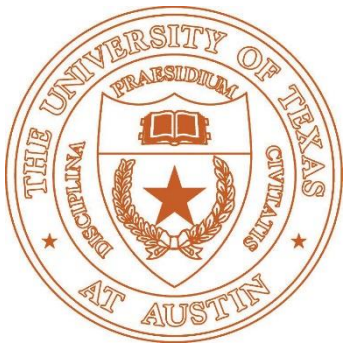
CS 395T
Advanced Geometry Processing

Qixing Huang

Janurary 17th 2017



Self-Introduction

- BS, MS: Tsinghua University
- PhD: Stanford University (2012)

- Research Assistant Professor at TTI Chicago (2014-2016)

- Assistant Professor in Computer Science (2016 - Now)

My Research

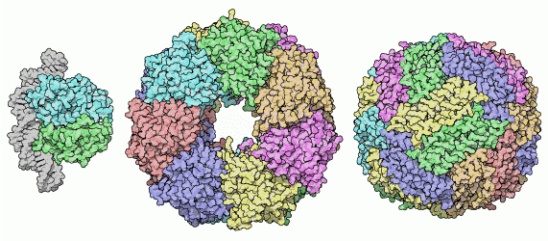
- Graphics/Computer Vision/Machine Learning

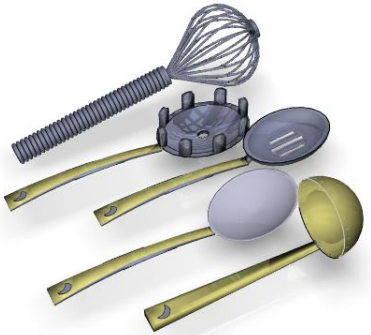
- Intersection of Graphics and Artificial Intelligence
  - Machine Learning
  - Natural Language Processing
  - Robotics
  - Computer Vision

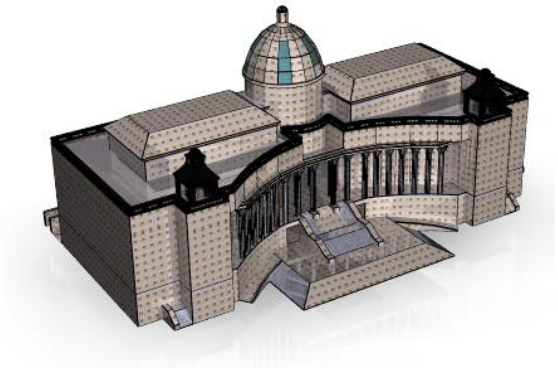
Logistic

- Office Hour: Fridays 3:00 pm --- 5:00 pm

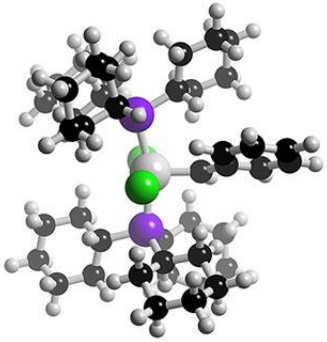
- Grading:
  - 30% Paper presentation + In-class participation
  - 70% Final project (Groups of 2-3)
    - Proposal
    - Final project presentation
    - Project report

