



# Digital Geometry -Motivations

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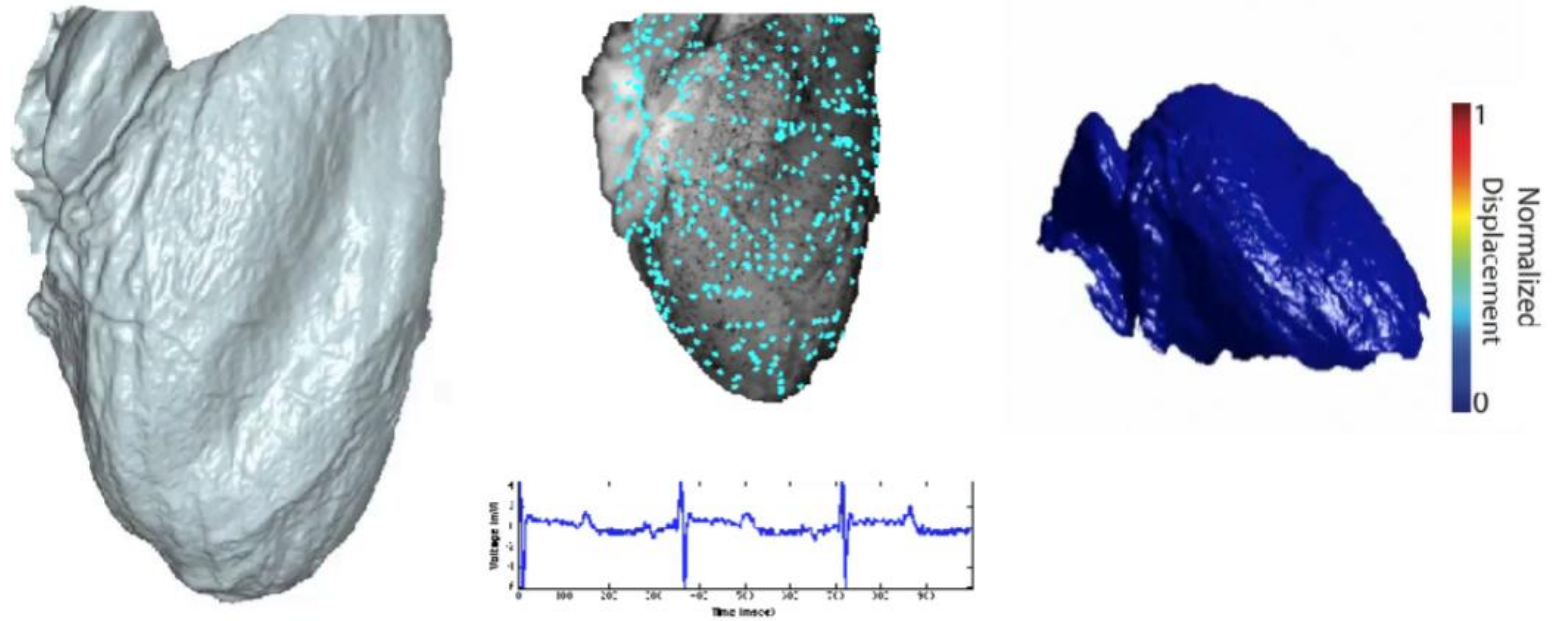
Spring 2018

<http://jjcao.github.io/DigitalGeometry/>

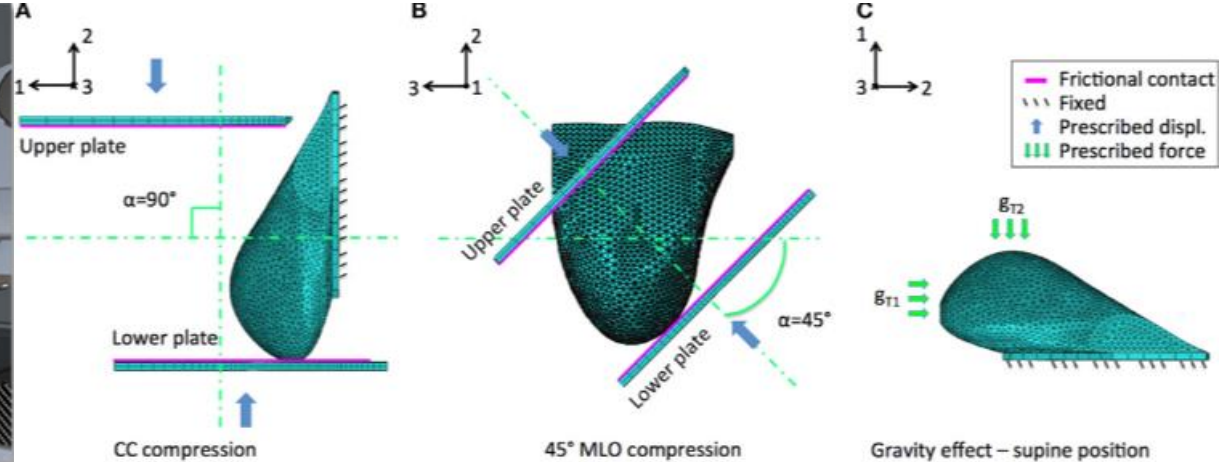
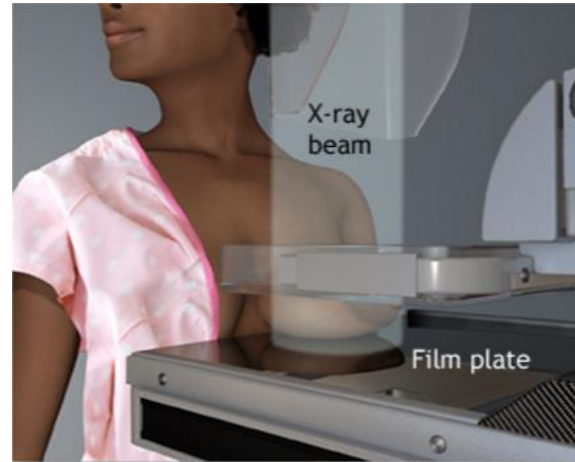
Pleasure may come from illusion, but happiness can come only of reality.

# **Impacting Science**

# Cardiology



# Mammographic



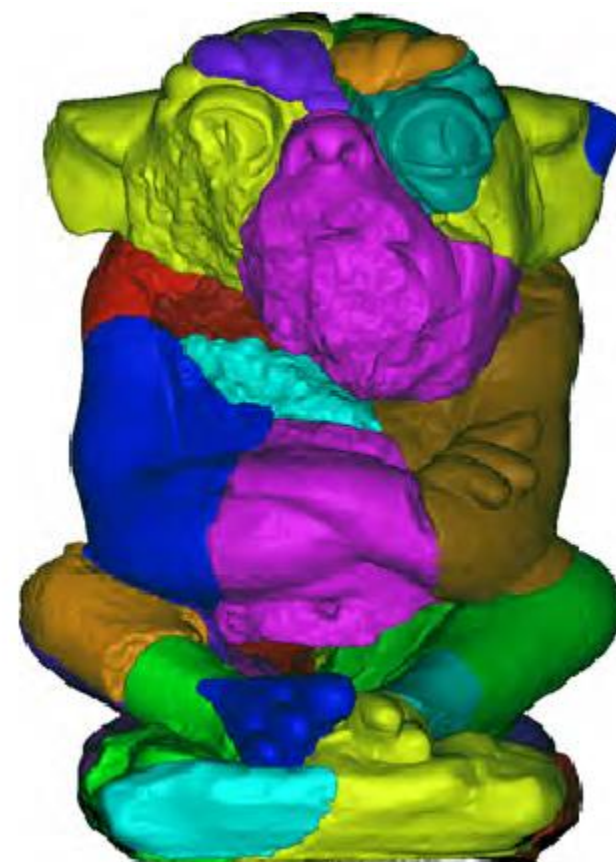
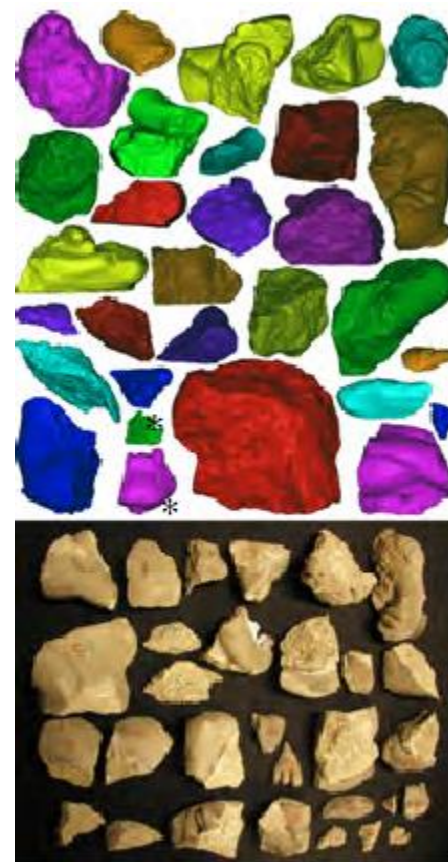


# Computational archaeology



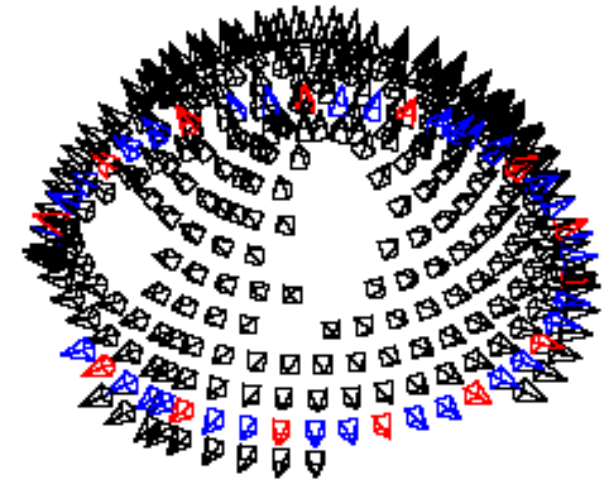
Eg14\_Content-Aware Surface Parameterization for Interactive Restoration of Historical Documents





