Introduction to computer vision: summary

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Artificial Intelligence & Information Analysis Lab

Computer vision overview

- **Image and video acquisition**
- Camera geometry
- Stereo and Multiview imaging
- Structure from
- 3D Robot Localization and Mapping
- Semantic 3D world mapping
- 3D object localization
- Multiview object detection and tracking
- Shot types in cinematography
- Object pose estimation

Images $f(x, y)$ and videos signal $f(x, y, t)$

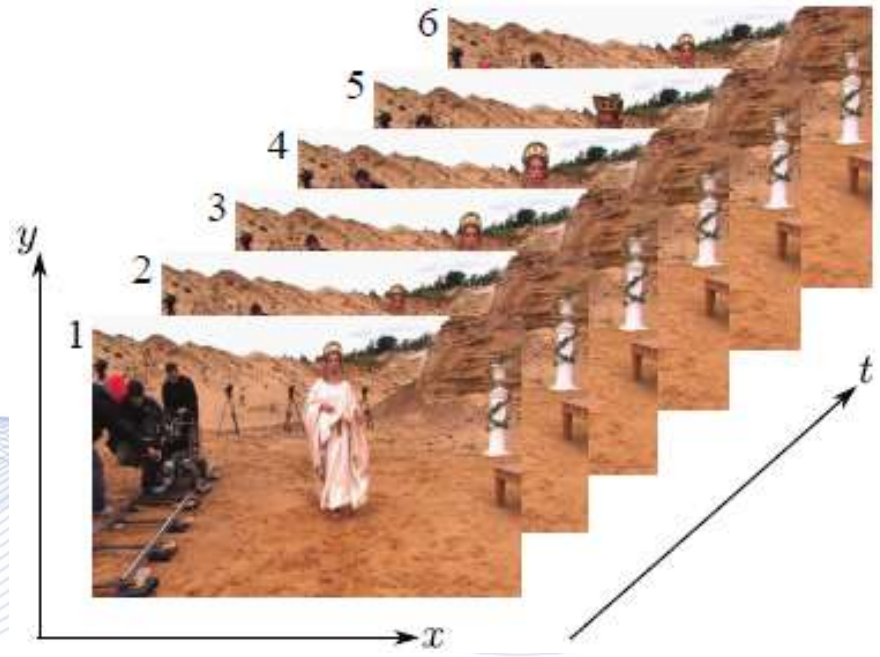
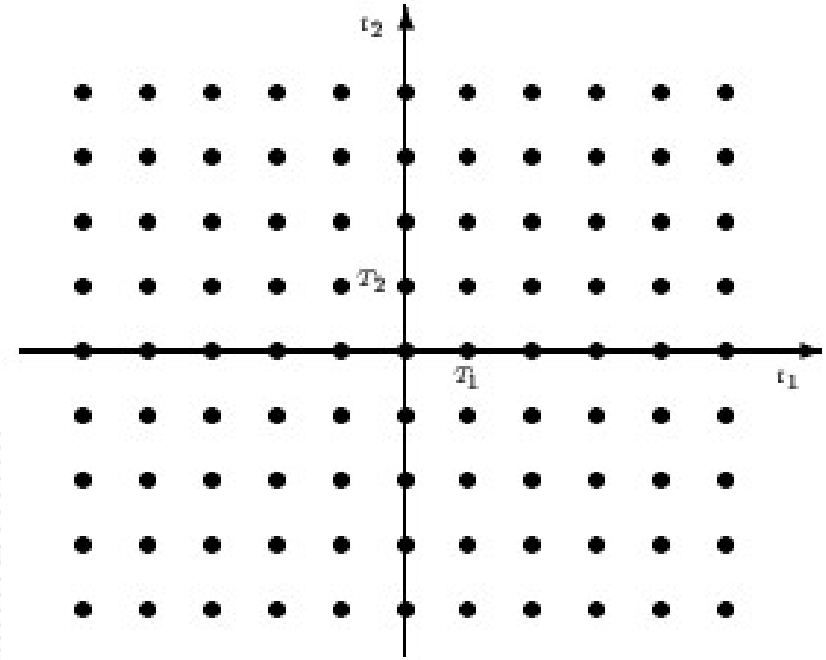
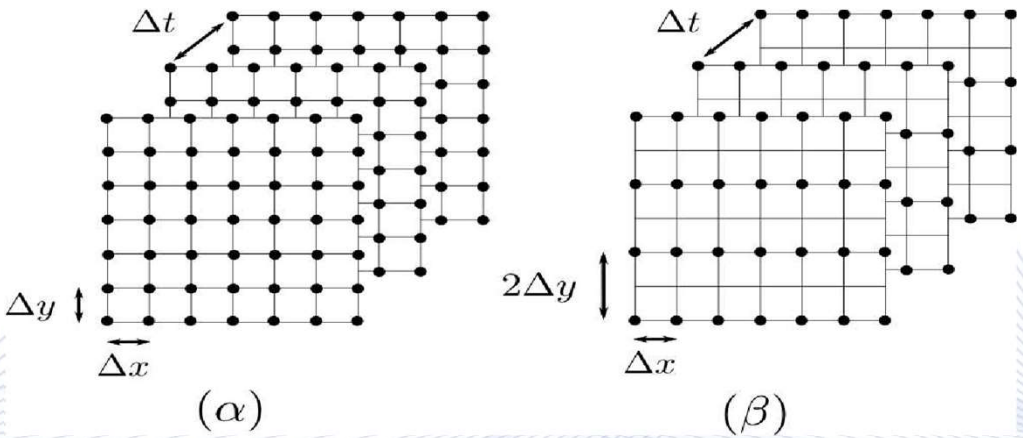


