3D Data Processing

Introduction of 3D Data Processing

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Many slides from lecture note of UIUC (Prof. Derek Hoiem)

Computer Vision

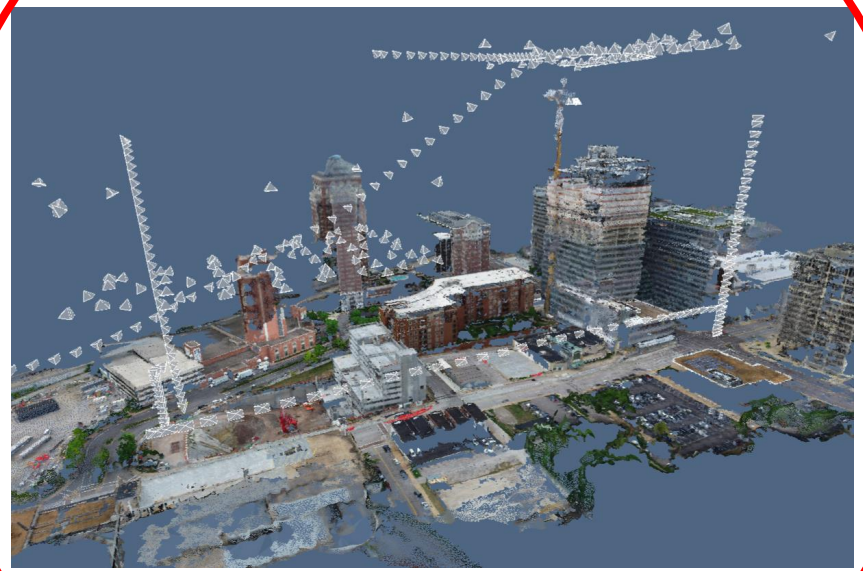
What

[Kirillov et al 2019]

Who

[Sun et al 2019]

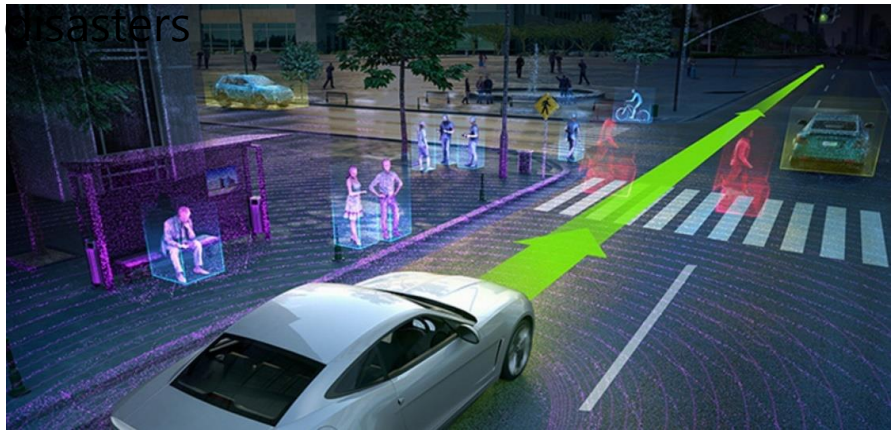
Where



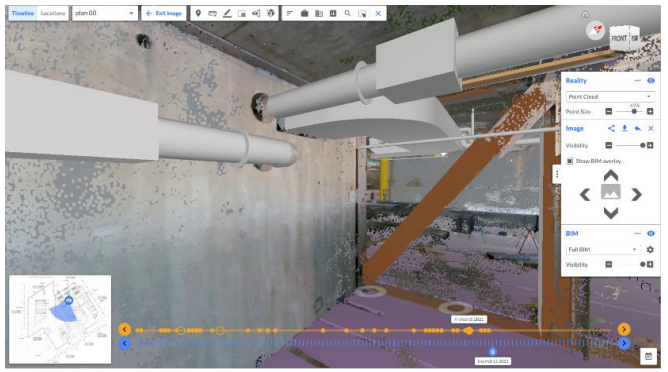
Reconstruct

3D Vision

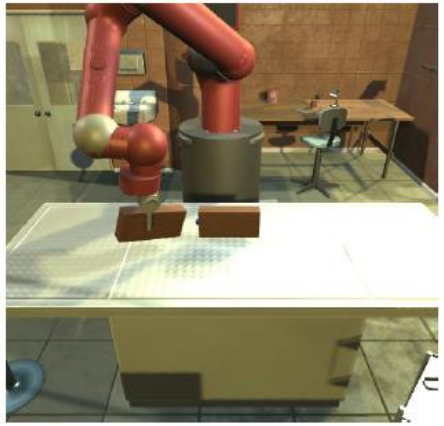
Inspection: Reduce cost and time of inspecti on to enable frequent inspection and reduce disasters



