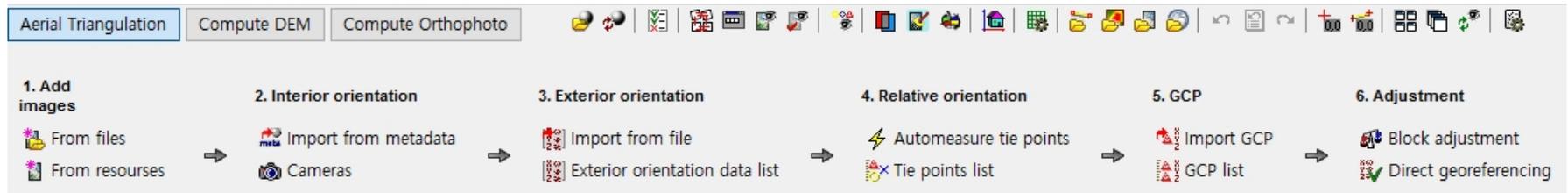


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『PHOTOMOD Drone Survey』  
**Digital Topographic MAP Drawing**  
**in 1/1,000 scale**

2019. 10. 28

# PHOTOMOD UAS



1. Add images

2. Interior orientation

3. Exterior orientation

4. Relative orientation

5. GCP observation

6. Block Adjustment

# PHOTOMOD UAS



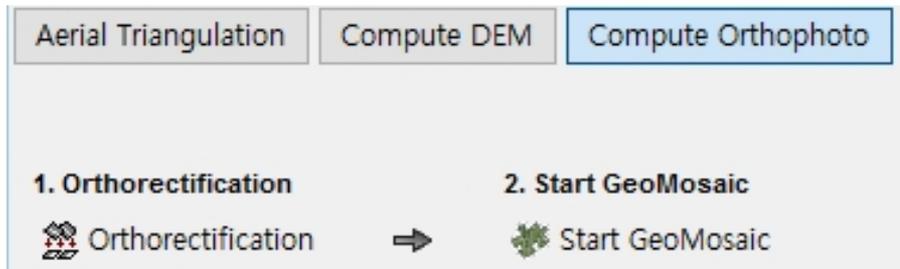
**7. Create points / DSM**

**8. Point, DSM – Filter building, geographic features**

**9. Generate TIN using points / Fill in NULL value of DSM**

**10. Generate DEM using TIN**

**11. Create contours**



1. Orthorectification

2. Start GeoMosaic

# Workflow

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1. Importing metadata
2. Generating Tie Points
3. Observing GCPs
4. Drawing topographic map
5. Generating TIN/DSM
6. Orthorectifying and mosaicking

# 1. Extract metadata(Camera, EO) from JPG



- Camera-integrated Drones
  - PHANTOM, INSPIRE, etc.
  - Camera and location information can be imported from JPG
- Detachable camera Drones
  - Drones with separate camera such as fixed wing Drones.
  - camera information is imported from JPG. The location and angle information are extracted from the aircraft attitude control controller.

# 1. Camera-integrated Drones

## 1. Add images

- From files
- From resources

1. Add images

## 2. Interior orientation

- Import from metadata
- Cameras

2. Import metadata, camera information

## 3. Exterior orientation

- Import from file
- Exterior orientation data list

3. Verify XYZ geo-location value (Drone posture information is not included.)

Exterior orientation parameters

Code	Name	X, m	Y, m	Z, m	Omega, °	Phi, °	Kappa, °
2	DJI_0002	172383.355...	359416.277...	360.537...			
3	DJI_0003	172426.570...	359411.990...	360.537...			
4	DJI_0004	172469.050...	359408.060...	360.537...			
5	DJI_0005	172515.026...	359404.749...	360.637...			
6	DJI_0006	172556.124...	359400.115...	360.637...			

# 1. Detachable camera Drones

## 1. Add images

- From files
- From resources

1. Add images

## 2. Interior orientation

- Import from metadata
- Cameras

2. Import metadata, camera information

## 3. Exterior orientation

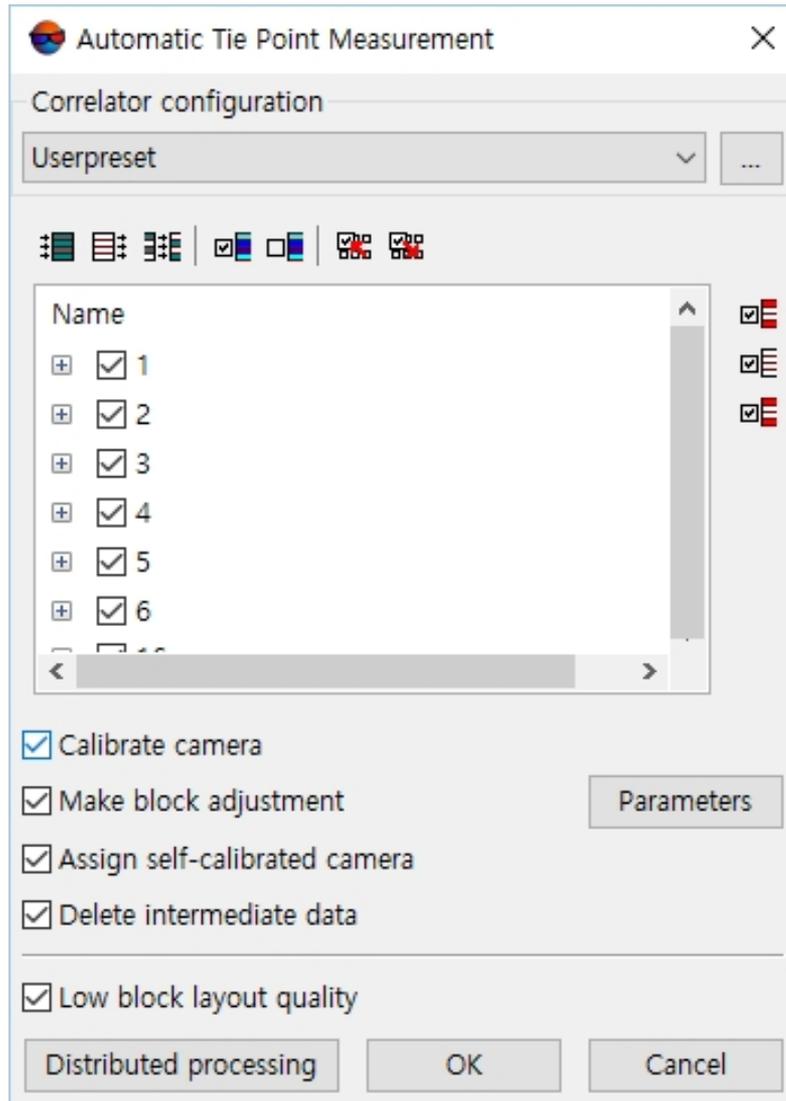
- Import from file
- Exterior orientation data list