Image sampling



Rectangular sampling grid

Video sampling



Sampling grids for: a)progressive and b) 2:1 interlaced video

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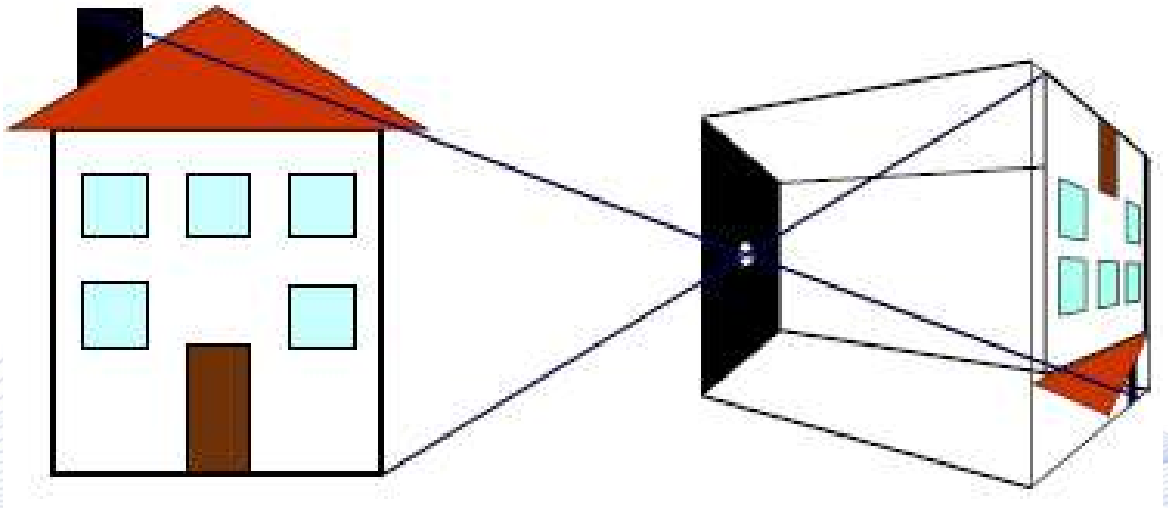
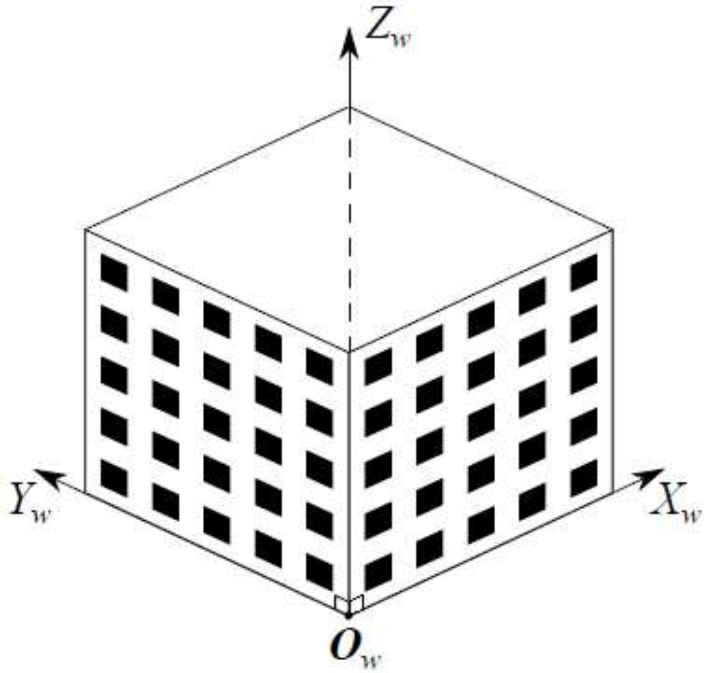
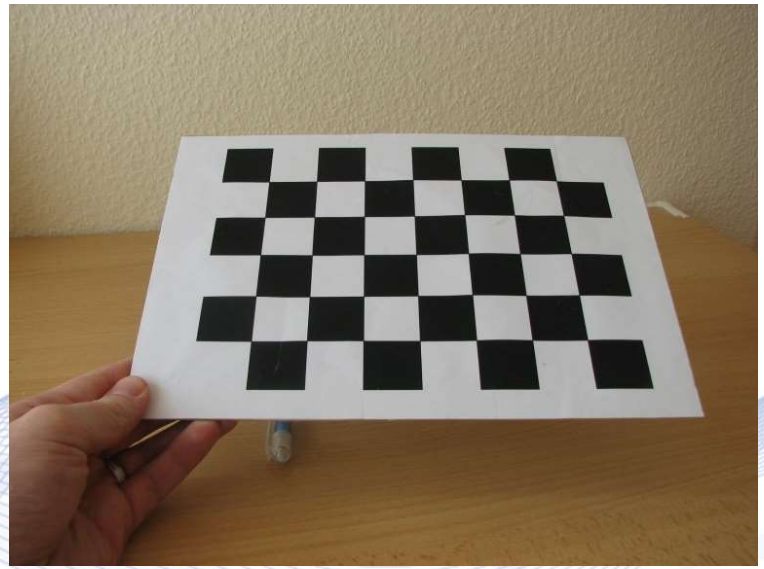
Pinhole Camera and Perspective Projection



Camera Calibration

Determining the extrinsic and intrinsic camera parameters:





Calibration patterns.