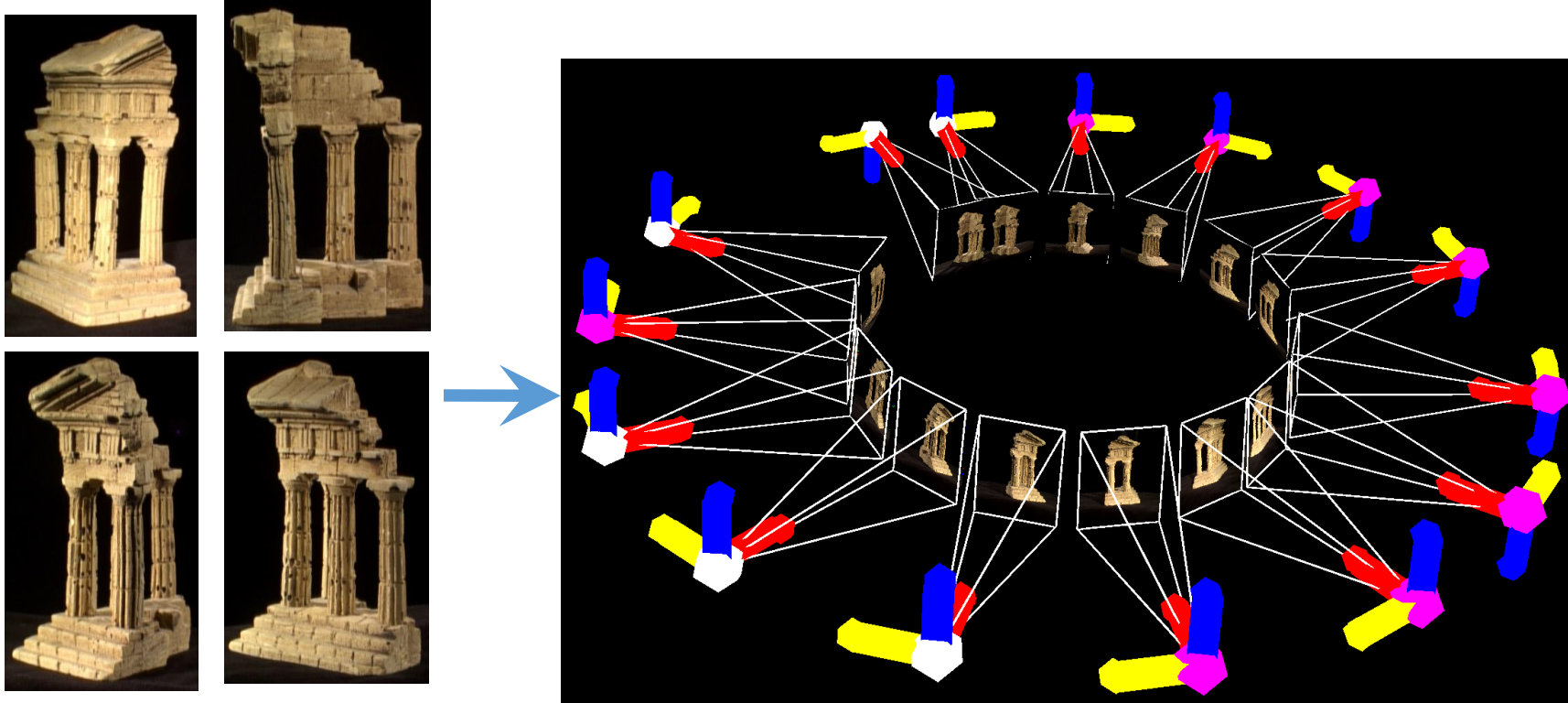
Reassembling a gargoyle statue: photo (bottom left) and 3D models (top left) of the fragments, final assembly (right).

# Multi-View Stereo



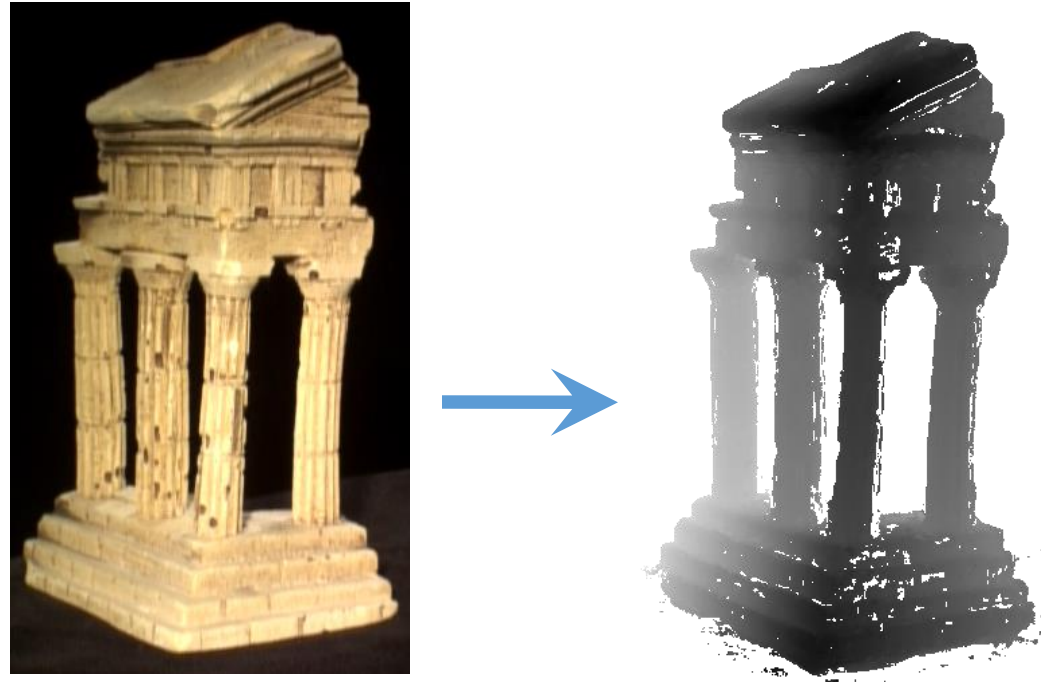


# Image Calibration



- Input: set of pictures
- Output: camera position, orientation, intrinsic parameters (focal length, optical center)

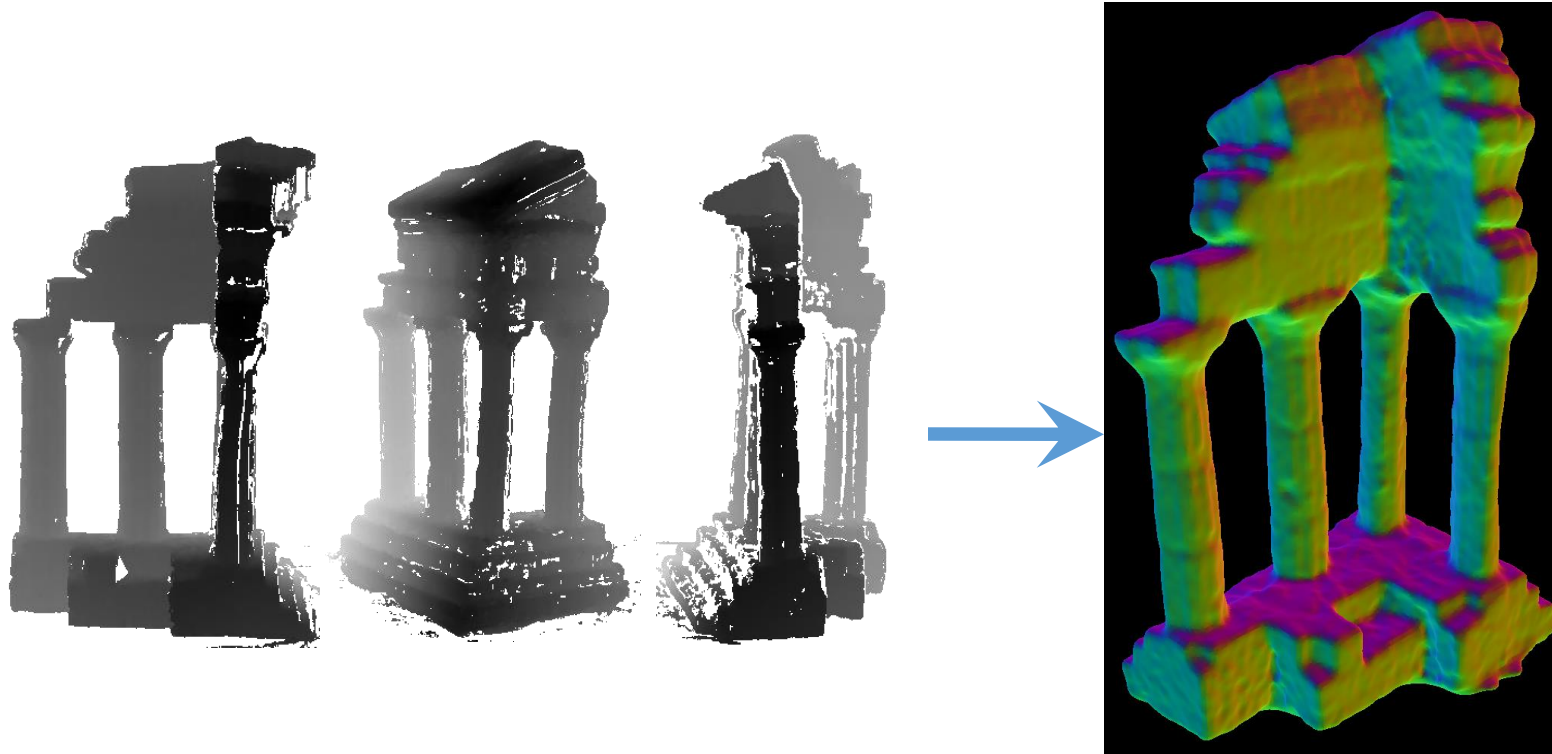
# Depth Map Construction



- Input: set of calibrated images
- Output: distance to object for each pixel in the image

