

# Politecnico di Milano - Courses on Photogrammetry

## Laboratory report

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CFU group:	10	Date:	01/01/2024
Lab Topic:	Drone Photogrammetry		

### Description of the performed activity (*max 50 lines*)

#### Drone Photogrammetry Lab Workflow

##### Introduction

This report explores the application of drone surveys using Agisoft Metashape for a portion of Milan, emphasizing meticulous processing and analysis in diverse applications.

##### Survey Data Overview

A total of 222 images were captured during the survey, with a flying altitude of 30.9 meters. These images were meticulously processed to produce valuable spatial data. The camera stations numbered 219, resulting in a dense point cloud with 221,664 tie points and 717,311 projections. The high level of detail achieved is reflected in the reprojection error of 0.992 pixels.

##### Camera Calibration Insights

The primary instrument utilized, the FC6520 DJI MFT 15mm F1.7 ASPH (15mm) camera, was meticulously calibrated. The camera model boasts a resolution of 5272 x 2962 pixels, a focal length of 15mm, and a pixel size of 3.58 x 3.58  $\mu\text{m}$ . The calibration coefficients, including distortion parameters (K1-K3) and principal point coordinates (Cx, Cy), contribute to the precision of the entire photogrammetric process.

##### Ground Control Points and Accuracy Assessment

Accurate georeferencing is paramount for meaningful spatial analyses. Ground Control Points (GCPs) were established and assessed for accuracy. Control points exhibited a Root Mean Square Error (RMSE) of approximately 1.84 cm in the X direction, 2.79 cm in the Y direction, and 1.91 cm in the Z direction. Similarly, check points demonstrated an RMSE of 2.80 cm, 5.89 cm, and 5.14 cm in the X, Y, and Z directions, respectively.

##### Digital Elevation Model (DEM) and Point Cloud

The reconstruction process yielded a highly detailed Digital Elevation Model (DEM) with a resolution of 2.67 cm/pixel and a point density of 0.14 points/cm<sup>2</sup>. The point cloud, comprising 27,347,905 points, was classified into distinct categories such as Ground, High Vegetation, Building, Road Surface, Car, and Man-made Object. This detailed classification aids in subsequent analyses and visualizations.

##### Orthomosaic and Spatial Parameters

The orthomosaic, a composite representation of the survey area, was created with meticulous attention to spatial parameters. The blending mode was set to Mosaic, hole filling was enabled, and the resulting orthomosaic had a size of 17,414 x 24,431 pixels.

##### Conclusion

Agisoft Metashape facilitated a comprehensive analysis of the drone survey data, offering a rich dataset for further studies. The accuracy of camera calibration, precise georeferencing through GCPs, and the detailed reconstruction of terrain through DEM and point cloud contribute to the robustness of the dataset. This report serves as a testament to the power of drone photogrammetry in acquiring, processing, and analyzing spatial data for a myriad of applications.

As part of this project, we demonstrate how drone surveys can be used to calculate length, area, and volume.



One side of the building measures 20.7 meters in length



bridge measures 4.79 meters in length



Area and perimeter of the road

3D Polygon, 45 vertices

Point	Easting (m)	Northing (m)	Altitude (m)	DEM altitude (m)	Alt. var (m)
1	541083.262222	5041521.161933	150.095		
2	541083.174465	5041523.347355	150.817		
3	541091.344979	5041523.248059	152.289		
4	541113.490450	5041531.099762	153.289		
5	541188.419919	5041547.899923	151.496		
6	541195.899575	5041585.154625	150.422		
7	541176.410271	5041585.331752	151.764		
8	541234.423635	5041771.543973	150.515		
9	541248.599575	5041771.531038	150.577		
10	541194.173276	5041693.888933	150.678		
11	541176.179979	5041693.892979	150.776		
12	541180.495969	5041692.248789	150.784		
13	541225.154946	5041615.876649	150.432		
14	541219.327737	5041609.899149	150.419		
15	541182.847339	5041595.846699	150.862		
16	541162.538944	5041595.389973	150.844		
17	541184.891426	5041597.794793	150.863		
18	541218.489997	5041577.948789	150.834		
19	541218.892122	5041575.175993	150.759		
20	541225.098977	5041579.869993	150.041		
21	541234.899575	5041573.493752	150.653		
22	541198.897989	5041572.273933	150.894		
23	541188.897989	5041578.256294	150.981		

Perimeter: 20 (m): 723.189  
 Area: 20 (m²): 1519.7  
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 Coordinate system: WGS 84 / UTM zone 32N (EPSG:32632)

area: 1519.7 m<sup>2</sup> Perimeter: 723.19 m



Volume of the building

3D Polygon, 45 vertices

Point	Easting (m)	Northing (m)	Altitude (m)	DEM altitude (m)	Alt. var (m)
1	541083.262222	5041521.161933	150.095		
2	541083.174465	5041523.347355	150.817		
3	541091.344979	5041523.248059	152.289		
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Volume: 929.16 m<sup>3</sup>