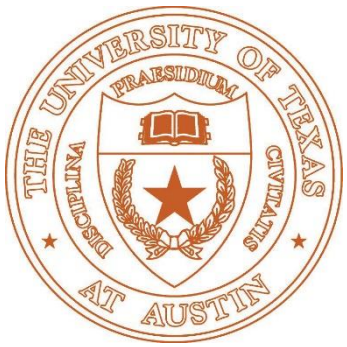
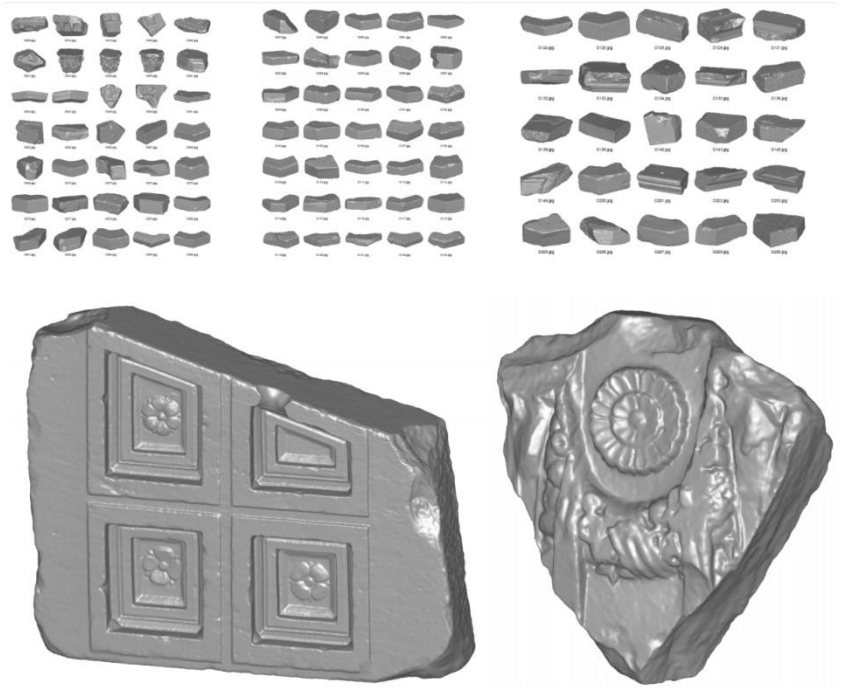
Overview of Geometry Reconstruction and Acquisition

Qixing Huang

Janurary 19th 2017



Geometry Reconstruction and Acquisition



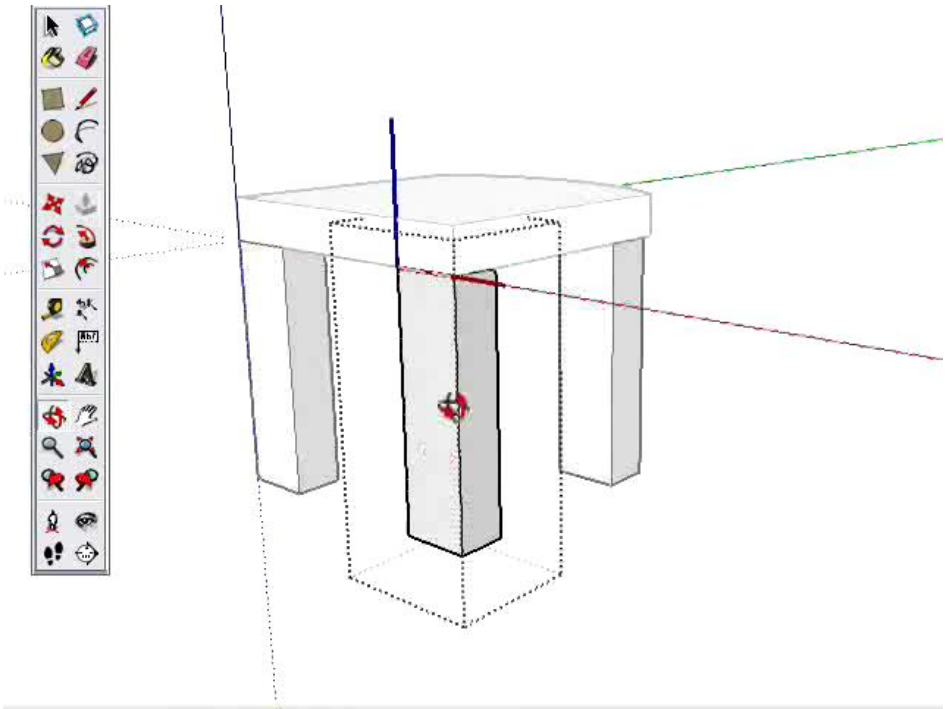
Method I --- Using 3D Scanners

Method II --- Image-Based Modeling

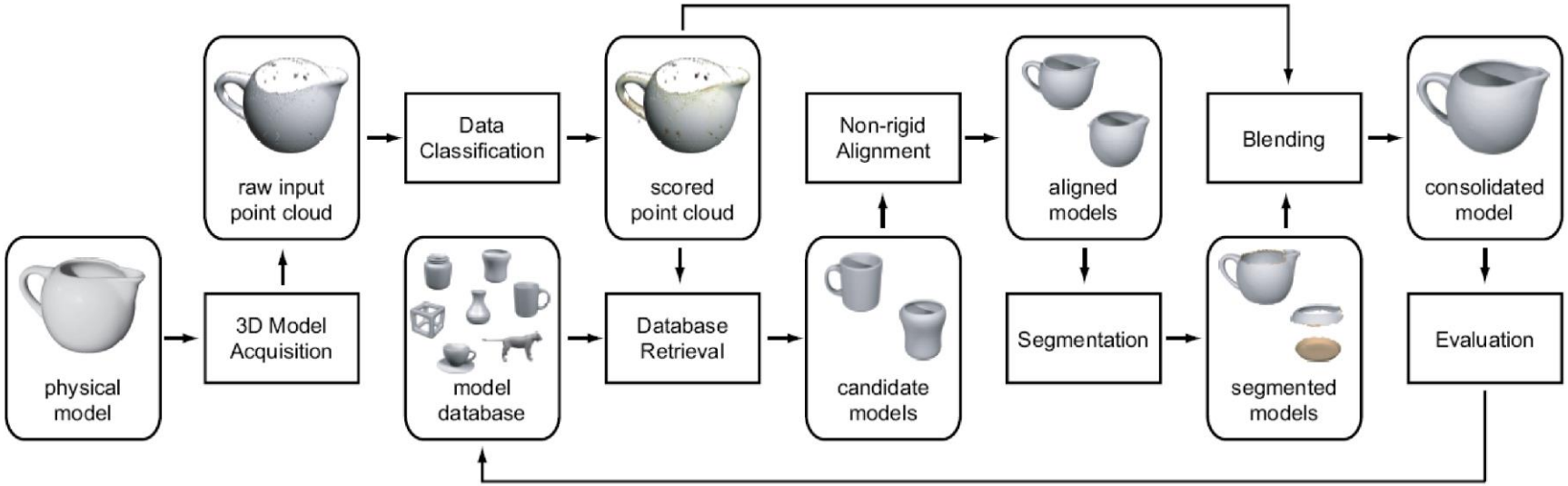
Touch Probes

Faro Arm – Faro Technologies, Inc.

Interactive Modeling



Data-driven geometry reconstruction



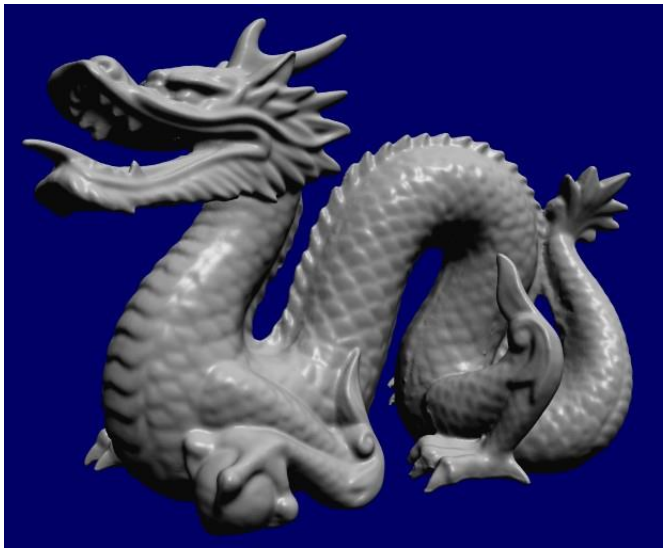
Projects to Remember

Stanford Model Repository (1994-2000)

69451 triangles

Stanford Model Repository (1994-2000)

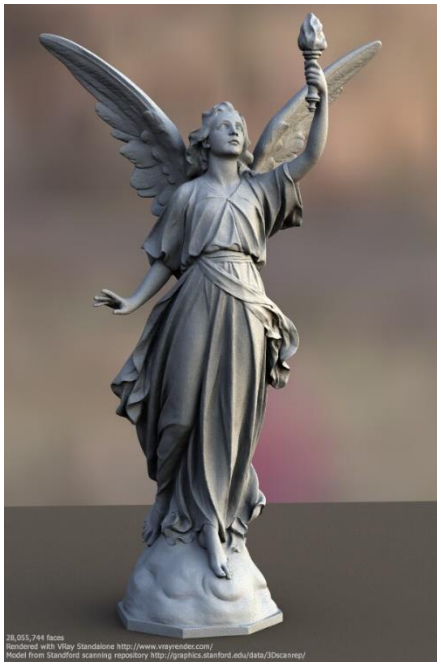
1,087,716
triangles



1,132,830
triangles

345,944
triangles

Stanford Model Repository (1994-2000)