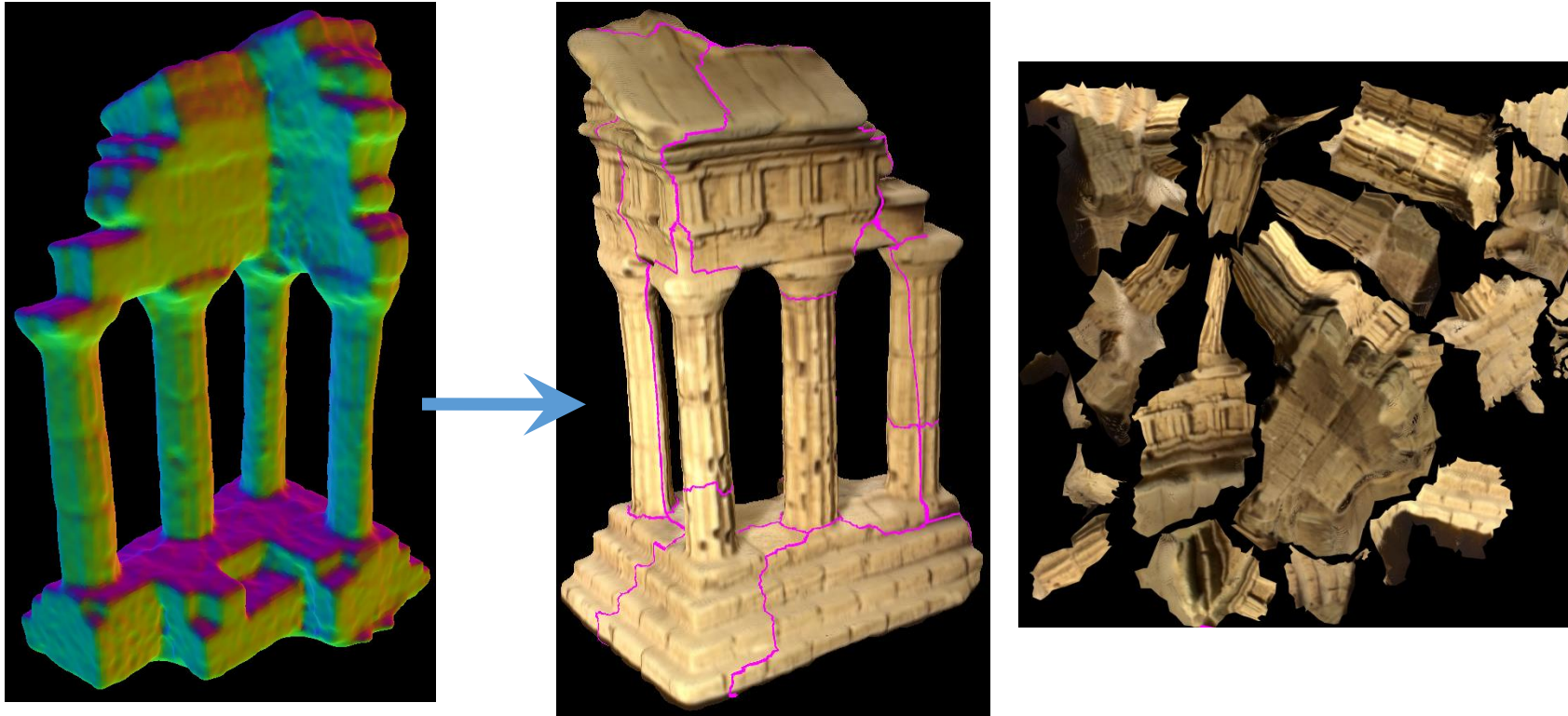


# Mesh Registration & Reconstruction



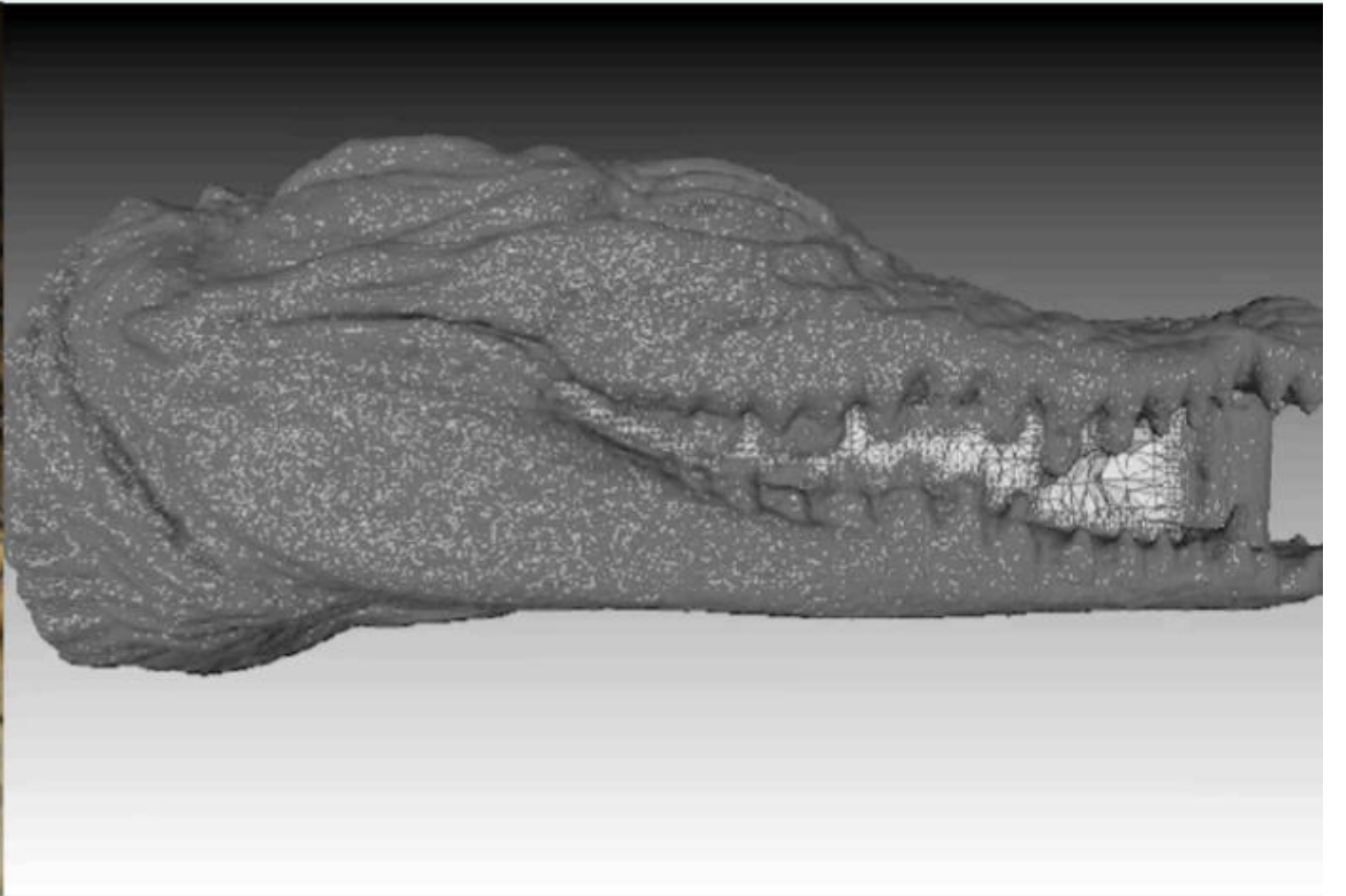
- Input: set of calibrated images & depth maps
- Output: mesh of object

# Texture Generation



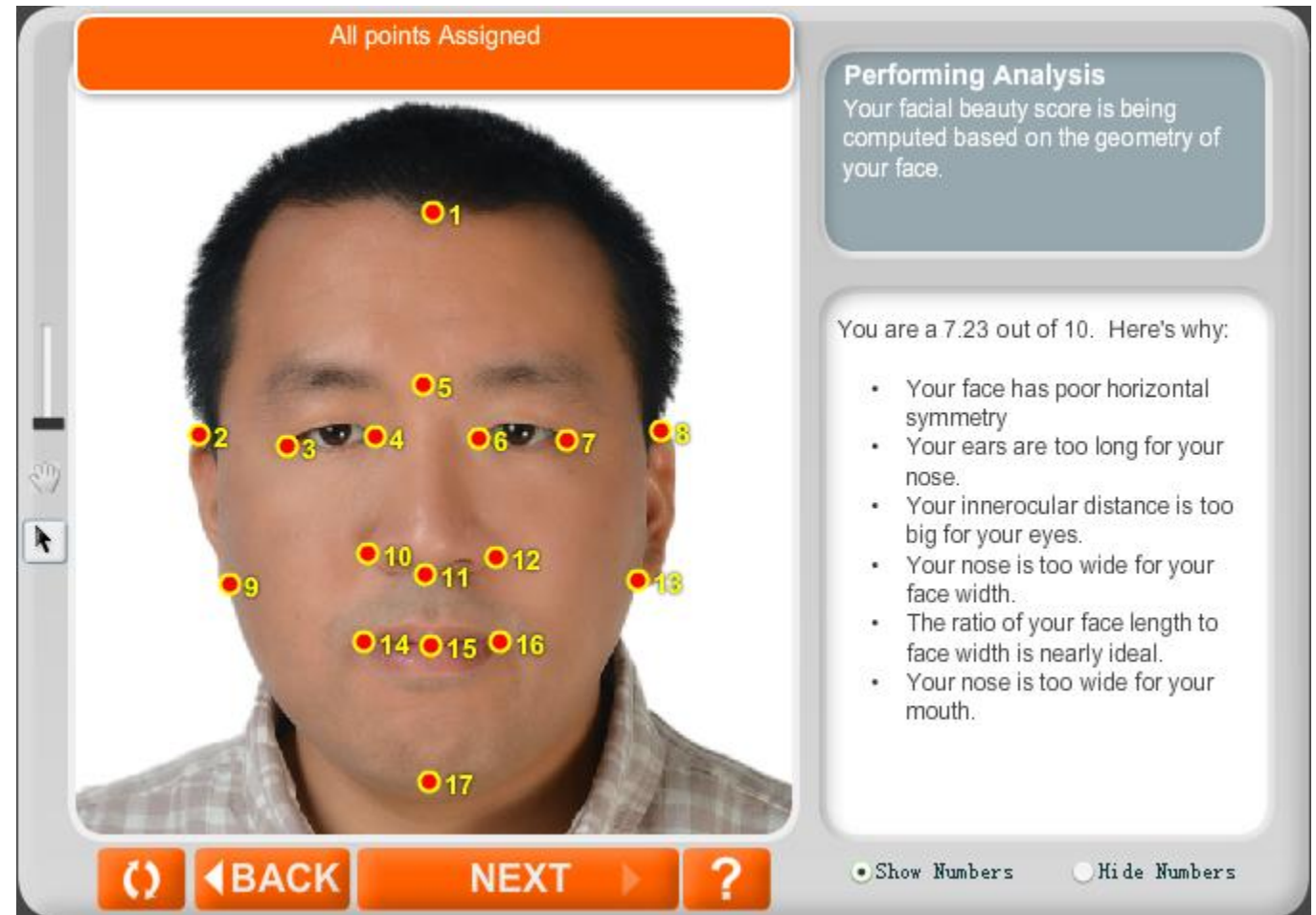
- Input: set of calibrated images and mesh of object
- Output: atlas and texture