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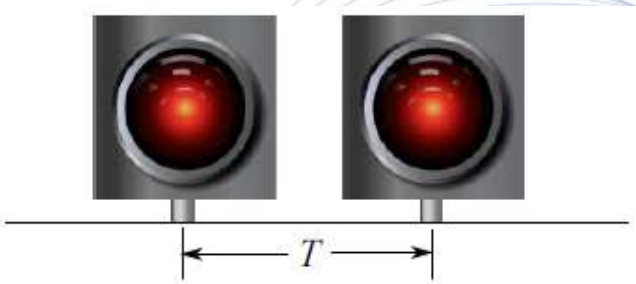
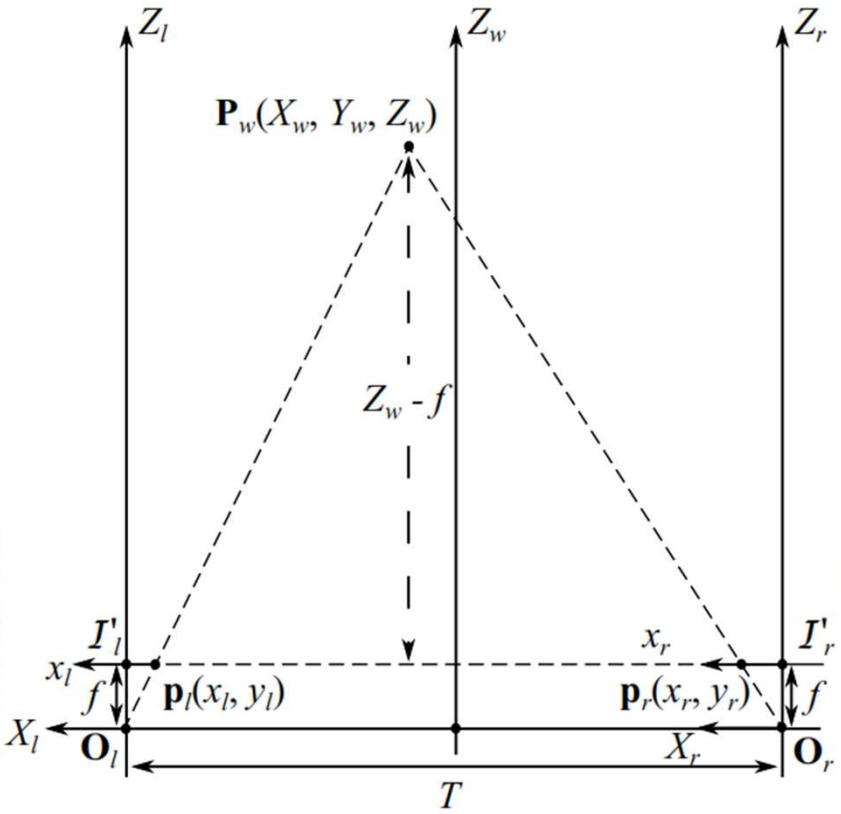
Stereo vision