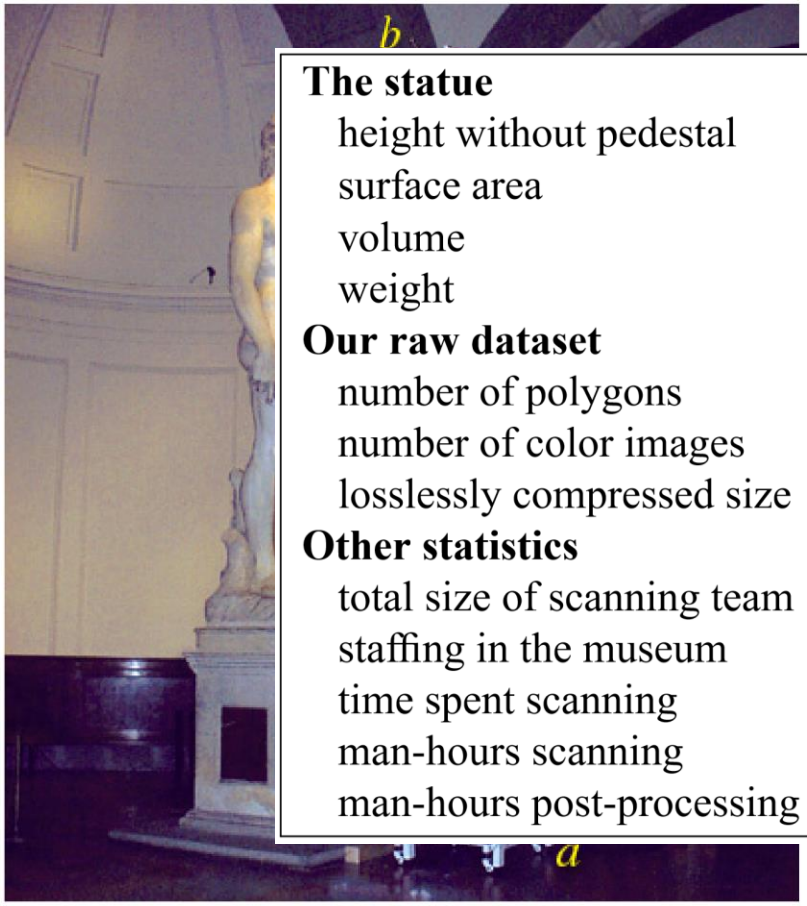


28,055,742
triangles

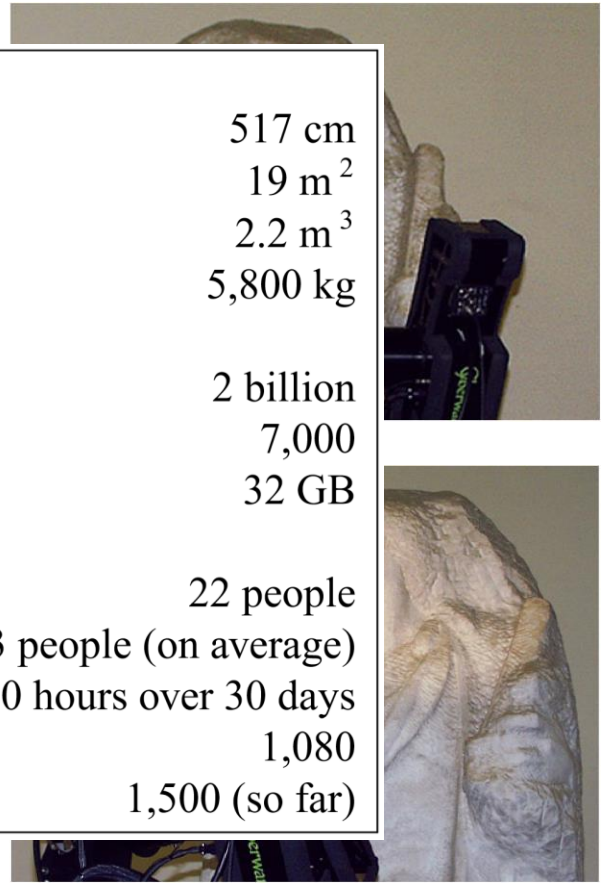
7,218,906
triangles

10,000,000
triangles

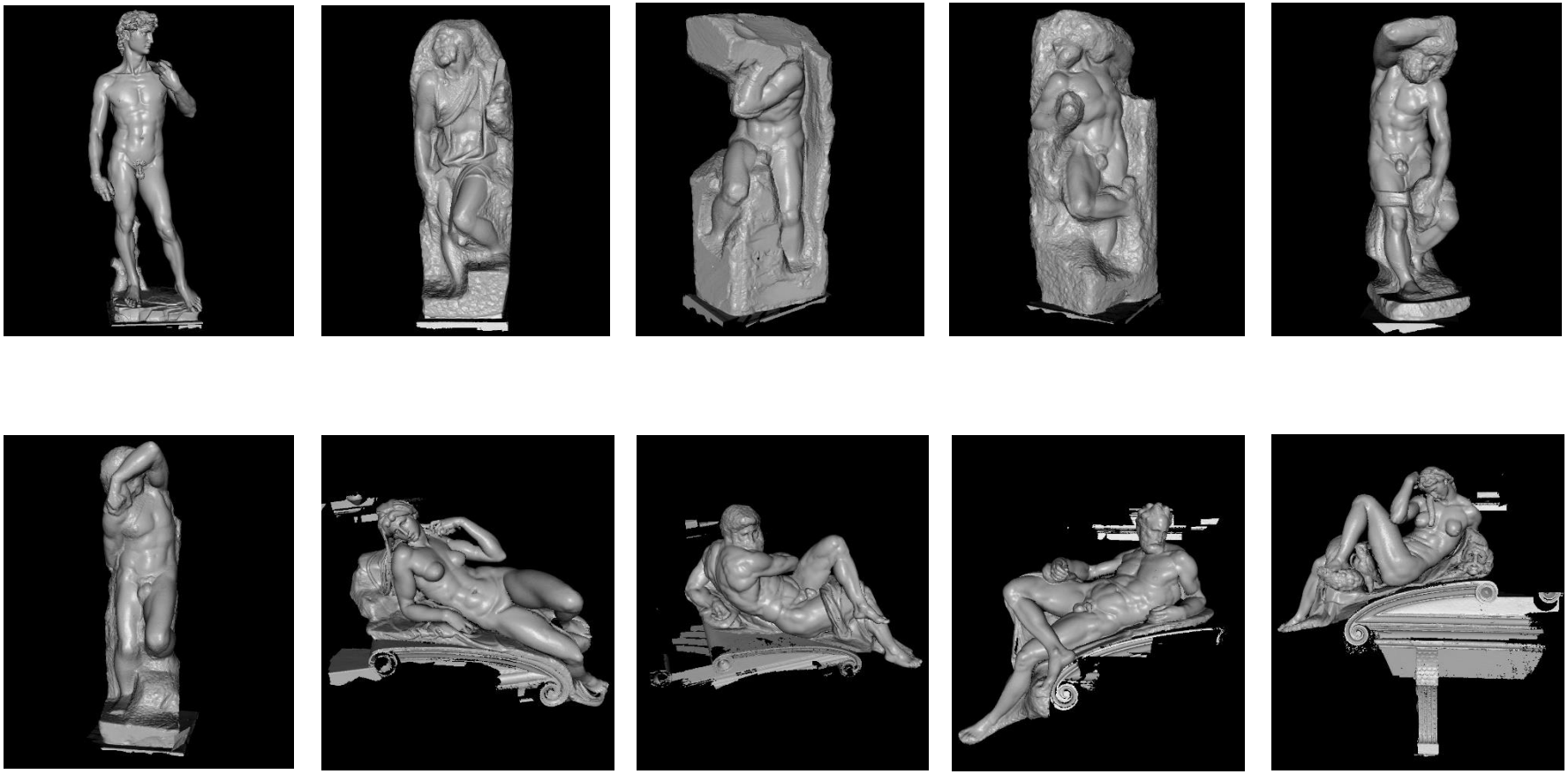
The Digital Michelangelo Project (2000)



The statue	
height without pedestal	517 cm
surface area	19 m^2
volume	2.2 m^3
weight	5,800 kg
Our raw dataset	
number of polygons	2 billion
number of color images	7,000
losslessly compressed size	32 GB
Other statistics	
total size of scanning team	22 people
staffing in the museum	3 people (on average)
time spent scanning	360 hours over 30 days
man-hours scanning	1,080
man-hours post-processing	1,500 (so far)



The Digital Michelangelo Project (2000)



A Large Dataset of Object Scans

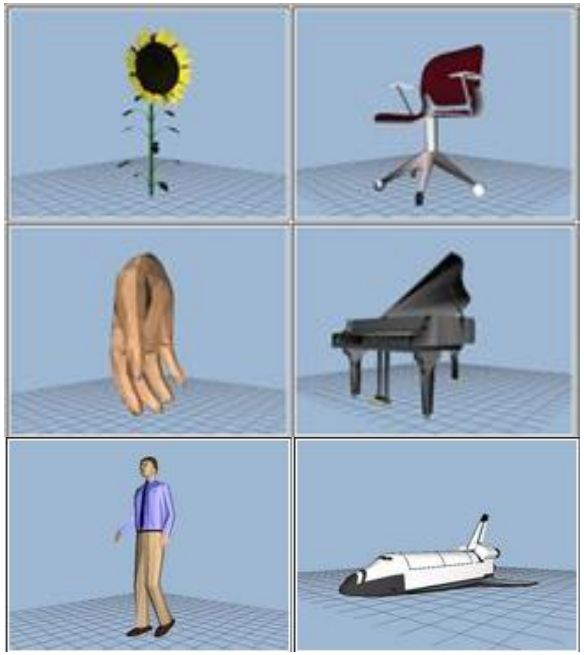
[Choi et al. 16]

10K 3D models

Other Projects

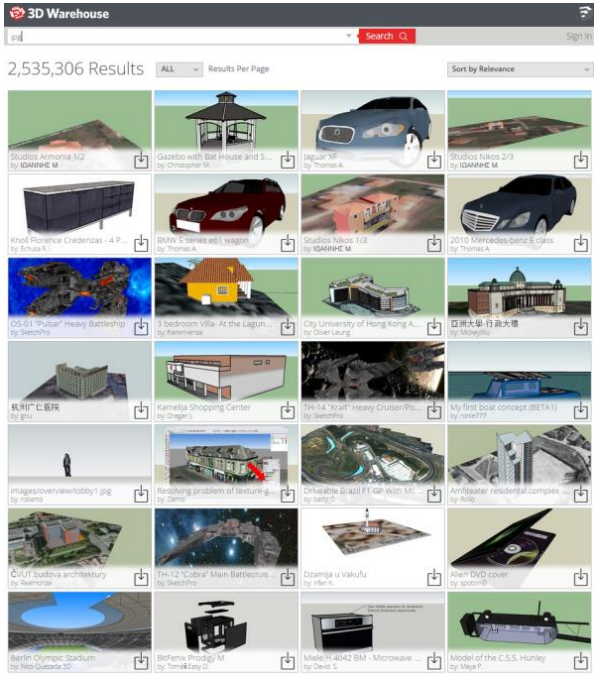
Princeton Shape Benchmark

1800 models in **90** categories

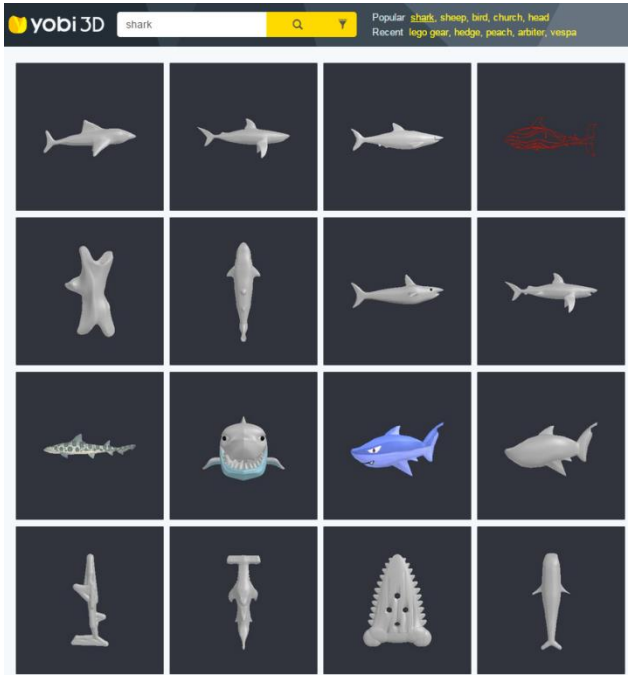


Princeton shape benchmark
[Shilane et al. 04]

Large-scale online repositories



3D Warehouse



Yobi3D

3M models in more than 4K categories

Discussion:
What is the next landmark project?