Driving: Fewer accidents, less stress



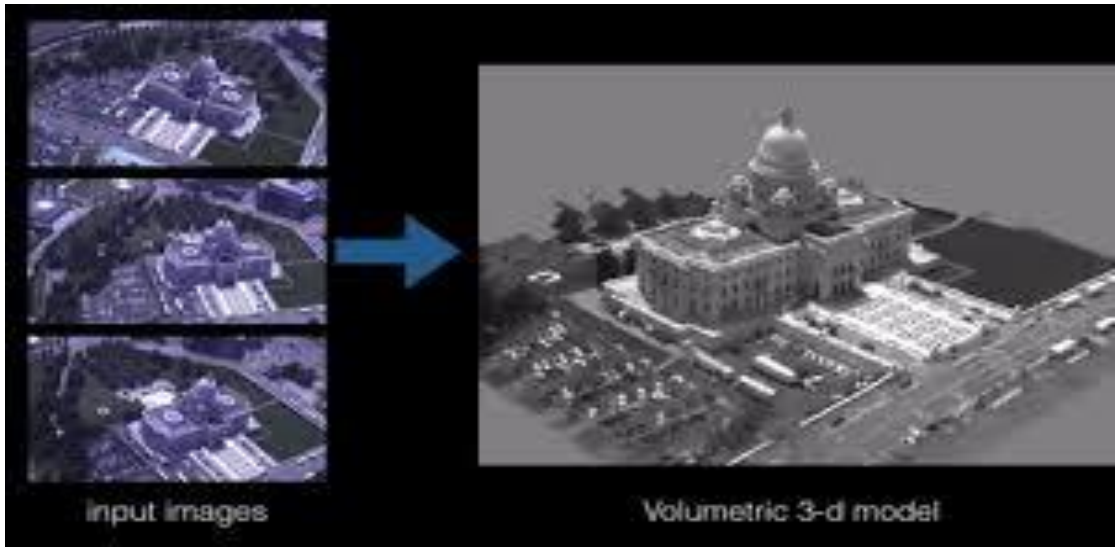
Construction: Reduce schedule cost, risk, and plan d eviation to benefit builders, owners, and dwellers



Robotics: Do repetitive jobs fast, dangerous jobs safely

Image: Hu et al. 2019

3D Vision

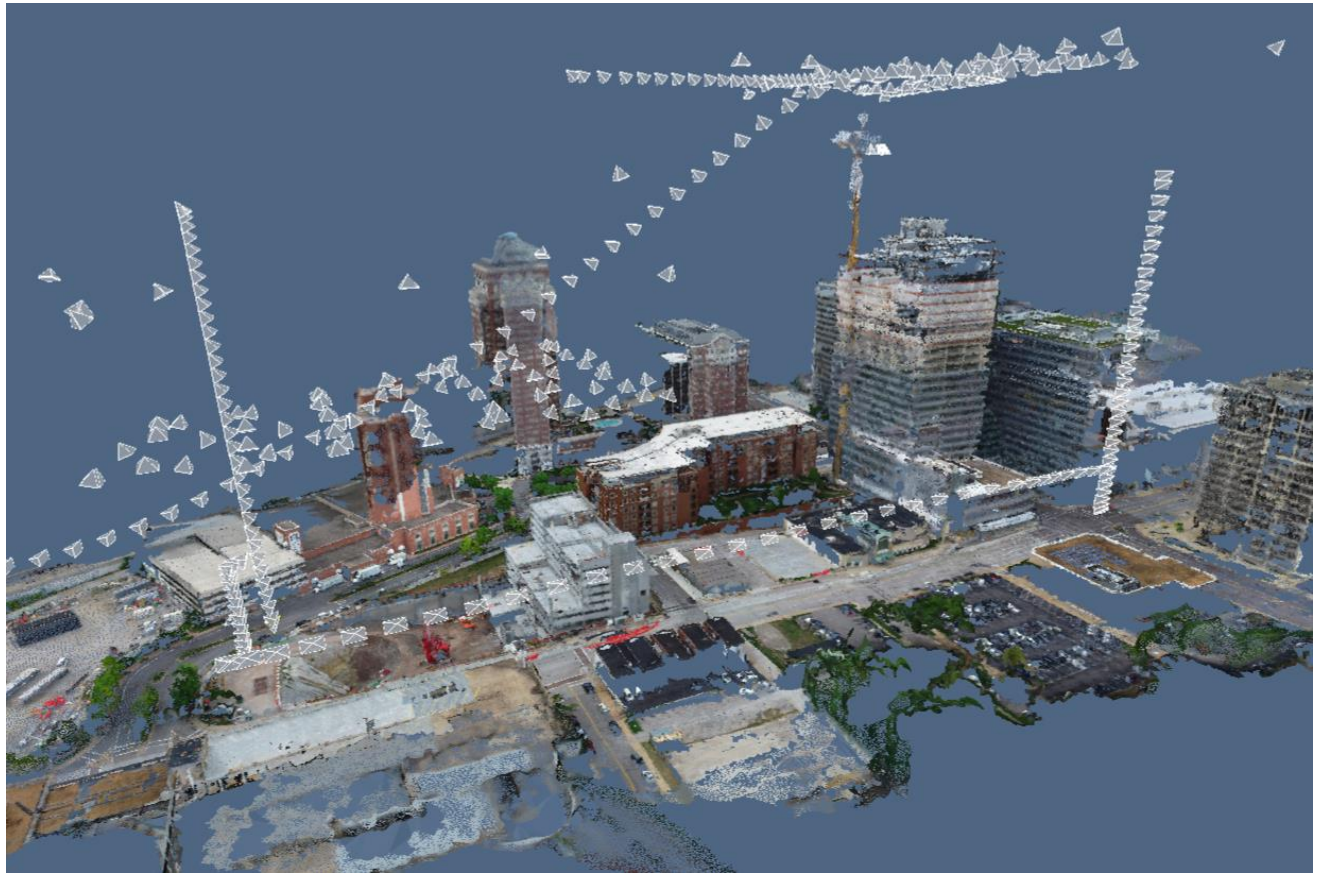


metaverse

digital twin

3D Reconstruction

Multiview Reconstruction



[Reconstruct]