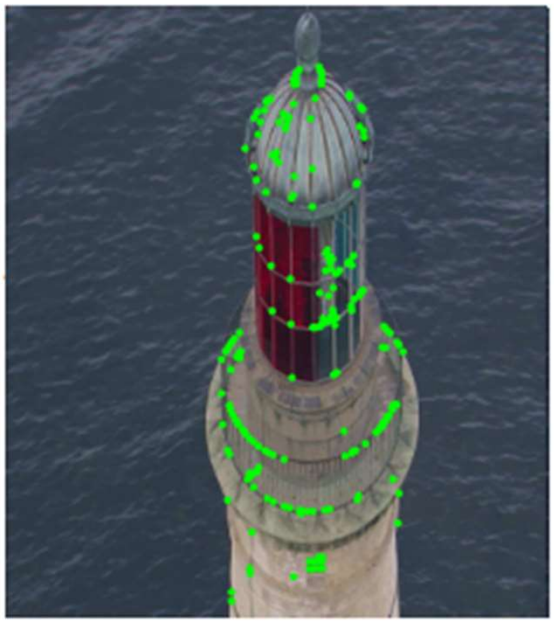
Parallel Stereo vision Geometry

T: baseline
f: focal length

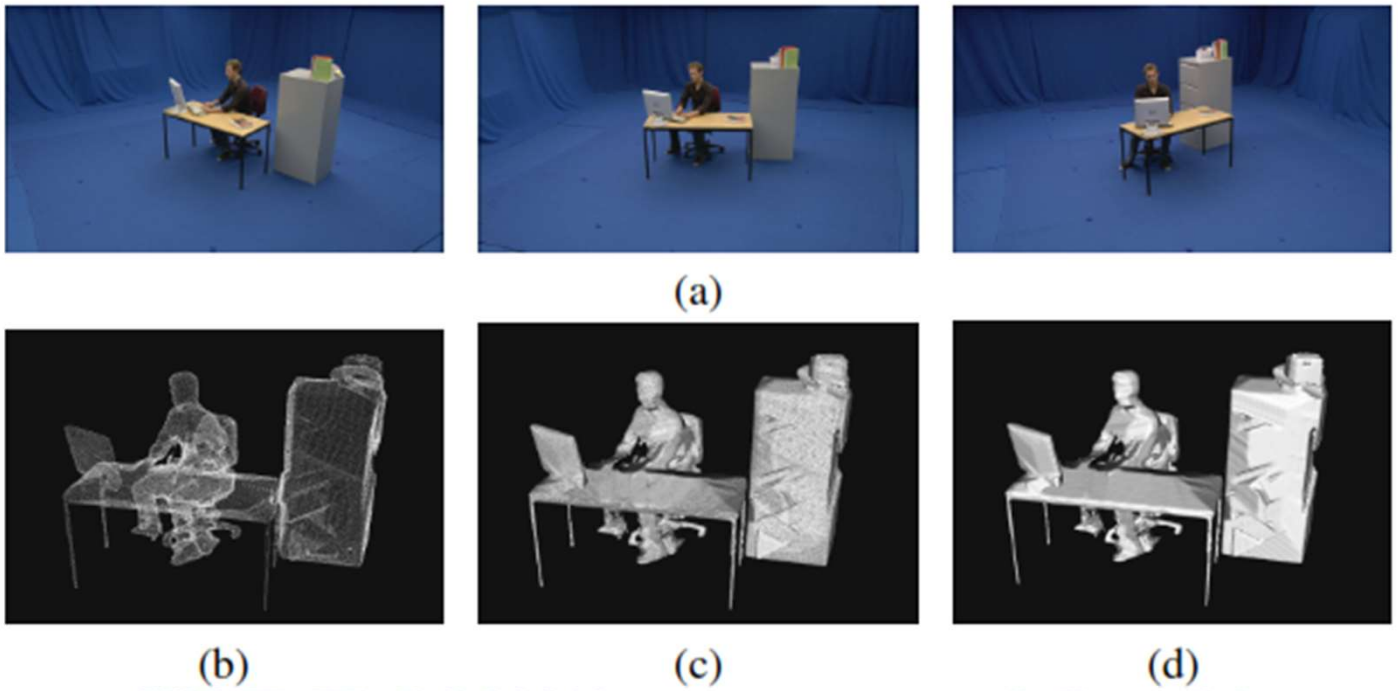




Feature Correspondence



3D geometry reconstruction



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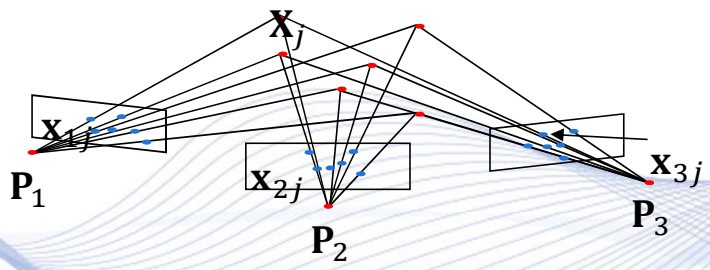
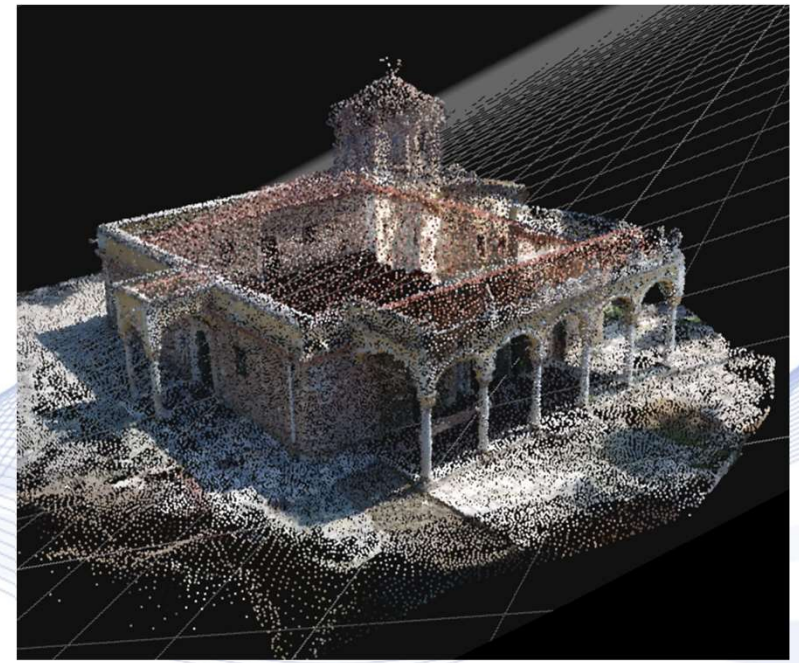
Structure from Motion

- Feature point correspondence
- Feature point matching
- Bundle adjustment and triangulation