3. verify EO data

### Exterior orientation parameters

Code	Name	X, m	Y, m	Z, m	Omega, °	Phi, °	Kappa, °
3	DSC000...	164130.868...	539424.107...	166.37...	-0.8428...	-2.4827...	-38.825...
4	DSC000...	164149.337...	539441.986...	166.95...	2.90049...	1.63161...	-39.124...
5	DSC000...	164168.553...	539459.204...	167.28...	2.16982...	0.47591...	-42.313...
6	DSC000...	164188.509...	539475.892...	167.63...	1.56063...	0.09059...	-44.620...
7	DSC000...	164209.319...	539492.379...	168.03...	0.65693...	-1.5289...	-46.084...

## 2. The creation of Tie Points



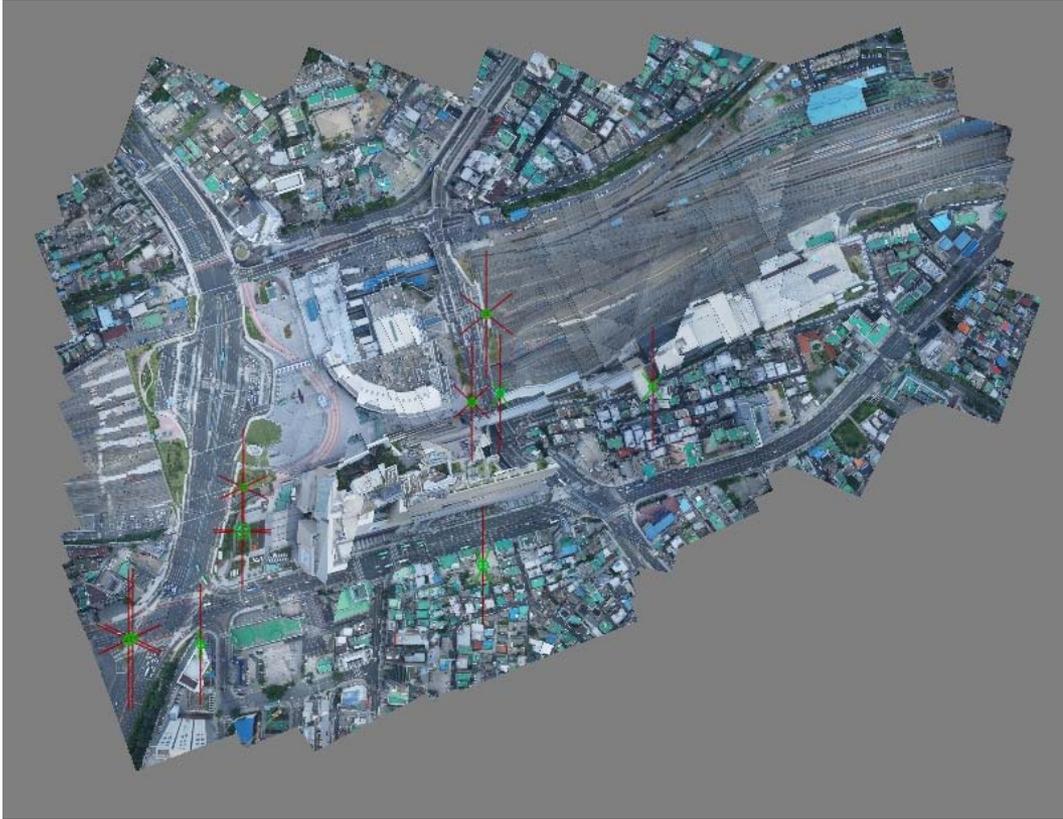
- Set up tie points
  - Pyramid Steps for Creating Tie Points.
  - The number of tie points created in one image
  - Set up the amount of error
  - The above settings affect accuracy and calculation time.
- Select the camera calibration option, : change the camera distortion correction and information.