# Evolutionary Biology

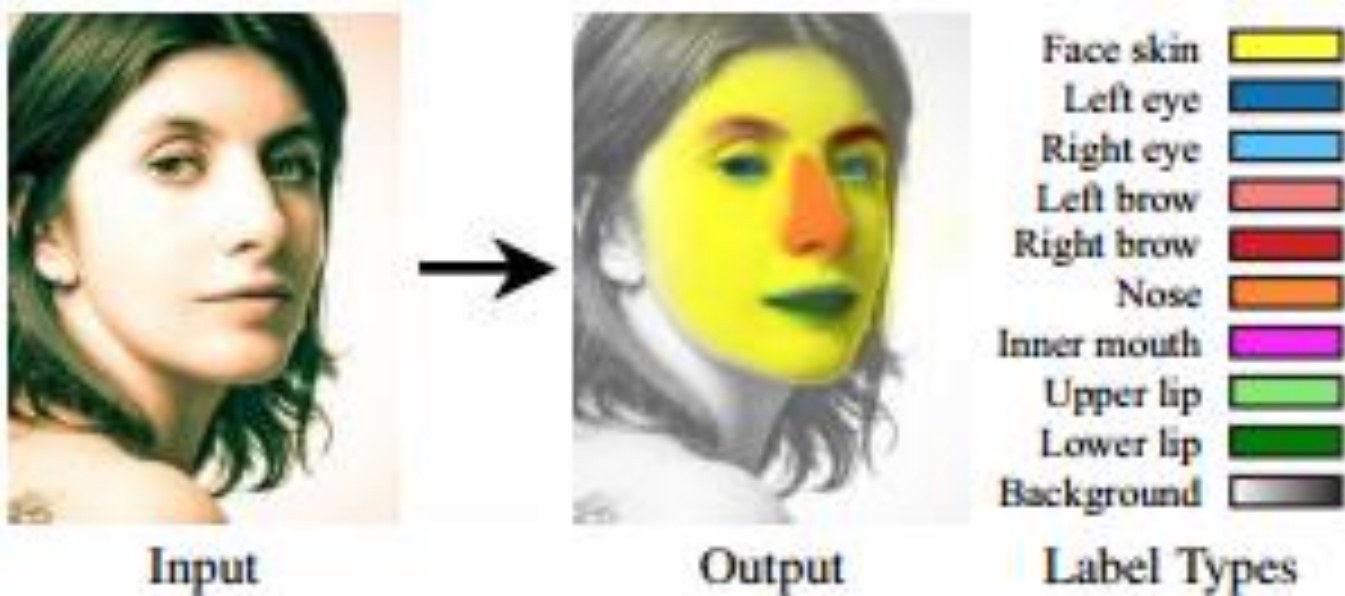




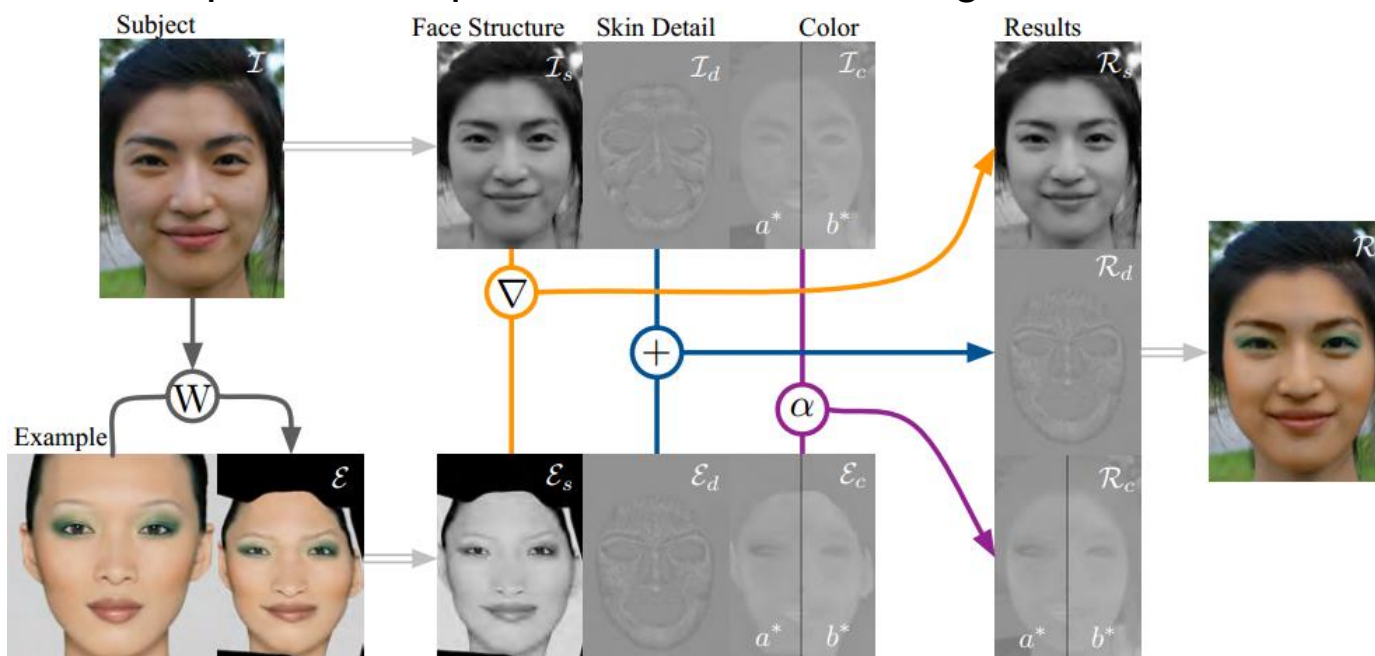
# Computational aesthetics



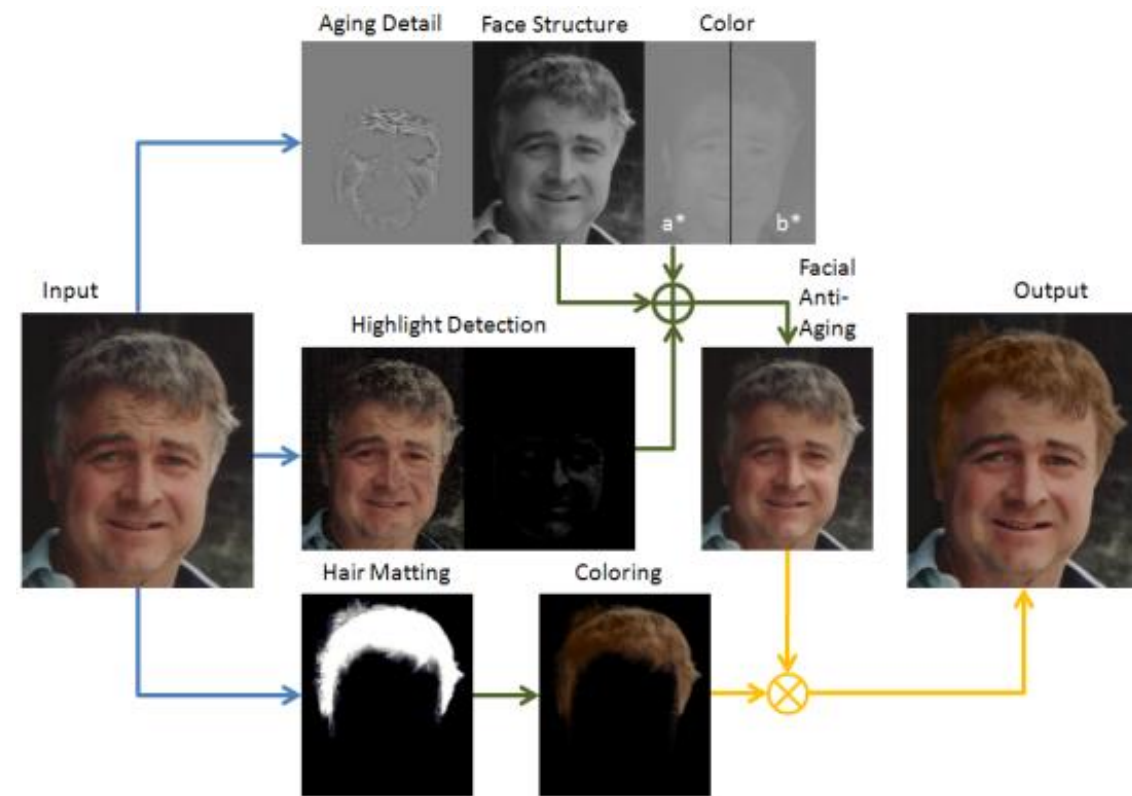
- [Facial Beauty Analysis - Score Your Face](#)