Applications of Geometry Reconstruction

Model Checking

Stability Analysis

Virtual Reality

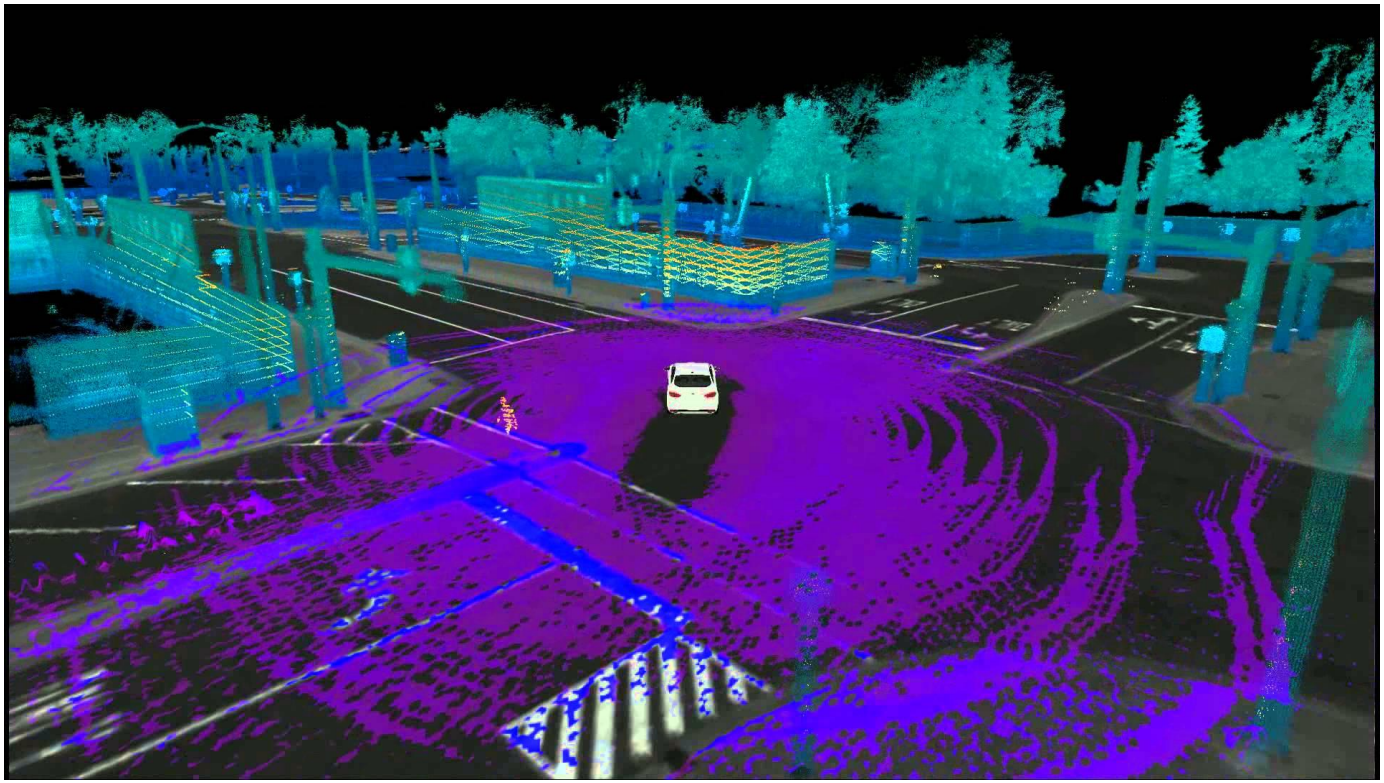
3D Scanning for Games

Medical Applications

Medical Applications

Autonomous Driving

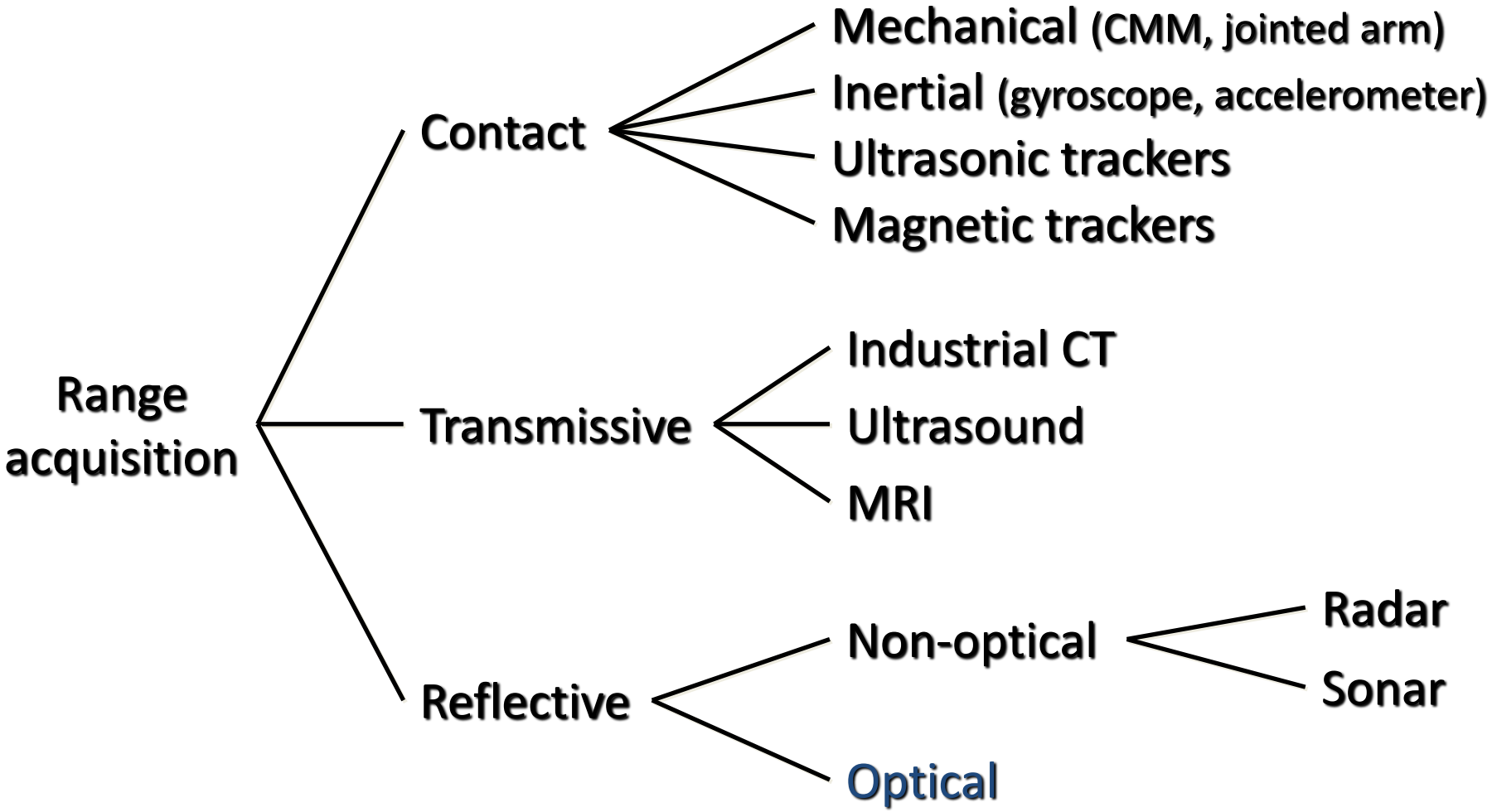
Autonomous Driving



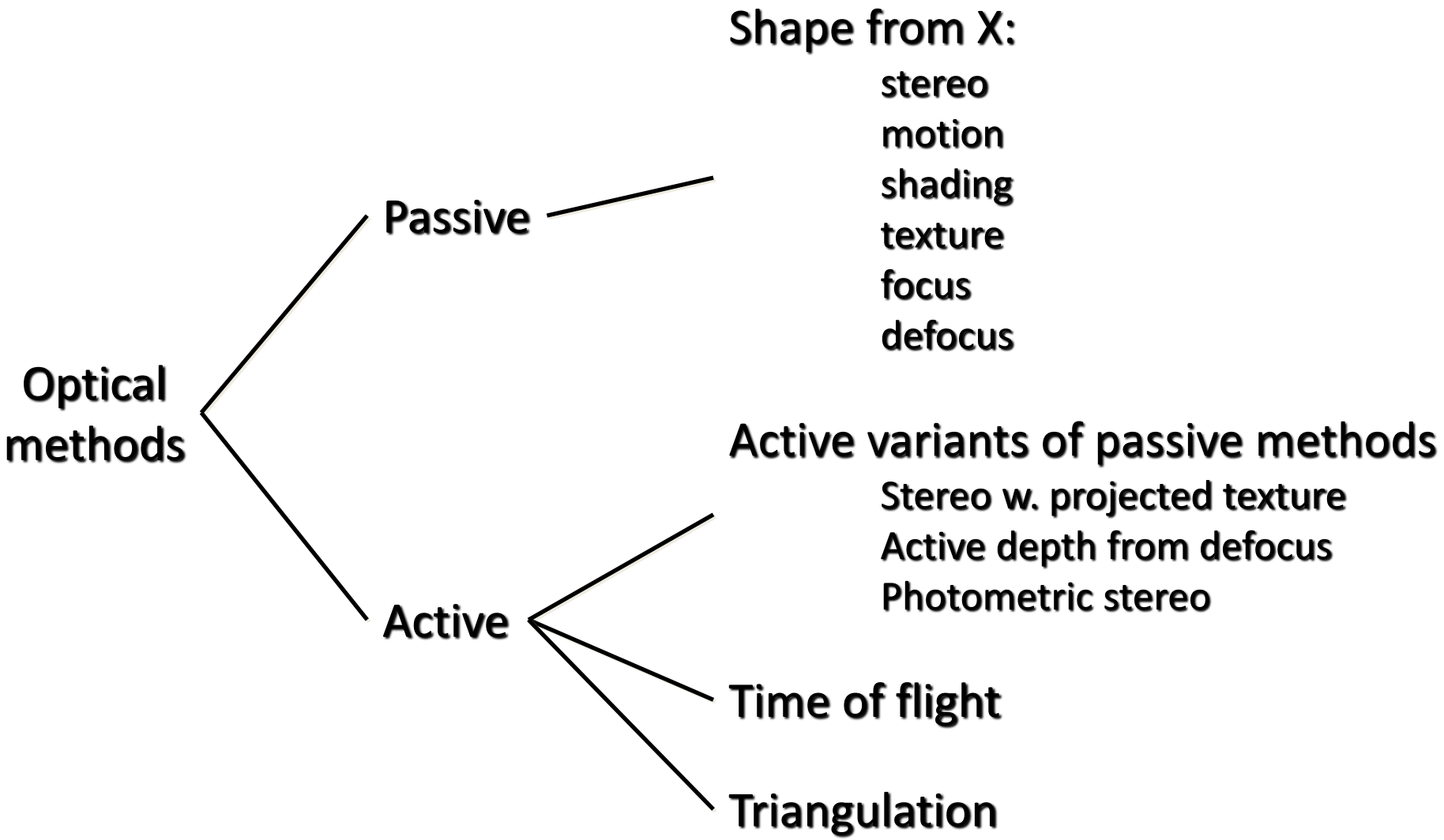
Geometry Reconstruction from 3D Scanners

