



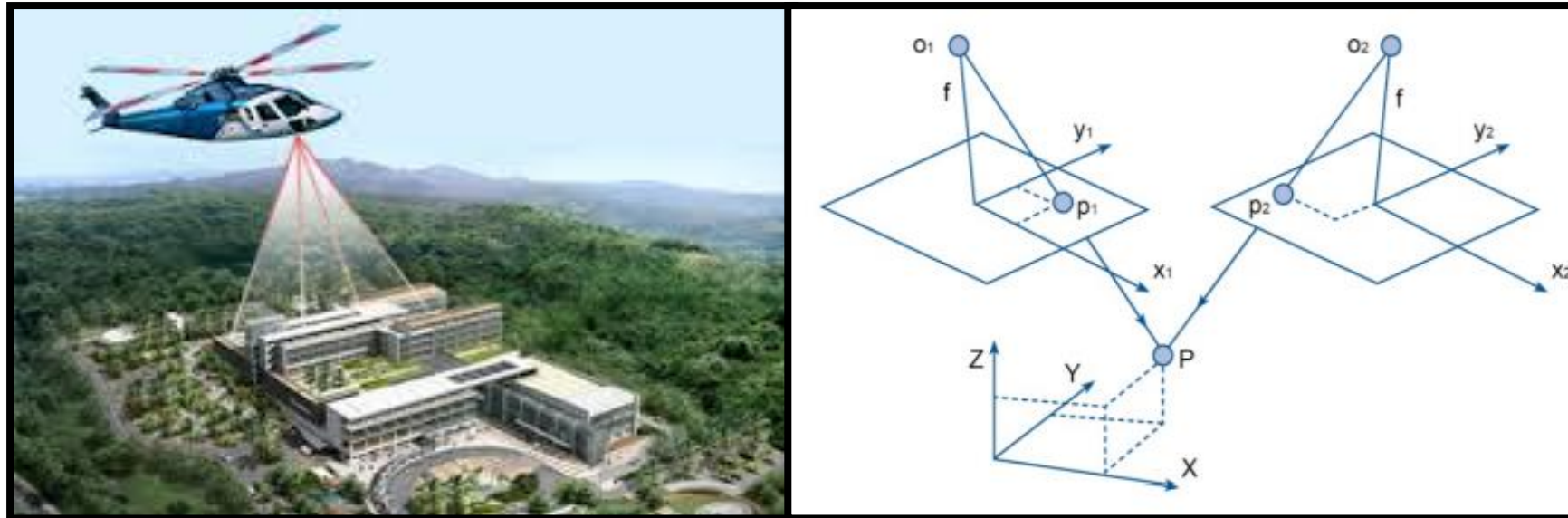
UNIVERSITY OF
BAGHDAD



COLLEGE OF
ENGINEERING



DEPARTMENT OF
SURVEYING ENG.



ANALYTICAL AERIAL PHOTOGRAMMETRY-**REVIEW**

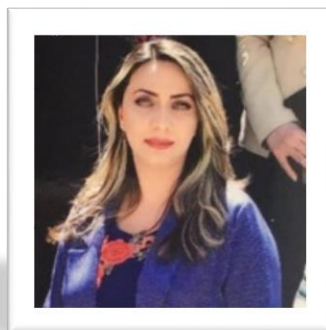
BSc - 4TH STAGE

2020-2021

LECTURE 1

DR. FANAR MANSOUR ABED

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“PLS” Theoretical Sequence

2nd Stage

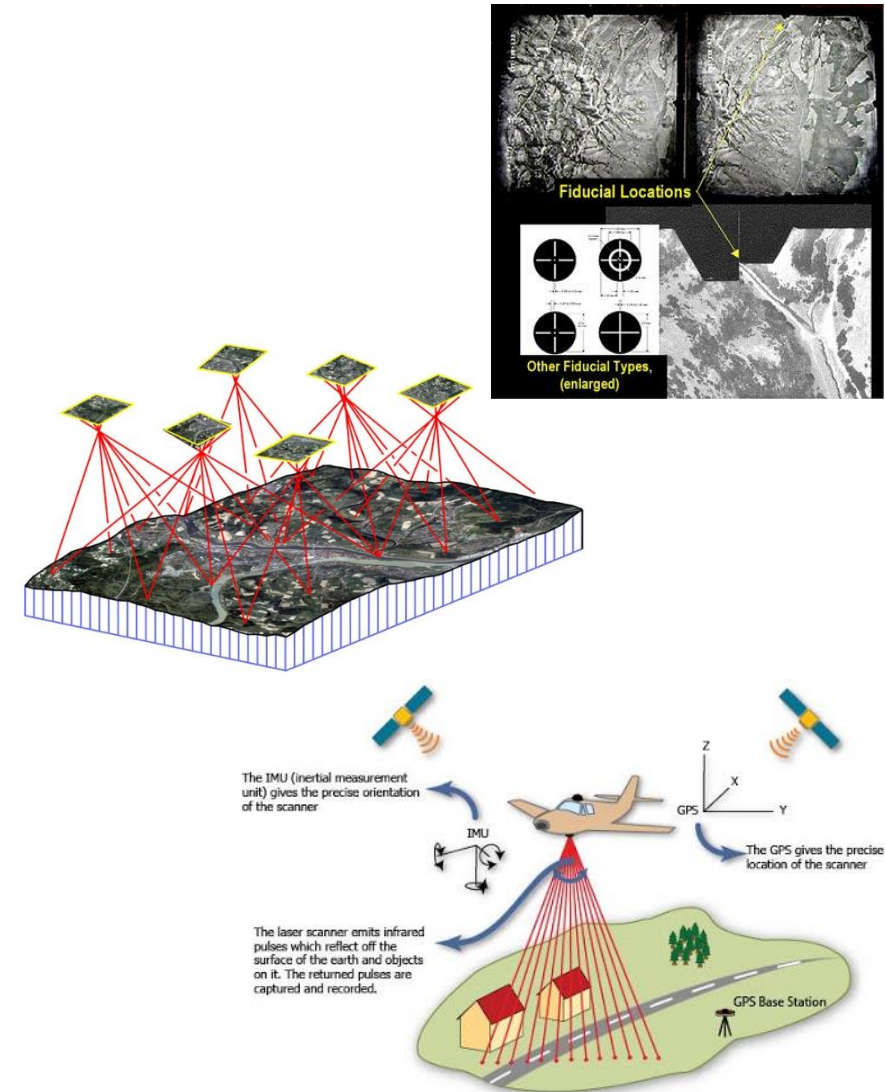
- Aerial photogrammetry in General.
- Vertical and tilted images.

3rd Stage

- Stereo aerial photogrammetry.
- **Analytical aerial photogrammetry.**

4th Stage

- **Close-range photogrammetry.**
- Lidar and laser scanning in general.



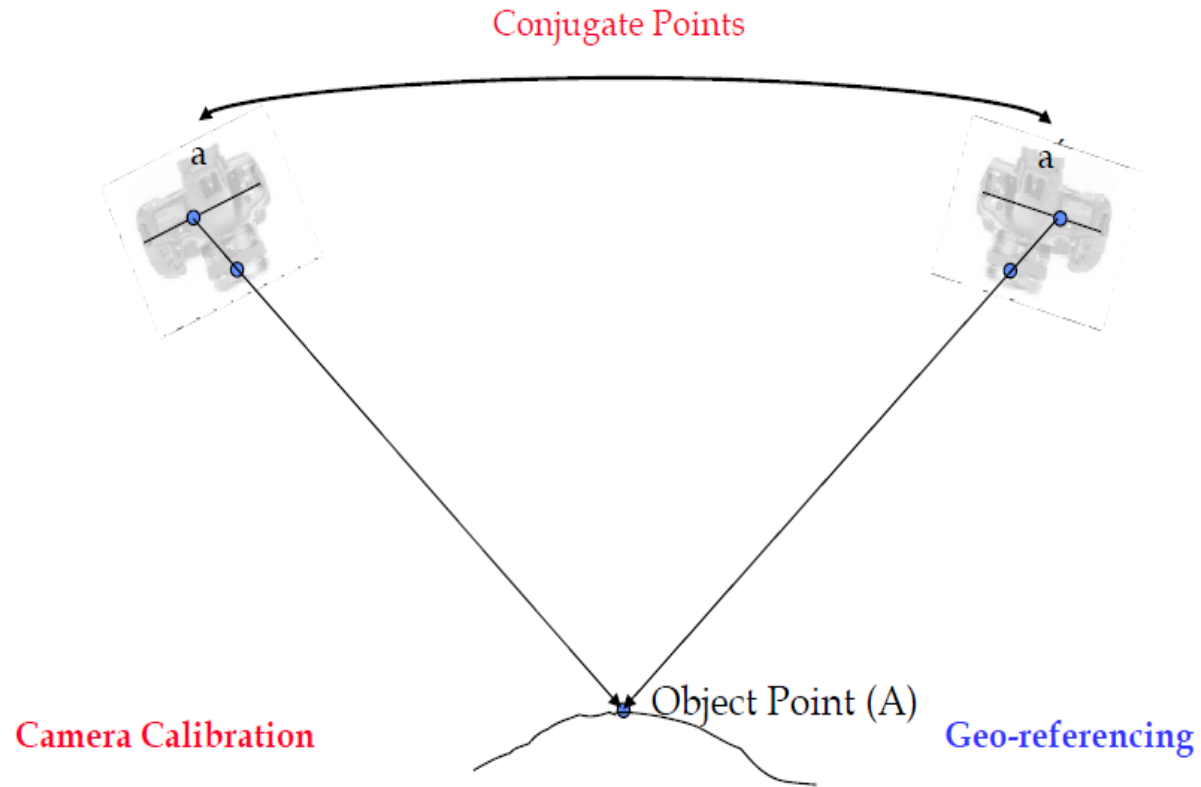
Headlines:

- Syllabus and referencing.
- Analytical aerial photogrammetry.
 - Aero-triangulation.
 - Model-based solution.
 - Image-based solution.
- Exercise.
- Applications.

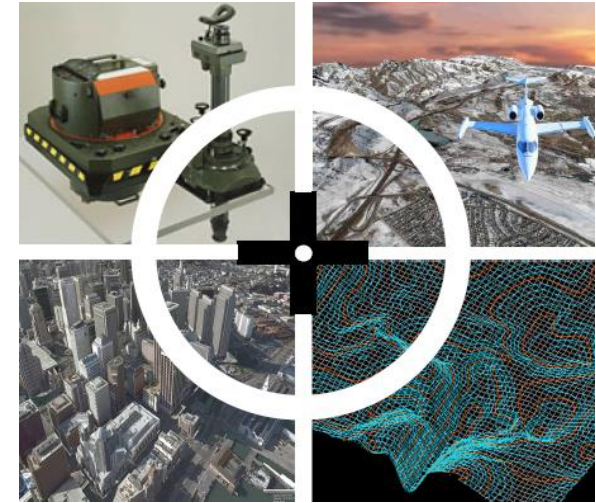
Analytical Photogrammetry

- **Objective**

Derive the position and shapes of objects from digital photographs.



- The interior orientation parameters of the involved cameras have to be known.
- The position and the orientation of the camera stations have to be known.