# Cvpr13\_Exemplar-Based Face Parsing



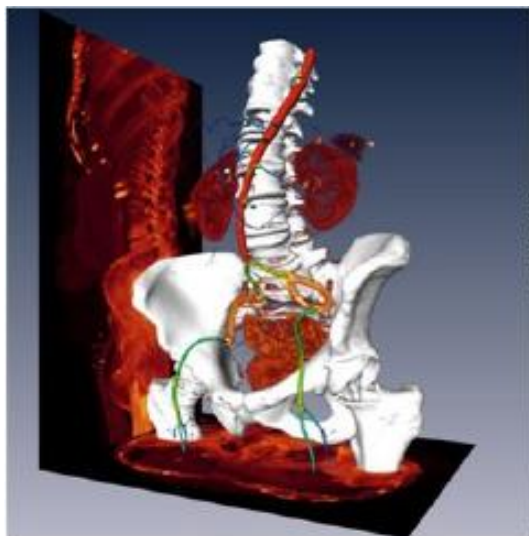
cvpr09\_Digital Face Makeup by Example



lccv11\_Digital anti-aging in face images



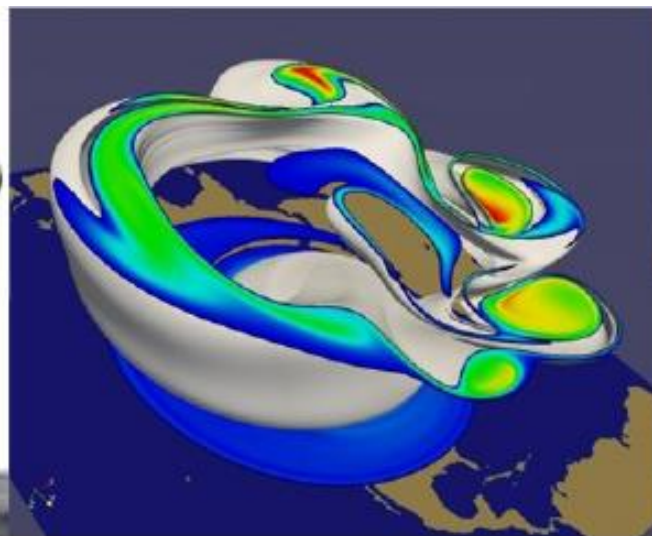
# Applications



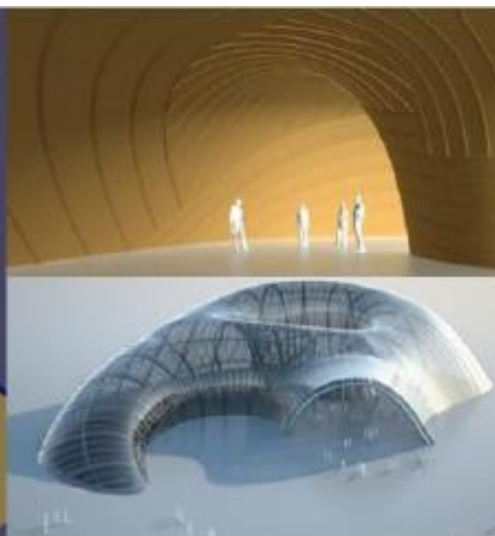
(a) 数字医疗



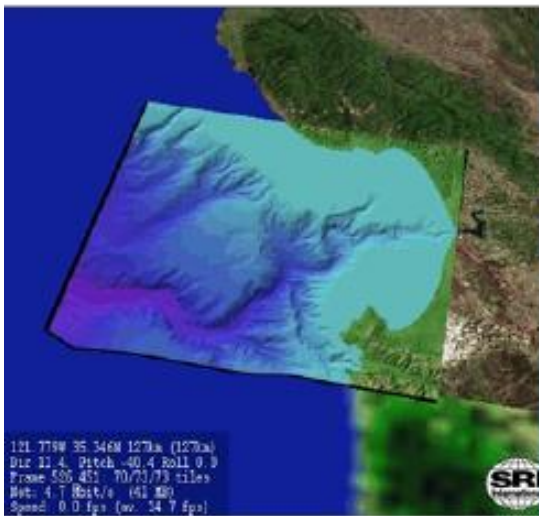
(b) 汽车设计



(c) 大气模拟



(d) 建筑设计



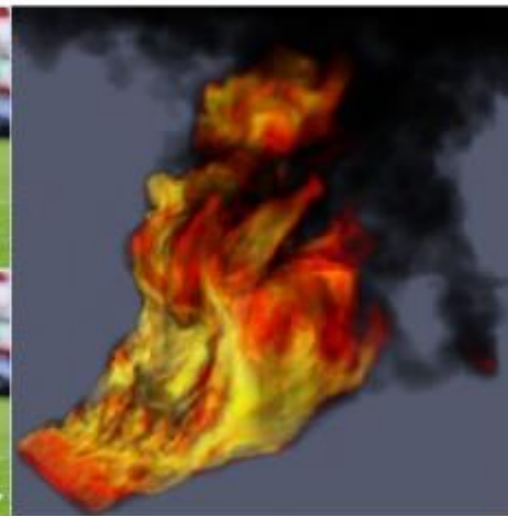
2018/2/22 (e) 地形分析



(f) 虚拟现实



(g) 影视娱乐

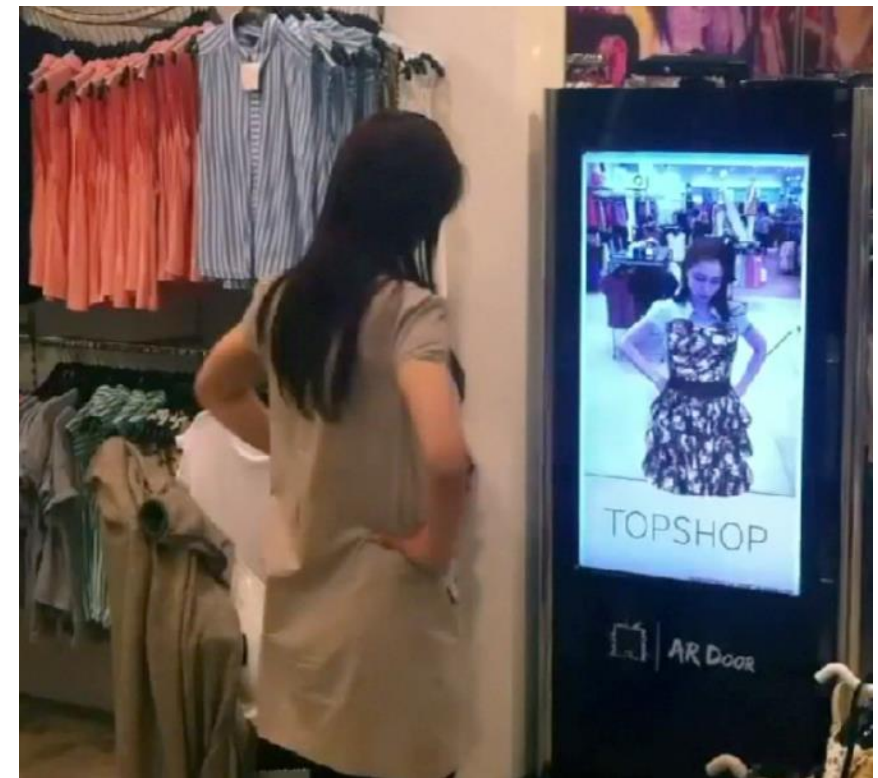


(h) 虚拟科学实验



# Digitized Future

## Webcam Social Shopper: the virtual dressing room



# In laptops, tablets, smartphones

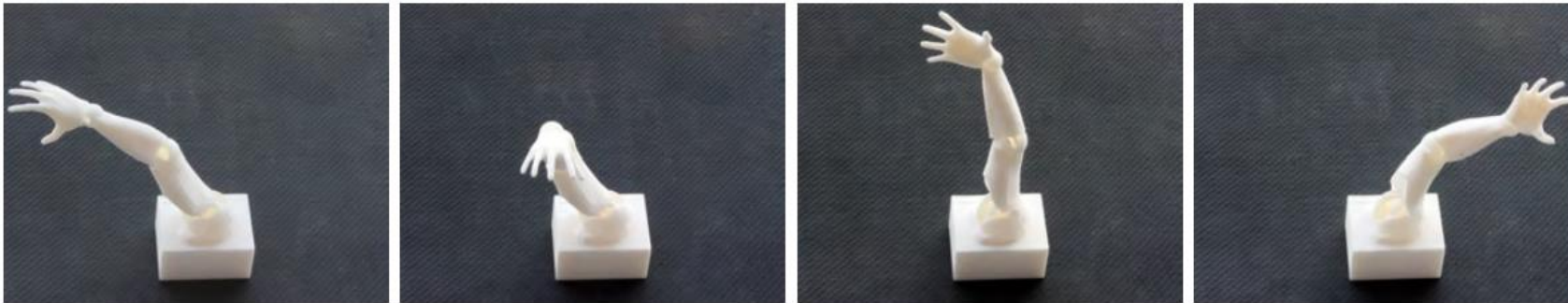
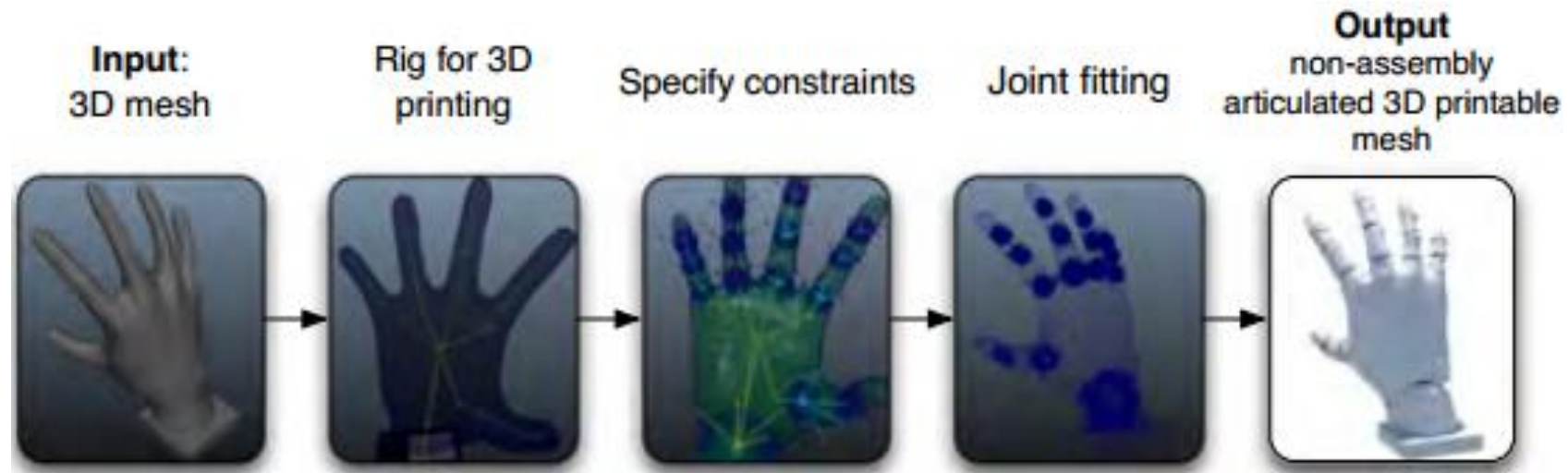




