4K Ultra HD: 3840×2160 24/25/30/48/50/60fps 2,7K: 2688×1512 24/25/30/48/50/60fps FHD: 1920×1080 24/25/30/48/50/60/120fps
Bitrate Video Maks	150 Mbps
Sistem File yang Didukung	FAT32 exFAT (rekomendasi)
Format Foto	JPEG/DNG (RAW)
Format Video	MP4/MOV (H.264/MPEG-4 AVC, H.265/HEVC)

Zoom Digital	4K 24/25/30fps – 4x 2,7K 24/25/30fps – 6x 1080p 24/25/30fps – 8x 2,7K 48/50/60fps – 4x 1080p 48/50/60fps – 6x Catatan: Zoom digital tidak tersedia saat merekam dalam D-log, HLG, atau gerakan lambat pada 120fps.
Pengendali Jarak Jauh	
Frekuensi Operasi	2,400-2,4835 GHz, 5,725-5,850 GHz
Sistem Transmisi Pengendali Jarak Jauh	OcuSync 2.0
Jarak Transmisi Maks (tidak terhalang, bebas gangguan)	12 km (FCC) 8 km (CE/SRRC/MIC)
Suhu Operasional	32° hingga 104° F (0° hingga 40° C)
Daya Pemancar (EIRP)	2,400-2,4835 GHz: < 26 dBm (FCC): < 20 dBm (CE/SRRC/MIC) 5,725-5,850 GHz: < 26 dBm (FCC): < 14 dBm (CE)
Kapasitas Baterai	5200 mAh
Arus/Tegangan Operasi	1200 mA@3,6 V (dengan perangkat Android) 700 mA@3,6 V (dengan perangkat iOS)
Ukuran Perangkat Seluler yang Didukung Max (TxLxT)	180x86x10 mm
Jenis Port USB yang Didukung	Lightning, Micro USB (Type-B), USB-C
Sistem Transmisi Video	
Sistem Transmisi Video	O3
Kualitas Tampilan Langsung	1080p@30fps
Jarak Transmisi Maks (tidak terhalang, bebas gangguan)	12 km (FCC) 8 km (CE/SRRC/MIC)
Format Pengodean Video	H.265/H.264
Bitrate Maks	16 Mbps
Latensi (tergantung kondisi lingkungan dan perangkat seluler)	120-130 mdtk
Pengisi daya	
Input	100-240 V, 50/60 Hz, 1,3 A
Output	Baterai: 13,2 V $\approx$ 2,82 A USB: 5 V/2 A
Nilai Daya	38 W
Baterai Penerbangan Cerdas	
Kapasitas Baterai	3500 mAh
Tegangan	11,55 V
Tegangan Pengisian Daya Maks	13,2 V
Jenis Baterai	LiPo 3S
Energi	40,42 Wh
Bobot	198 g

Suhu Pengisian Daya	41° hingga 104° F (5° hingga 40° C)
Daya Pengisian Maks	38 W
Aplikasi	
Aplikasi	DJI Fly
Sistem Operasi yang Dibutuhkan	iOS v11.0 atau lebih baru; Android v6.0 atau lebih baru
Kartu SD	
Kartu SD yang didukung	Kartu microSD peringkat UHS-I Speed Grade 3
Kartu microSD yang disarankan	SanDisk Extreme PRO 64GB V30 A2 microSDXC SanDisk High Endurance 64GB V30 microSDXC SanDisk Extreme 64GB V30 A2 microSDXC SanDisk Extreme 128GB V30 A2 microSDXC SanDisk Extreme 256GB V30 A2 microSDXC Lexar 667x 64 GB V30 A2 microSDXC Lexar High-Endurance 64GB V30 microSDXC Samsung EVO 64GB microSDXC Samsung EVO Plus 64GB microSDXC Samsung EVO Plus 256GB microSDXC Kingston 128 GB V30 microSDXC Netac 256GB A1 microSDXC