Analytical Photogrammetry

- **Image Registration**

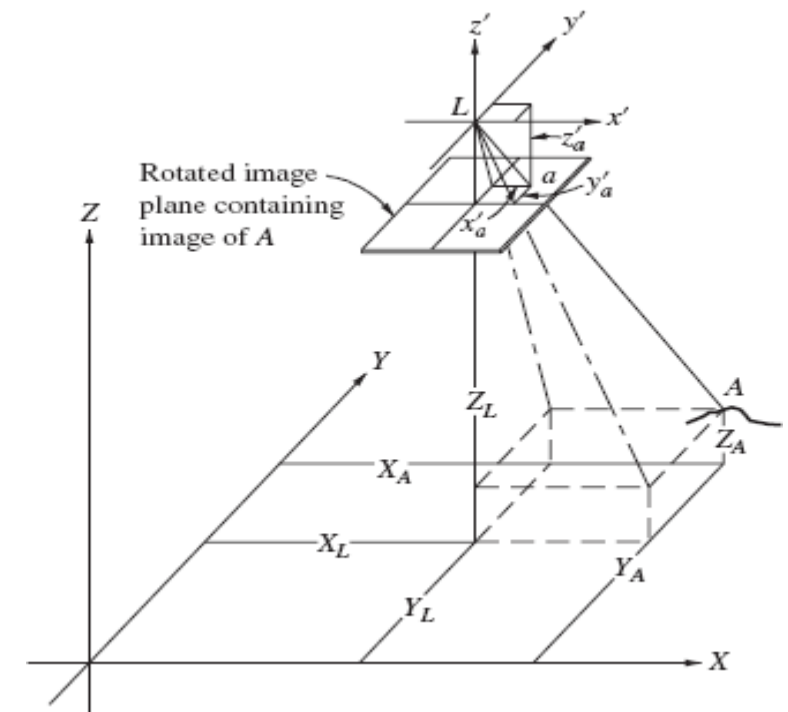
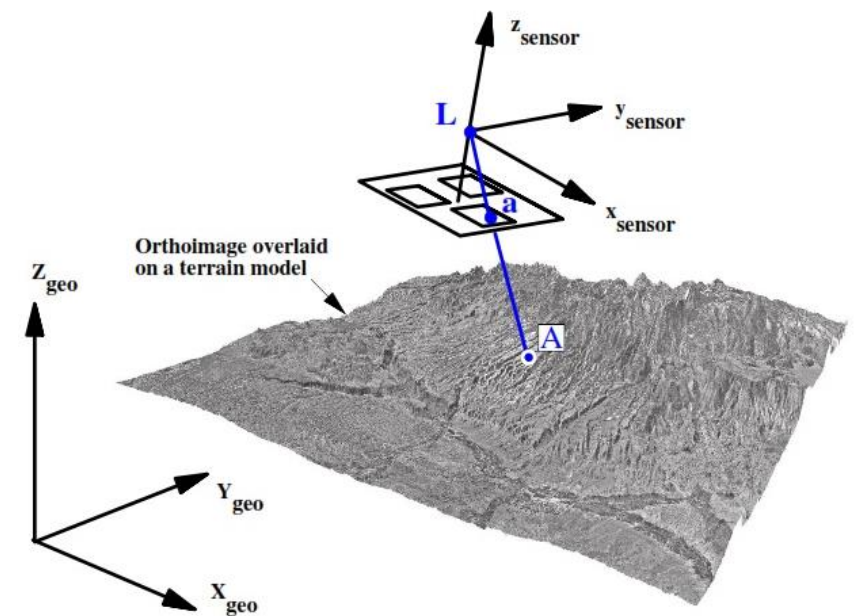
- Objectives

Integrate data from different sources of multi-temporal,
Multi-sensors, multi-types, Multi-resolution.

- Collinearity Condition Equations

$$x_a = x_o - f \left[\frac{m_{11}(X_A - X_L) + m_{12}(Y_A - Y_L) + m_{13}(Z_A - Z_L)}{m_{31}(X_A - X_L) + m_{32}(Y_A - Y_L) + m_{33}(Z_A - Z_L)} \right]$$

$$y_a = y_o - f \left[\frac{m_{21}(X_A - X_L) + m_{22}(Y_A - Y_L) + m_{23}(Z_A - Z_L)}{m_{31}(X_A - X_L) + m_{32}(Y_A - Y_L) + m_{33}(Z_A - Z_L)} \right]$$

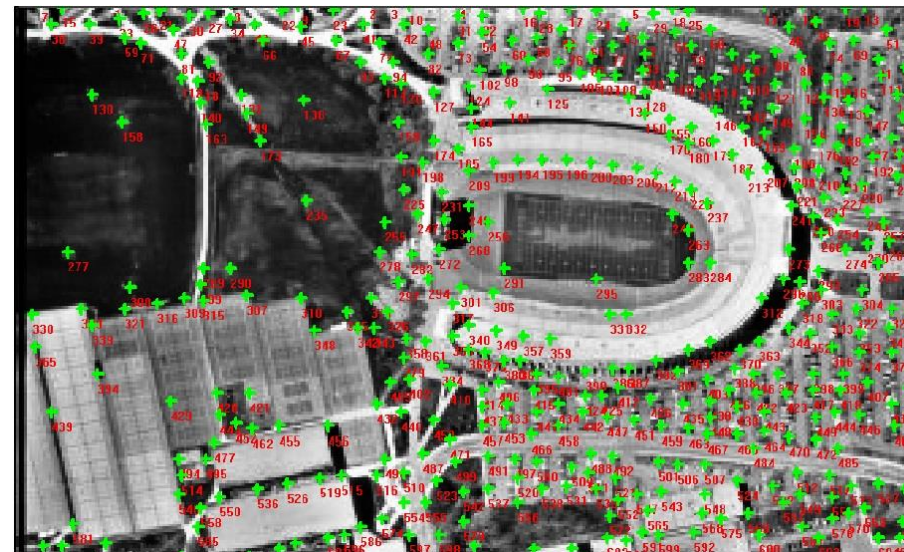
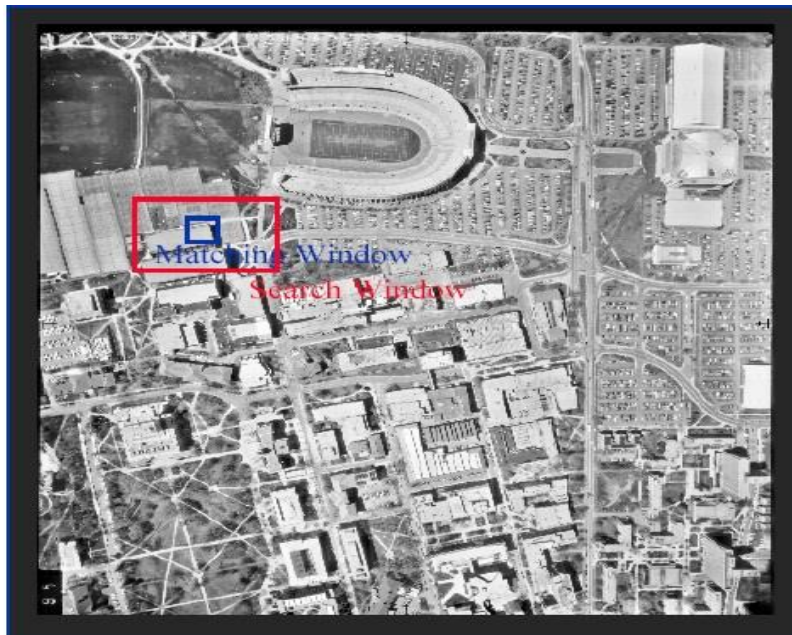
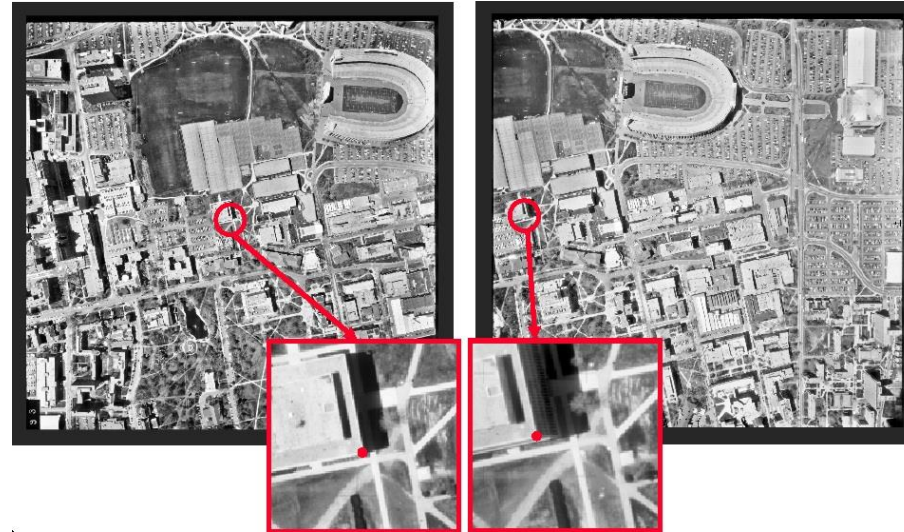


Analytical Photogrammetry

Digital image matching:

- By interest points
- By window
- By feature

Computer vision!



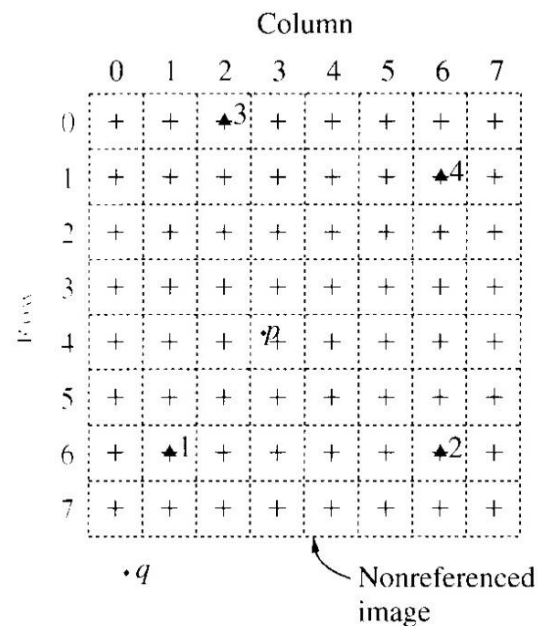
Analytical Photogrammetry

- **Image Geo-referencing**

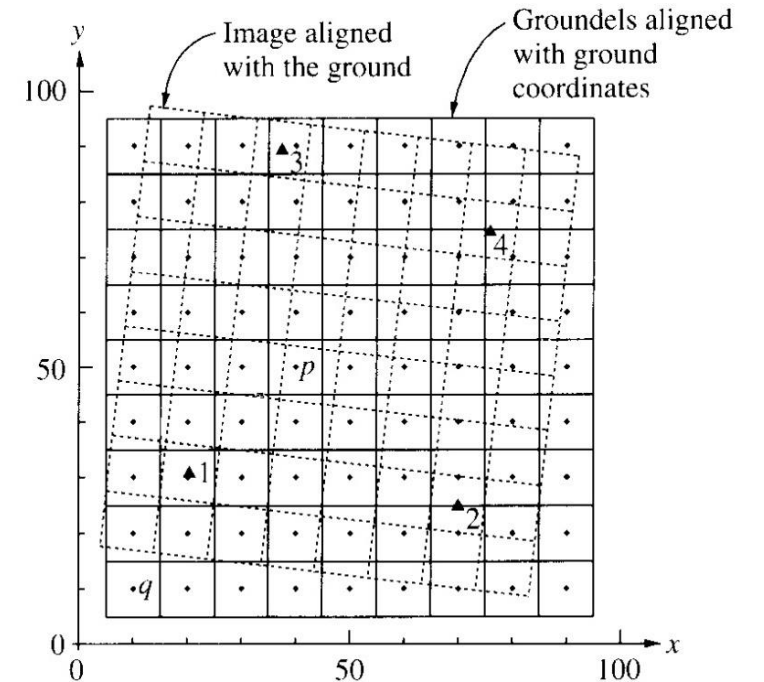
- Objectives

Tie image coordinate system with Ground coordinate system.

(2D to 3D) relation!