# From Capture to Fabrication



# Siga12\_3D-Printing of Non-Assembly, Articulated Models



Real-time Future



# Why Realtime?



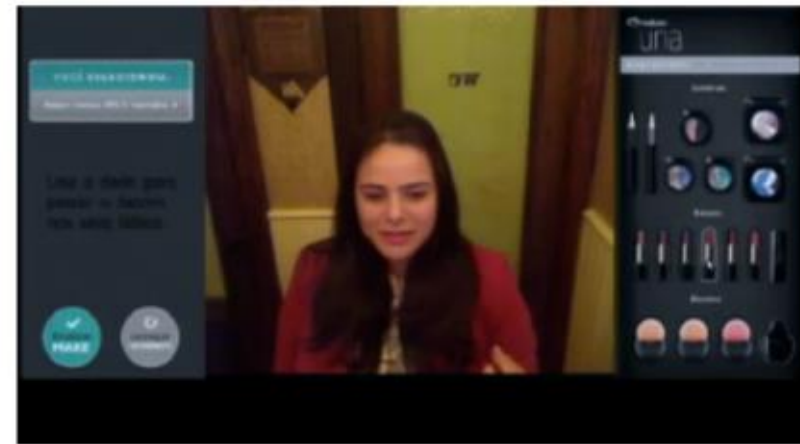
VFX/Game Production



Virtual Avatars



Robotics



AR/Virtual Mirror

# Realtime Facial Performance capture



# Siga10\_A Practical Appearance Model for Dynamic Facial Color



Geometry, motion, 2D or 3D texture



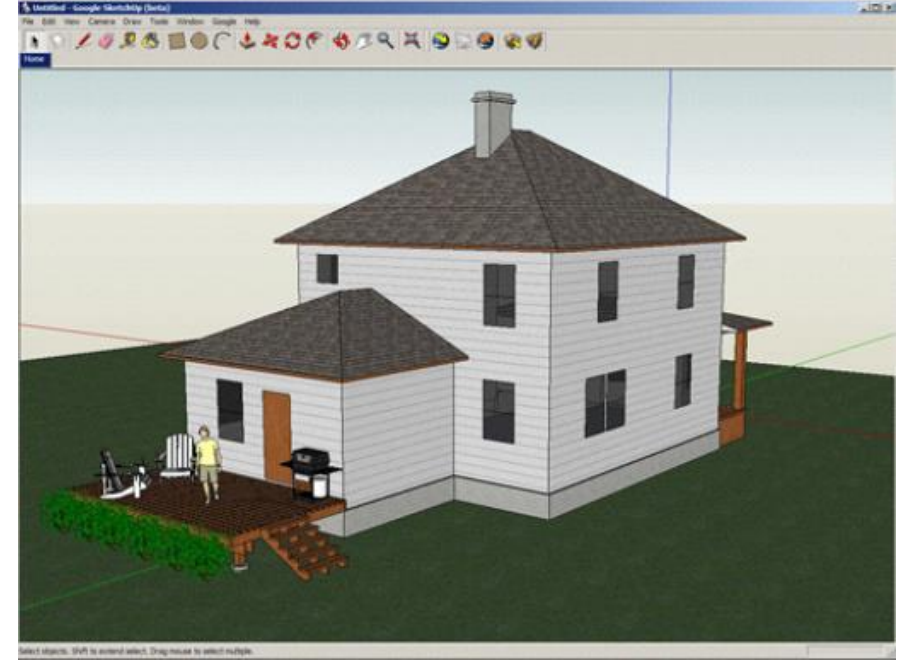
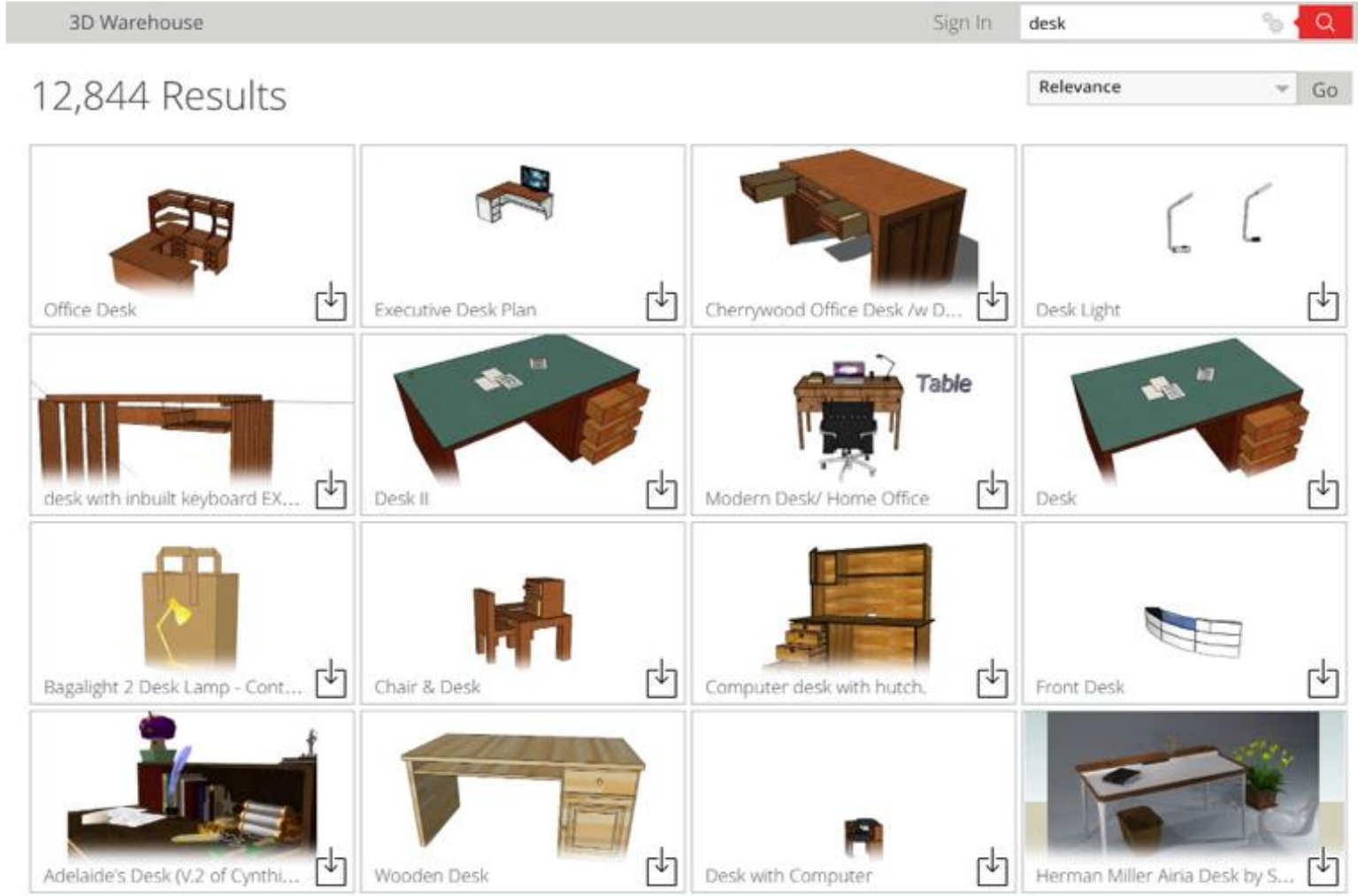
# Realtime Facial Animation



Snappers Facial Rig for Maya (also available for 3dsMax) by snappers mocaps

# Big data

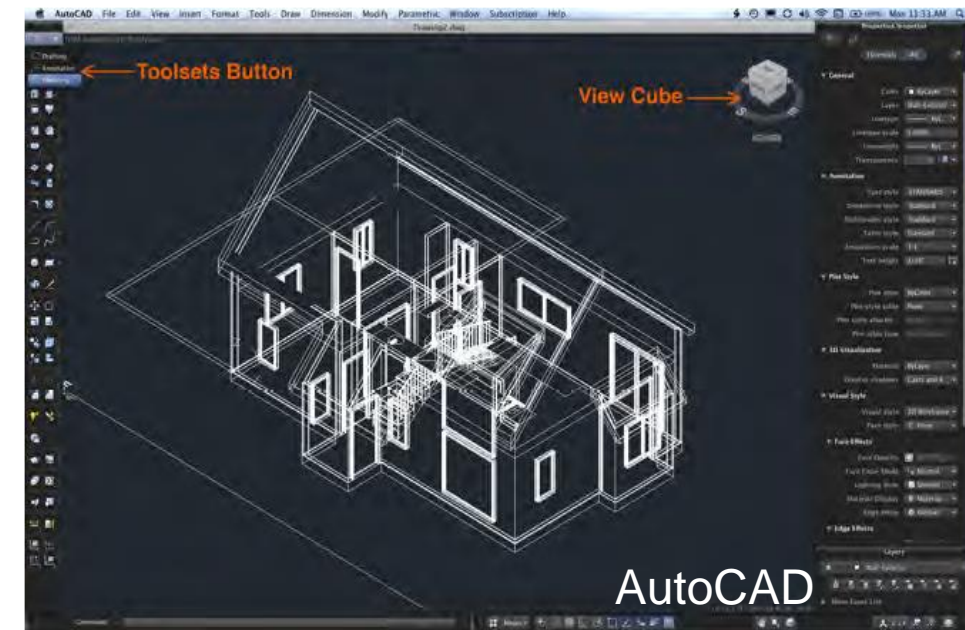
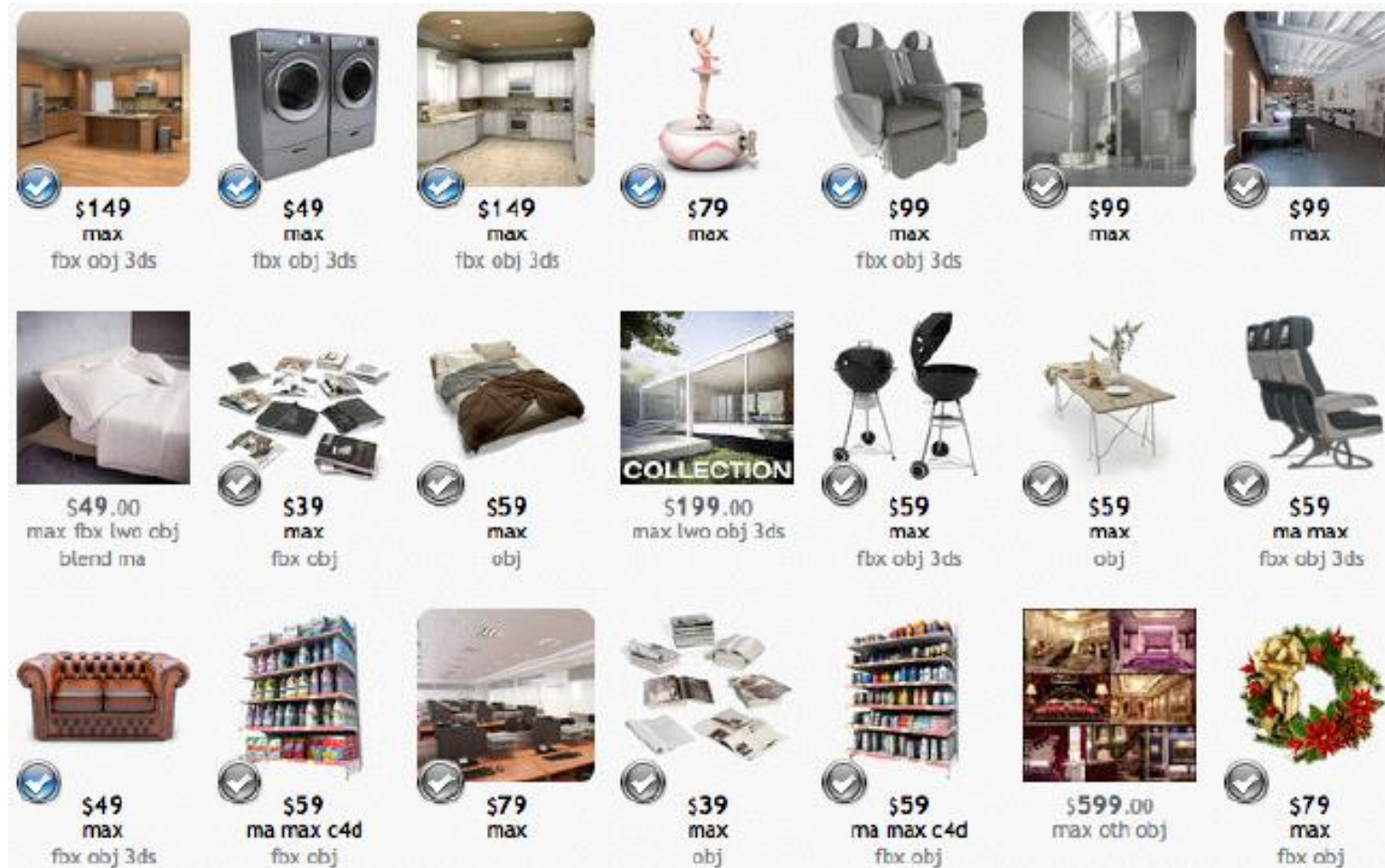
# Large and growing repositories of 3D Models