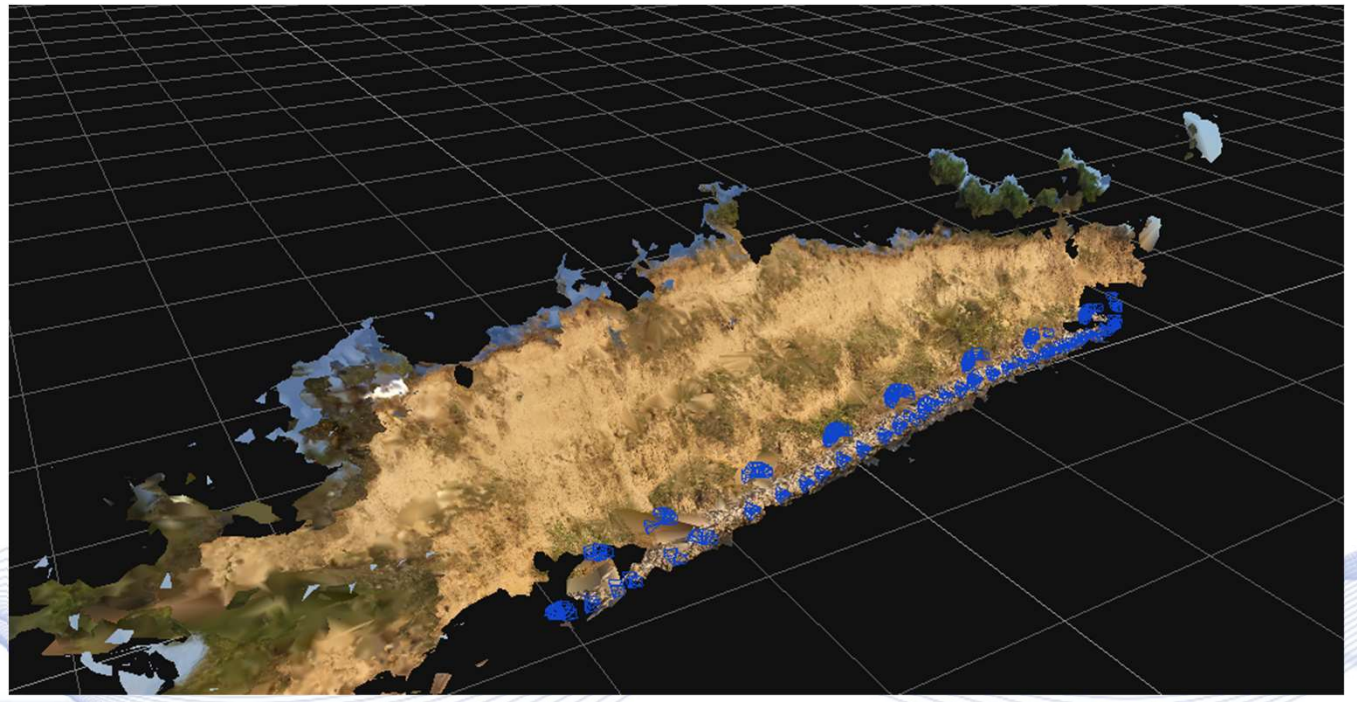




SfM in 3D landscape reconstruction

- Cliff images

SfM in 3D landscape reconstruction



- 3D Cliff surface reconstruction

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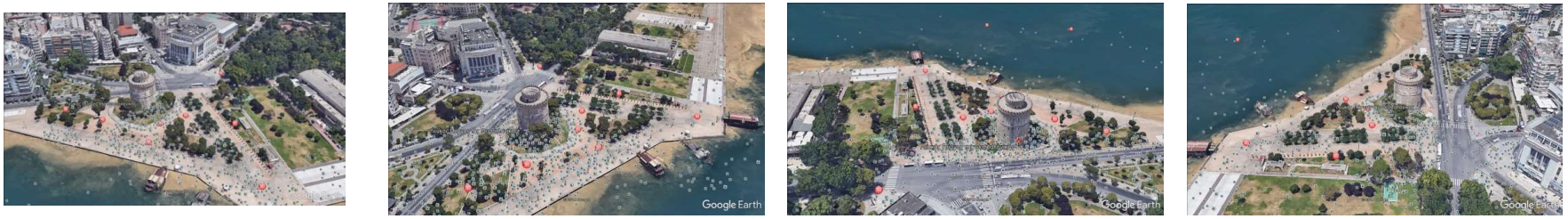
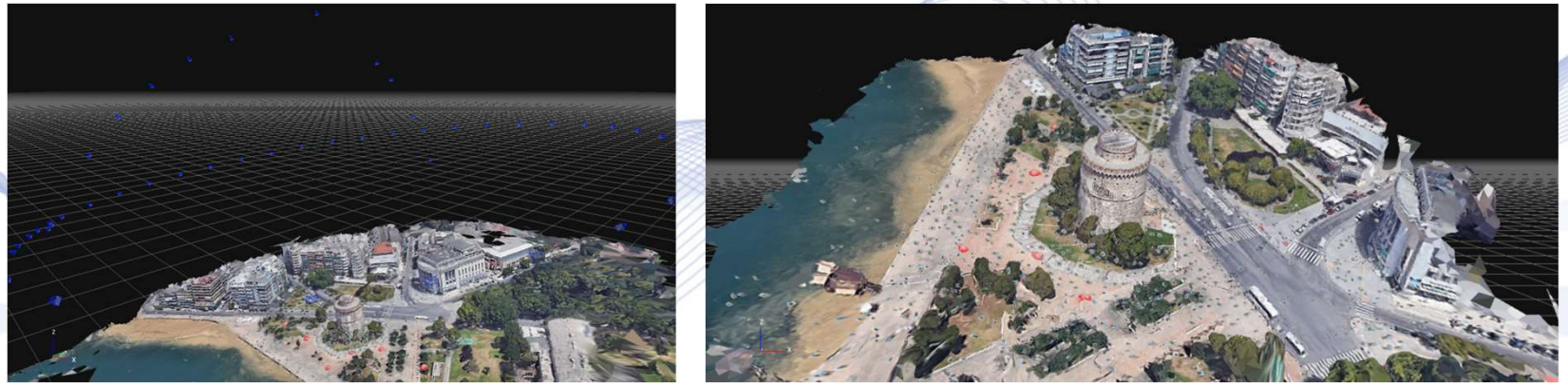
3D Robot Localization and Mapping