(a)



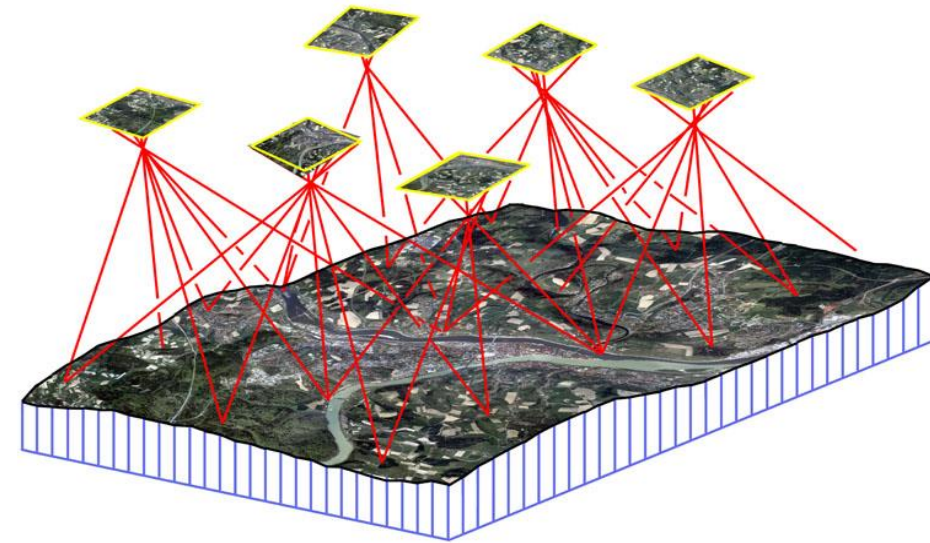
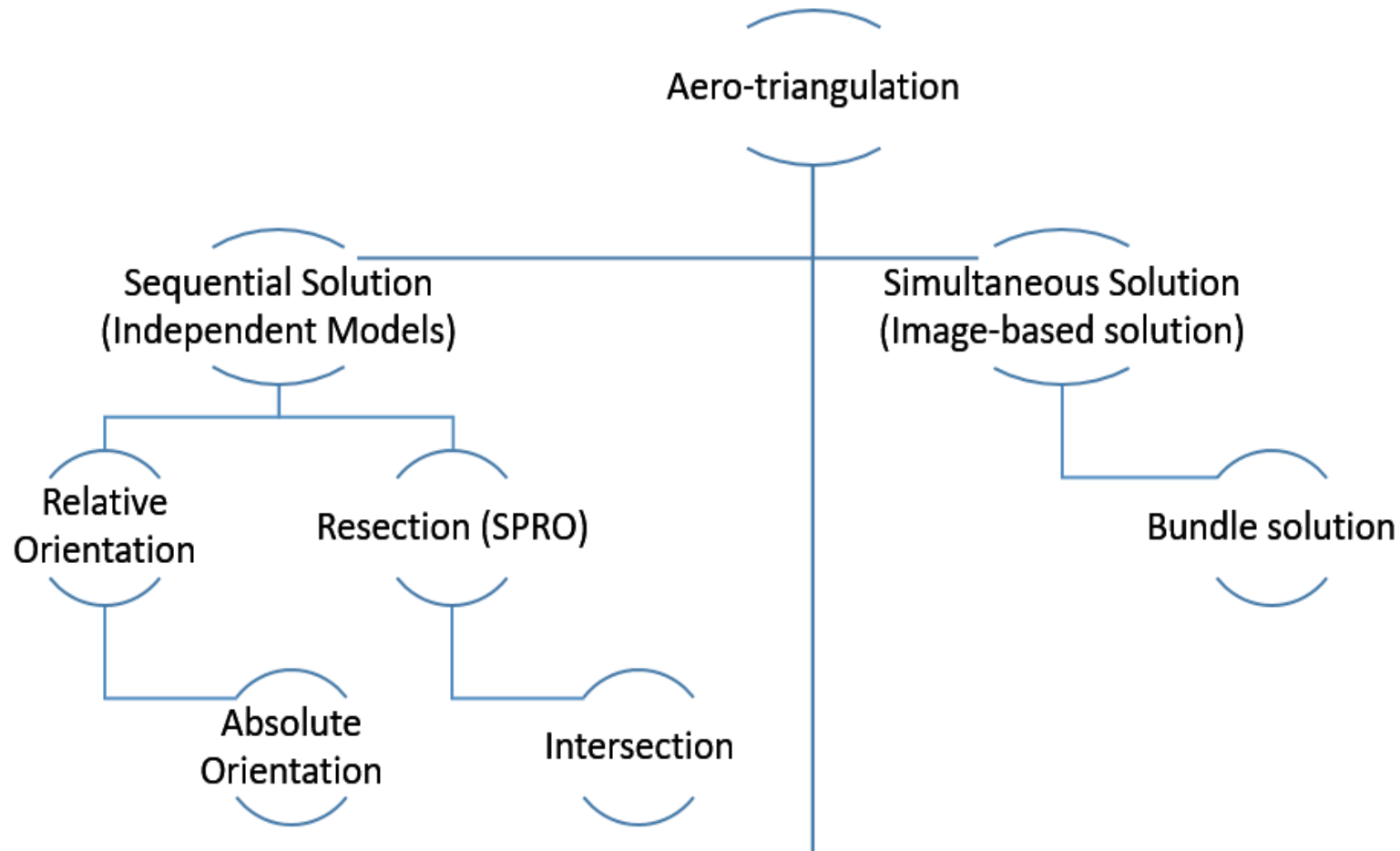
(b)

Analytical Photogrammetry

- Post-processing: Digital photogrammetric workstations (DPW/DPWS/DPS).
- DPW: hardware and software to derive photogrammetric products from digital photographs/images using automated techniques, e.g. SocetSet from BAE Systems.

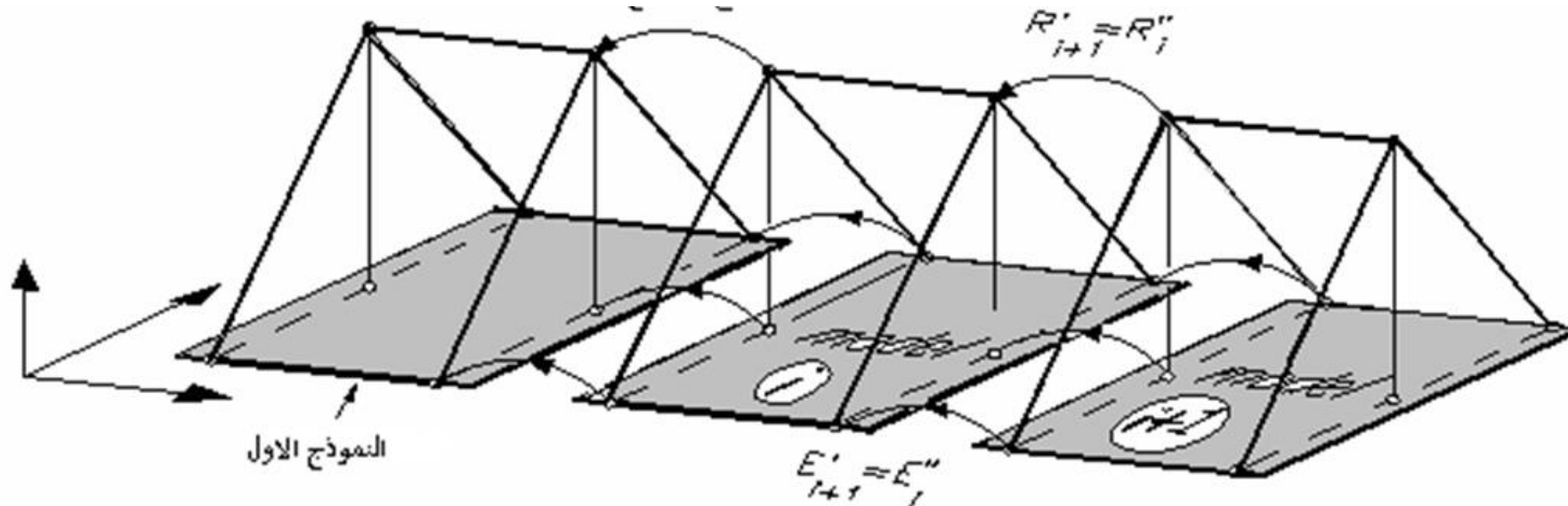


Aero-triangulation in Photogrammetry



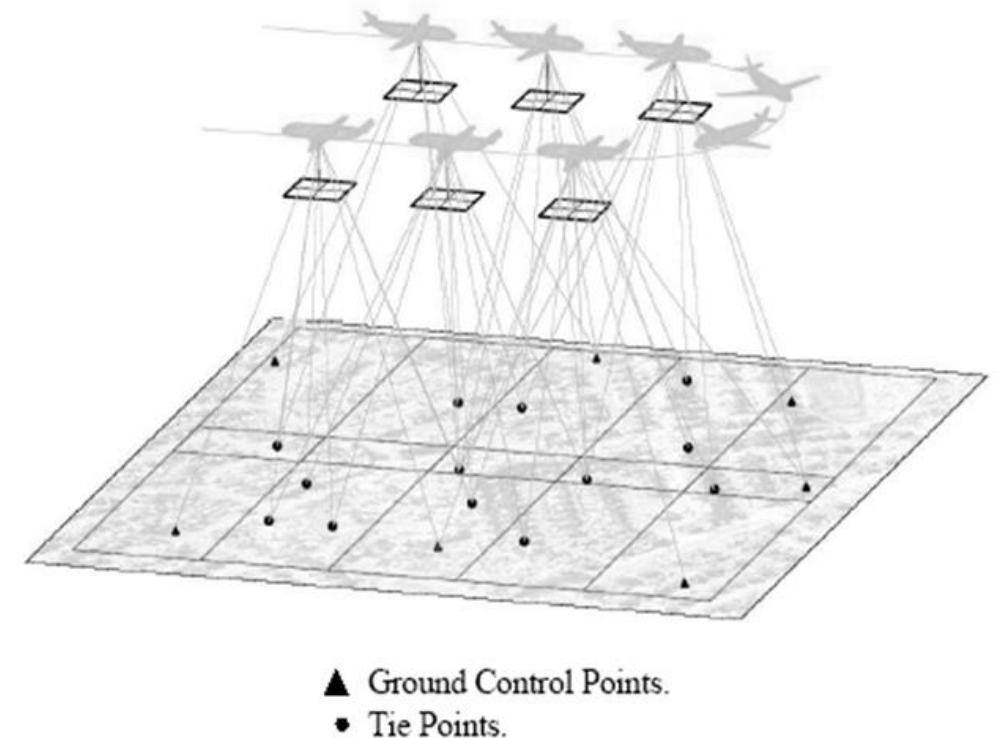
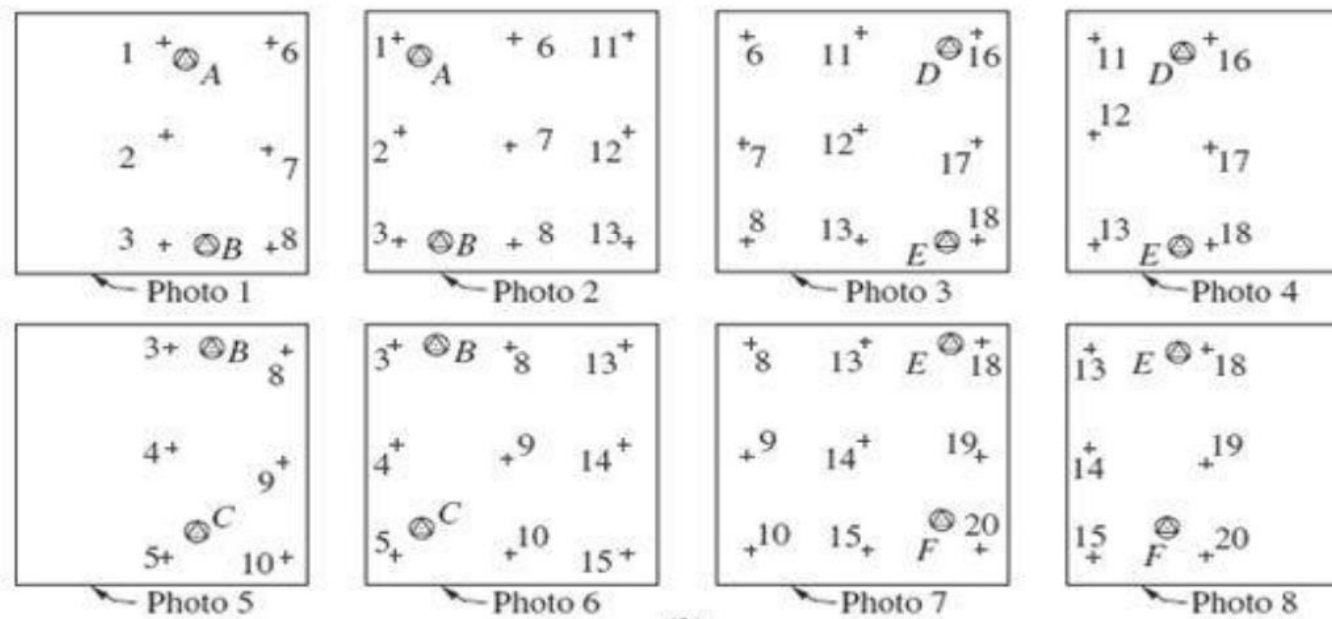
Independent Model Solution:

- Model-based solution.
- Apply R.O. to every individual 2-photos to generate 3D models.
- Apply 3D transformation to tie 3D models in individual strips.
- Apply 3D transformation to tie strips in one single block.
- Apply A.O. to georeferenced the block to a world coordinate system.



Bundle Block Adjustment (**Recommended**) Solution:

- Image-based solution.
- One direct solution.
- No-linear solution.
- Solve for tie-pass points based on G.C.P.s availability.



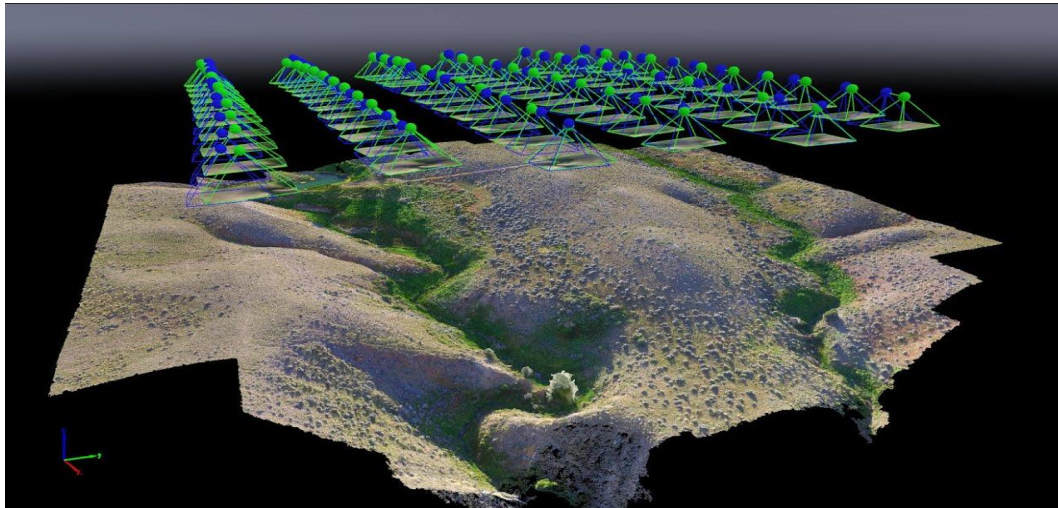
Exercise:

- Check example (4-1) for independent model solution in:
Analytical photogrammetry text book (Arabic version), p. 84.
- Check example (4-3) for bundle solution in:
Analytical photogrammetry text book (Arabic version), p. 102!

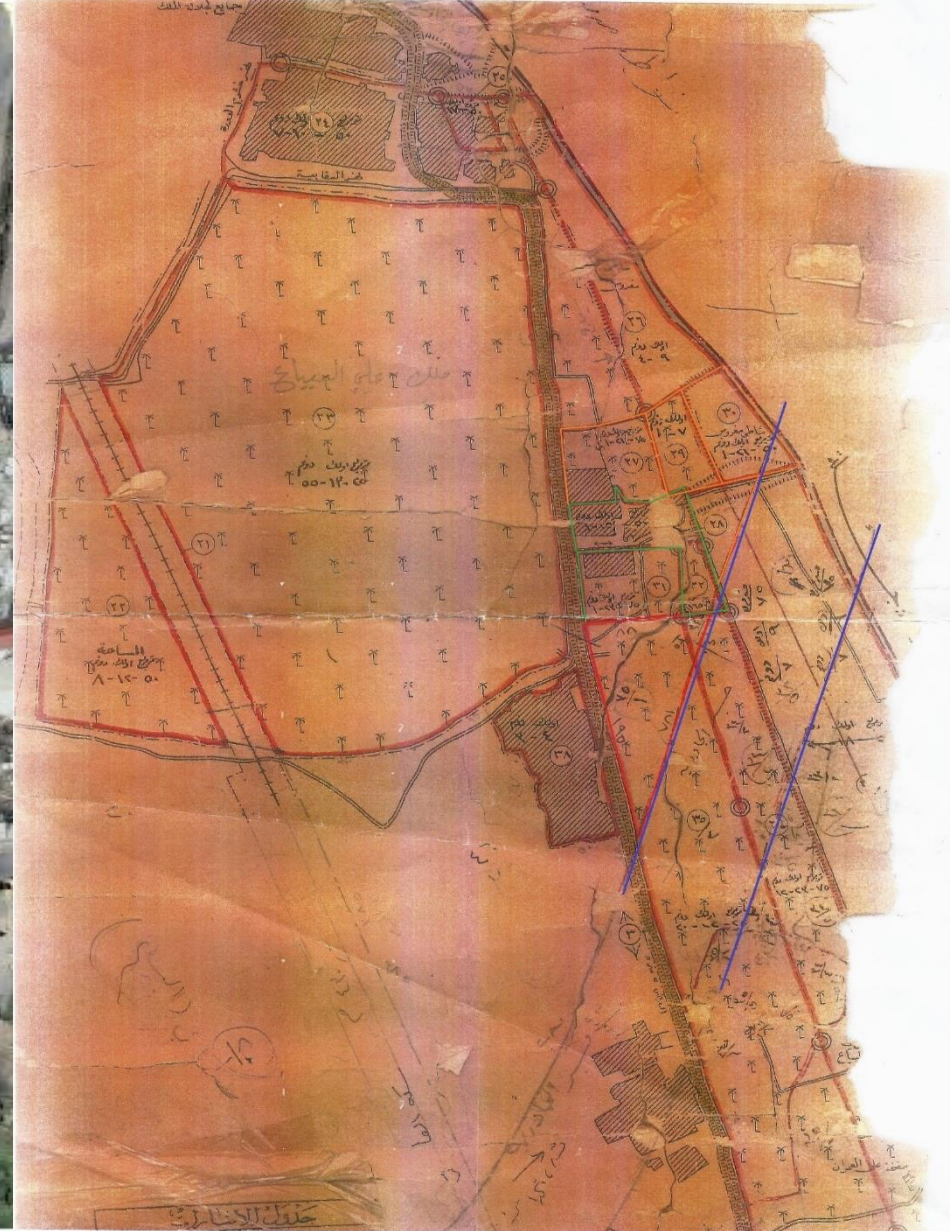
Applications!



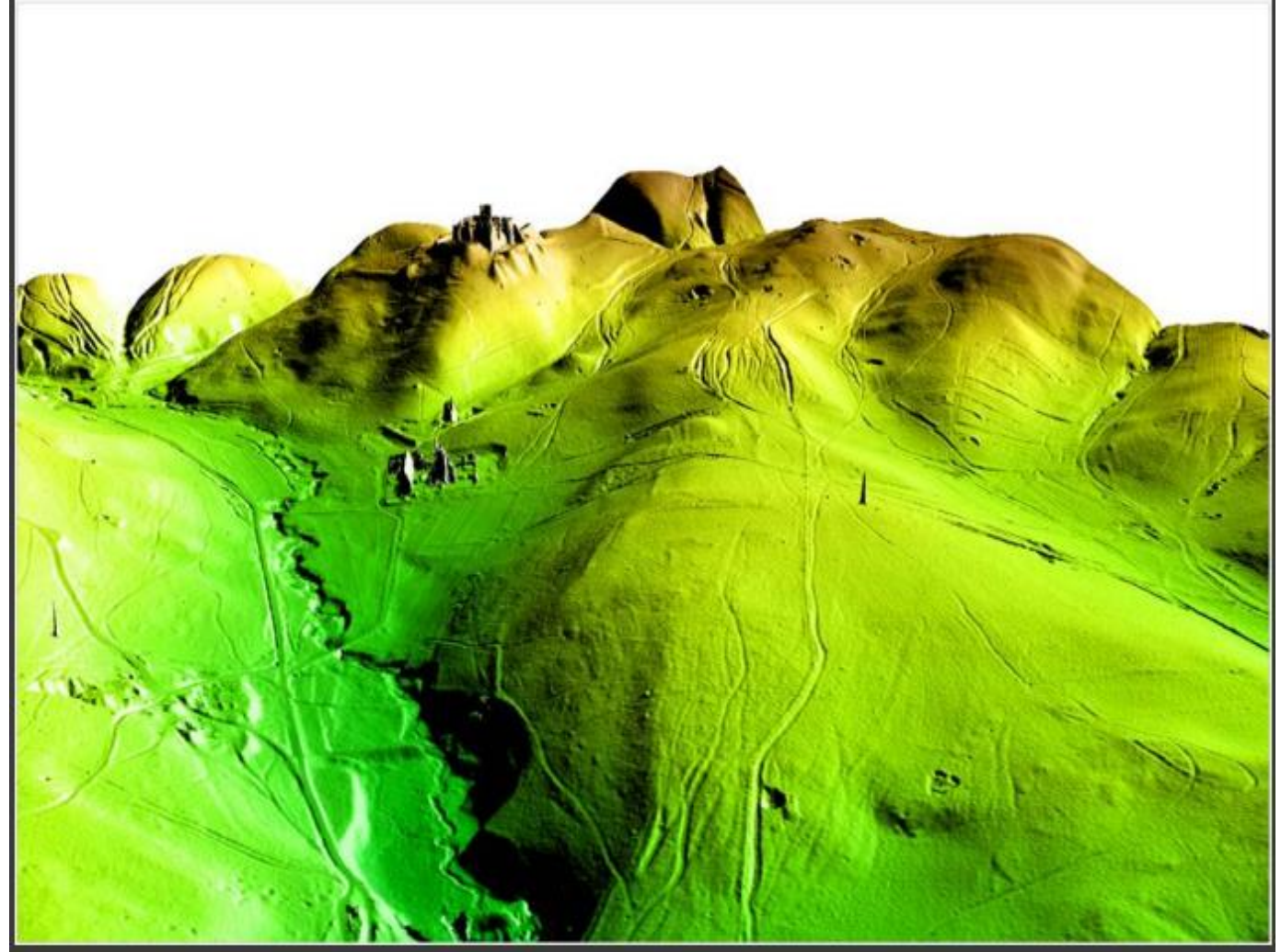
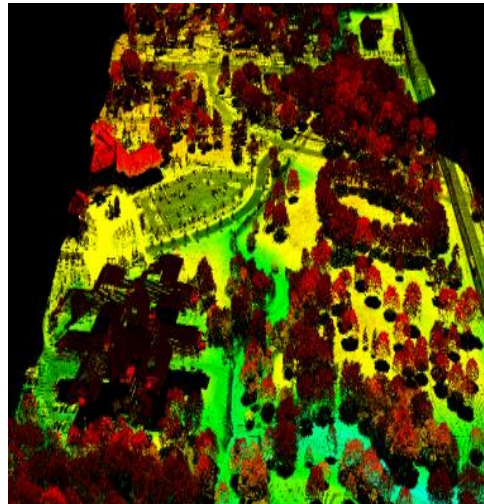
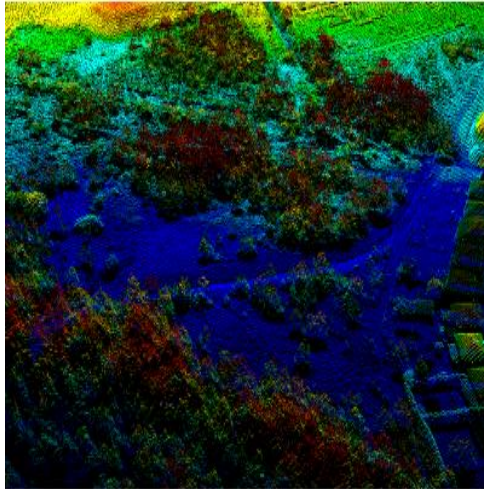
Topographic Mapping