**Trimble** 3D Warehouse  
powered by Google



# Large and growing repositories of 3D Models



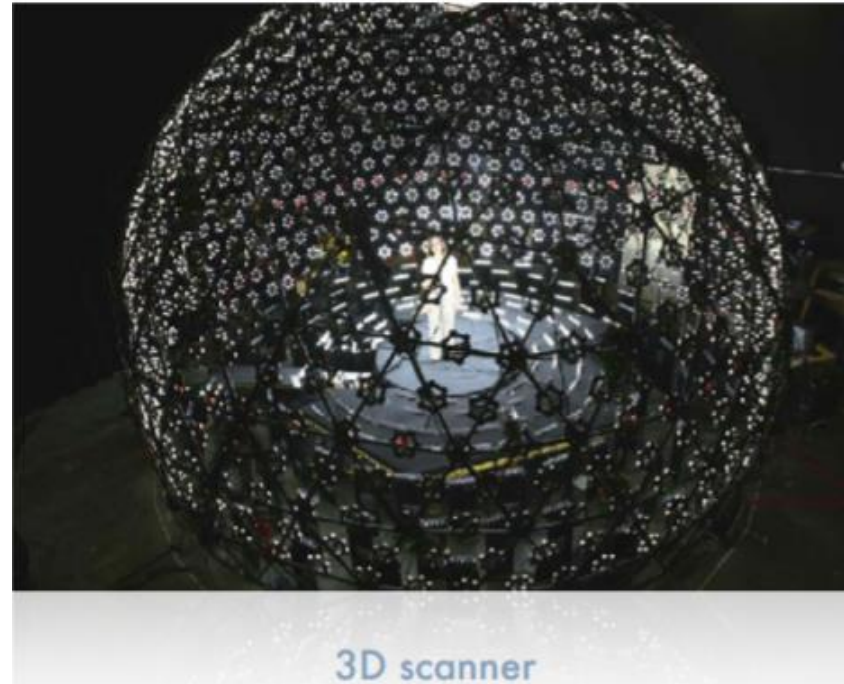




ZBrush



# Large and growing repositories of 3D Models



3D acquisition



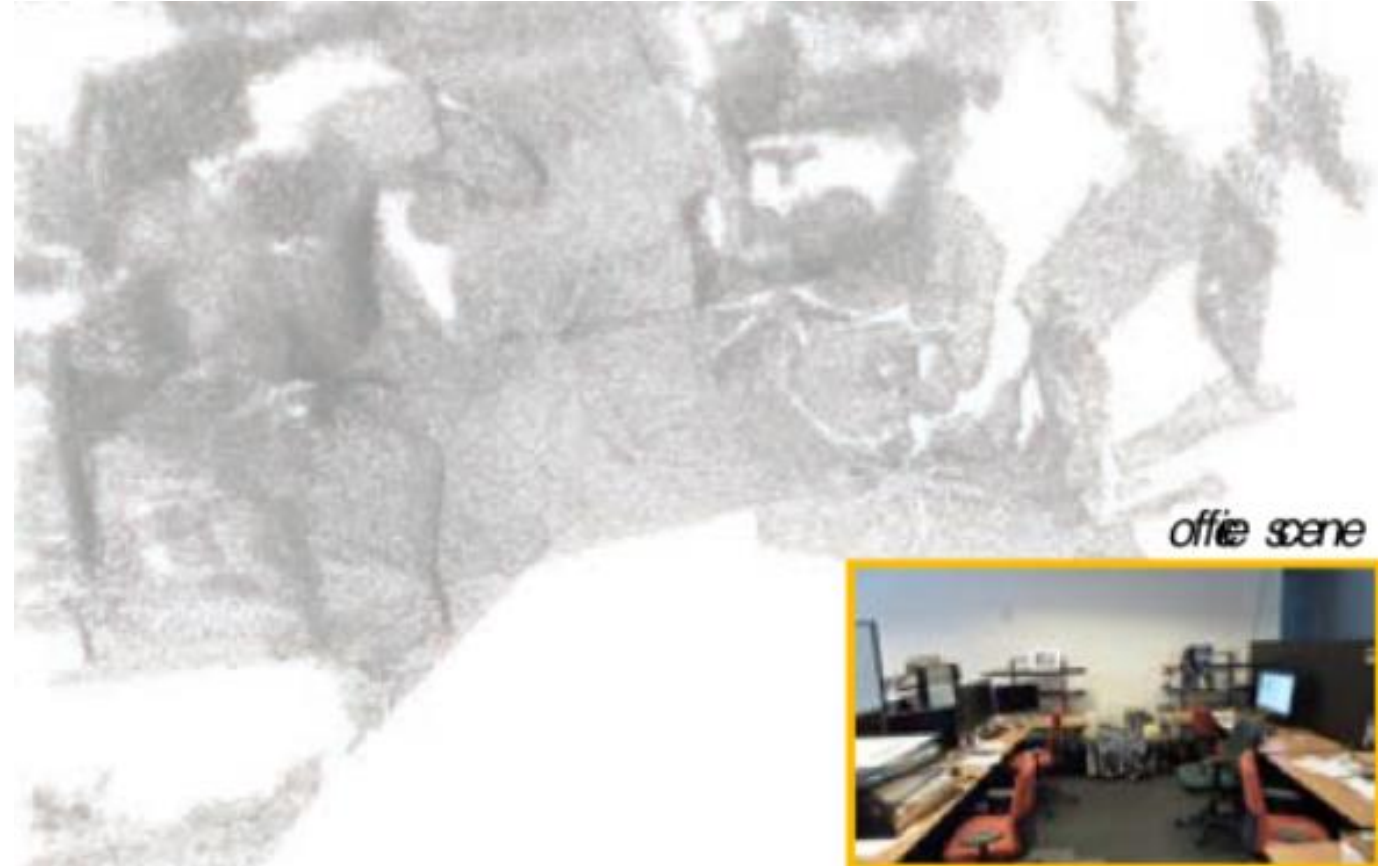
# Large and growing repositories of 3D Models



# Large and growing repositories of 3D Models



For Everyone

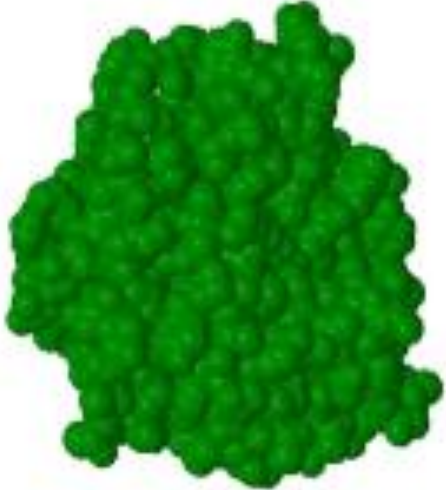


RGB-D data

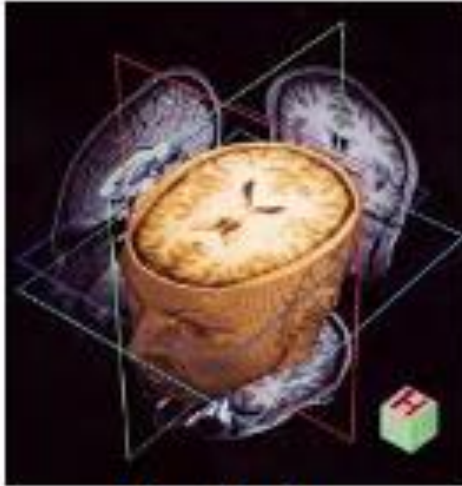


# Motivation

- **Lots** of geometric data in different domains!