Single-view Reconstruction

[Zou et al. 2018]

3D Reconstruction

Mesh-based

[Riegler Kolton 2020]

NeRF

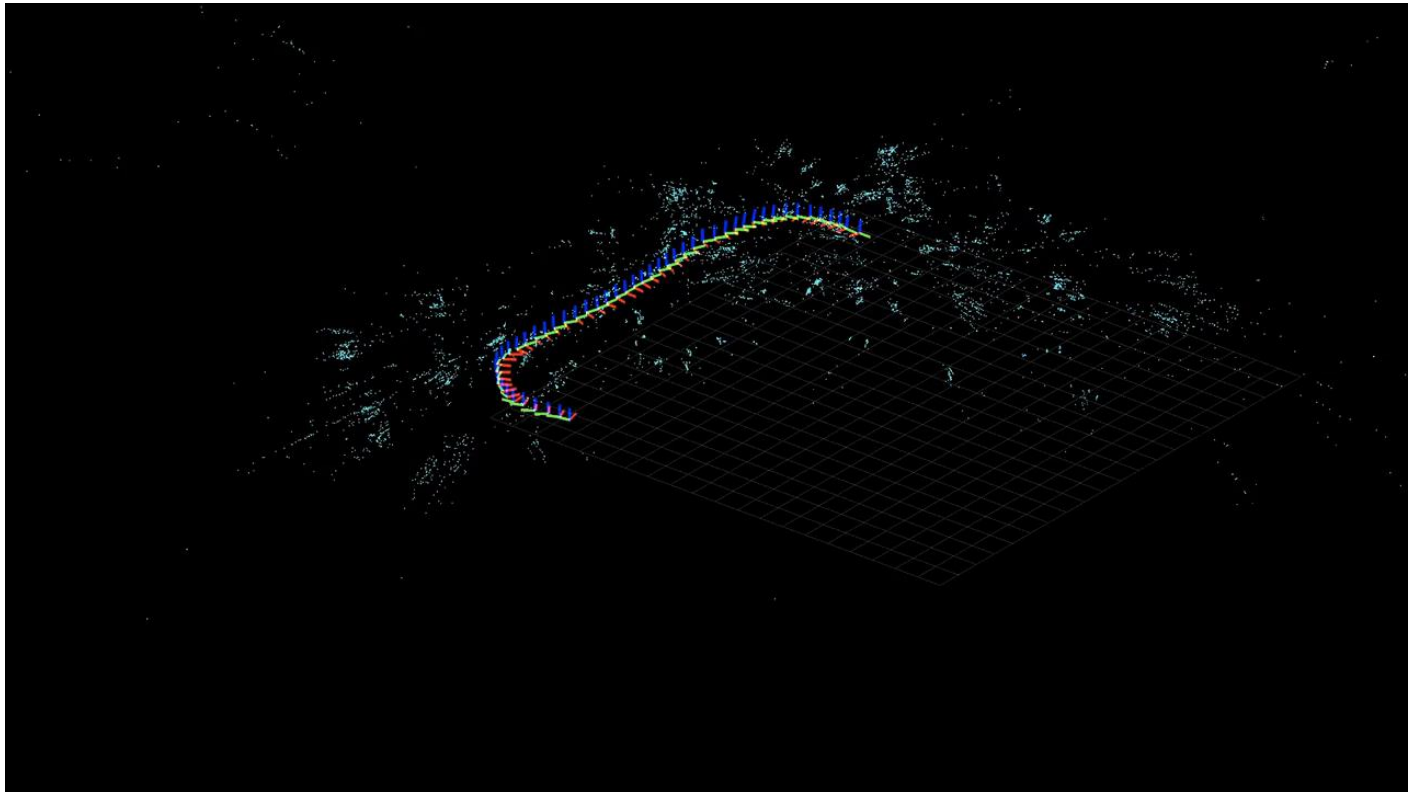
[Mildenhall et al. 2020]

Localization

Structure from Motion (SfM)

[Reconstruct]

