

Report -4

Aerial PhotoGrammetry:

Algorithm:

- Establish Ground Control Points (GCPs) and Check points
- Initialize Exterior Orientation elements ($\{X_p, Y_p, Z_p\}$ {Projection center coordinates}, $\{\phi, \omega, \kappa\}$ {ExteriorAzimuth elements}) and Ground points (X,Y,Z): Determine the approximate initial value of the exterior orientation elements of all images and the ground coordinates of the object points.
- Construct the Error Equation: Establishing the error equation about the encryption point and the control point of each image according to the collinear condition.
- Construct and Solve the Normal Equation: Establishing the normal equation of error equation point by point and using the elimination and cyclic block method to solve the normal equation.
- Get the exterior orientation elements of each image.
- Get the ground points by forward intersection.
- Assess the accuracy through checkpoints and manual tie-points (MTP).

Packages and Repos:

Bundle Adjustment: https://scipy-cookbook.readthedocs.io/items/bundle_adjustment.html

Panoramic Image Stitching Using Bundle Adjustment:

<https://github.com/freddieb/panoramic-image-stitching>

PhotoGrammetry Tool Box : Implements a pipeline to perform 3D reconstruction from a set of pictures. It follows the classic reconstruction process. It takes pictures as input and performs automatic 3D reconstruction for the images for which 3D registration is possible.

[https://hal-enpc.archives-ouvertes.fr/file/index/docid/834940/filename/moulon_bezzi-PythonPhoto grammetryToolbox.pdf](https://hal-enpc.archives-ouvertes.fr/file/index/docid/834940/filename/moulon_bezzi-PythonPhoto%20grammetryToolbox.pdf)

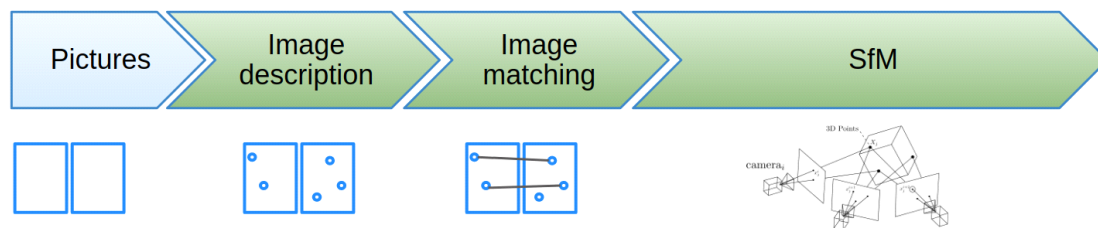
Shapely and GeoPandas: With shapely we can create geometric objects and manipulate them. It does not however provide the options to read/write file

GeoPandas : combines the geometry objects of shapely, the read/write/ projection functions of fiona and the powerful dataframe interface of the pandas library. In the spreadsheet-like dataframe, the last column geometry stores the shapely geometry objects, all shapely functions can be applied. The pandas mechanics offers super easy ways to manipulate, plot and analyze the data.

GeoPandas: <https://geopandas.org/>

OpenSfM: OpenSfM is a Structure from Motion library written in Python. The library serves as a processing pipeline for reconstructing camera poses and 3D scenes from multiple images. It consists of basic modules for Structure from Motion (feature detection/matching, minimal solvers) with a focus on building a robust and scalable reconstruction pipeline. It also integrates external sensor (e.g. GPS, accelerometer) measurements for geographical alignment and robustness. A JavaScript viewer is provided to preview the models and debug the pipeline. <https://www.opensfm.org/docs/>

OpenMVG: OpenMVG provides an end-to-end 3D reconstruction from images framework compounded of libraries, binaries, and pipelines. Libraries provide easy access to features like: images manipulation, features description and matching, feature tracking, camera models. Binaries solve unit tasks that a pipeline could require. Pipelines are created by chaining various binaries to compute image matching relation, solve the Structure from Motion problem



<https://openmvg.readthedocs.io/en/latest/>

Scikit-Image: Image Manipulation Library. <https://scikit-image.org/>

scikit-learn: The best and at the same time easy-to-use Python machine learning library. Regression, classification, dimensionality reductions etc. <https://scikit-learn.org/stable/>

folium: Lets you visualize spatial data on interactive leaflet maps.

descartes: Enables plotting of shapely geometries as matplotlib paths/ patches. Also a dependency for the geometry plotting functions of geopandas. <https://pypi.org/project/descartes/>

pyproj: For transformation of projections. Mostly unnecessary when using the more convenient geopandas coordinate reference system (crs) functions.

PySAL: The Python Spatial Analysis Library contains a multitude of functions for spatial analysis, statistical modeling and plotting. <https://pysal.readthedocs.io/en/latest/>