## 2. Create and adjust tie points

The screenshot displays a photogrammetry software interface with a central 3D view of a block scheme. The interface includes several panels and toolbars:

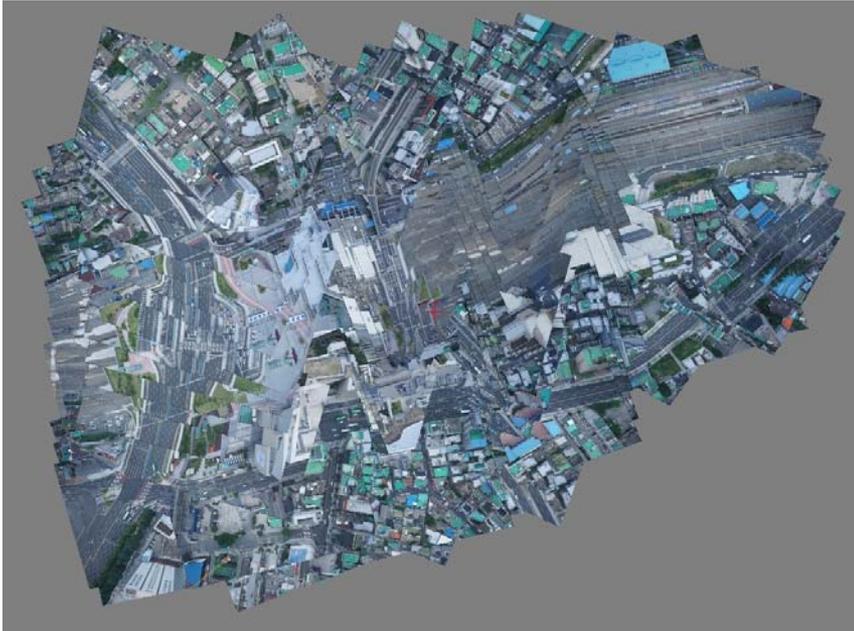
- Point attributes:** Contains sections for 'Selected point' (no selected points), 'Type by coordinates' (Control, Check, Excluded), 'Type by ties' (Tie, Excluded), and 'Type' (tree view showing <none>, coordinates, tie, code: <none>).
- Residuals:** A table showing RMS, Mean abs. value, and Max for ground control points, control projection centers, and stereopair residuals (tie points from mean, mutual, targeted points).
- Block adjustment toolbar:** Located at the top right of the 3D view, containing icons for various adjustment functions.
- Display options:** A panel on the right with settings for Mode (Block scheme), Point display settings (Show method: symbols, points; Point size: 5 pix), Show names (Selected), Show errors (By ground XY, Z, ties between stereopairs XY/Z, on images, on excluded points), and View errors scale (real, Magnification: 1.0, screen, Scale: 100.0 pix/m).
- Layer Manager:** On the far right, showing layers like Marker, Triangulation p, Vectors, Block scheme, and Raster.
- Status Bar:** At the bottom, displaying coordinates (167337.497858 m; 364645.626914 m; 0.000000 m) and camera parameters (R=255 G=000 B=255).

## 2. Tie Point adjustment

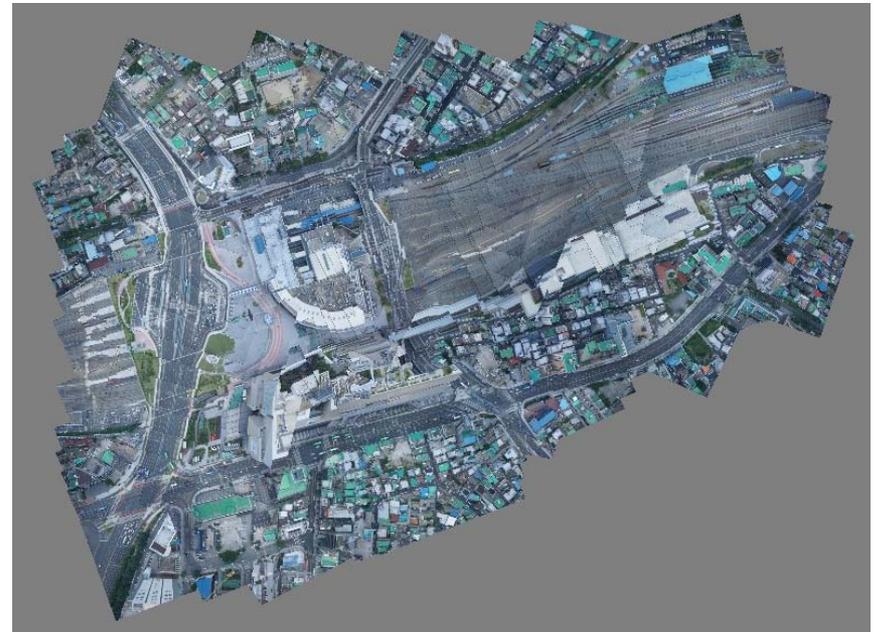


- Delete or move a tie point with an incorrect location
- Delete tie points of unusual height
- Delete tie points created in waterbody (sea, lake, etc.)