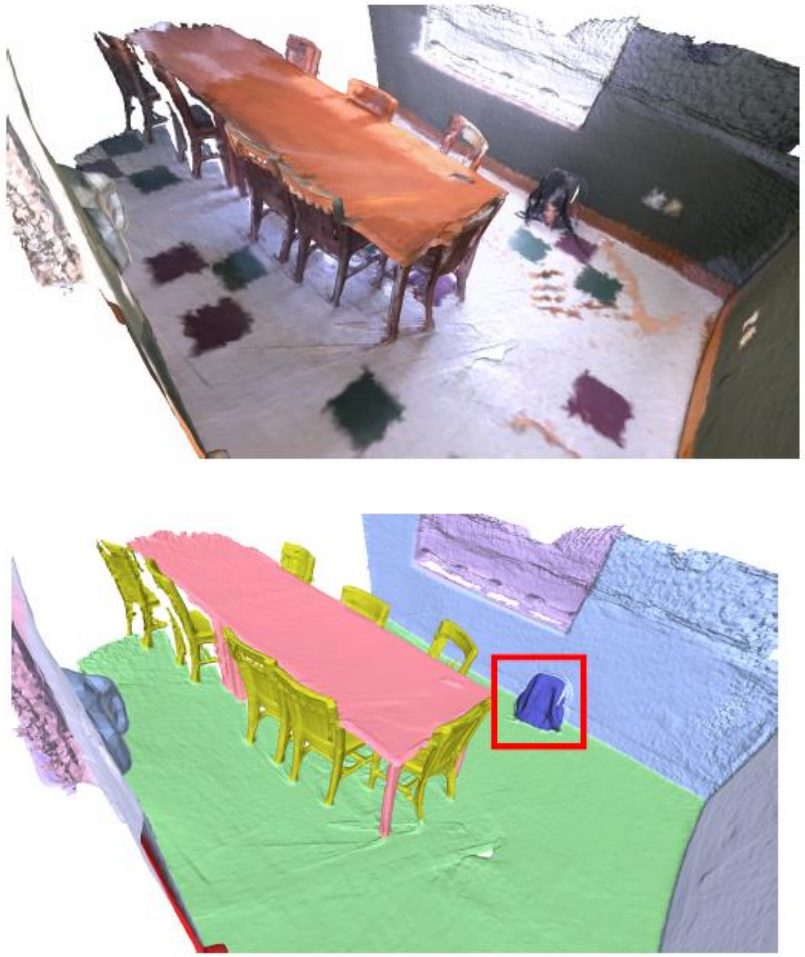
Simultaneous Localization and Mapping (SLAM)



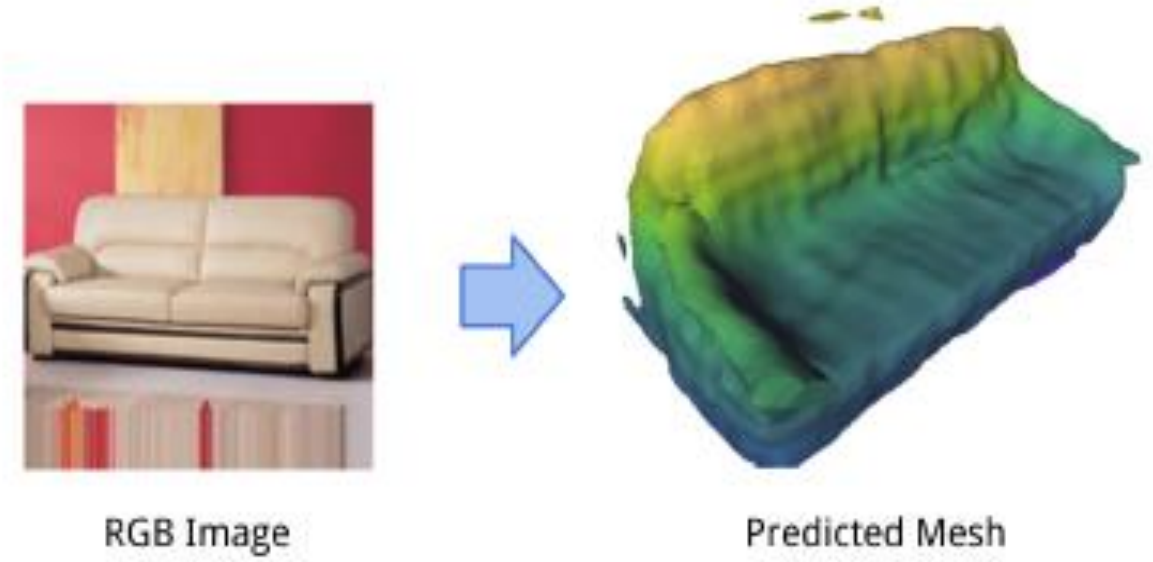
[OpenSpace.ai]

Pose estimation

Semantic Segmentation



[Hu et al. 2021]



[Shin et al. 2018]

3D Data Processing

- We do reconstruct 3D using geometry (some optimization technique)