- 3D scene point mapping+Camera calibration

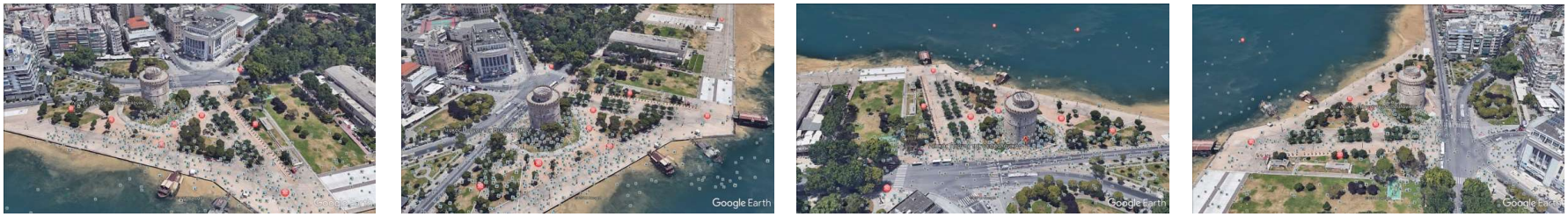


Images obtained from Google Earth

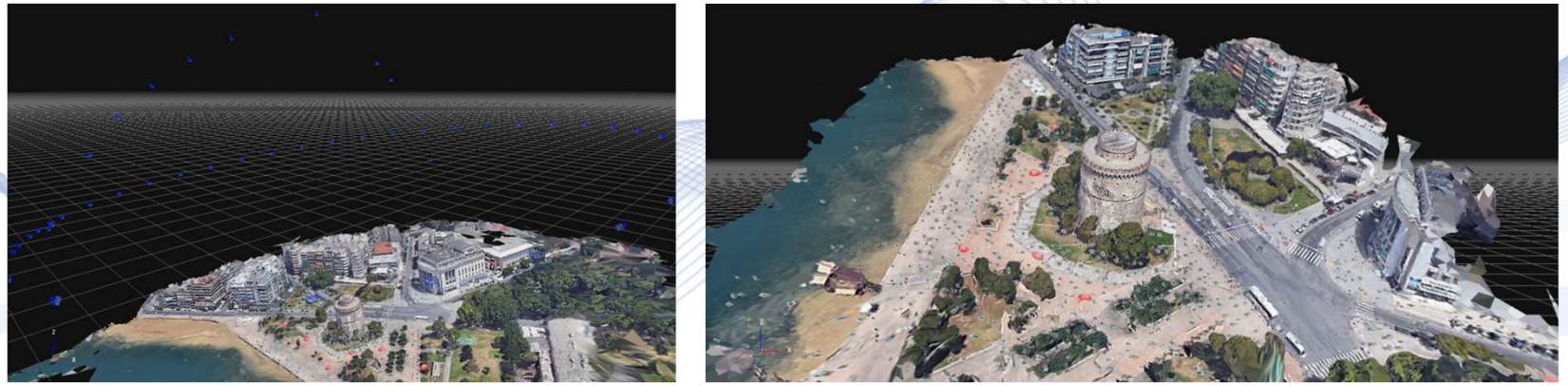


3D models reconstructed in 3DF Zephyr Free using 50 images from Google Earth

3D Scene mapping from Uncalibrated Multiple Cameras



Images obtained from Google Earth



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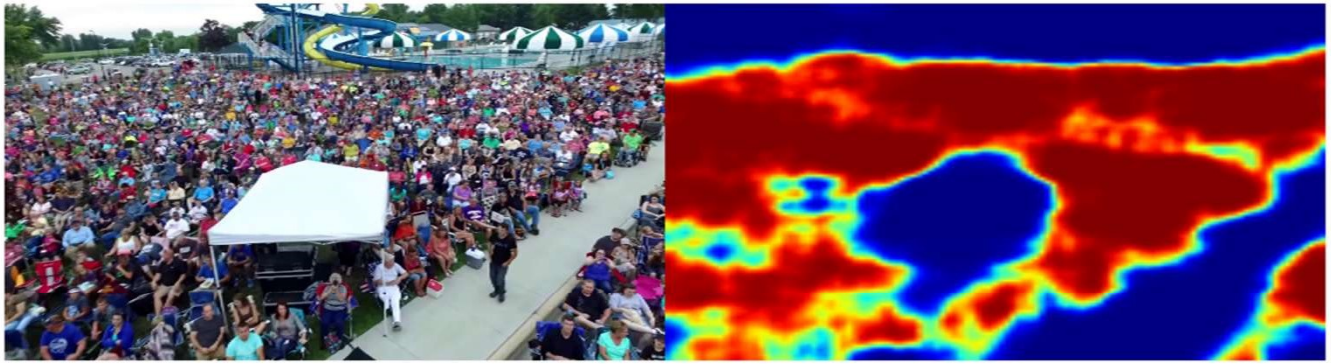
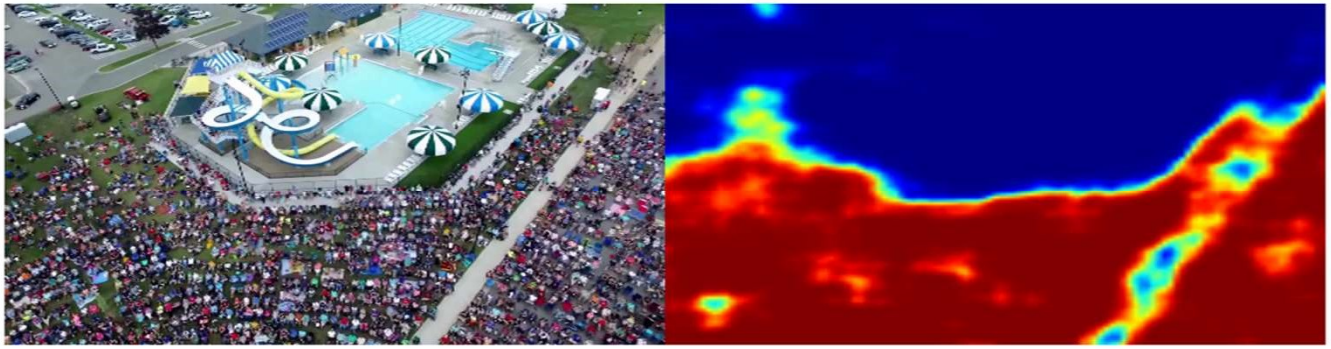
Semantic 3D World Mapping

- Semantic mapping overlays semantic information on 2D or 3D scene maps.
  - These semantic entities are assigned specific spatial coordinates in a consistent manner and overlay a geometric 3D scene map.
  - The goal is cognitive comprehension of the outdoors environment where a robot moves and operates.