Acquisition

Range Acquisition Taxonomy

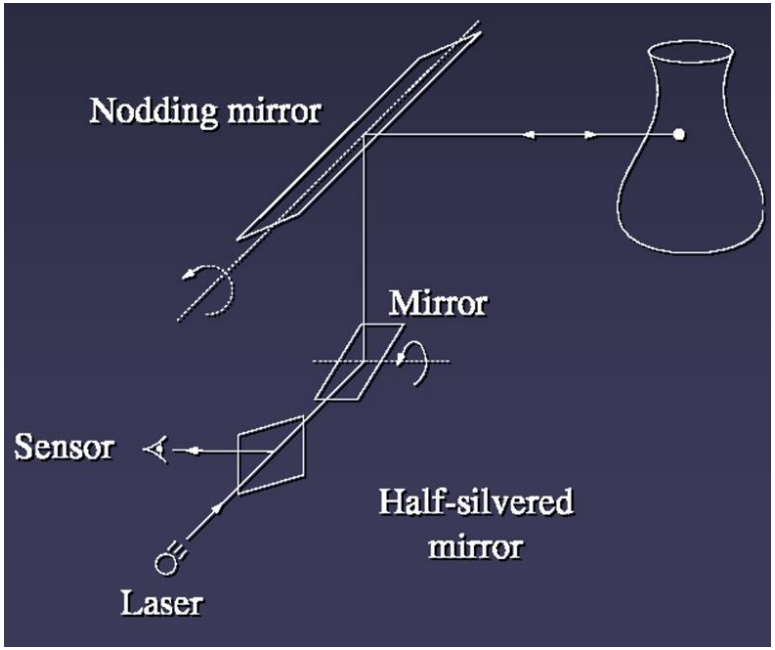


Range Acquisition Taxonomy



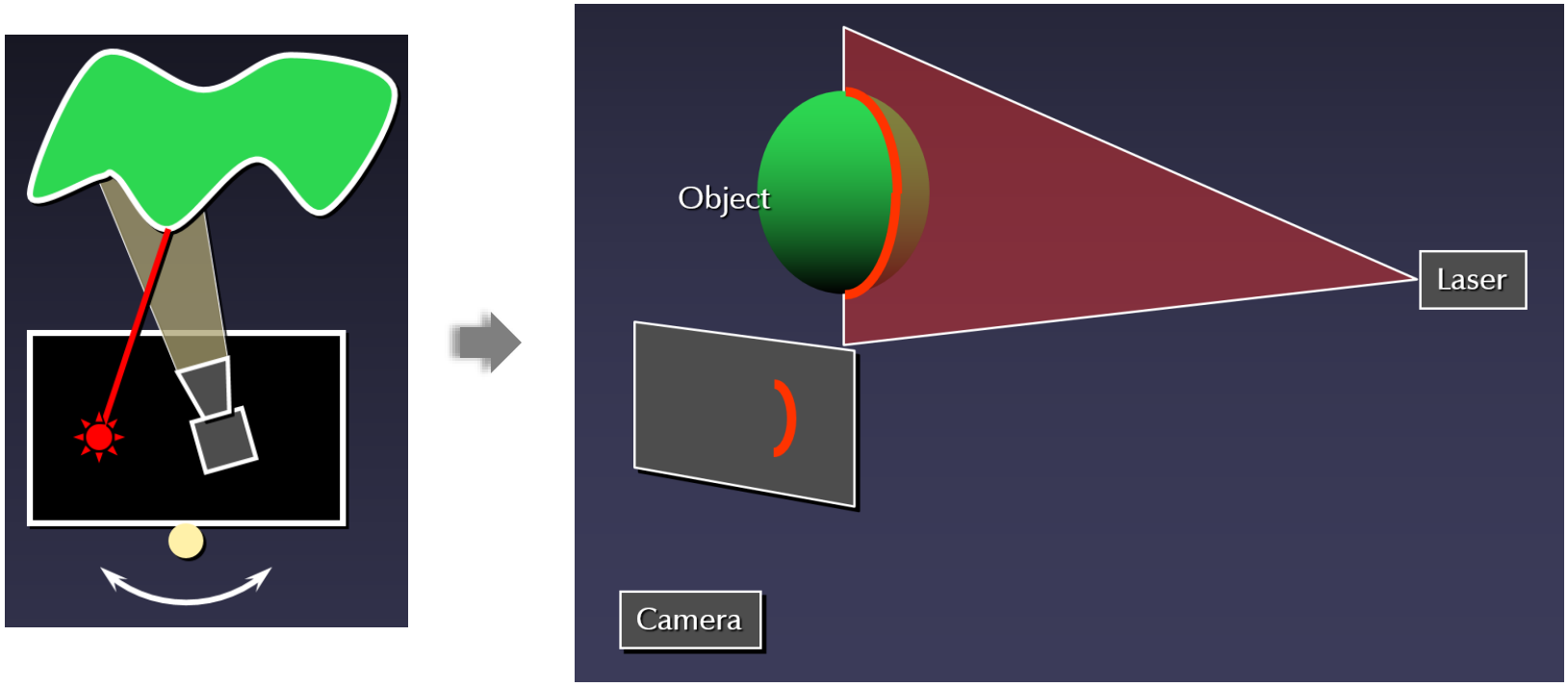
Time of Flight

- Send out pulse of light (usually laser), time how long it takes to return



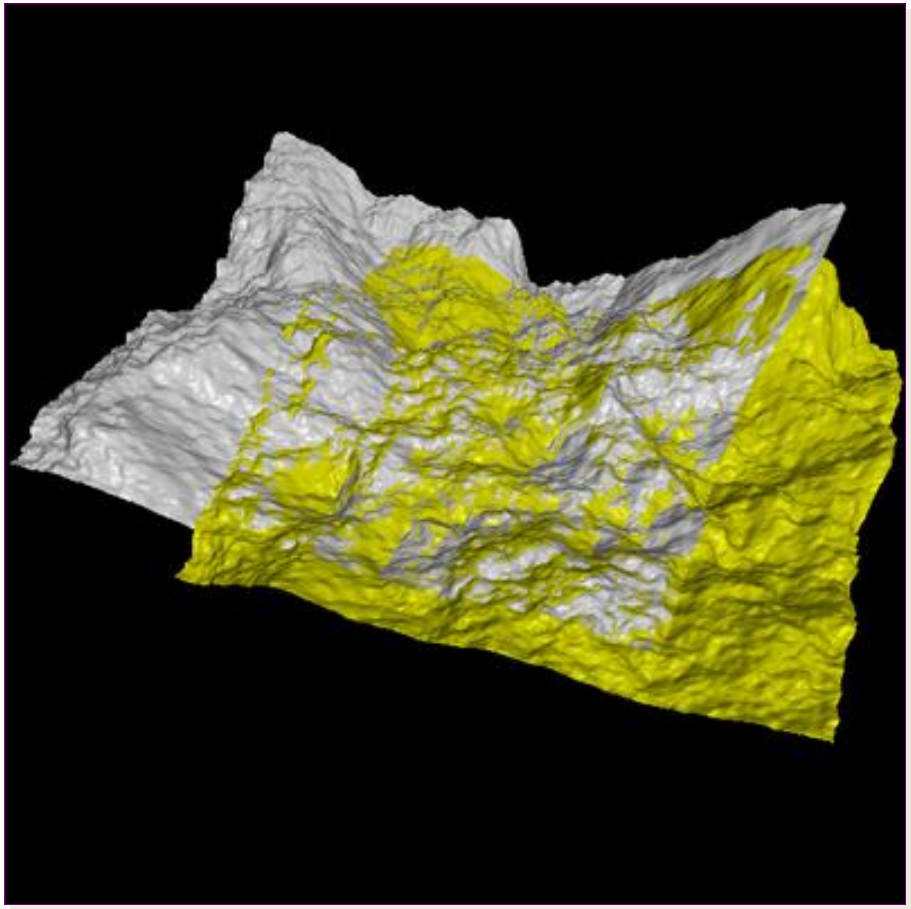
Buildings + Large Volumes

Triangulation



Registration

Geometry Registration

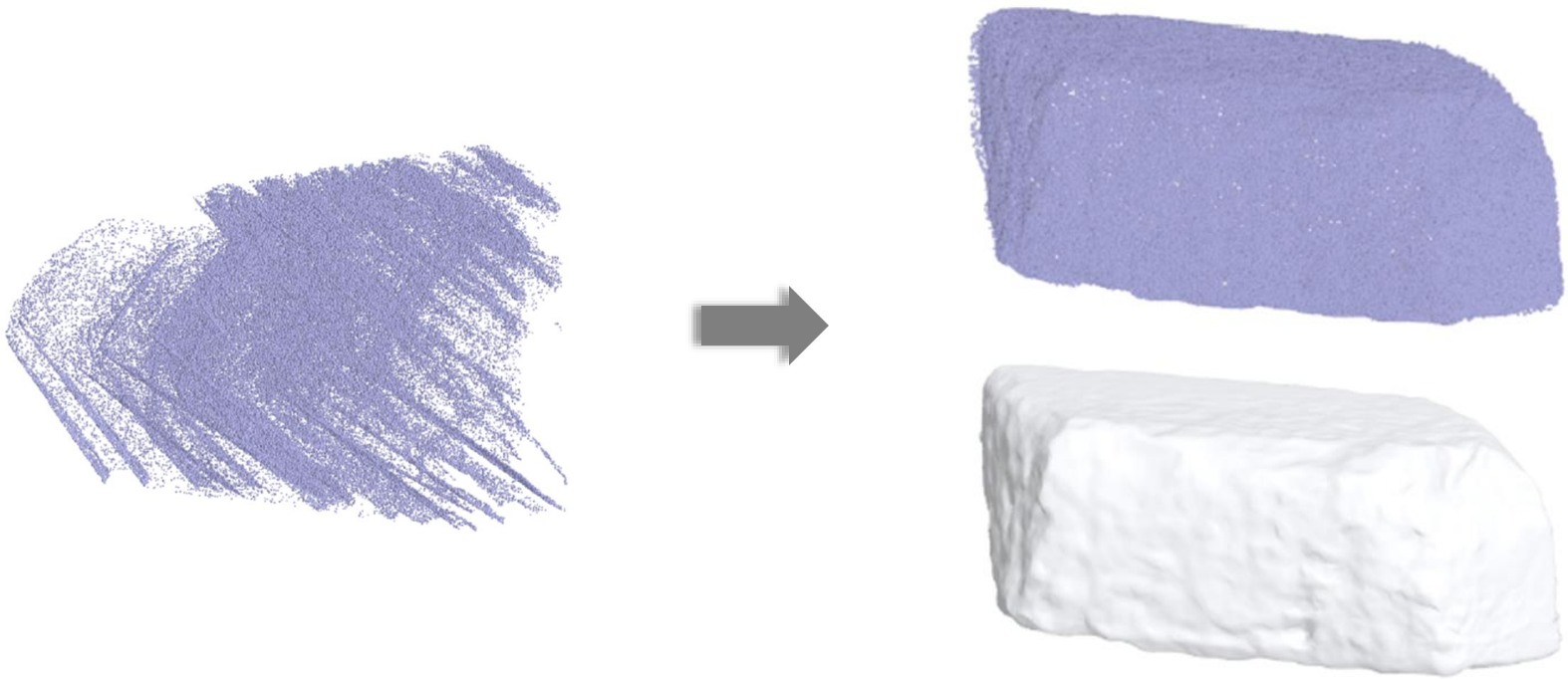


ICP:

Point-2-point

Point-2-plane

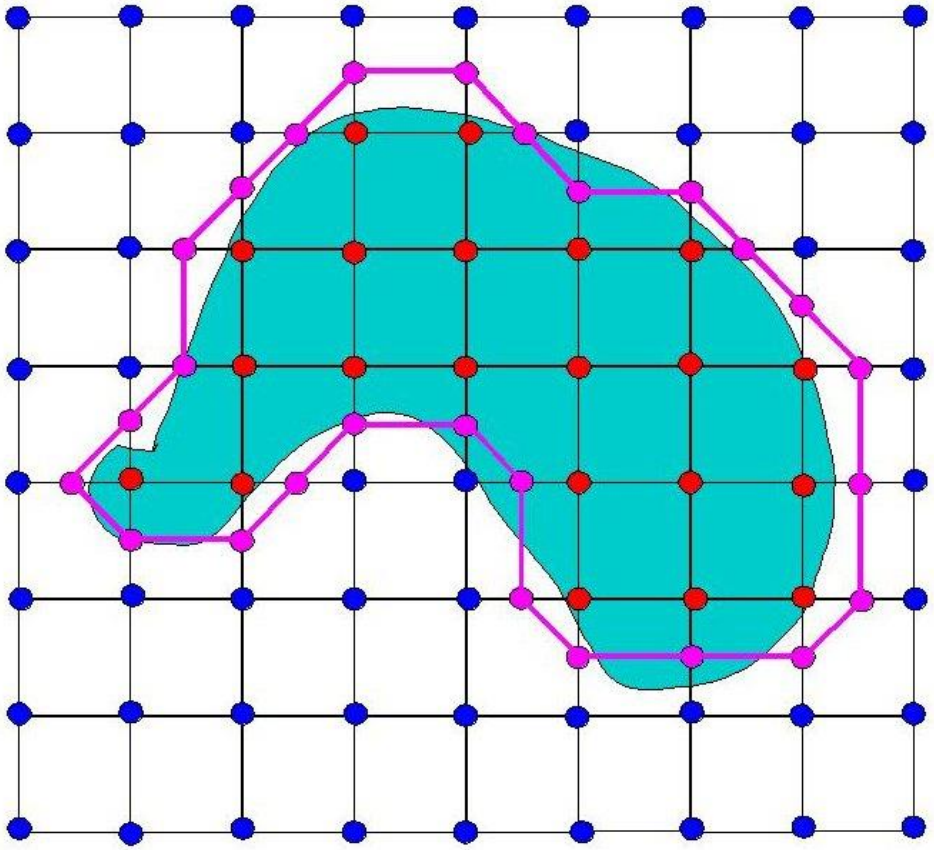
Multi-View Registration



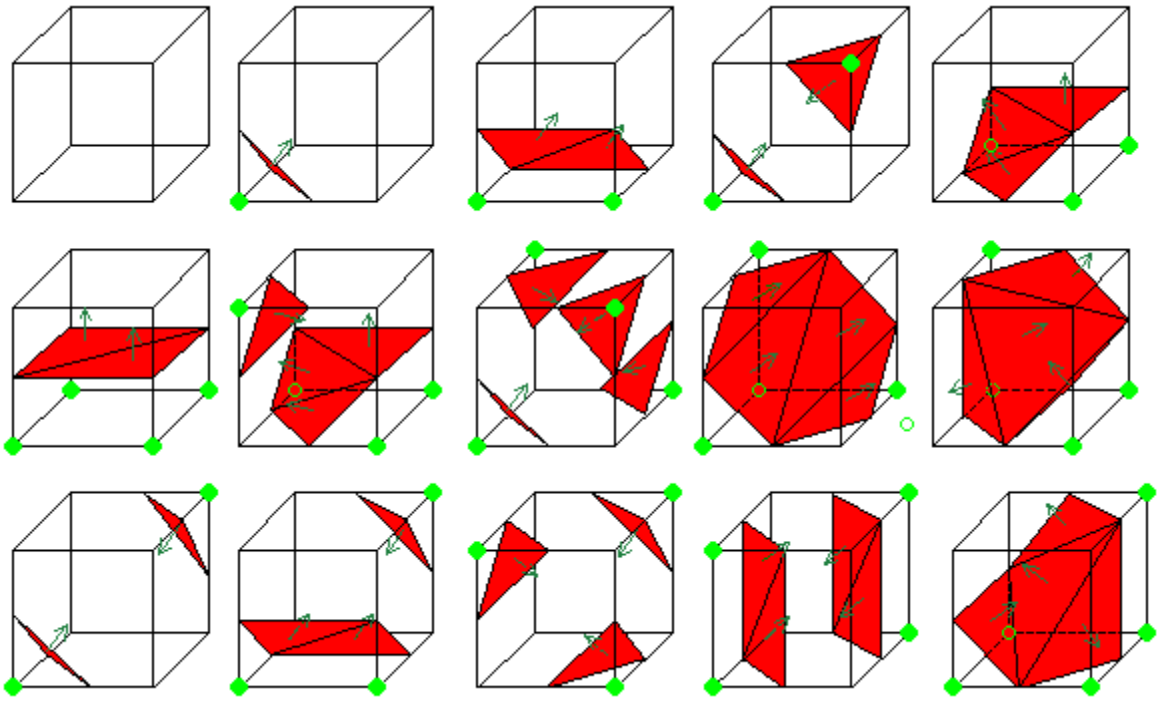
Discussion

Reconstruction

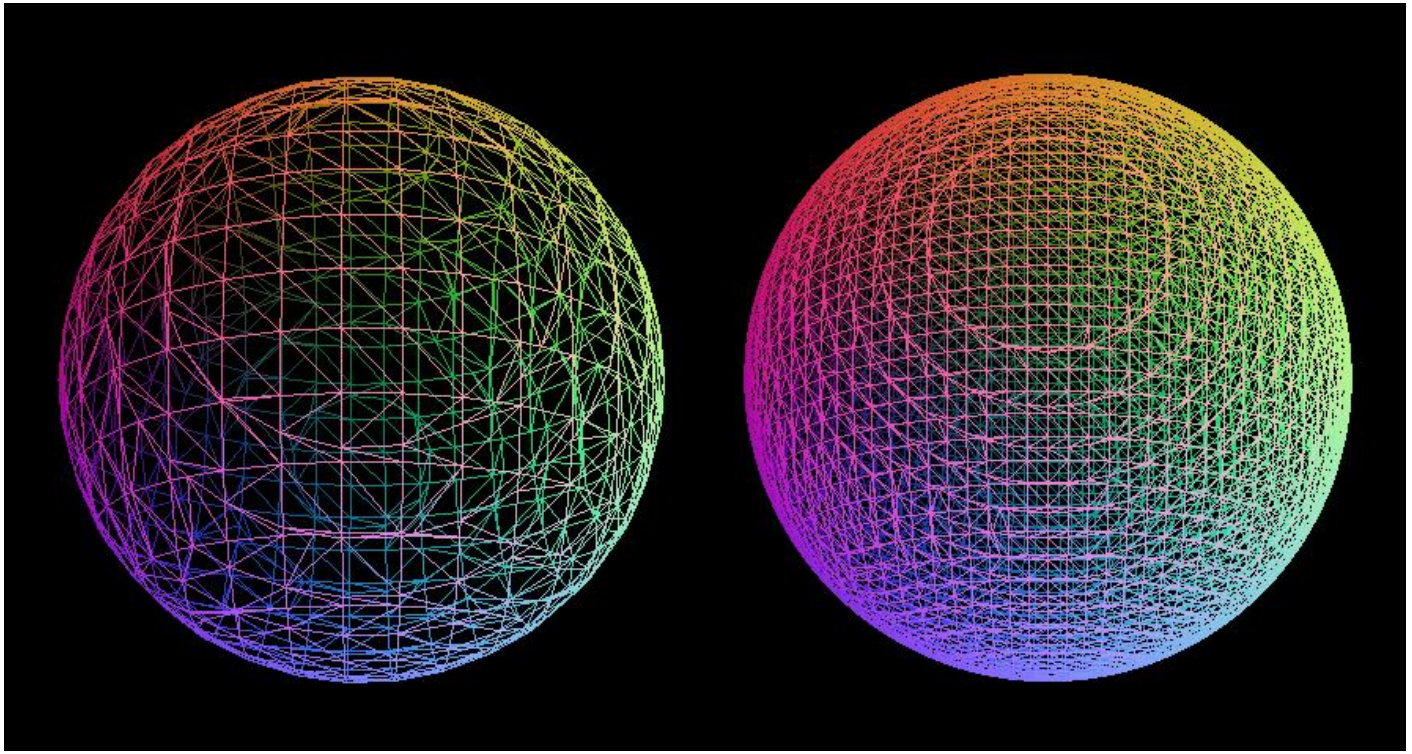
Marching Cube (1987)



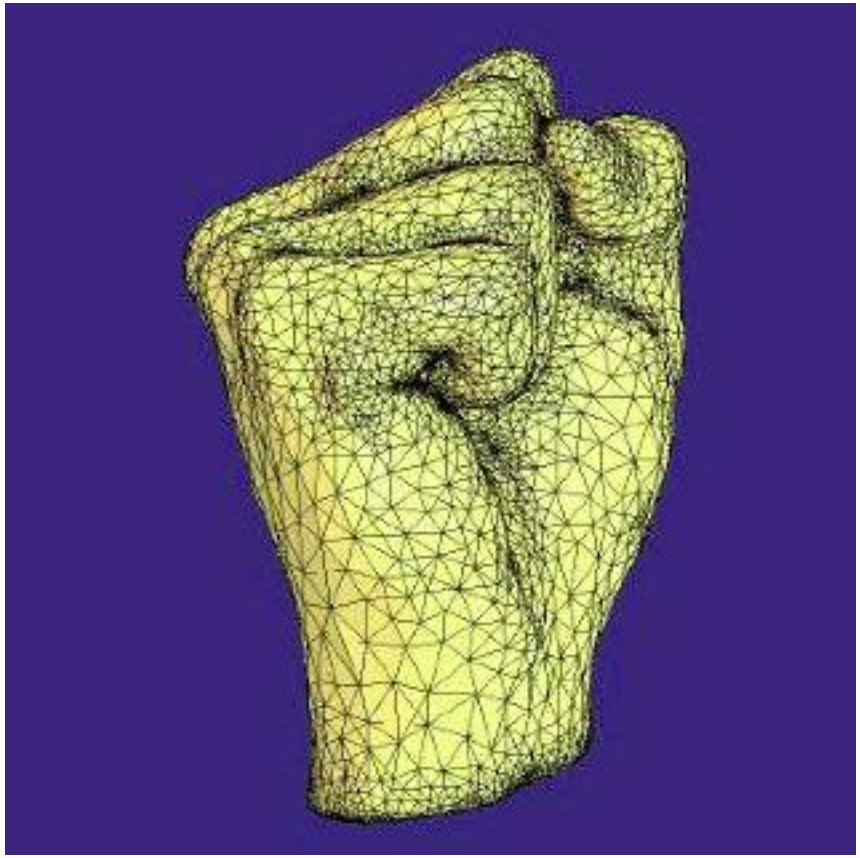
Marching Cube (1987)

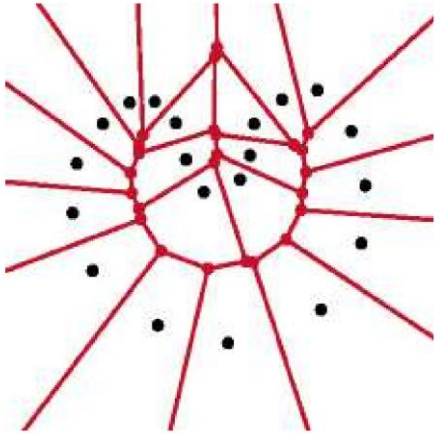


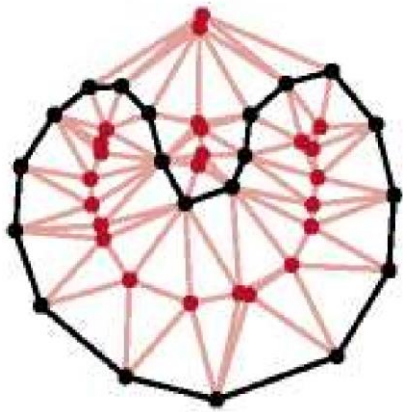
Marching Cube (1987)



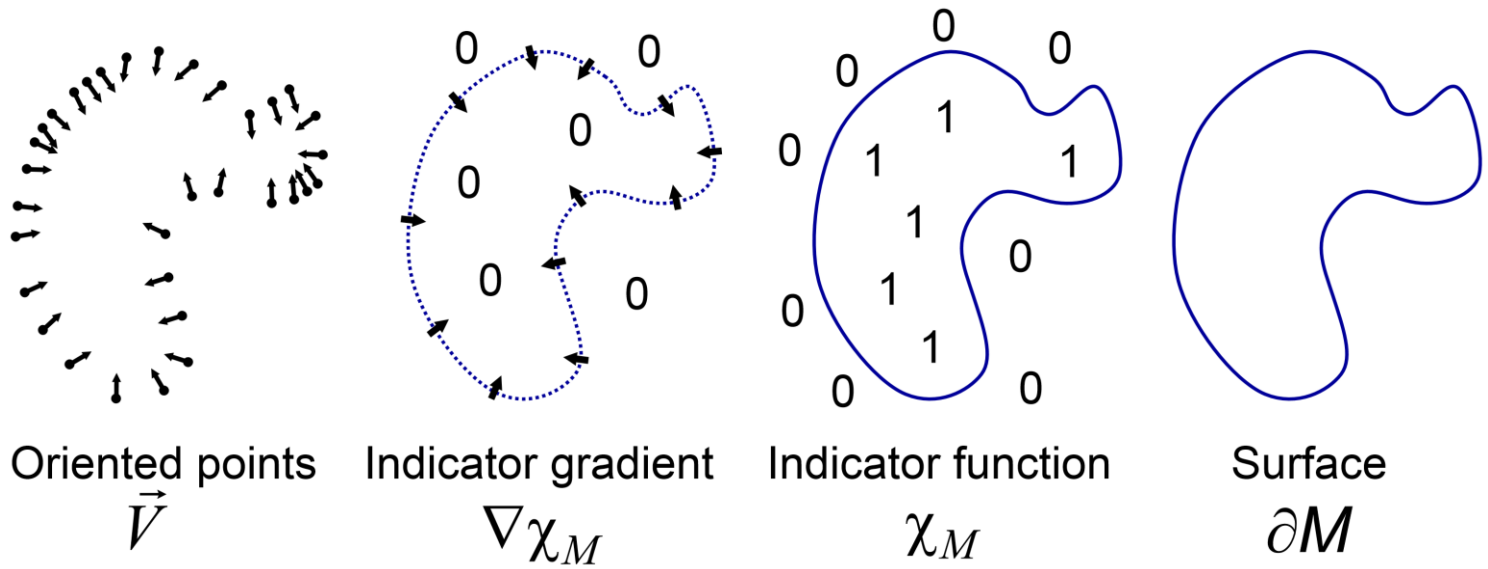
Computational Geometry Based (1998)



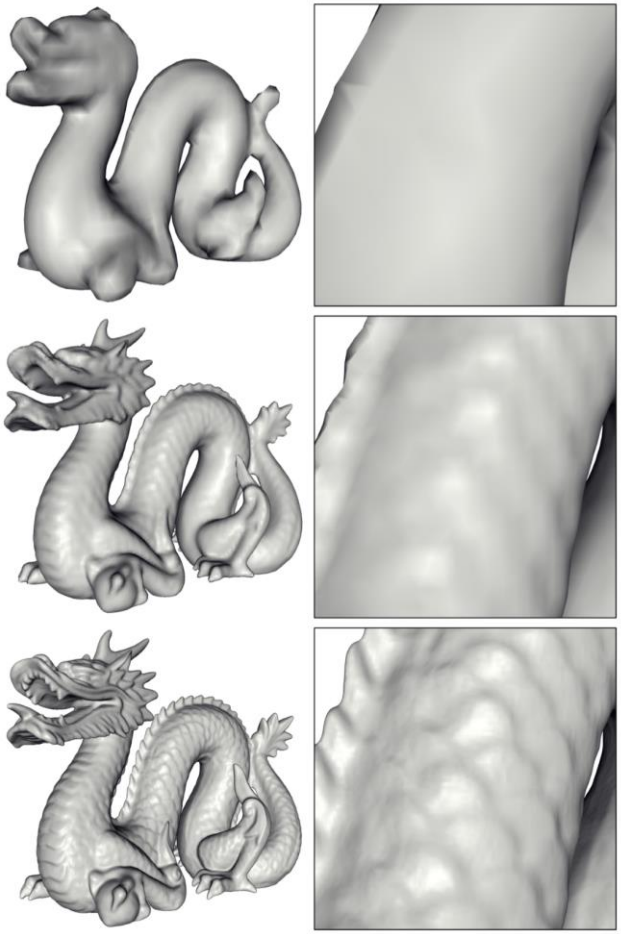


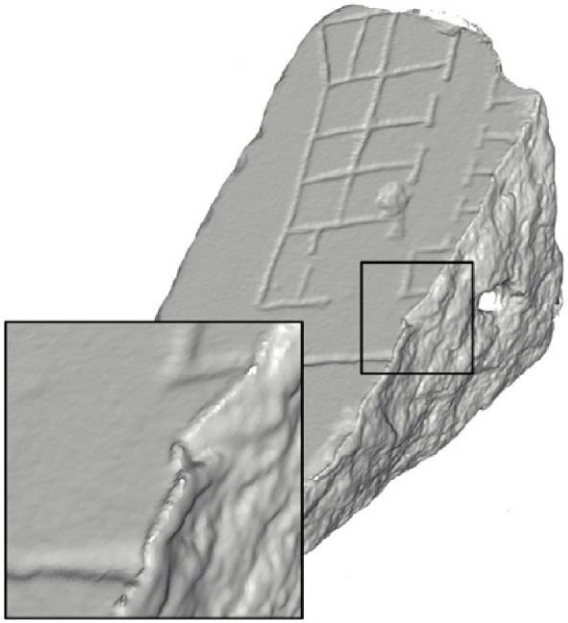


Poisson Geometry Reconstruction (2006)