## 2. Create Tie Points – Imagery before and after adjustment

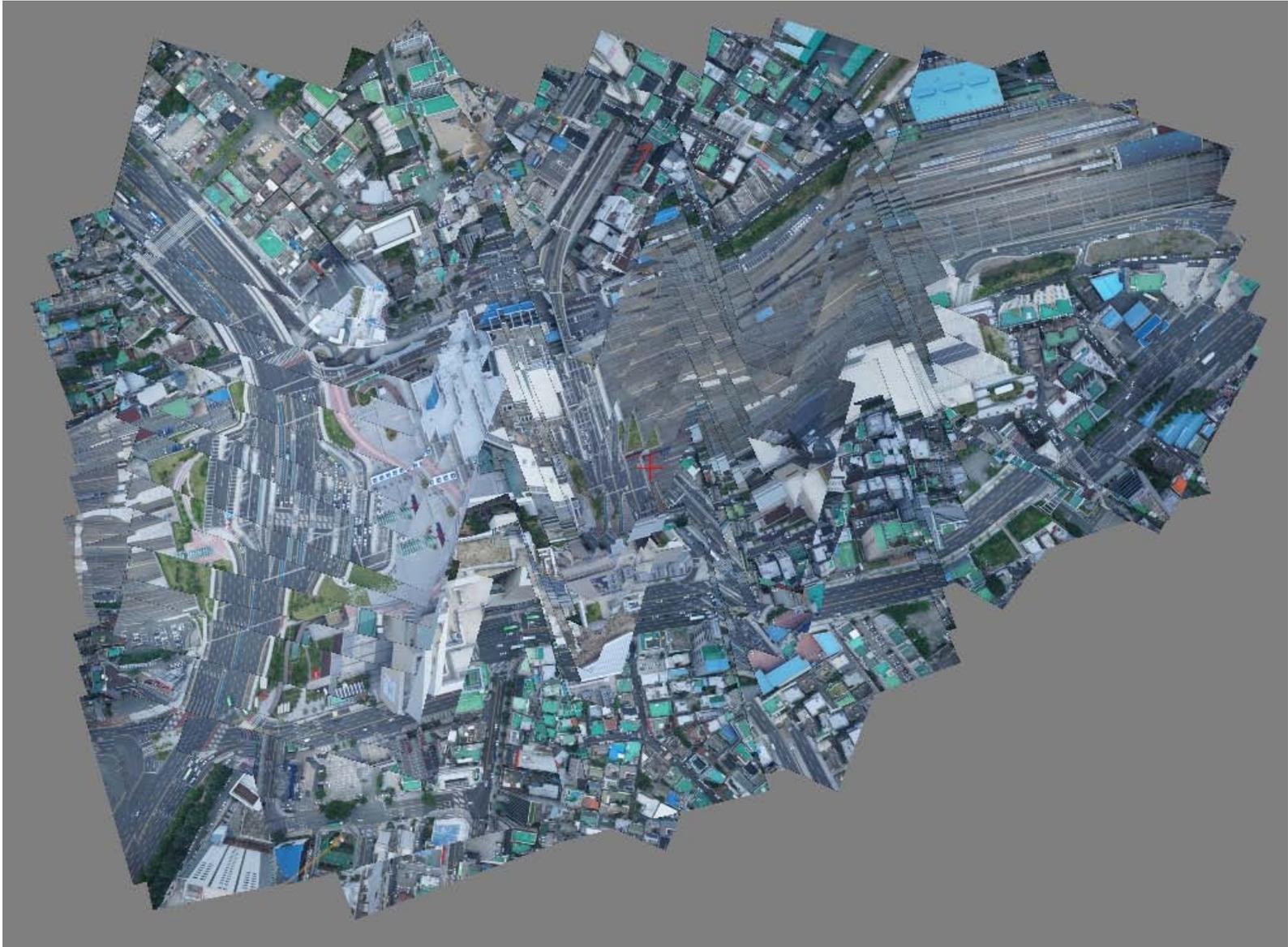


Images created only with metadata.