single-view 3D reconstruction

소프트웨

with Efros, Hebert

multiple-view 3D reconstruction

with Efros, Hebert

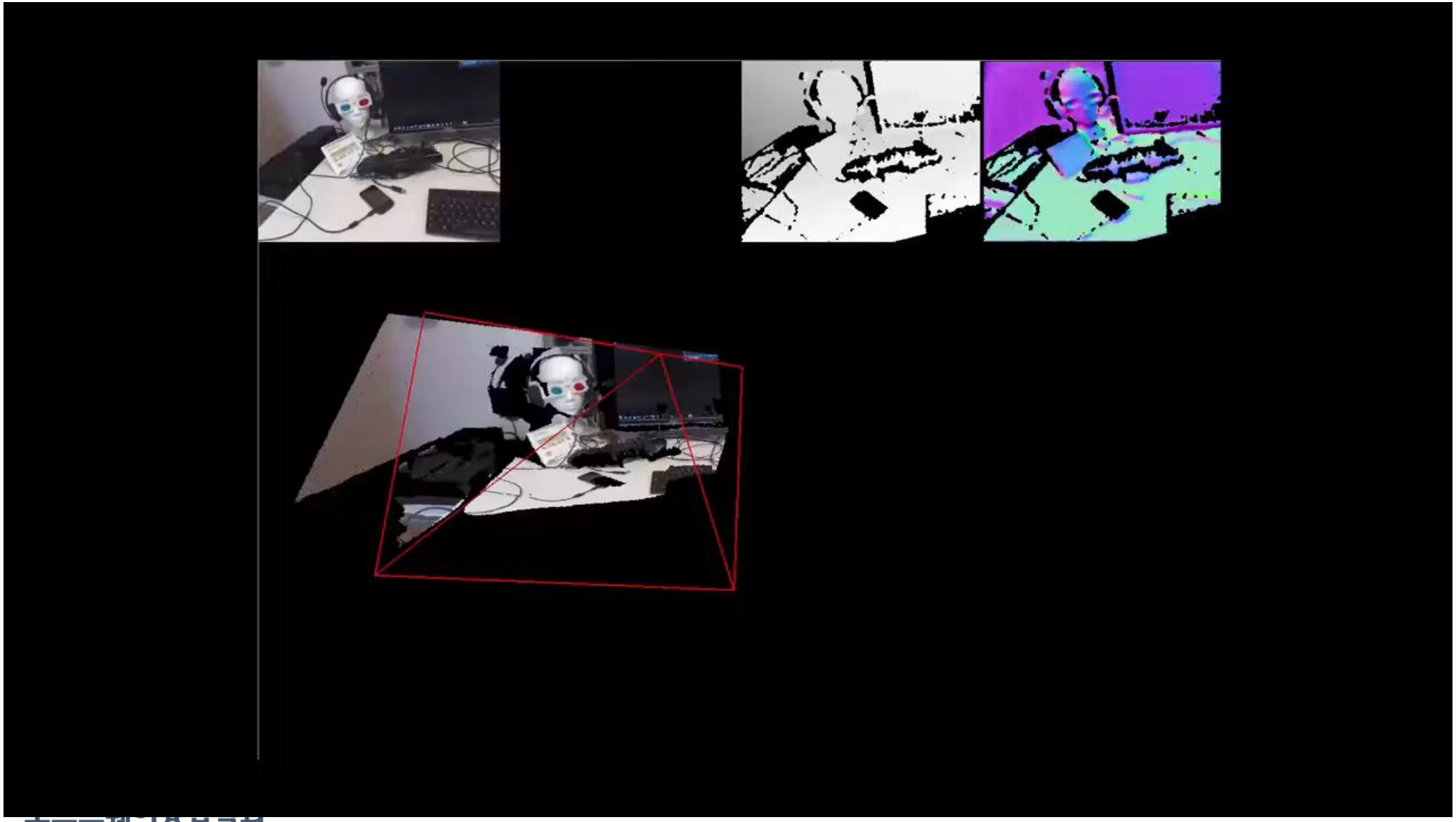
Sparse 3D reconstruction - SLAM

with Efros, Hebert

Point Clouds 3D reconstruction

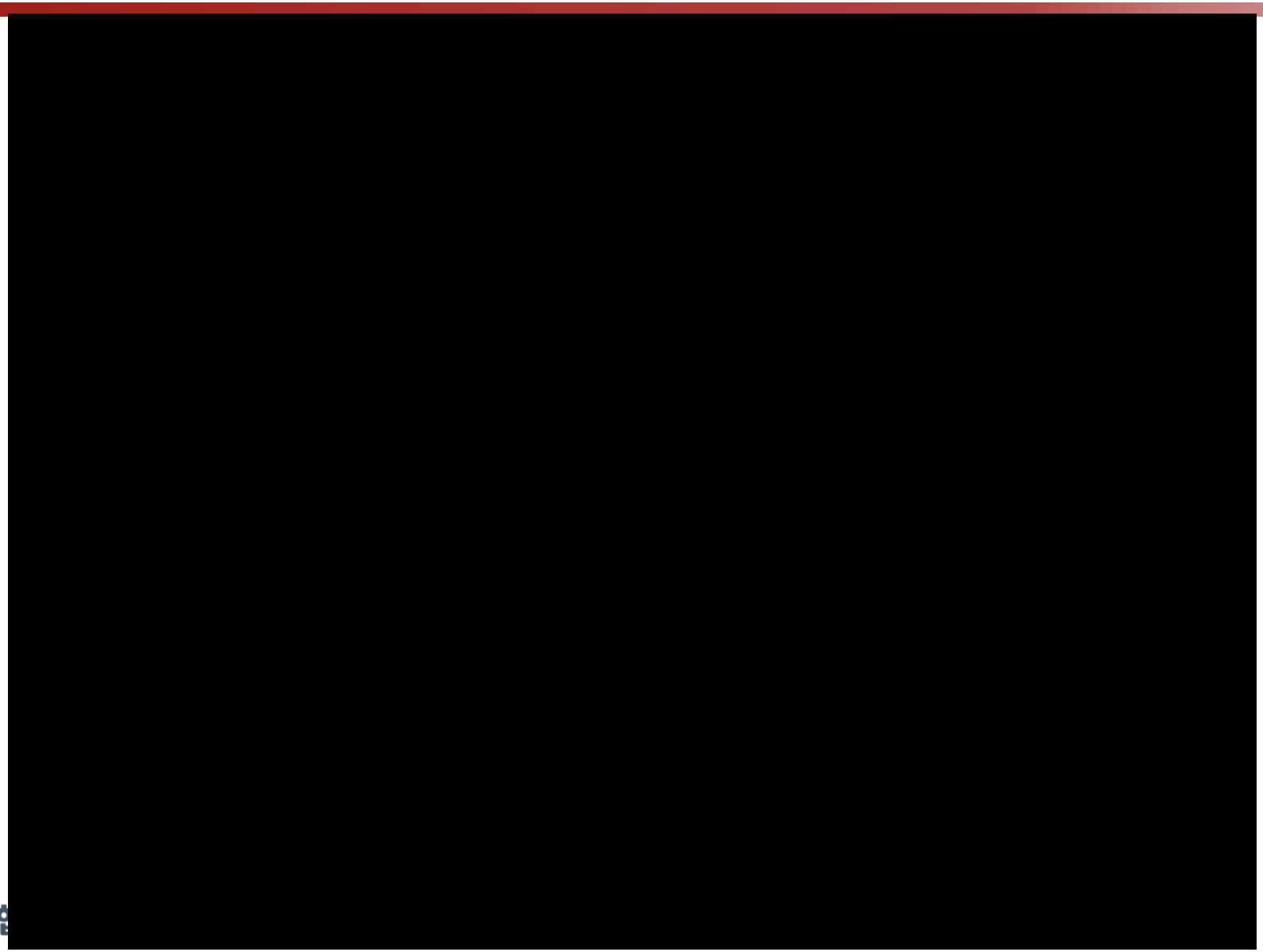
https://youtu.be/orTH1XichlQ

Point Clouds 3D reconstruction



https://youtu.be/vbqWfGcXc6I

Structure from motion (N images)