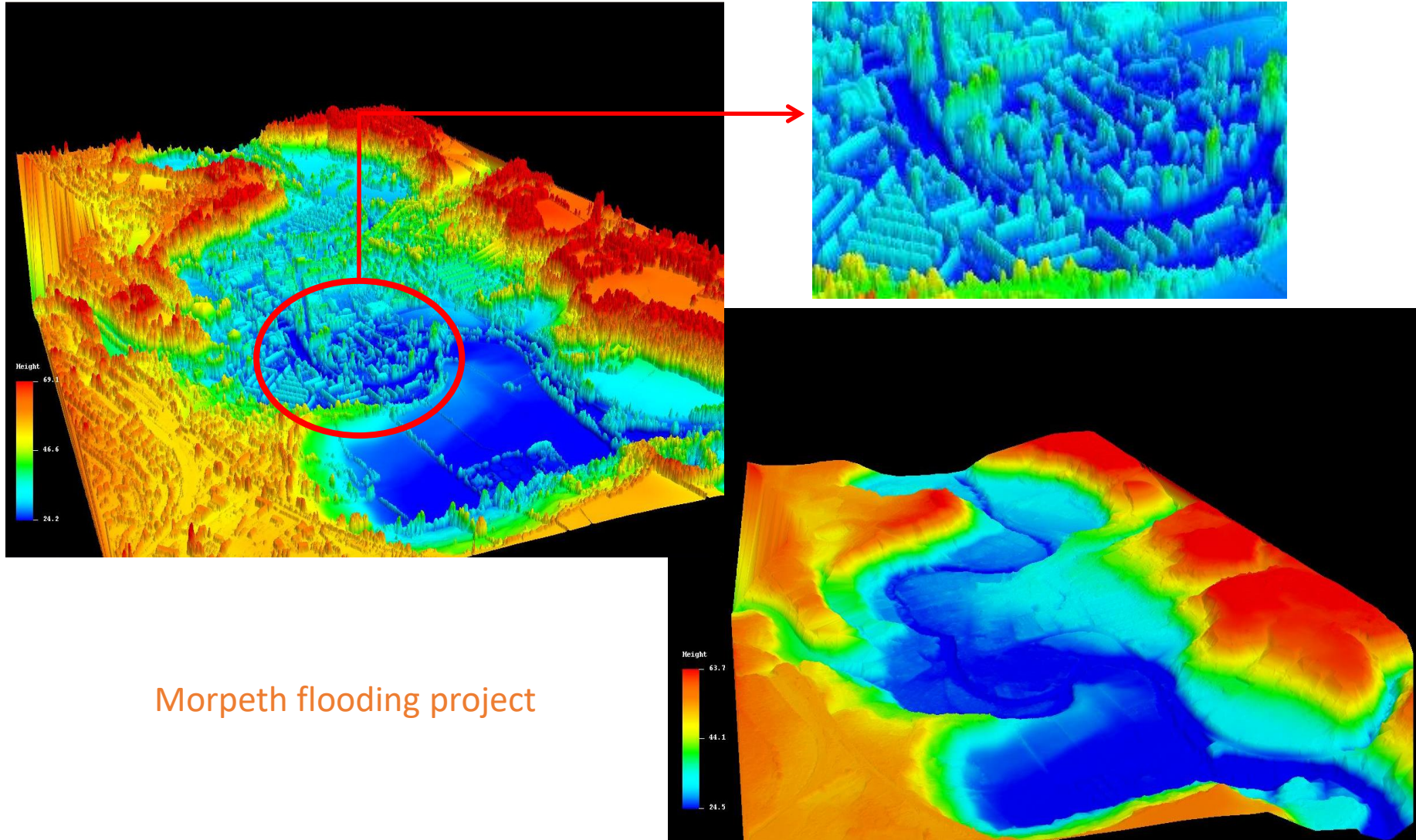
Cadstro Mapping Auto-Production



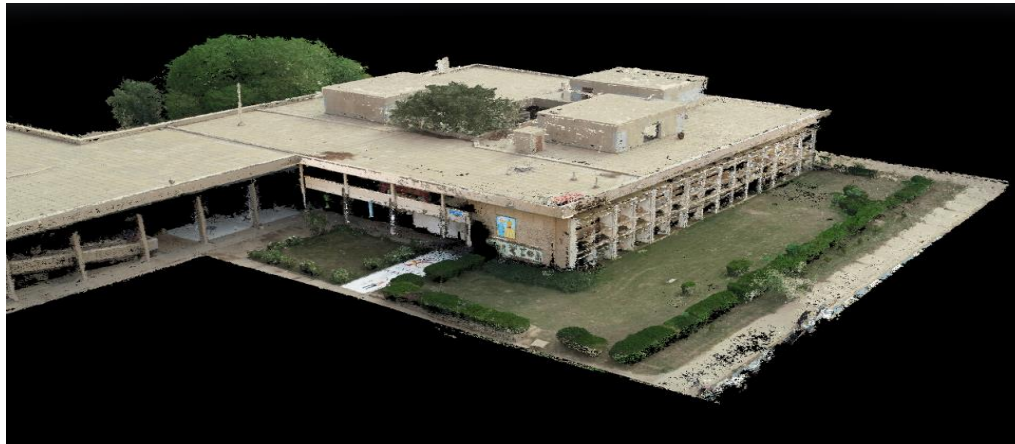
DSM and DTM Generation .. Study of drainage pattern



Flood Mapping and Natural Disasters Studies

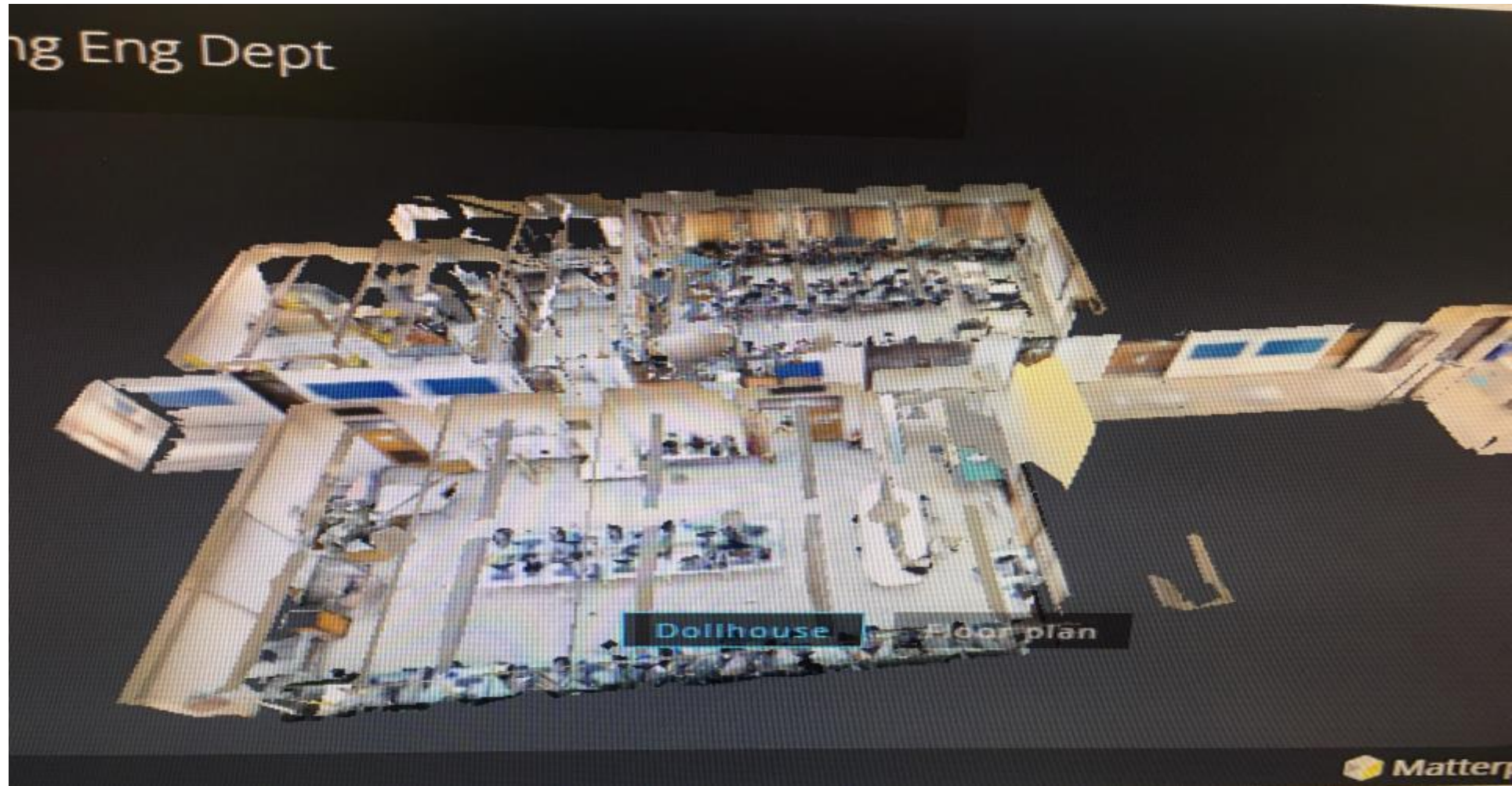
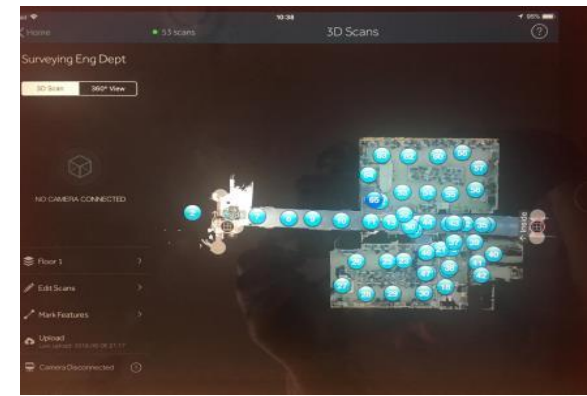