Semantic 3D Map Annotation for crowd localization





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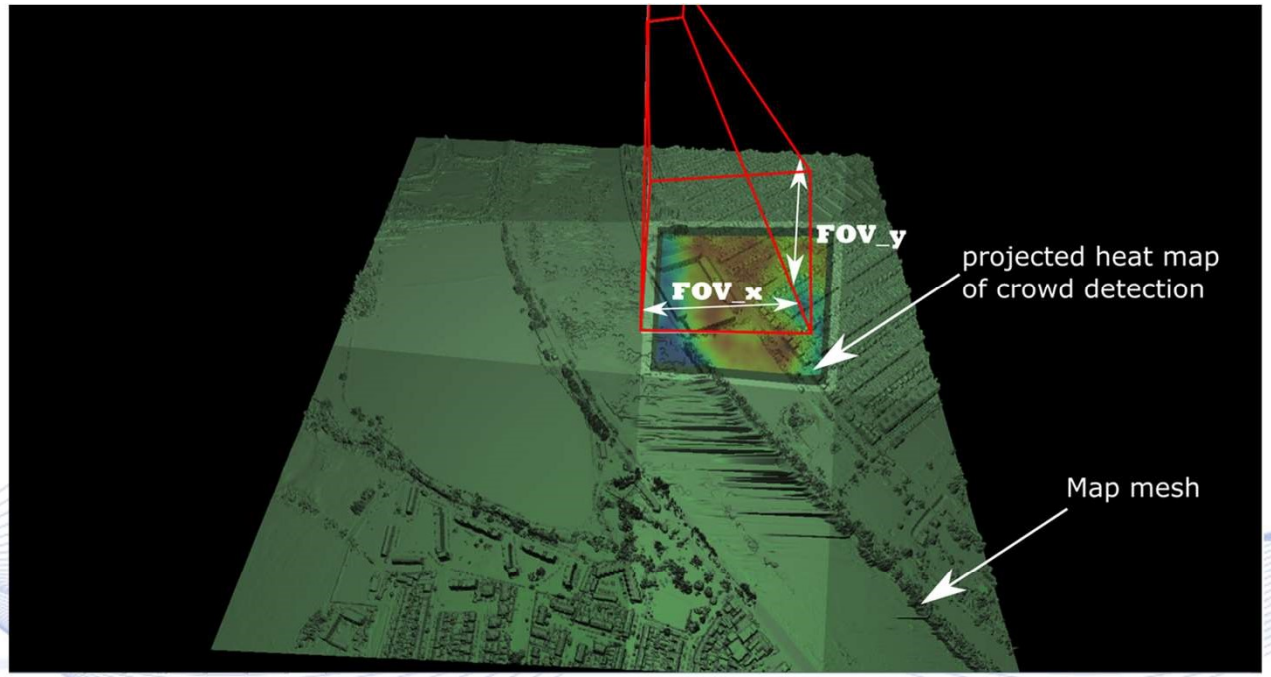

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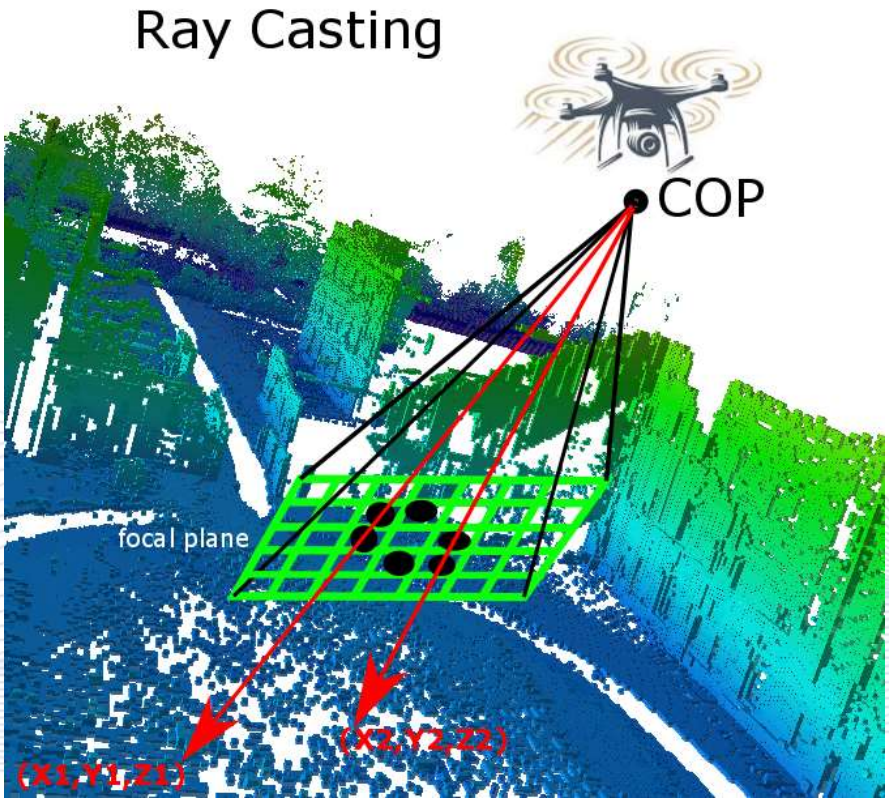
3D object localization using 3D maps



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Multiview Object Detection and Tracking

Multiview 3-UAV ORBIT

(a) Video frame from UAV 0.

(b) Video frame from UAV 1.

(c) Video frame from UAV 2.