https://youtu.be/i7ierVkXYa8

Structure from motion (N uncalibrated images)

Creating 3D model of buildings and monuments using structure from motion

https://youtu.be/om-j9CEROmw

3D Data Processing

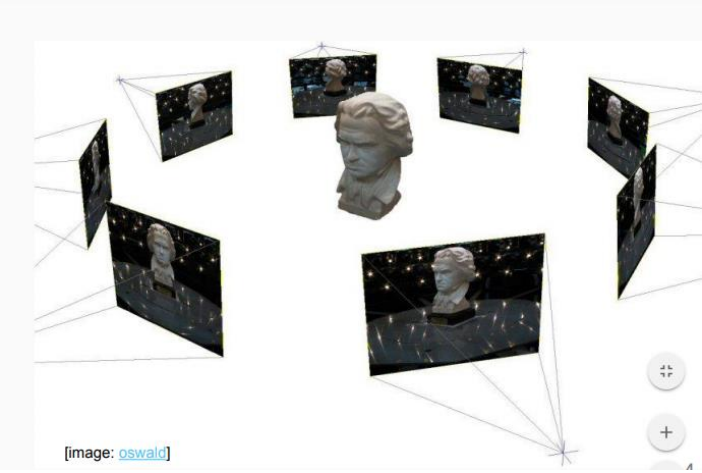
- We do not reconstruct 3D using probability, implicit model, and machine learning

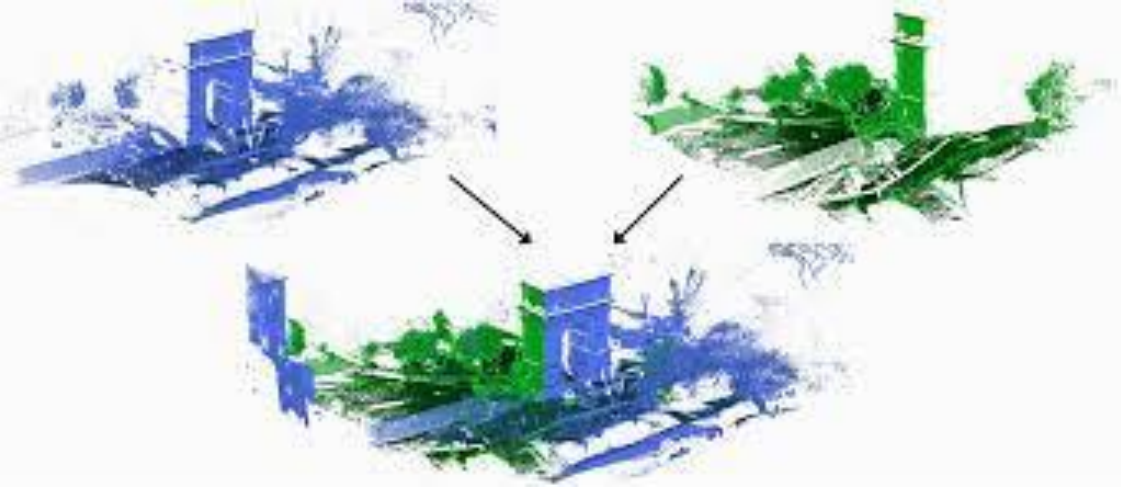
single-view 3D reconstruction – implicit model