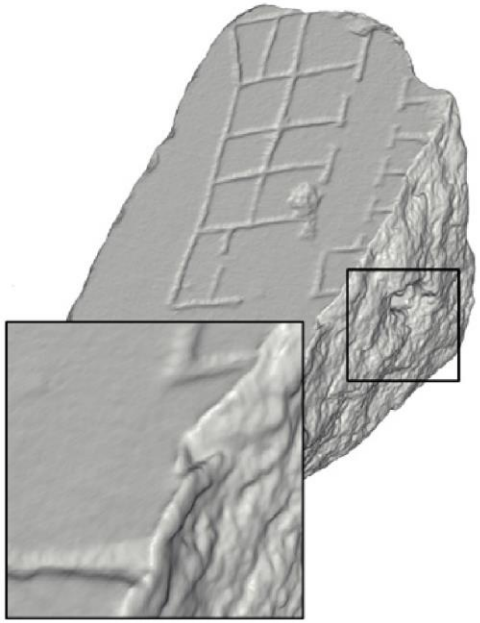


Poisson Geometry Reconstruction (2006)





VRIP

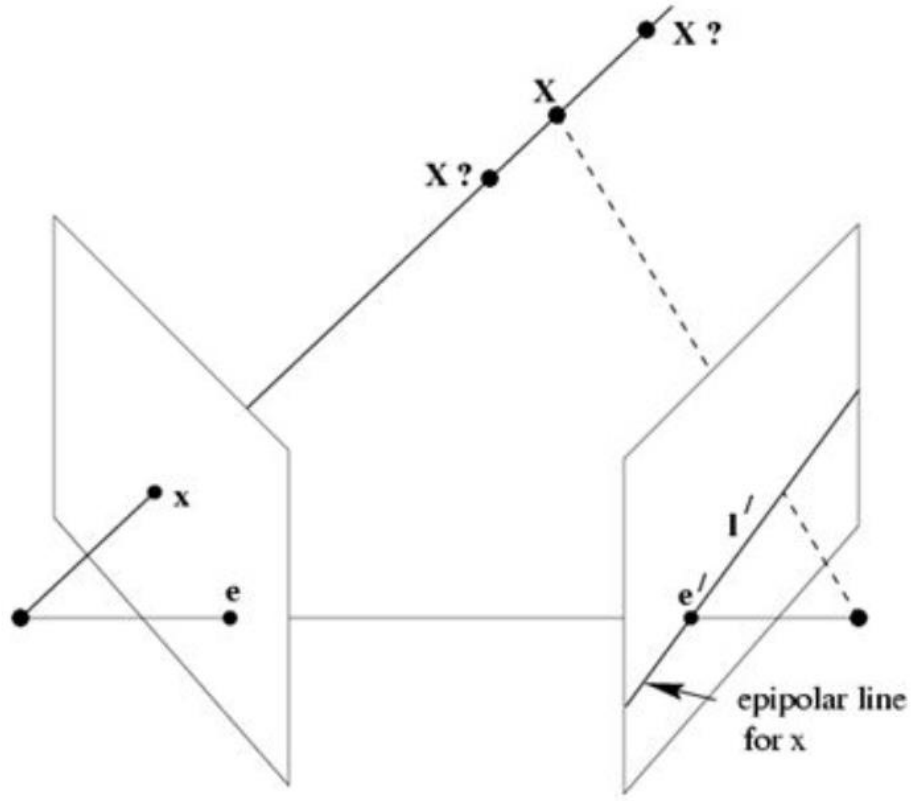


Poisson solution

Discussion

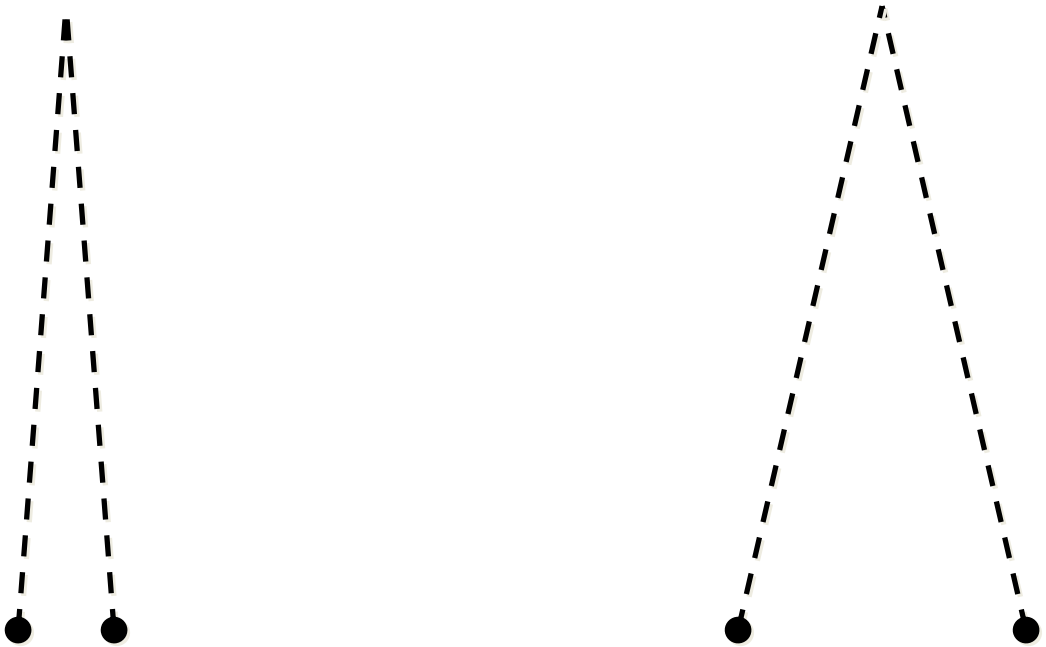
Stereo-Based Reconstruction

Stereo --- Two-View Geometry

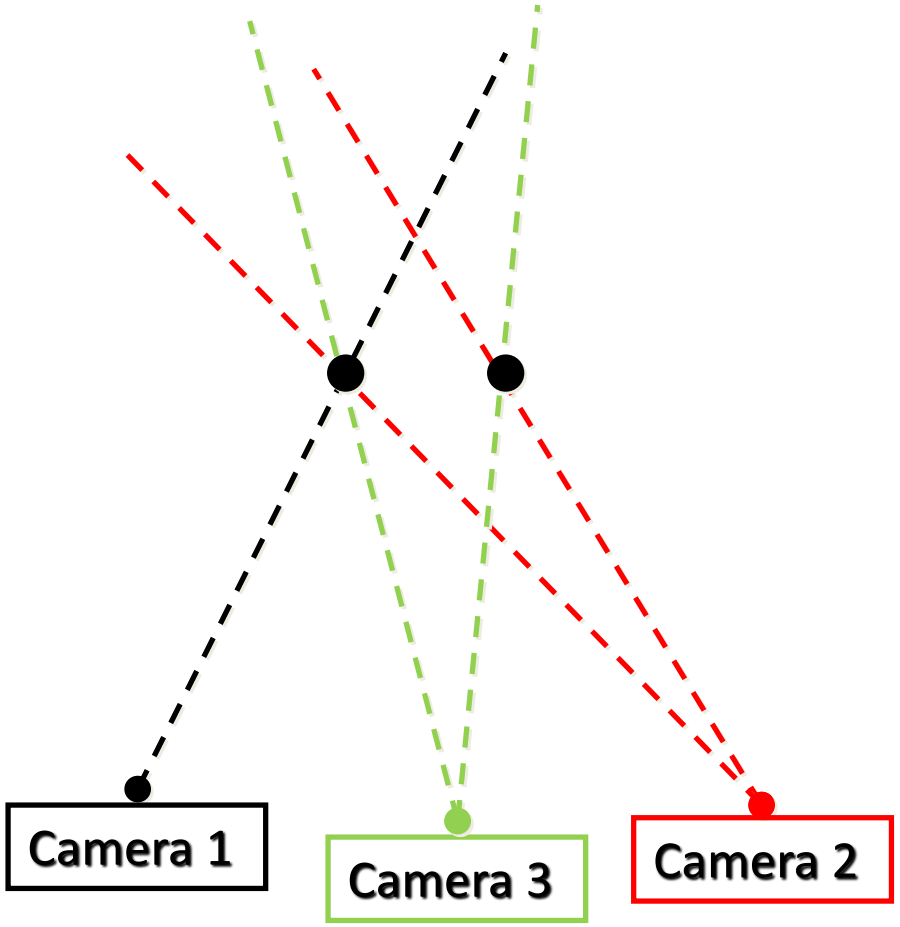


Why More Than 2 Views?

- Baseline
  - Too short --- low accuracy
  - Too long --- matching becomes hard



Multi-View Stereo



Where should the Cameras Come from?

Landmark Projects

Photo Tourism (2006)

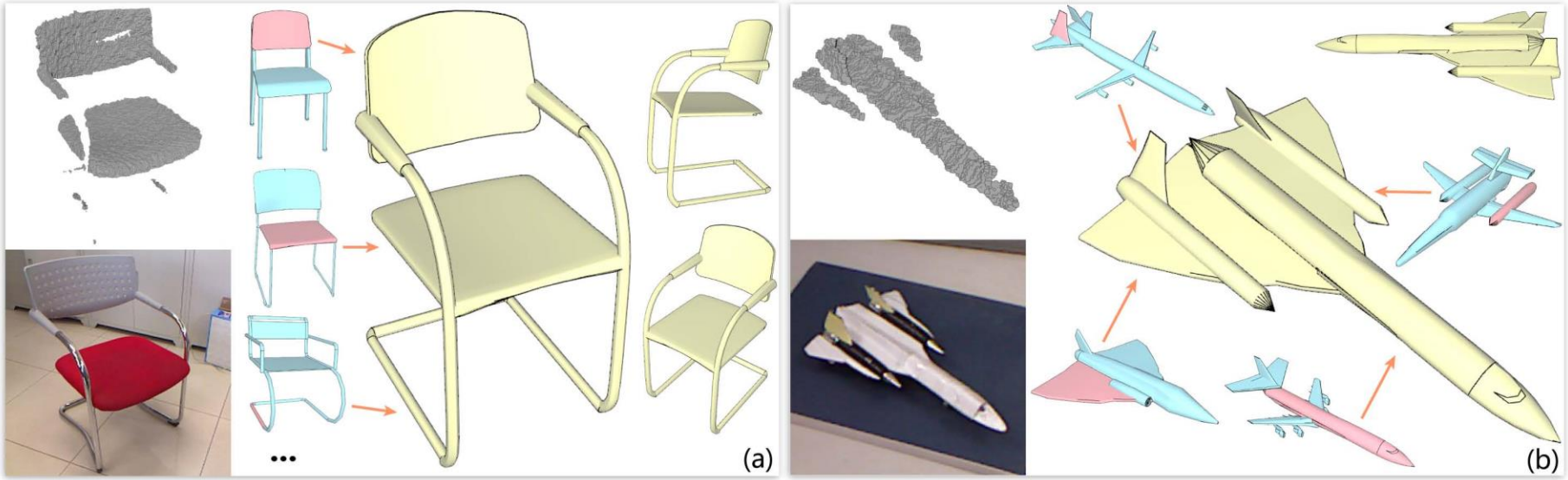
[Snavely et al. 06]

Building Rome on a Cloudless Day (2010)