3D City Modeling

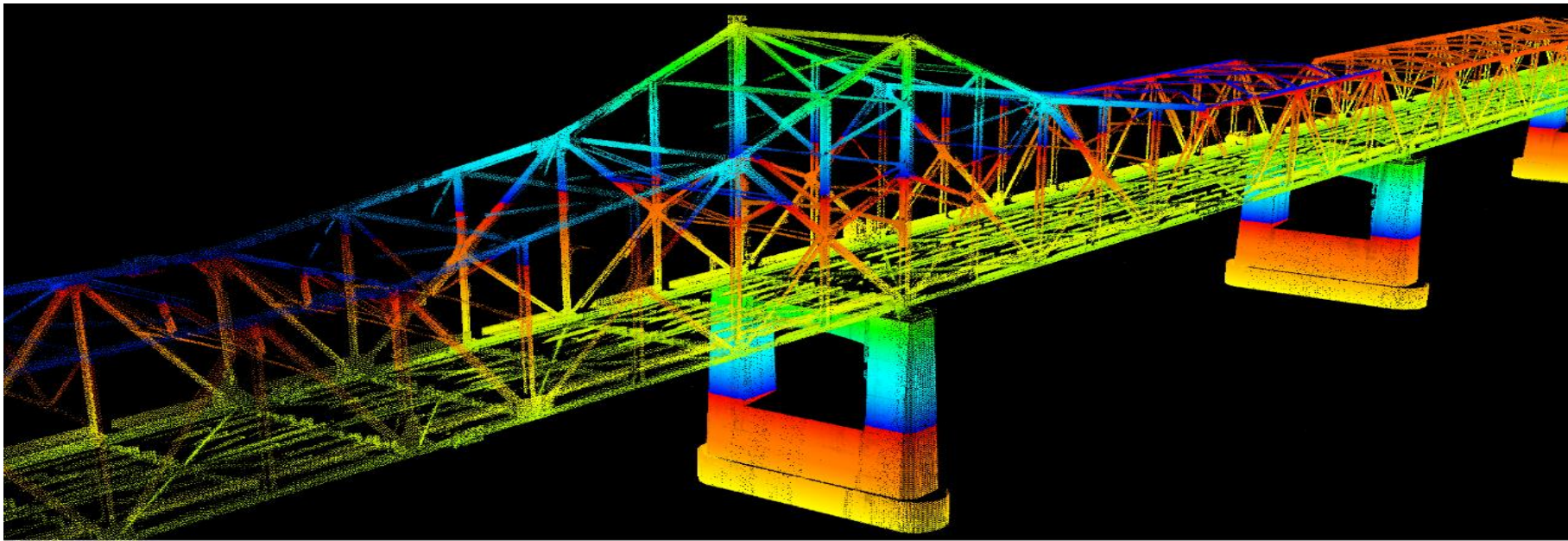
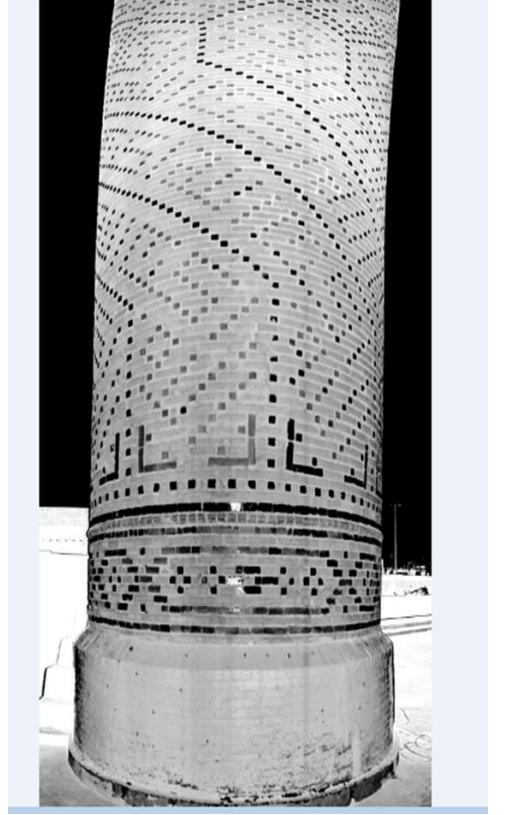
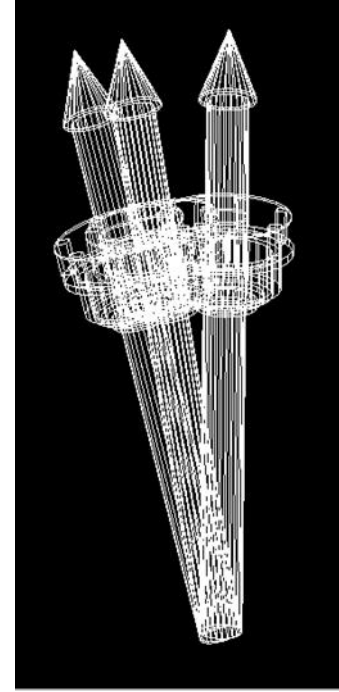
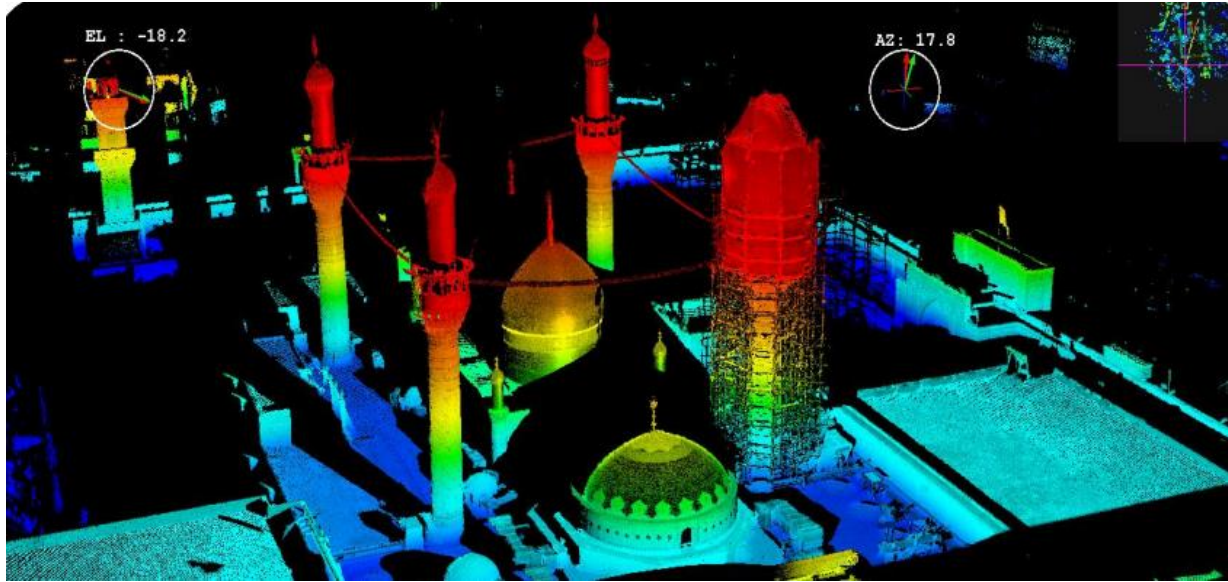




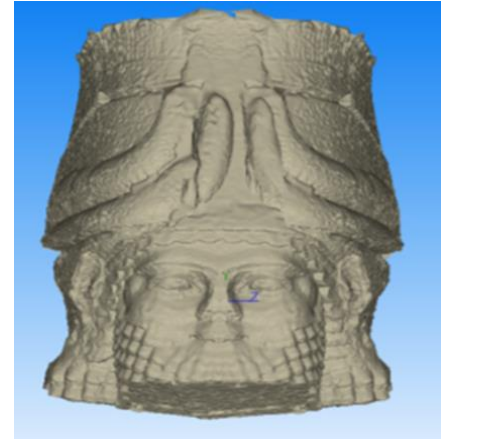
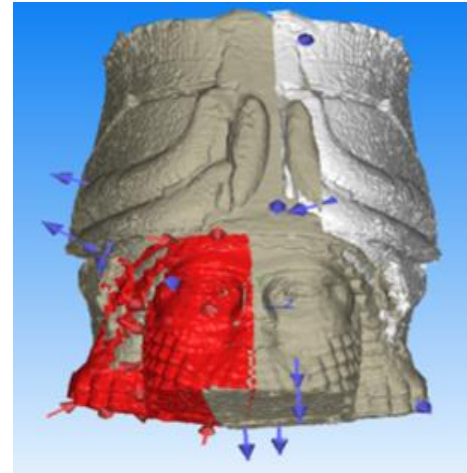
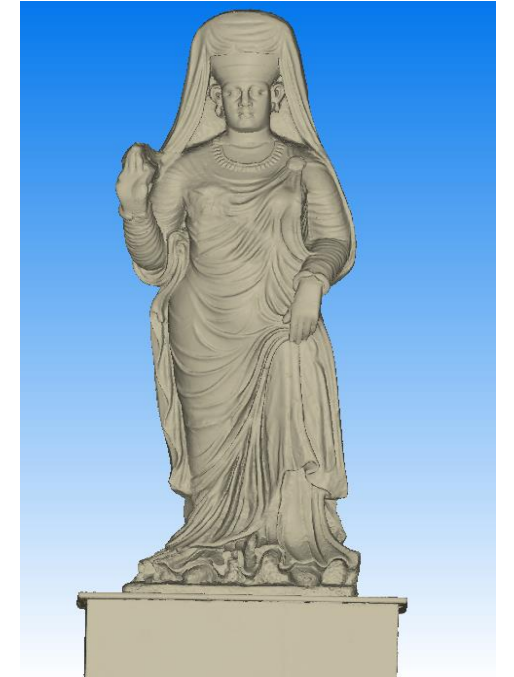
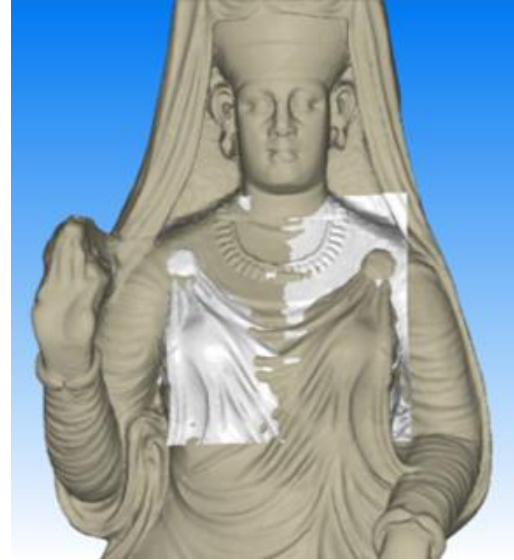
Virtual Reality