with Efros, Hebert

3D Data Processing

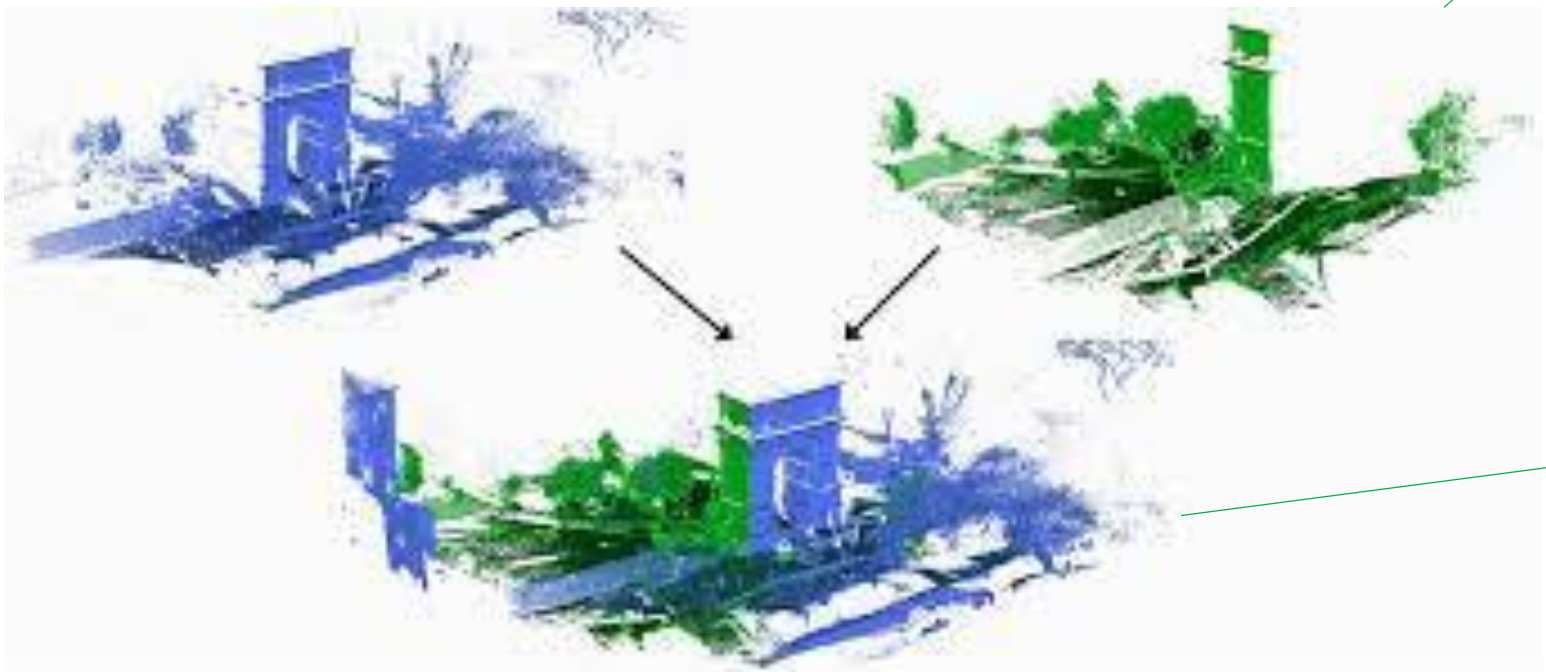
- We deal with 3D computer vision
  - 3D reconstruction
    - 2D-based reconstruction
    - 3D-based reconstruction
    - 2D-3D reconstruction





Course summary

- Top-down approach
  - What does it take to restore?
    - Case of 3D sensor



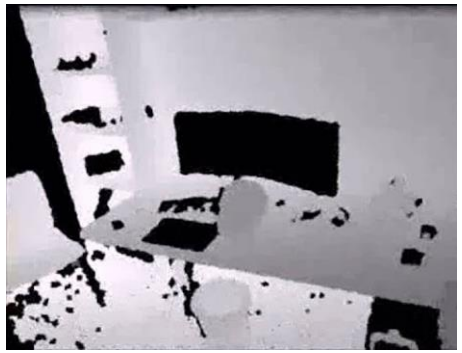
Point clouds processing
Week 9, 12

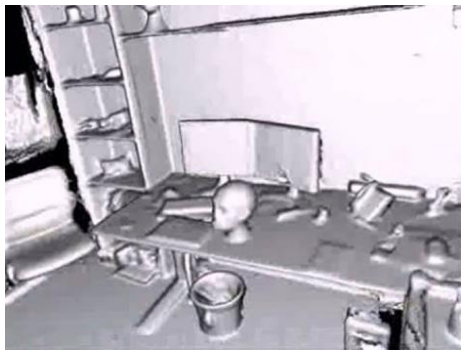
Lidar
Week 3

registration
Week 13

Course summary

- Top-down approach
  - What does it take to restore?
    - Case of 2+1D sensor (RGBD)