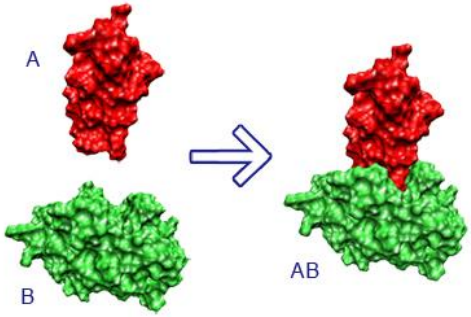




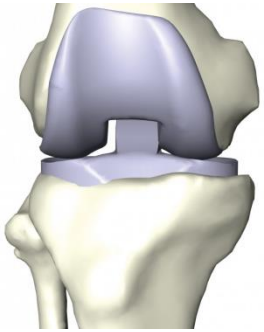


3D model as a data representation





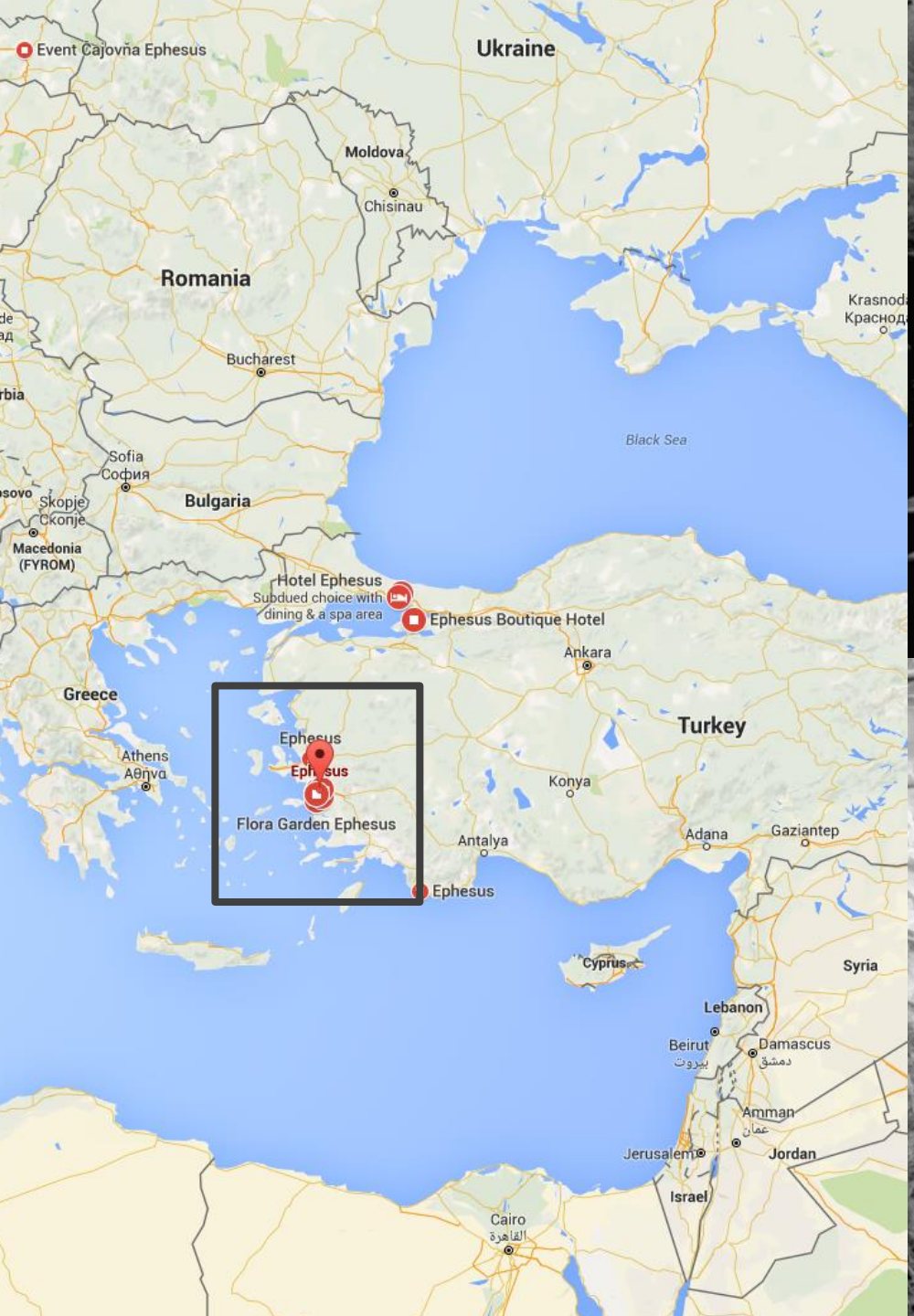
Biology & Chemistry

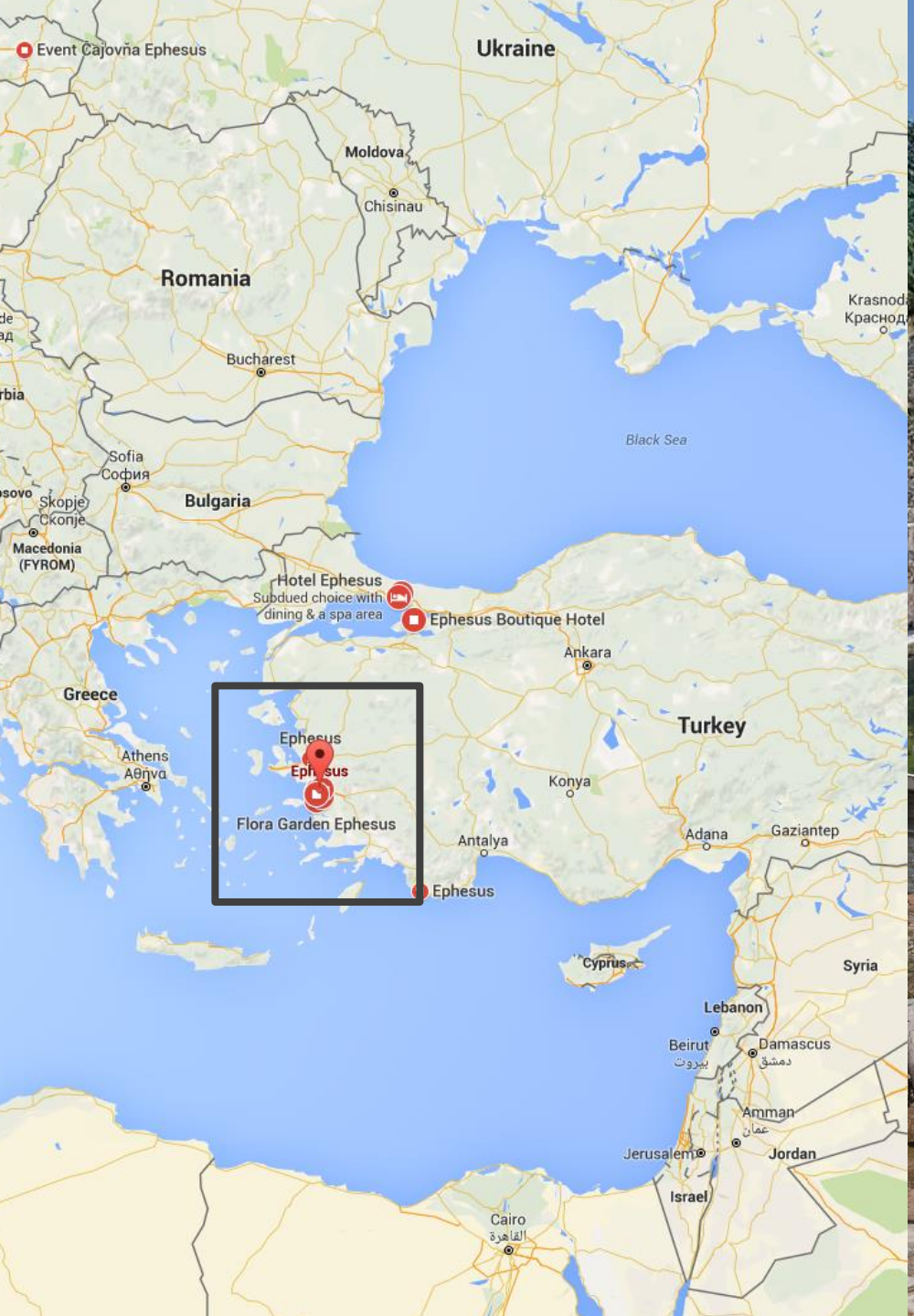


Medicine

Virtual reality

A Personal Story


Event Cajovna Ephesus
Ukraine
Moldova