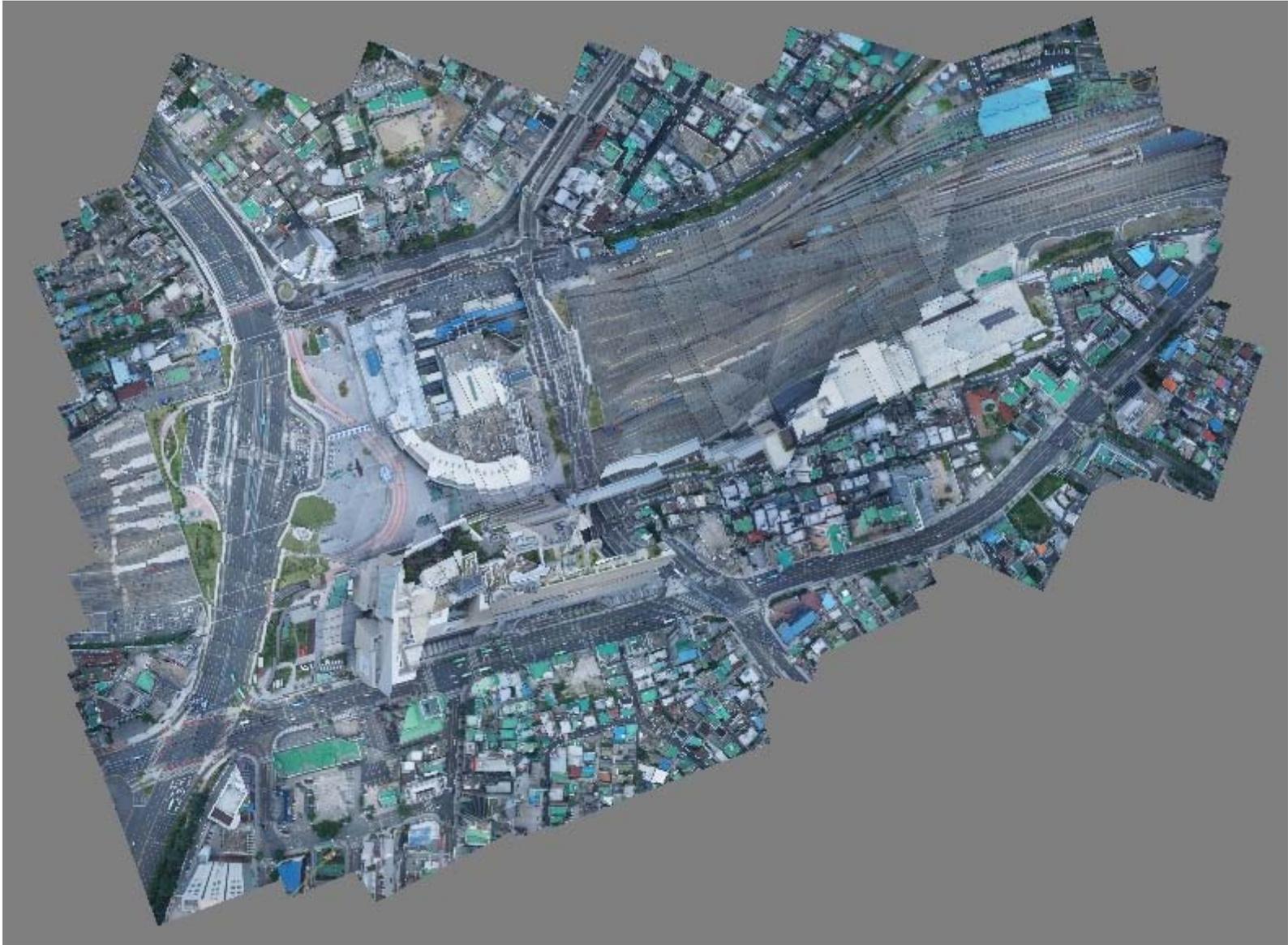


Images adjusted with Tie Points.

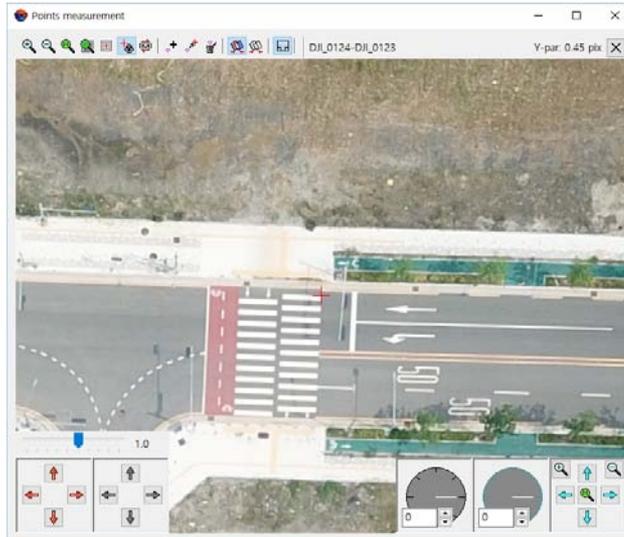
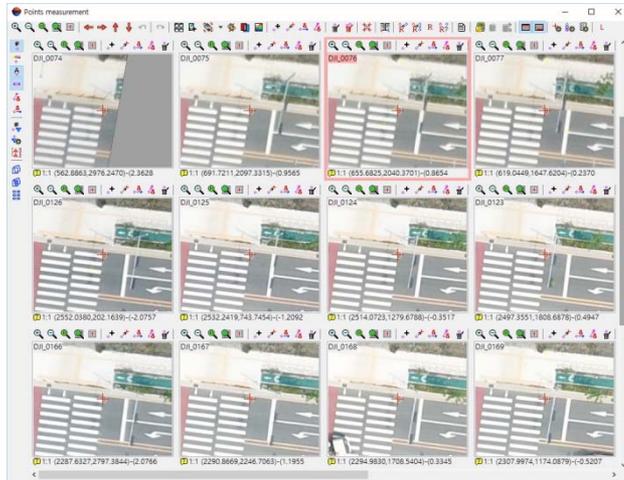
## 2. Create Tie Points – Imagery before adjustment



## 2. Create Tie Points – Imagery after adjustment



### 3. GCP Observation



- Import original GCP data, or input GCPs
- Select XYZ, XY, Z points to use
- Observe all possible images of GCP location
- Do not observe images obscured by terrain features (unsure points)
- Better in 3D stereo mode for increasing accuracy
- remove Y parallax and adjust Z in 3D stereo mode.

## 4. Produce digital topographic map (1:1000)

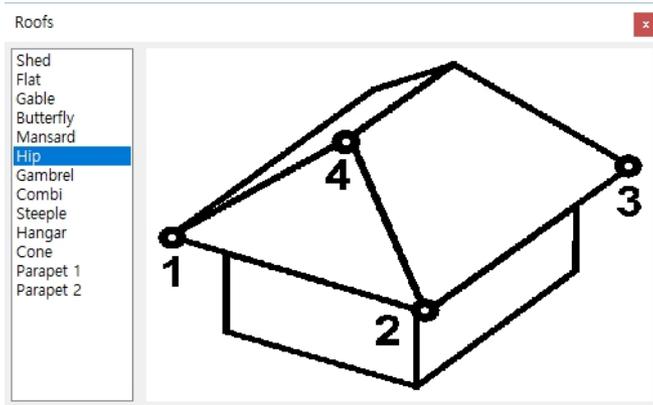


- Use the existing code you used and the layers with 8-digit layer code
- 3D drawing with polarized or blue red glasses
- Can be drawn with a mouse