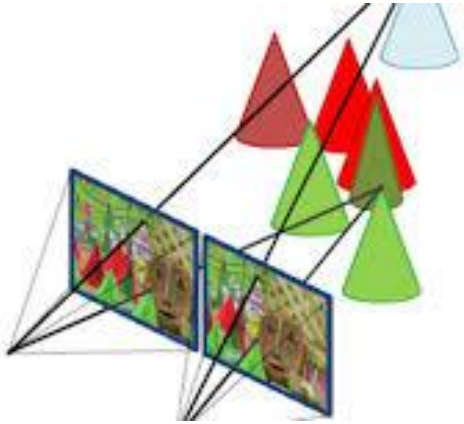


Camera, RGBD
Week 3

Depth, PC
Week 9, 11

Course summary

- Top-down approach
  - What does it take to restore?
    - Case of 2D sensor (RGB)



Camera	Stereo, triangulation	calibration	Structure from motion
Week 3	Week 10	Week 7	Week 14

Course summary

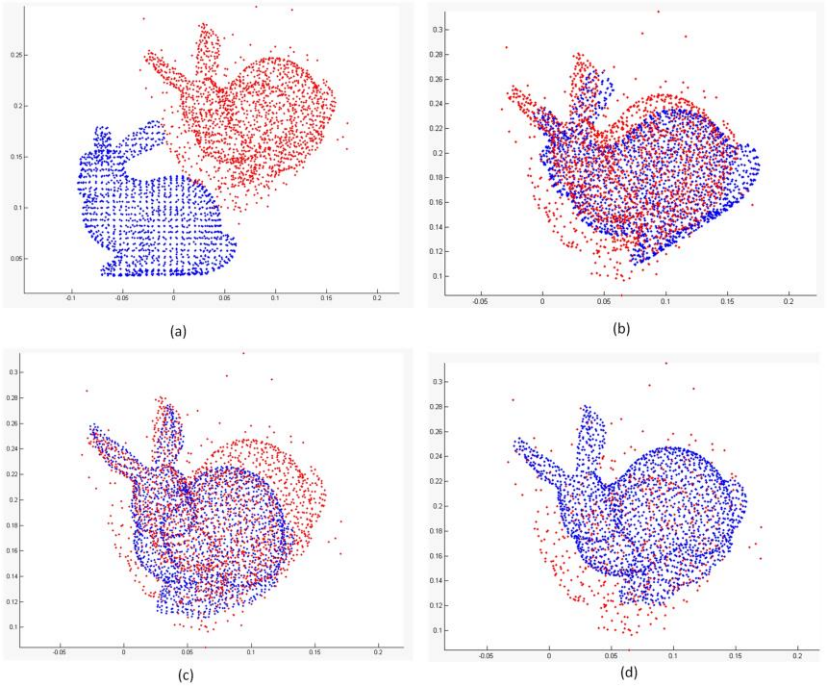
- Top-down approach
  - What does it take to restore?
    - Case of 2D sensor (RGB) → Feature point processing

Feature extraction
Week 6

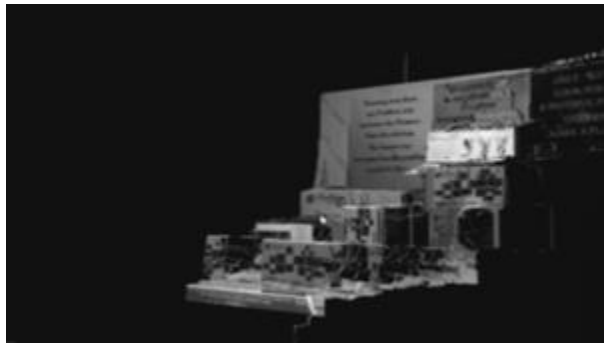
Feature descriptor
Week 7

Course summary

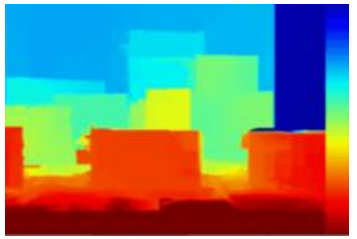
- Top-down approach
  - What does it take to restore?
    - Hybrid (2D-3D convert)



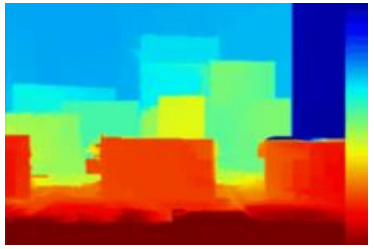
PC registration is hard



matching



convert



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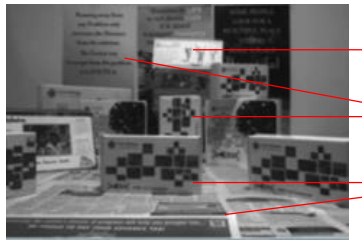
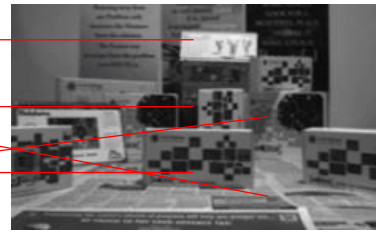


matching



Course summary

- Top-down approach
  - What does it take to restore?
    - Optimization (Bundle adjustment)