Chisinau
Romania
Bucharest
Black Sea
Sofia
София
Bulgaria
Skopje
Скопје
Macedonia
(FYROM)
Hotel Ephesus
Subdued choice with dining & a spa area
Ephesus Boutique Hotel
Ankara
Greece
Turkey
Athens
Αθήνα
Ephesus
Flora Garden Ephesus
Konya
Antalya
Adana
Gaziantep
Ephesus
Cyprus
Syria
Lebanon
Beirut
بيروت
Damascus
دمشق
Amman
عمان
Jerusalem
Jordan
Israel
Cairo
القاهرة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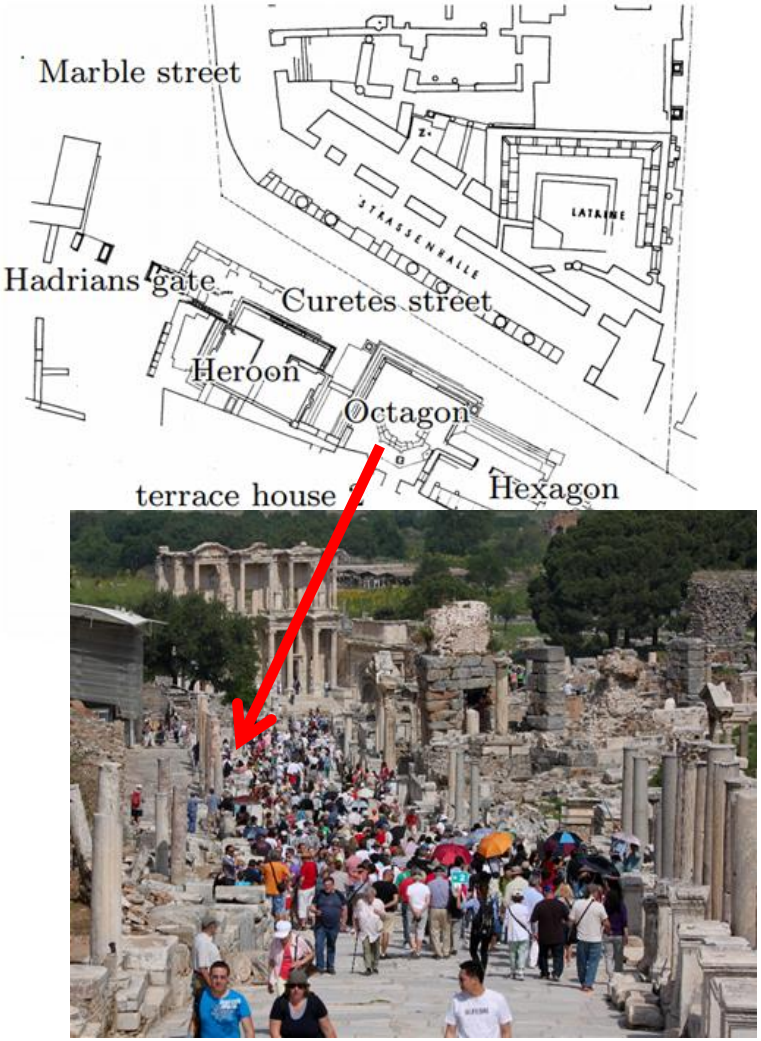
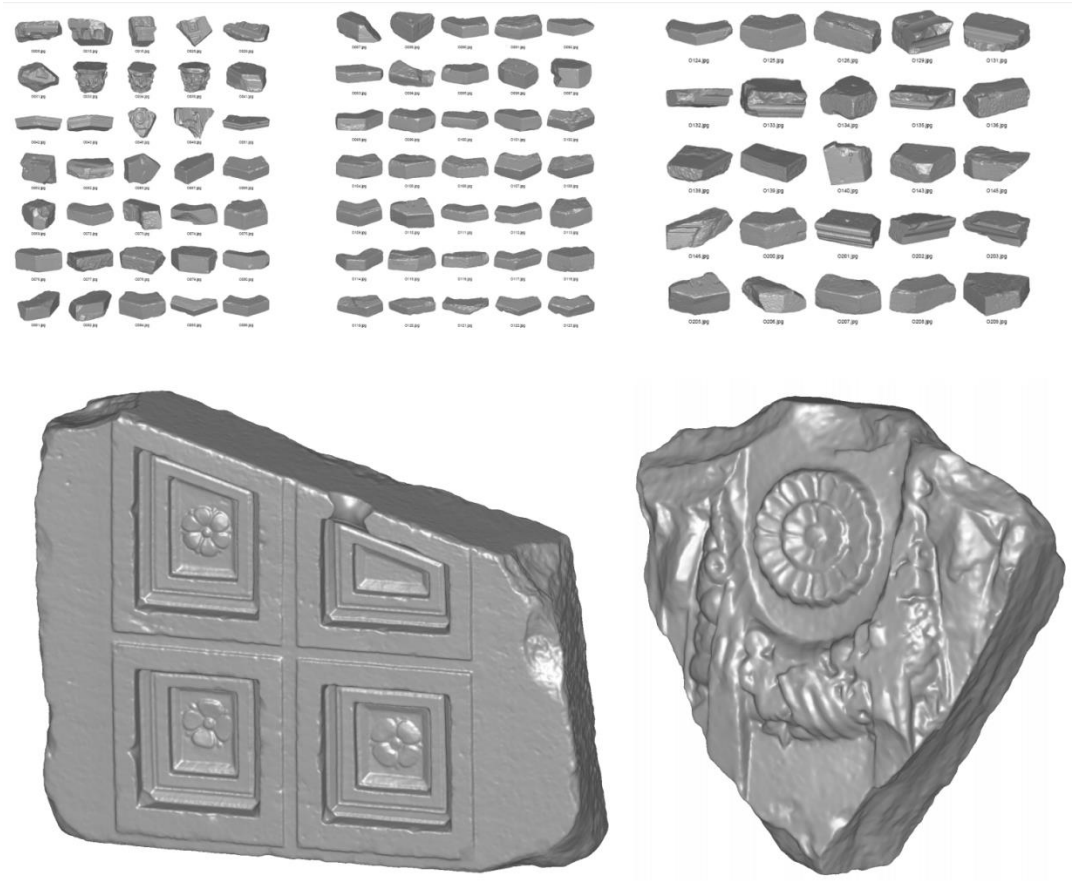
Adana
Gaziantep
Ephesus
Cyprus
Syria
Lebanon
Beirut
بيروت
Damascus
دمشق
Amman
عمان
Jerusalem
Jordan
Israel
Cairo
القاهرة