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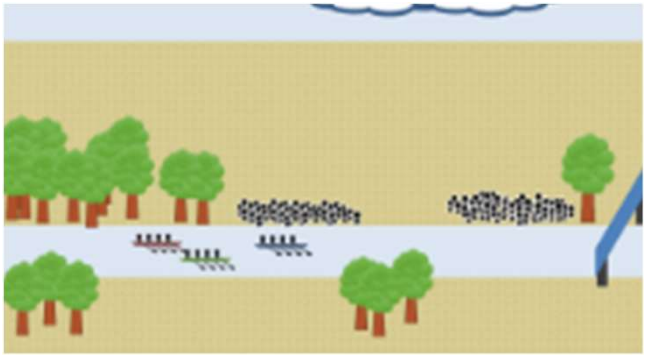
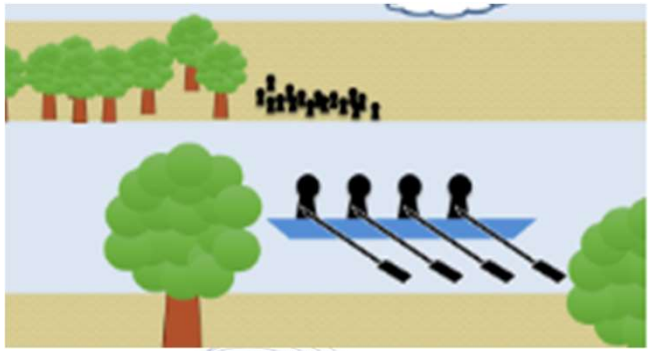
Framing Shot Types

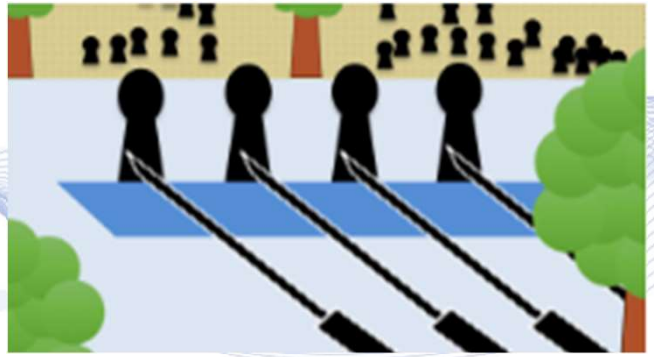
- Example UAV shot types when shooting boat targets from the side.



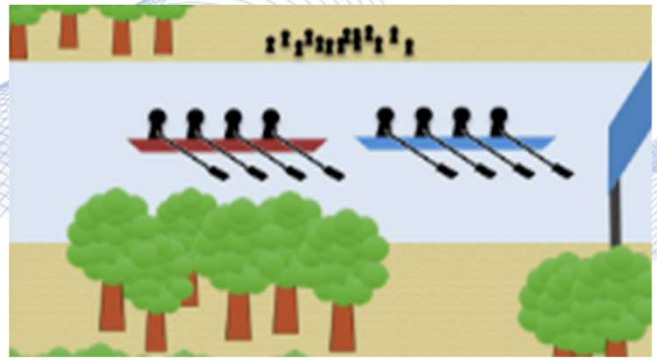
Extreme Long Shot



Long Shot



Medium Close Up



Two Shot

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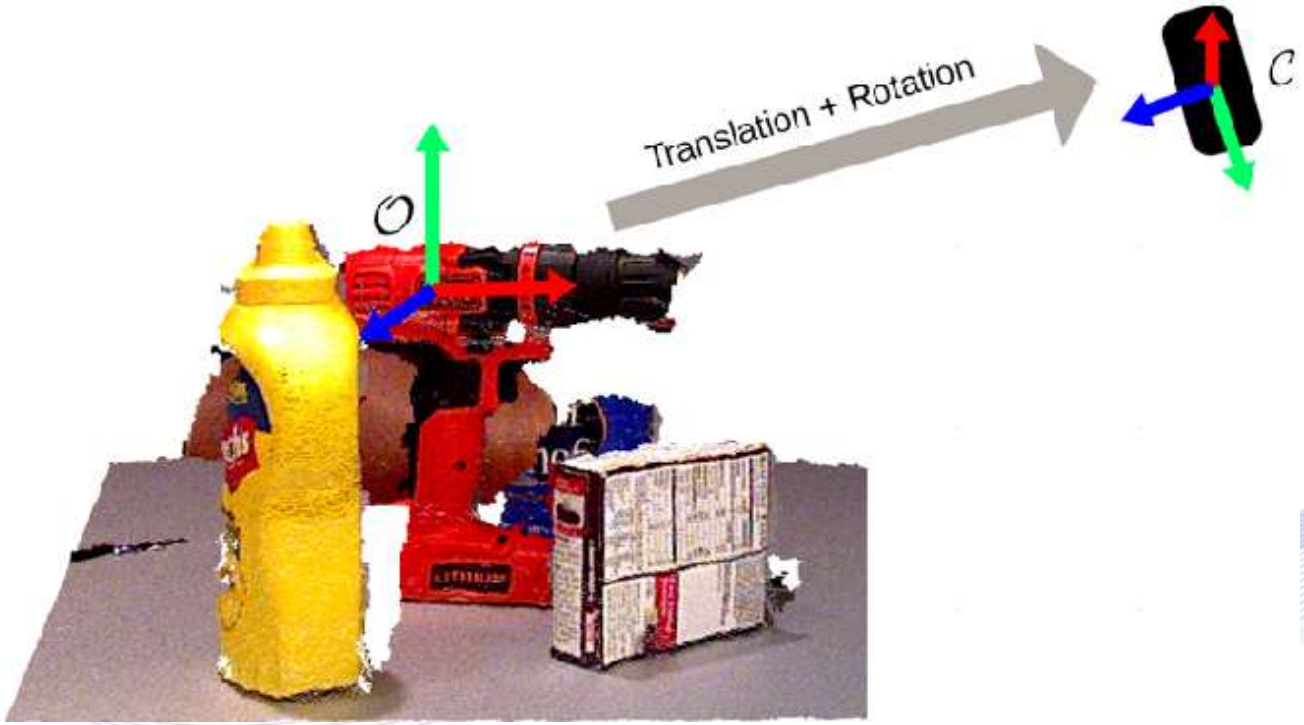
6D object pose estimation



Q & A

Thank you very much for your attention!

Contact: Prof. I. Pitas
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