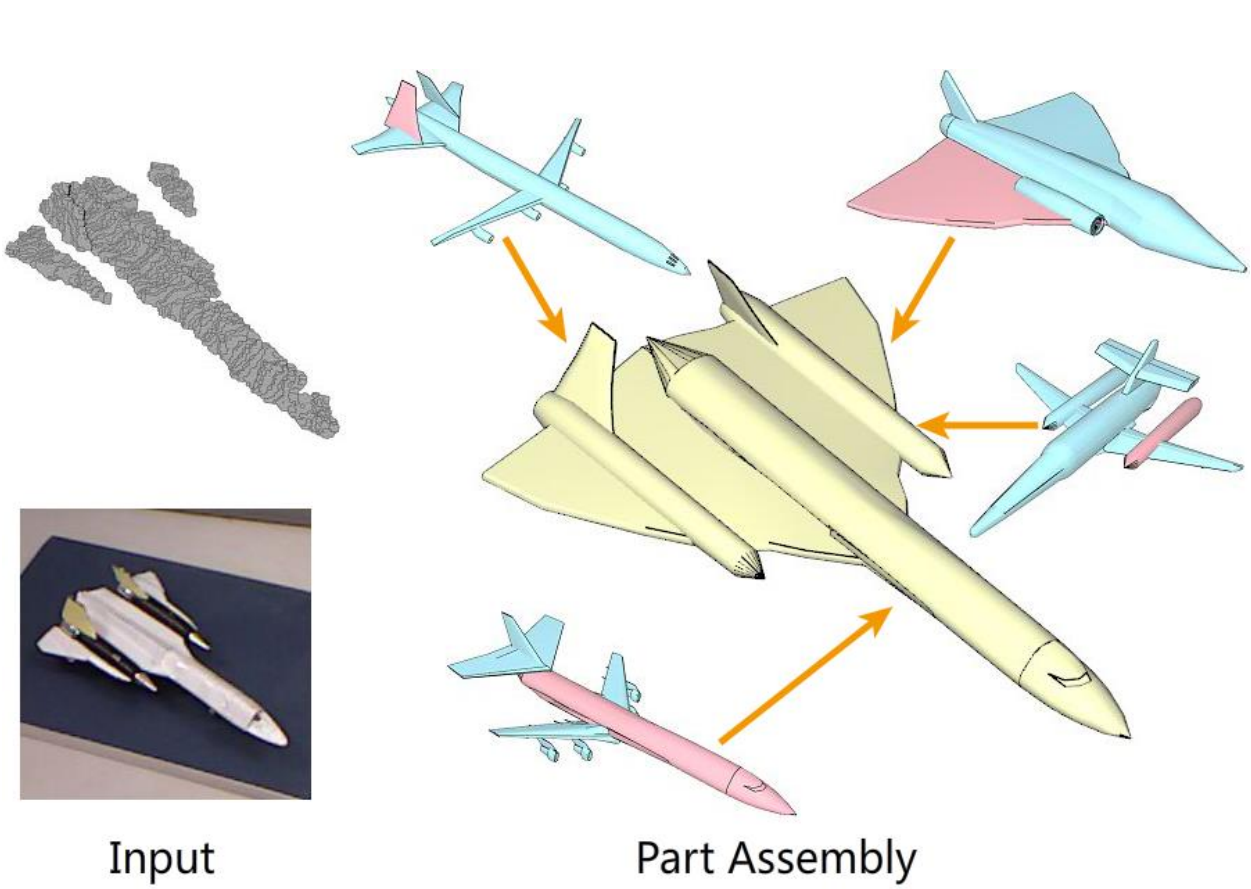
The impact of Big-Data on Geometry Reconstruction

Data-Driven Geometry Reconstruction

[Shen et al. 12]