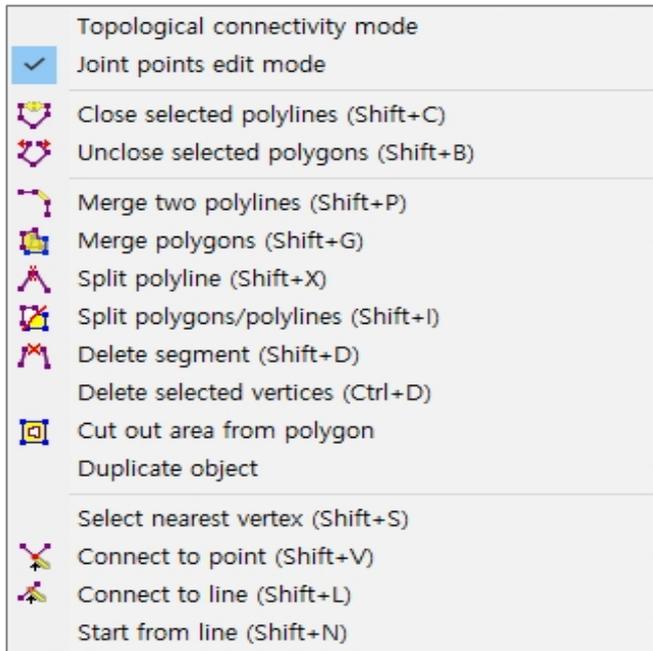
Codes		Attributes		
Vision	Code v	Name	Type	Color
☞	1111	보통철도	L	
☞	1222	플랫폼의지붕	C	
☞	2111	실폭하천	L	Blue
☞	2112	세류	L	Blue
☞	2114	호수,저수지	L	Blue
☞	2211	콘크리트제방(상)	L	Red
☞	2241	수문	L	Red
☞	2243	보	L	Red
☞	3111	고속국도	L	Red
☞	3112	일반국도	L	Red
☞	3113	지방도	L	Red
☞	3114	특별시도광역시도	L	Red
☞	3115	시도	L	Red
☞	3116	군도	L	Red
☞	3117	면리간도로	L	Red
☞	3118	부지안도로	L	Red

- can be Searched for the layers you need.
- Select and display only the layers you need

## 4. Produce digital topographic map (1:1000)



- Various ways to draw a roof.
- Create contours from drawing data or draw contours manually