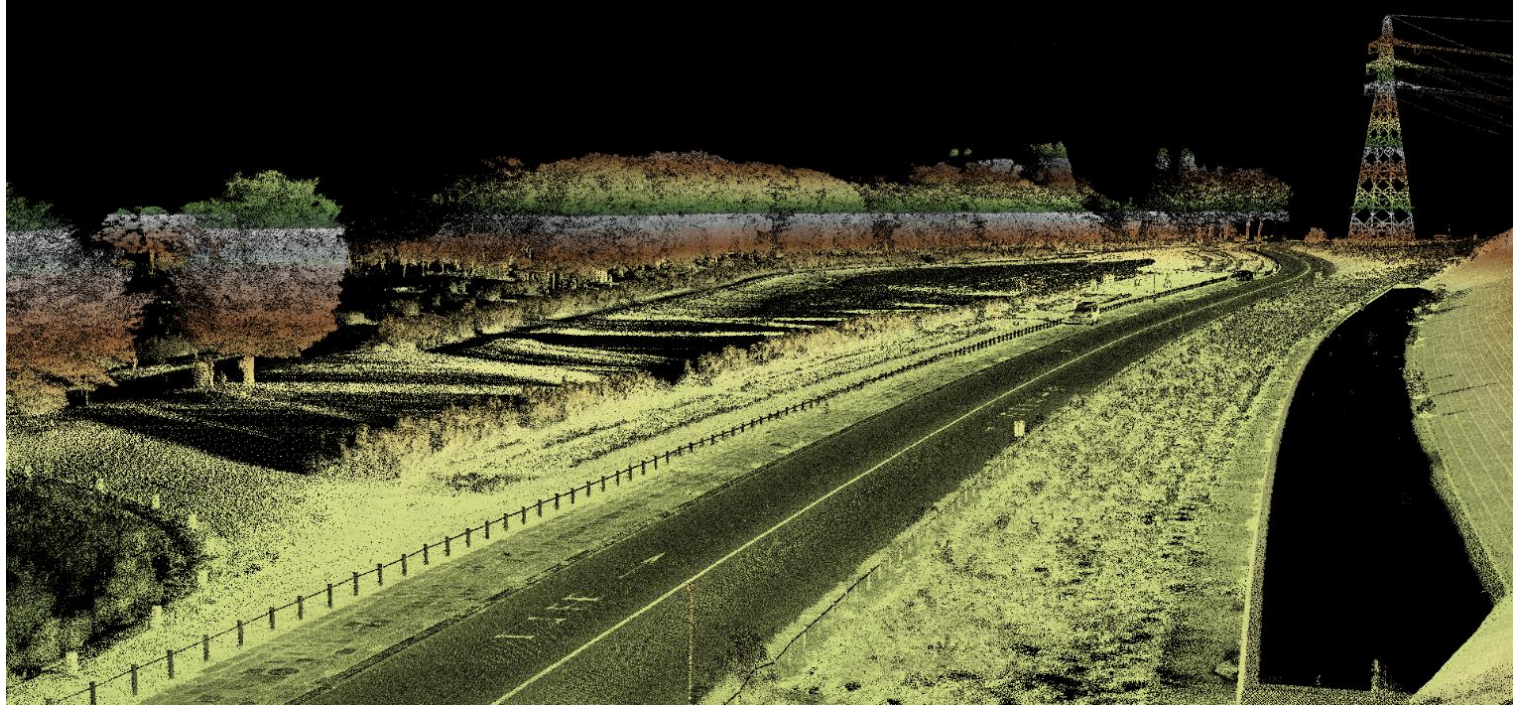
Structure Monitoring



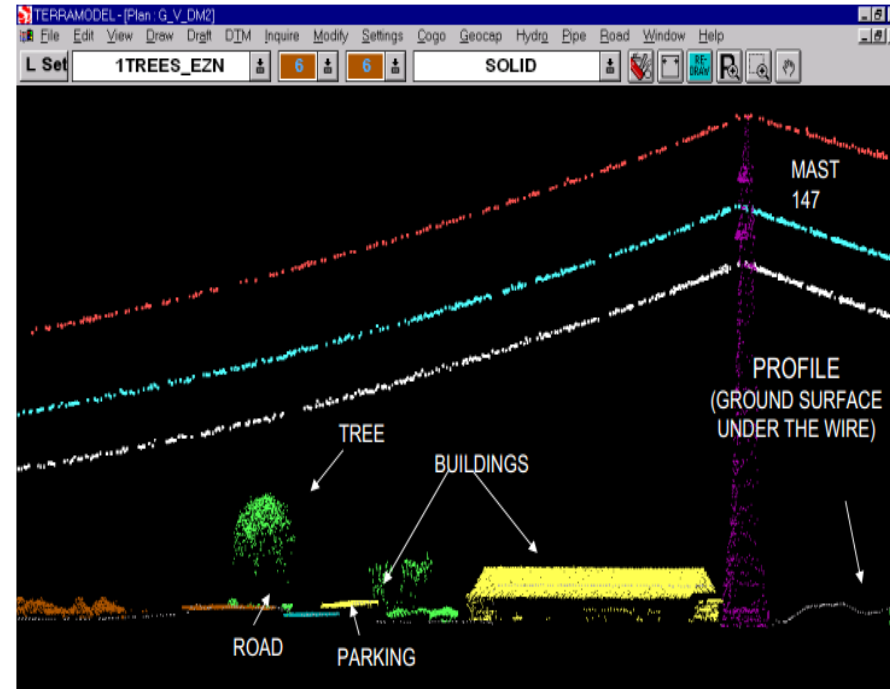
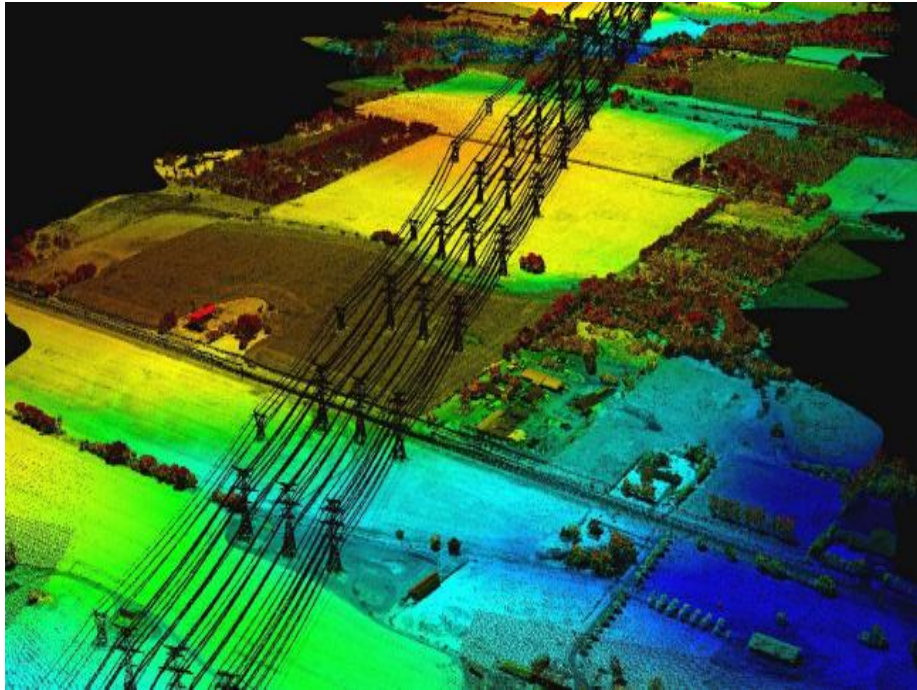
Cultural & Architectural Heritage Conservation and Restoration



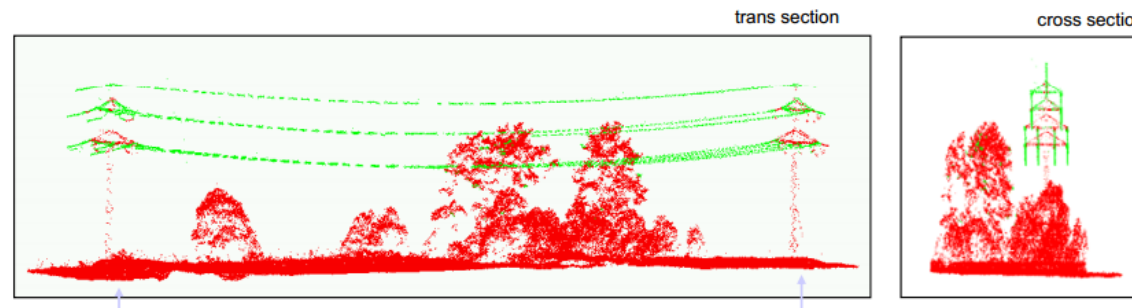
Corridor Mapping, roads, railway tracks, pipelines, etc.



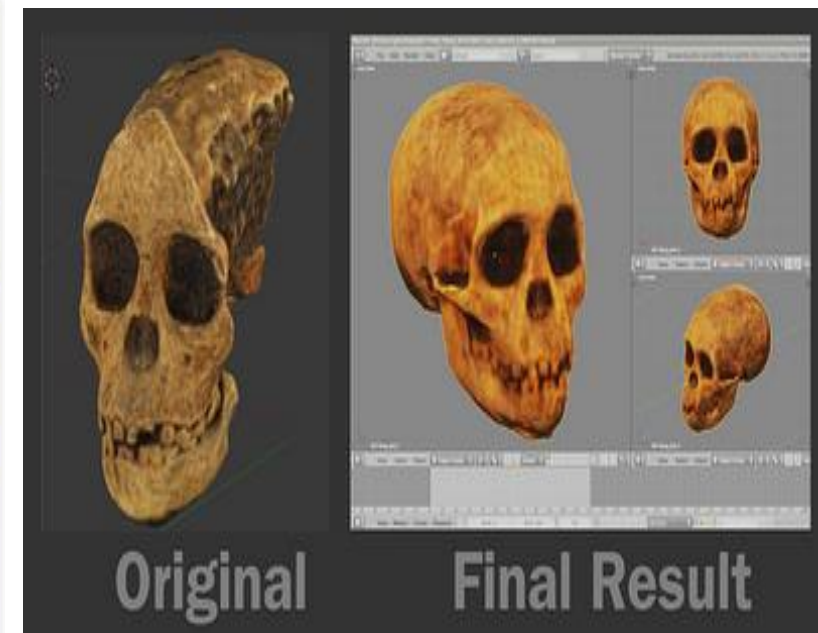
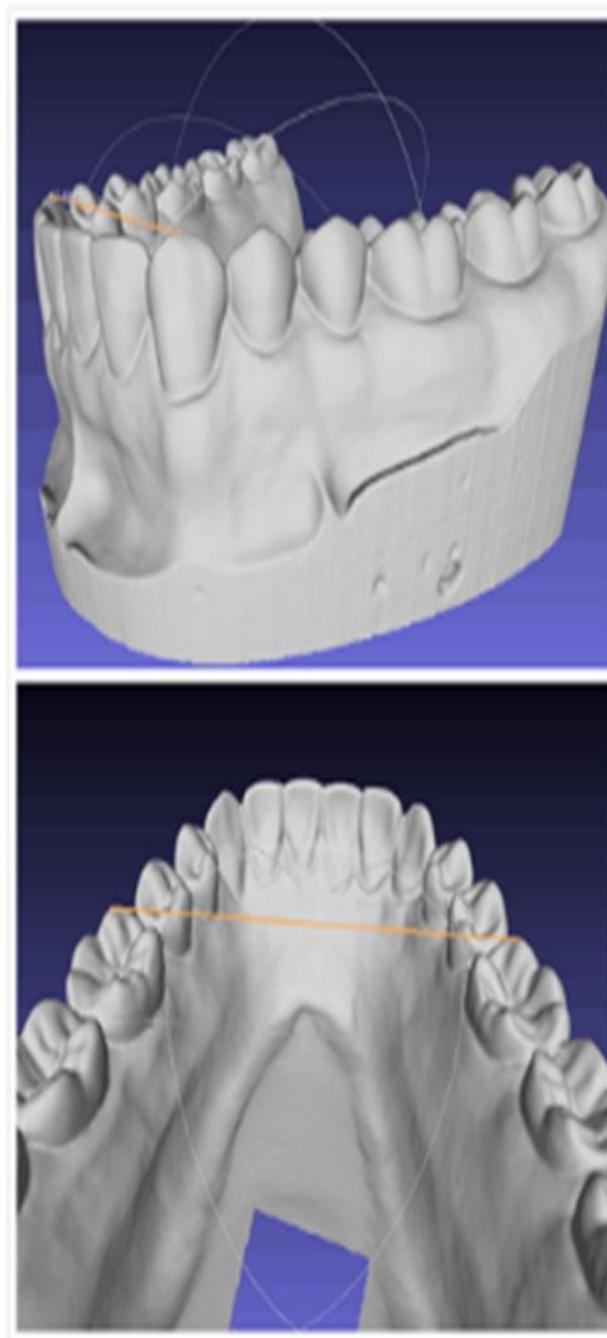
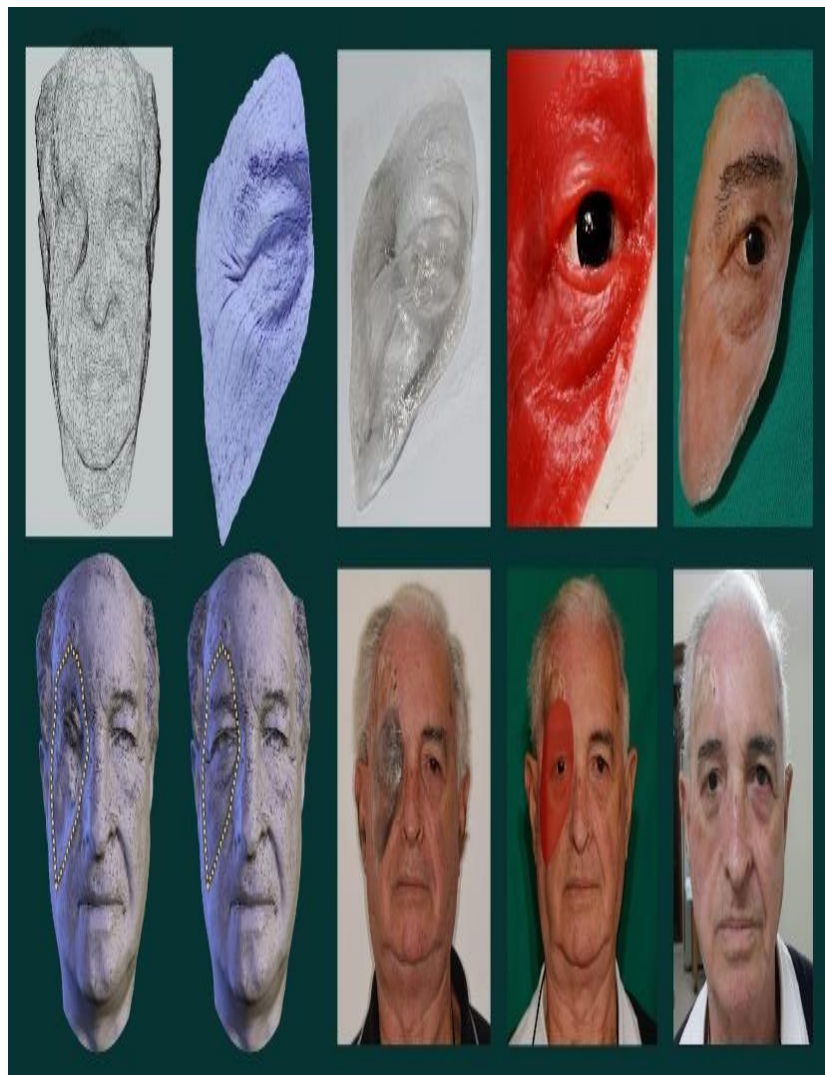
Mapping of Electrical Transmission Lines and Towers Including Tree Clearance