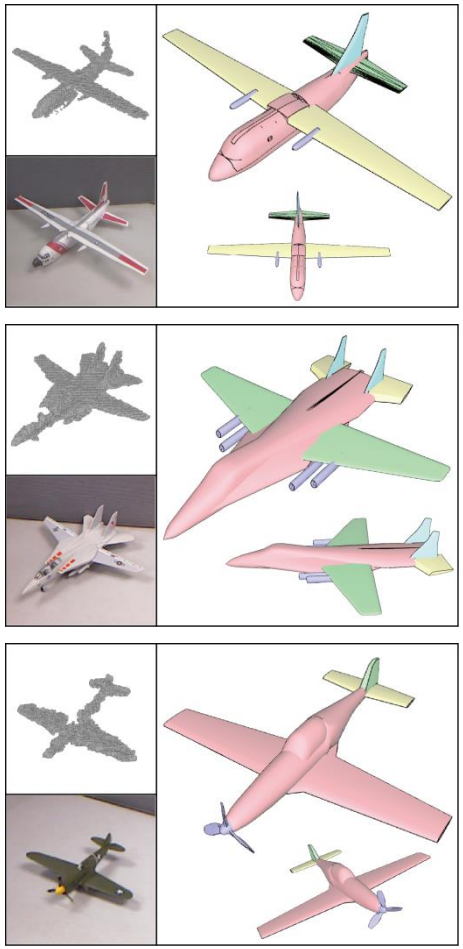


Data-Driven Geometry Processing

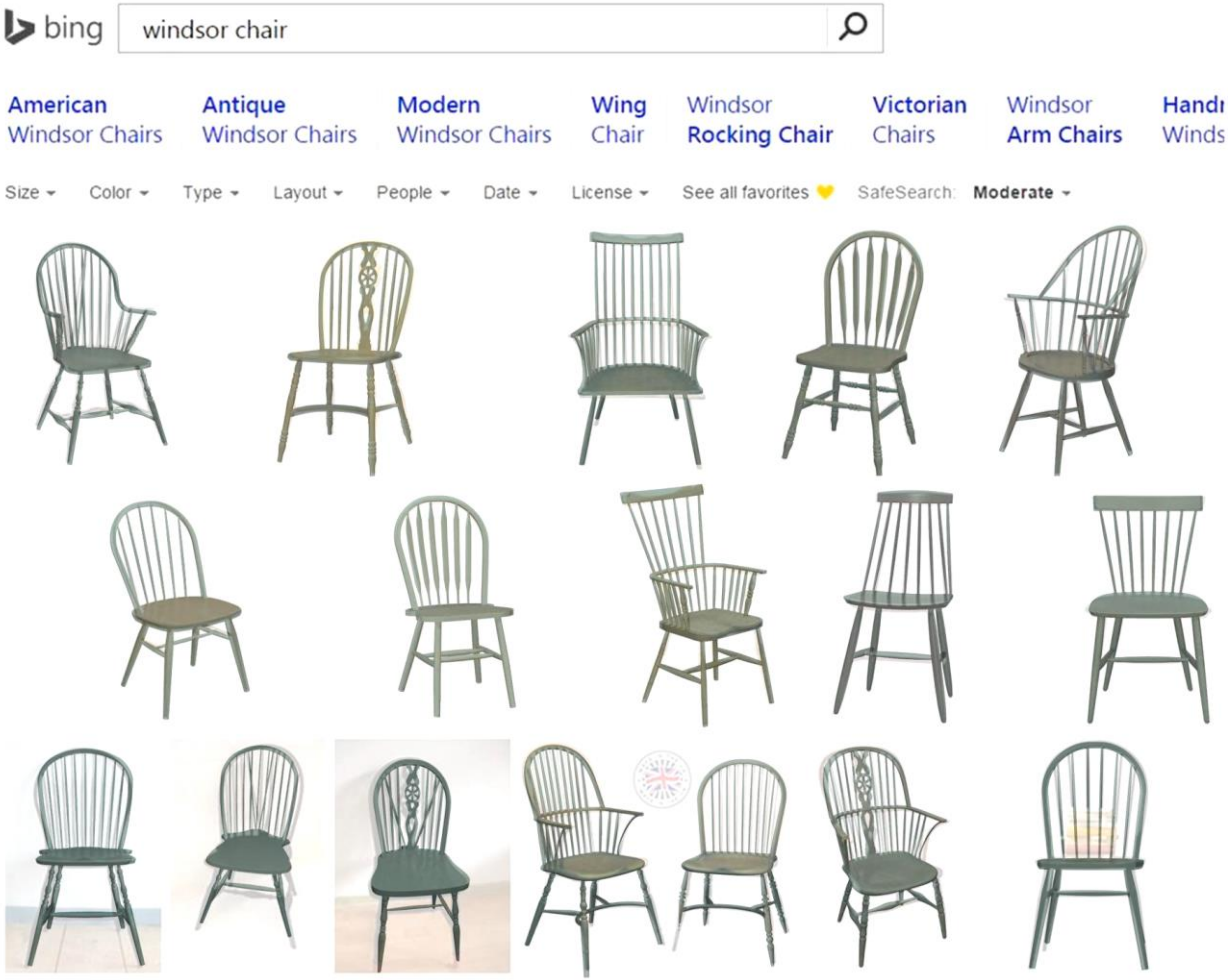


Input

Part Assembly



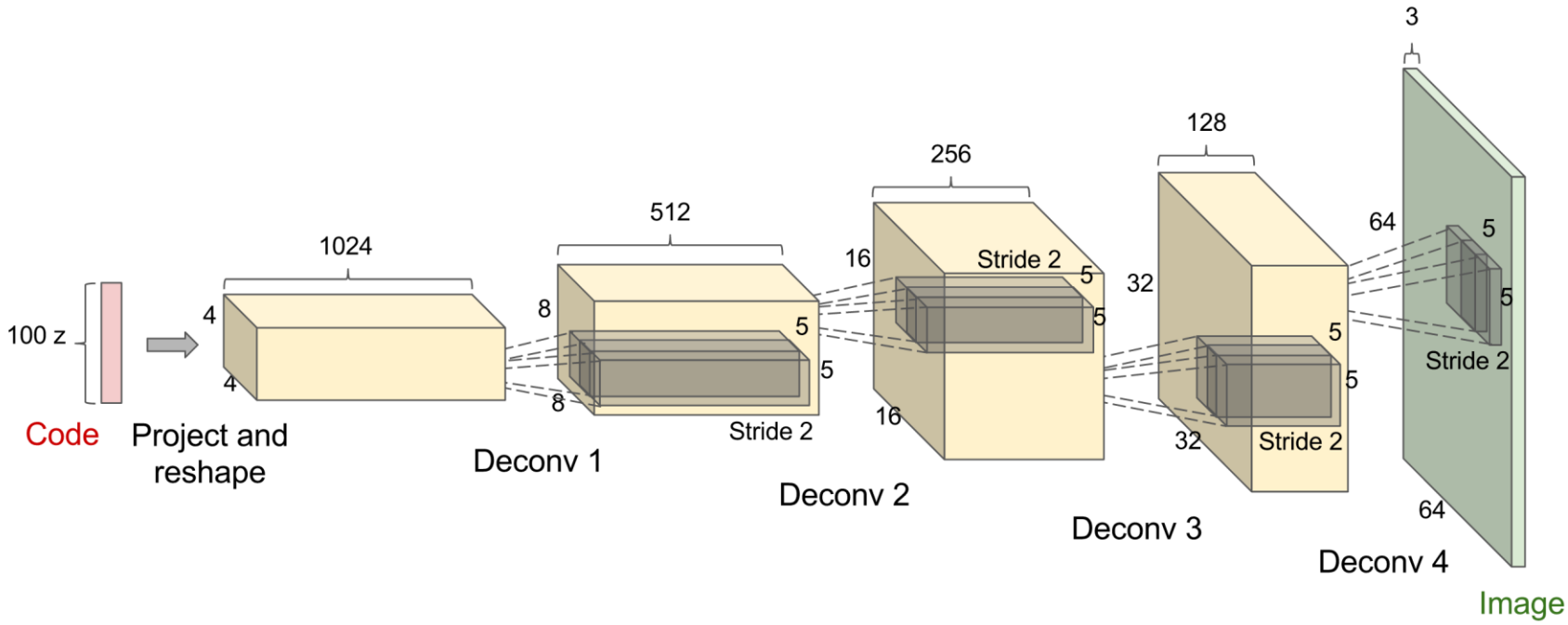
Data-Driven Image-Based Modeling



The impact of Deep Learning on Geometry Reconstruction

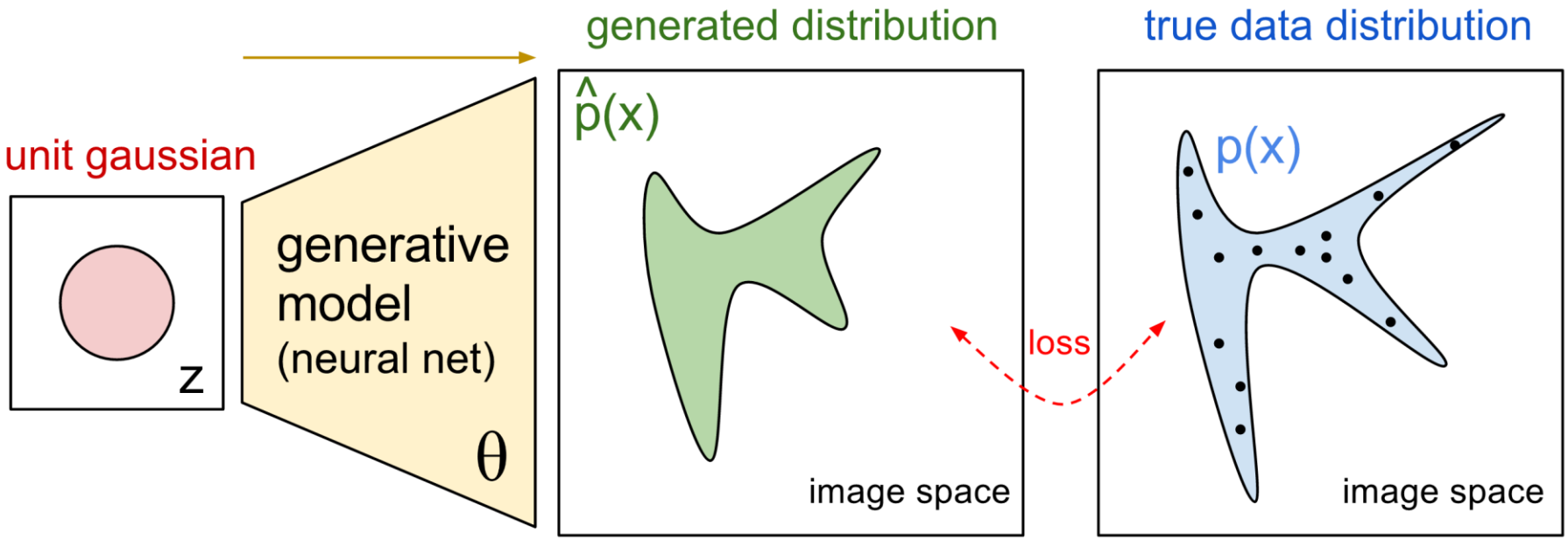
Generative Adversarial Network for Image Generation

[Goldfellow et al. 14]



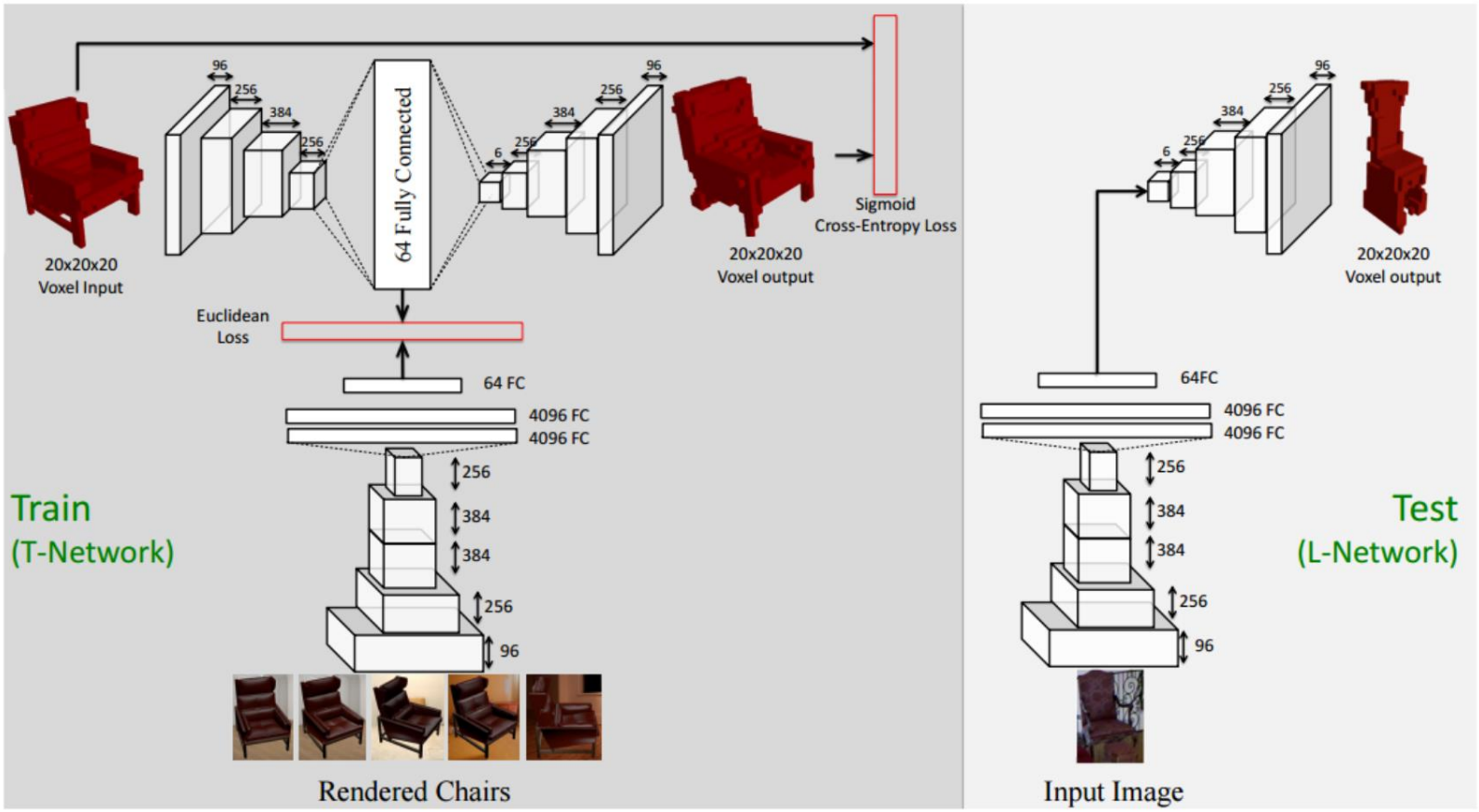
Generative Adversarial Network for Image Generation

[Goldfellow et al. 14]



Auto-Encoder on 3D Model Generation

[Girdhar et al. 16]

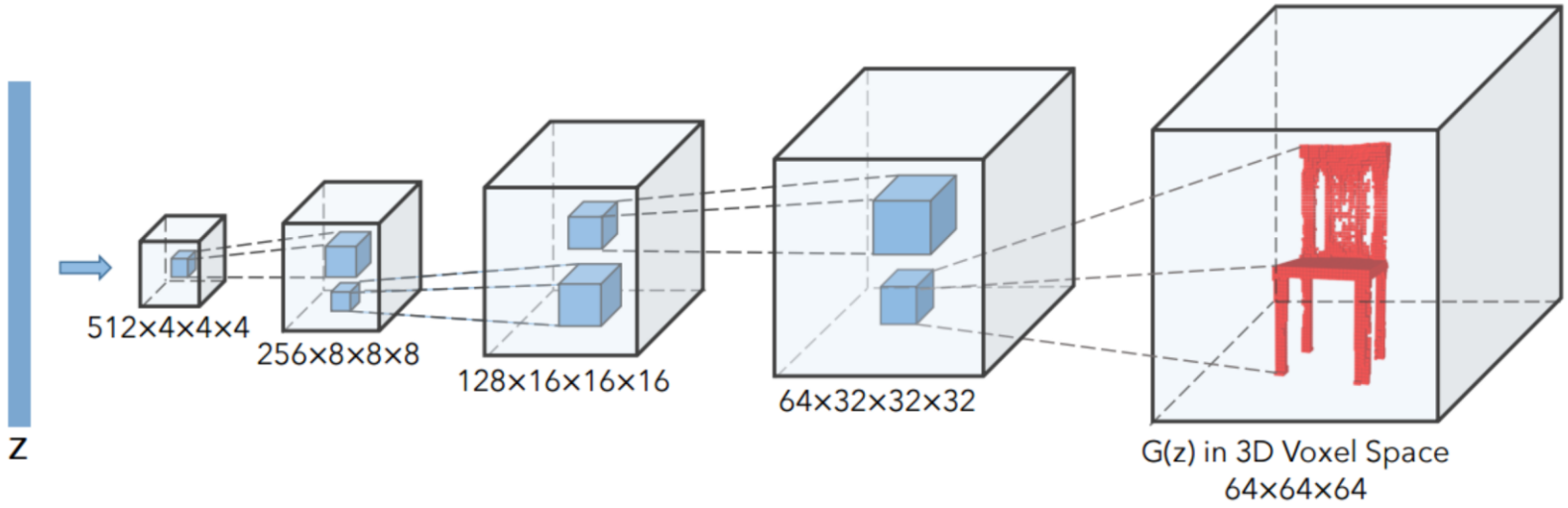


Auto-Encoder on 3D Model Generation

[Girdhar et al. 16]

GAN on 3D Model Reconstruction

[Wu et al. 16]



GAN on 3D Model Reconstruction

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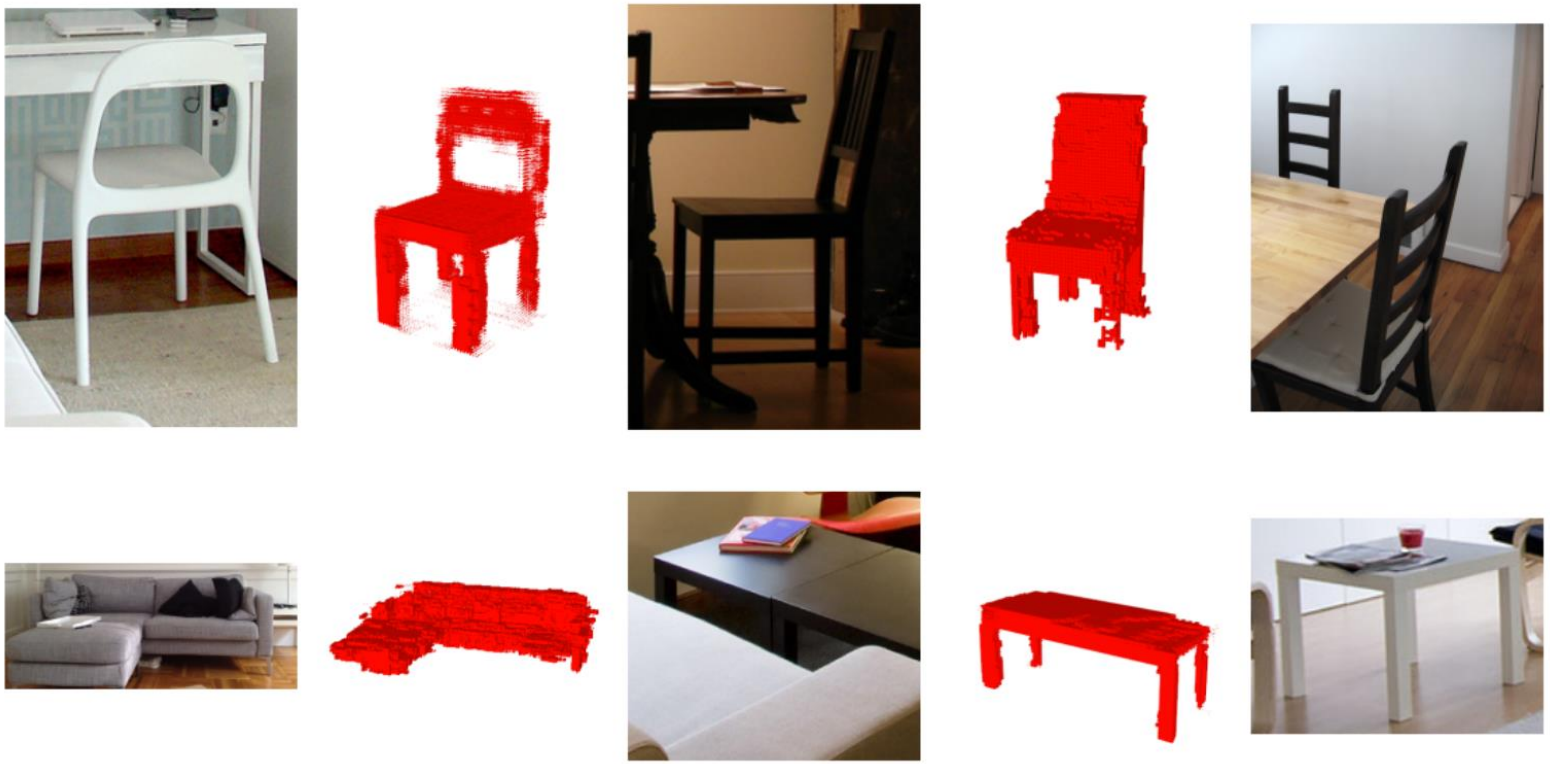

Questions?