Molecular Biology



Medicine



Engineering



Cultural Heritage



Paleontology



Computer Graphics





microscope



ultrasound



MRI scanner



x-ray diffractometer

# Geometry

## γεωμετρία



stereo camera



radio telescope



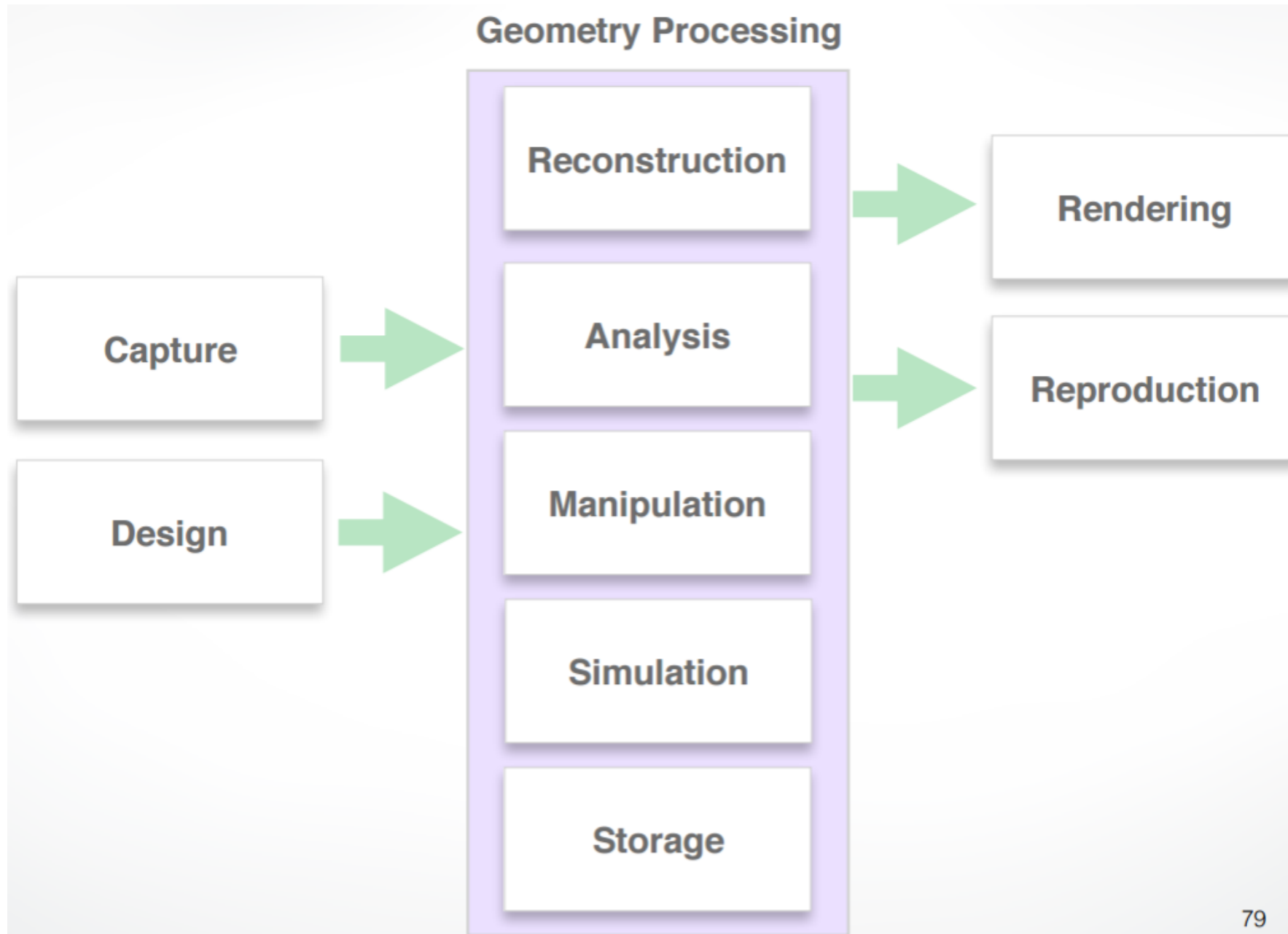
laser scanner



time-of-flight scanner

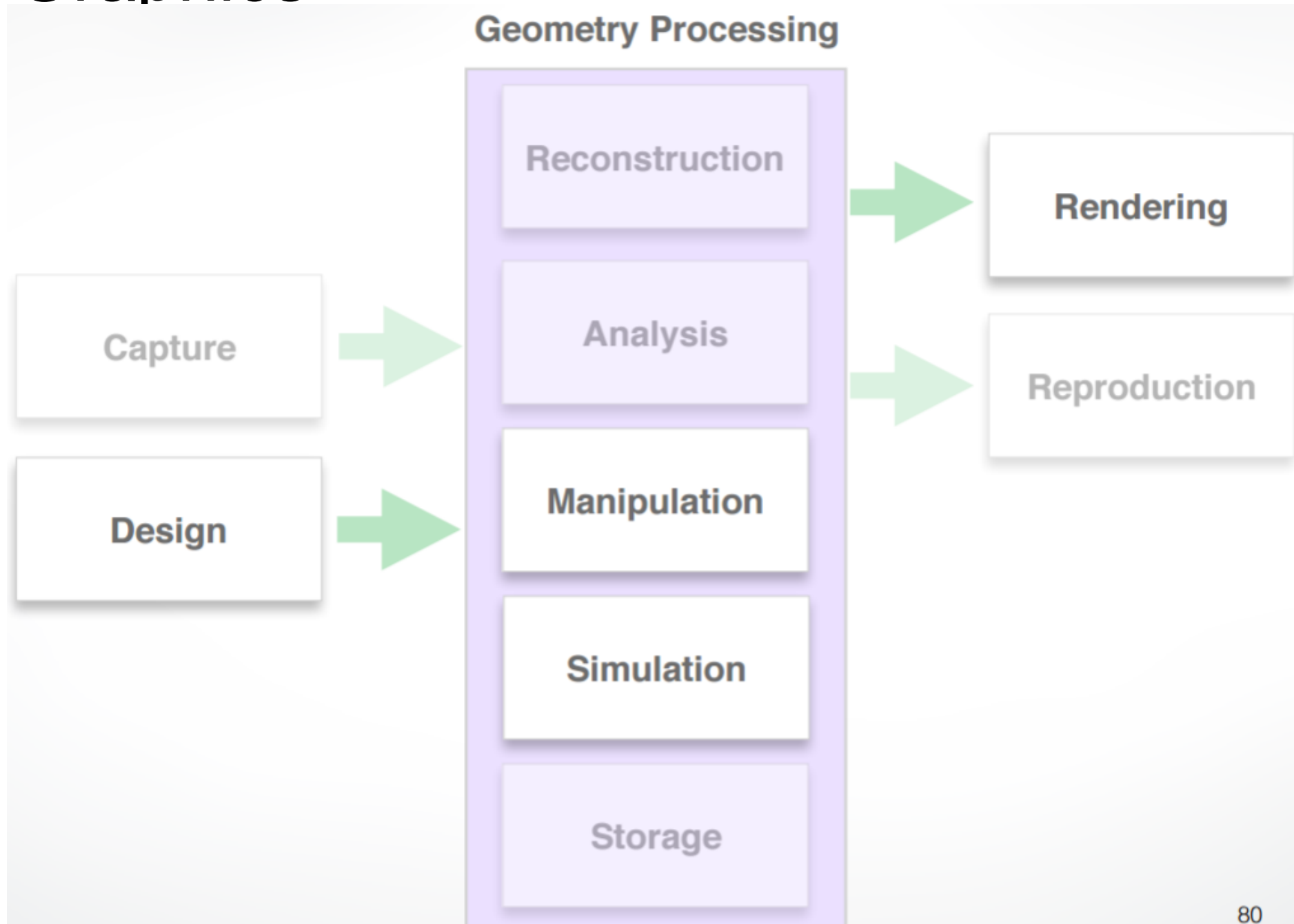
# Summary

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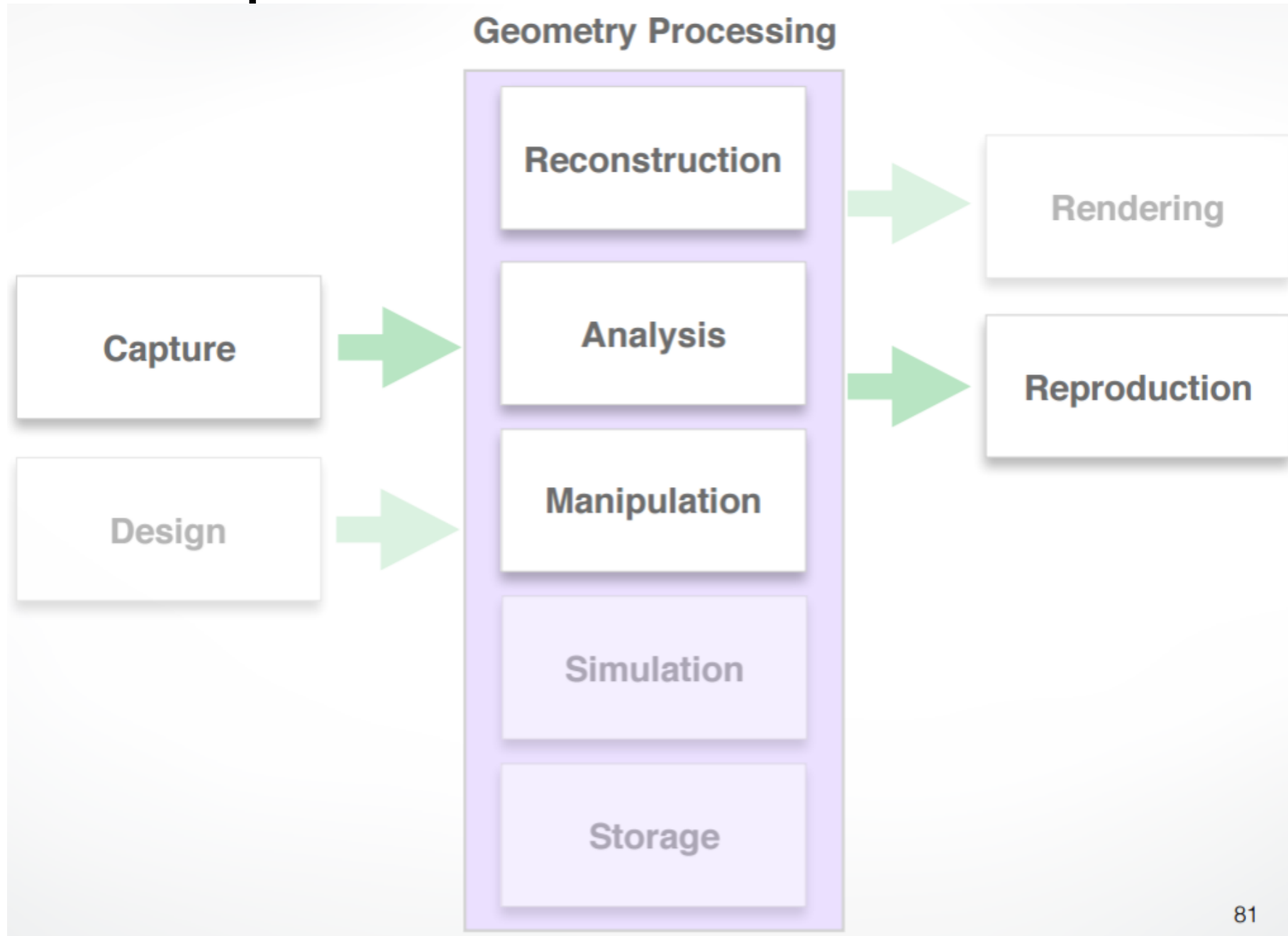




# Classic Graphics



# Modern Graphics/Vision



# The Future: Big Data / Robotics