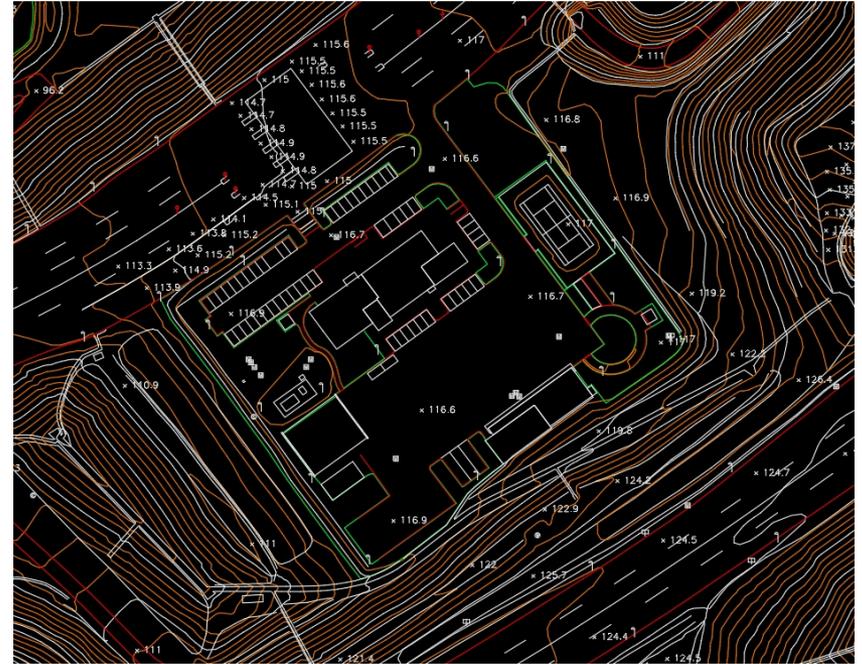


- Import and export DXF and SHP files
- Edit Vector Data

## 4. Produce digital topographic map (1:1000)

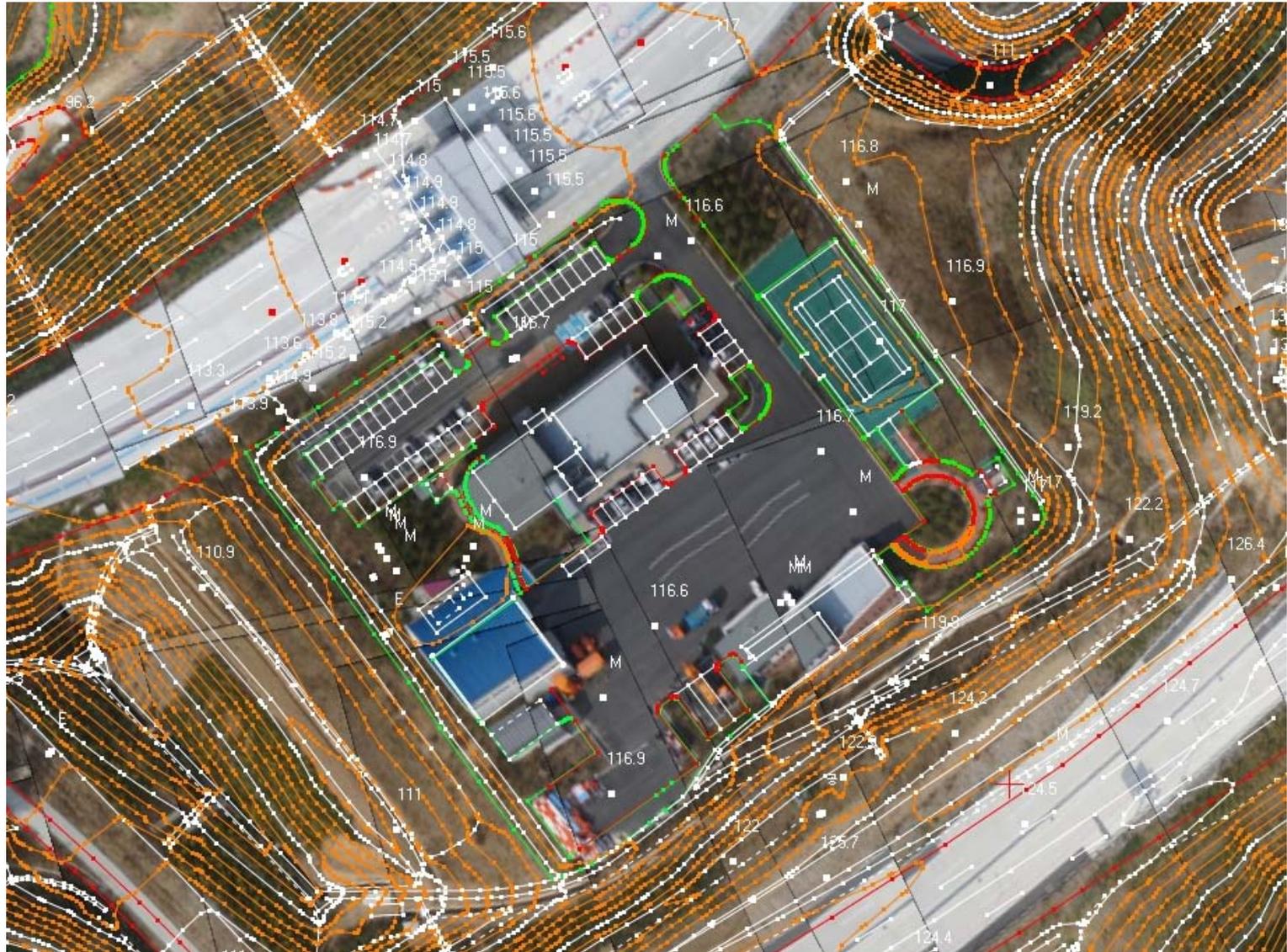


Drone images with the completed topographic map



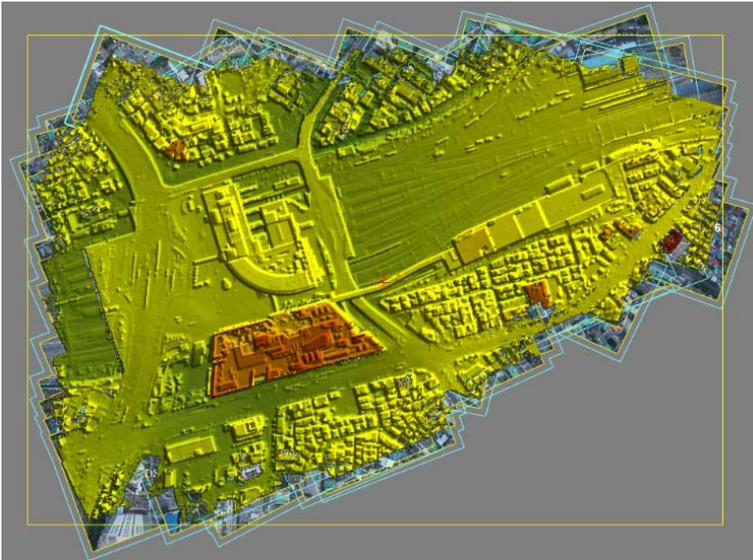
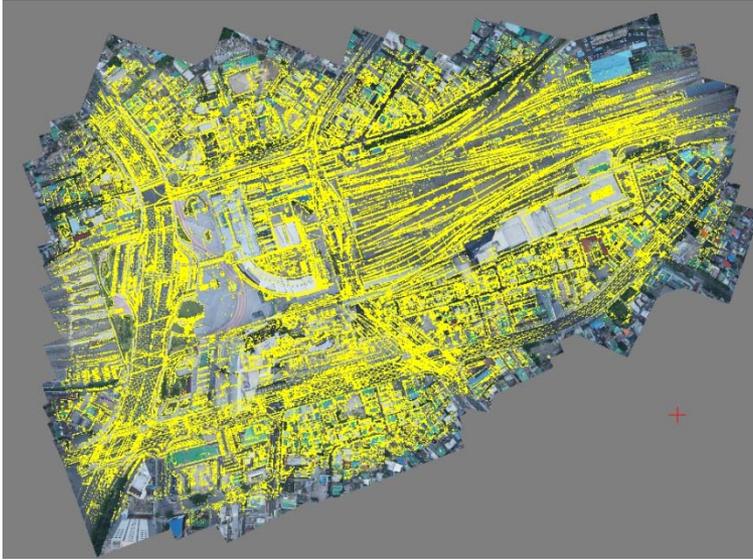
The completed digital topographic map (DXF OUT)