Integrated Helicopter Corridor Mapping (IHCM)

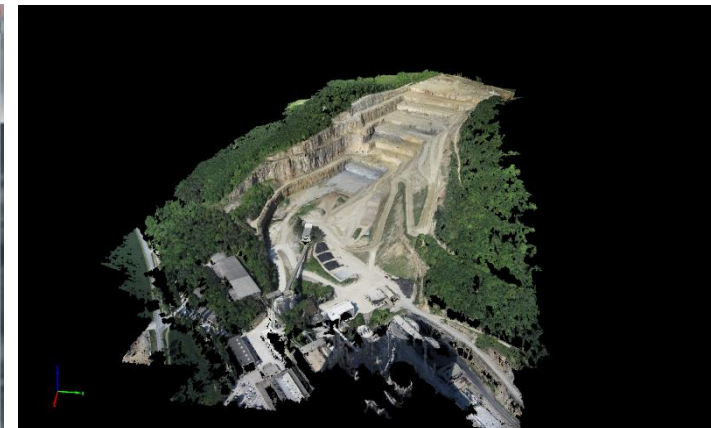
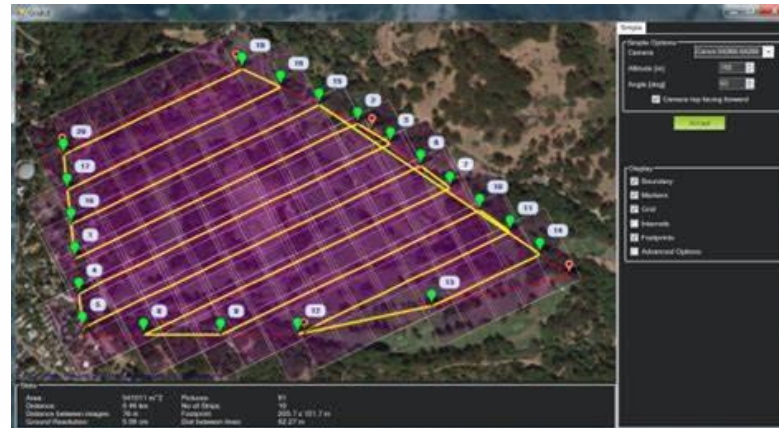
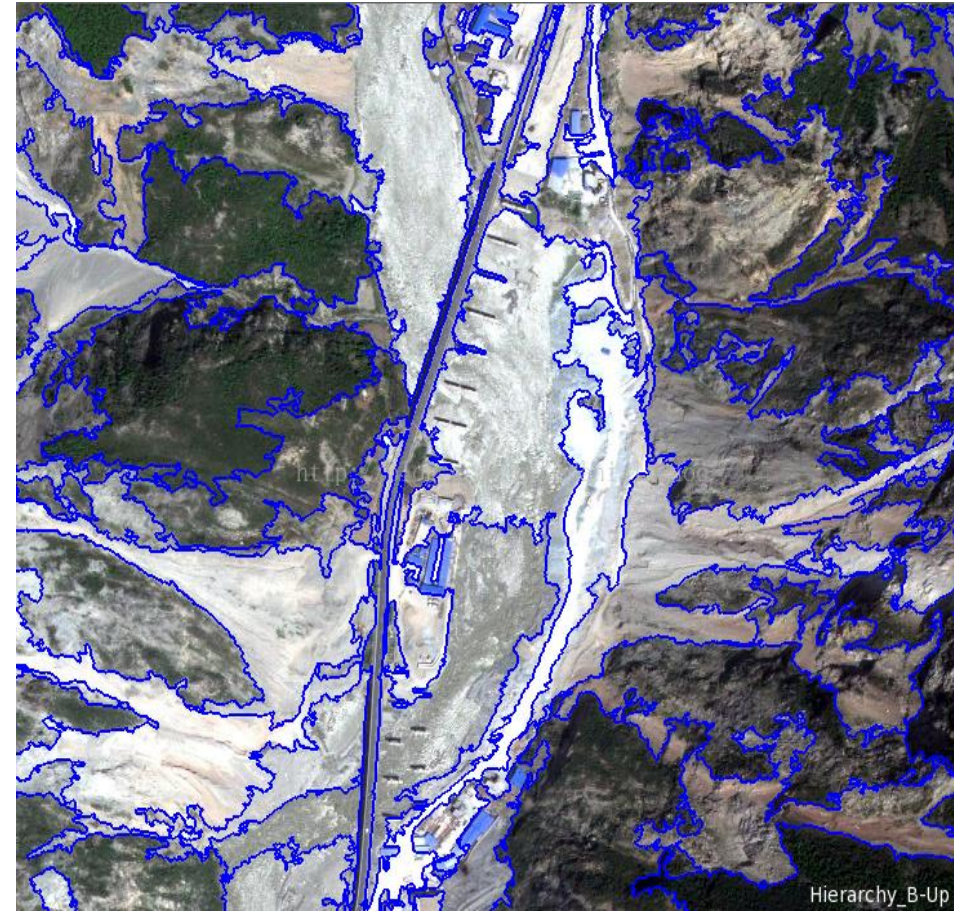


Medical Applications



Boundary detection:

- Image segmentation using Ecognition software.
- Line extraction.
- Contour generation.
- Accuracy assessment:





BIM

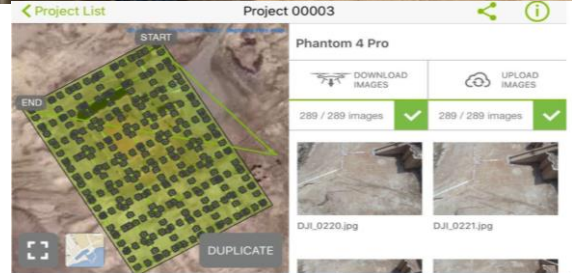


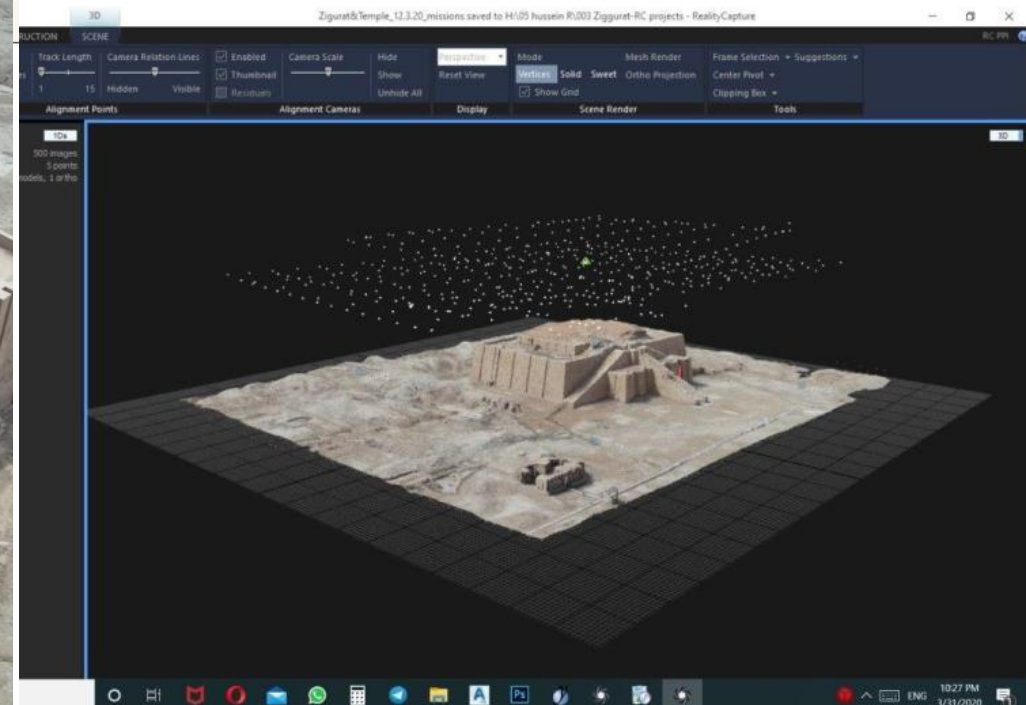
Image captured by UAV



Dense point cloud obtained from
The photogrammetry project



HBIM model of the building
Made by Revit



Acknowledgment Credits

- Geomatic Engineering department, Calgary University, Canada.
- Civil Engineering and Geosciences, Newcastle University, UK.
- University of Glasgow, UK.
- Geo-sensing Engineering and Mapping (GEM), University of Florida, USA.
- ITC, University of Twente.
- Vienna University of Technology.
- University of Texas, USA.