LAMPIRAN 11. Spesifikasi GPS Geodetik SINOGNSS

T300 GNSS Receiver

T Series GNSS Receiver

Ver.2020.11.30

Signal Tracking

572 channels for simultaneously tracking satellite signals

GPS	L1, L2, L2C, L5
BeiDou	B1, B2, B3
BeiDou Global Signal	B1C, B2a
GLONASS	L1, L2
Galileo	E1, E5a, E5b
QZSS	Reserved
SBAS	WAAS, EGNOS, MSAS, GAGAN

Performance Specifications

Cold start	<50 s
Warm start	<30 s
Hot start	<15 s
Initialization time	<10 s
Signal re-acquisition	<1.5 s
Initialization reliability	>99.9%

Positioning Specifications

Static and Fast Static	2.5 mm + 0.5 ppm Horizontal 5 mm + 0.5 ppm Vertical
Long Observations Static	3 mm + 0.1 ppm Horizontal 3.5 mm + 0.4 ppm Vertical
Real Time Kinematic	8 mm + 1 ppm Horizontal 15 mm + 1 ppm Vertical
DGPS	<0.4 m RMS
SBAS	1 m 3D RMS
Standalone	1.5m 3D RMS

Communications

1 Serial port (7 pin Lemo)	Baud rates up to 921,600 bps
UHF modem: Tx/Rx with full frequency range from 410-470 MHz ¹	Transmit power: 0.5-2 W adjustable Range: 1-5 km ²
4G modem	4G Bands: 800/900/1800/2100/2600 MHz 3G Bands: 900/2100 MHz 2G Bands: 900/1800 MHz Support GSM, Point to Point/Points and NTRIP
Position data output rates: 1 Hz, 2 Hz, 5 Hz, 10 Hz, 20 Hz	
5 LEDs (indicating Power, Satellite Tracking, GPS Status and Differential Data)	
Bluetooth [®] : V 4.0 protocol, compatible with Windows OS and Android OS	

Data Format

Correction data I/O	RTCM SC104 Version 2.x, 3.x formats, CMR(GPS only), CMR+(GPS only)
Position data output	ASCII: NMEA-0183 GSV, RMC, HDT, VHD, GGA, GSA, ZDA, VTG, GST; PTNL, PJK; PTNL, AVR; PTNL, GGK ComNav Binary update to 20 Hz

Physical

Size(L × W × H)	15.8 cm × 7.5 cm
Weight	0.95 kg with two batteries

Environmental

Operating temperature	-40 °C to + 65 °C
Storage temperature	-40 °C to + 85 °C
Humidity	100% non-condensing
Waterproof and dustproof	IP67 protected from temporary immersion to depth of 1 m
Shock	Designed to Survive a 2 m drop onto concrete

Electrical and Memory

Input voltage	5-27 VDC
Power consumption	3.1 W ³
Li-ion battery capacity	2 × 2000 mAh, up to 9 hours typically
Memory	8 GB ⁵

Software

Survey Master Android-based data collection software
Carlson SurvCE field data collection software (optional)
MicroSurvey FieldGenius field data collection software (optional)

- 1.UHF Modem and 4G Modem is default configuration and it can be removed according to your specific needs.
 - 2.Integrated UHF ranges from 410 to 470 MHz with 12.5 KHz channel spacing.
 - 3.Working distance of internal UHF varies in different environments, the maximum distance is 5 Km in ideal situation.
 - 4.Power consumption will increase if transmitting corrections via internal UHF.
 - 5.8GB is the default internal memory and optional 16GB, 32GB is available to order. Please clarify when placing the order.
- Specifications subject to change without notice.

SinoGNSS
By ComNav Technology Ltd.

ComNav Technology Ltd.
Building 2, No. 618 Chengliu Middle Road,
201801 Shanghai, China

Web: www.comnavtech.com
Email: sales@comnavtech.com
Tel: +86 21 64056796 Fax: +86 21 54309582

LAMPIRAN 12. Peta Situasi