## 4. Produce digital topographic map (1:1000)





## 5. Generate TIN, DEM



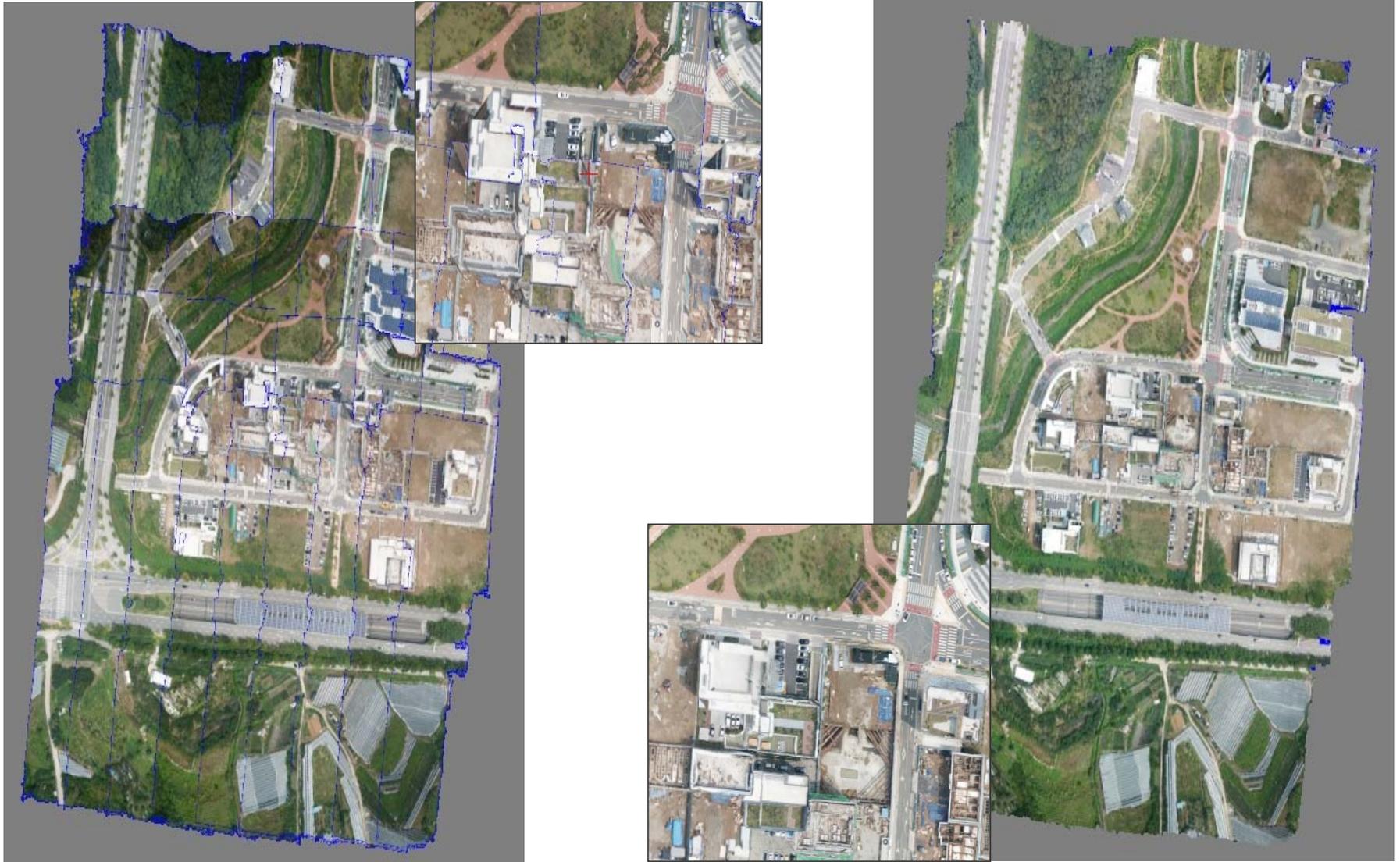
- Create TIN after creating points
- Review and Fix TIN errors
- Generate DEM from TIN
- Create DSM or DTM
- Create contours from DTM

## 6. Generate ortho-image



- Create ortho-images using DSM or DEM
- create borderlines
- Modify images to fit geographic feature such as buildings and roads based on boundaries
- Auto color balancing

## 6. Before and after correction of ortho-image



## 6. Before correction of ortho-image



## 6. After correction of ortho-image



# Advantages (PHOTOMOD UAS)

**3D stereoscopic work using drone image is completely possible.**

- Convenient solution for 3D drawing with drone image

## **CPU management with Distributed Processing**

- PC resource management is the key to process large sized drone images
- Maximize work reliability with PHOTOMOD Distributed Processing function

## **Compatibility of Korean National Topographic Map (1:1000) with accuracy requirements**

Map Scale	Standard Deviation			Maximum Error		
	Planimetric	Contours	Height	Planimetric	Contours	Height
1/1000	0.2m	0.3m	0.15m	0.4m	0.6m	0.3m

**In conclusion. PHOTOMOD UAS solution is a very flexible solution for producing 1:1000 digital topographic map using drone images.**