Reconstructing of the Octagon Monument



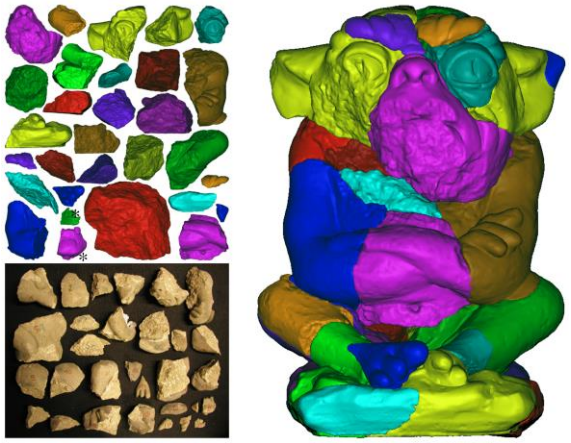
Finding matching fragments is a tedious job

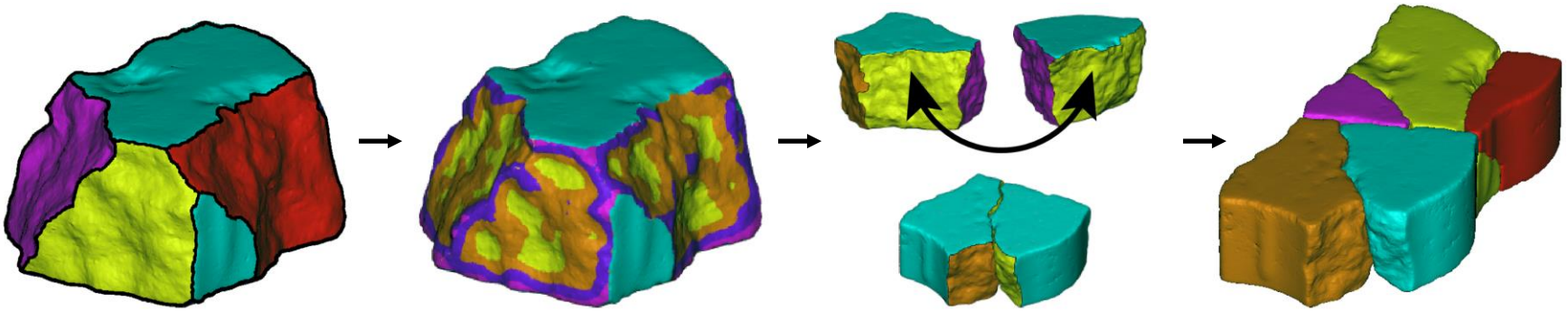
3D reconstruction of fragments



3D reconstruction and completion

Reconstruction Pipeline [Huang et al. 06]





Data segmentation

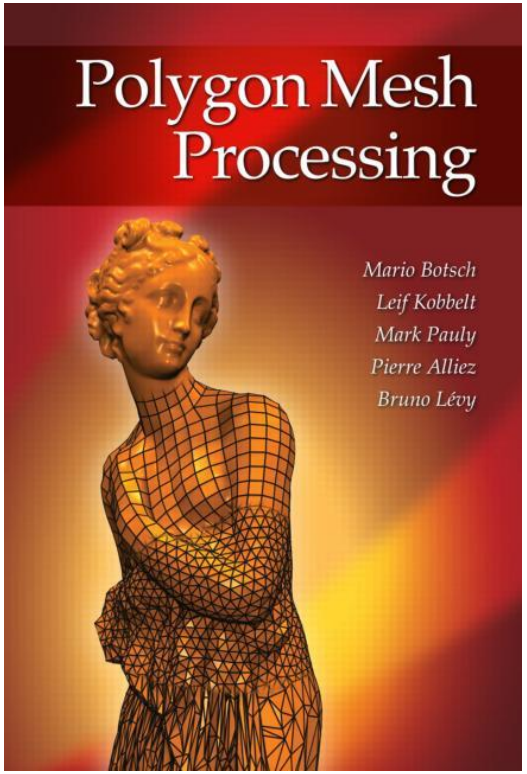
Feature selection

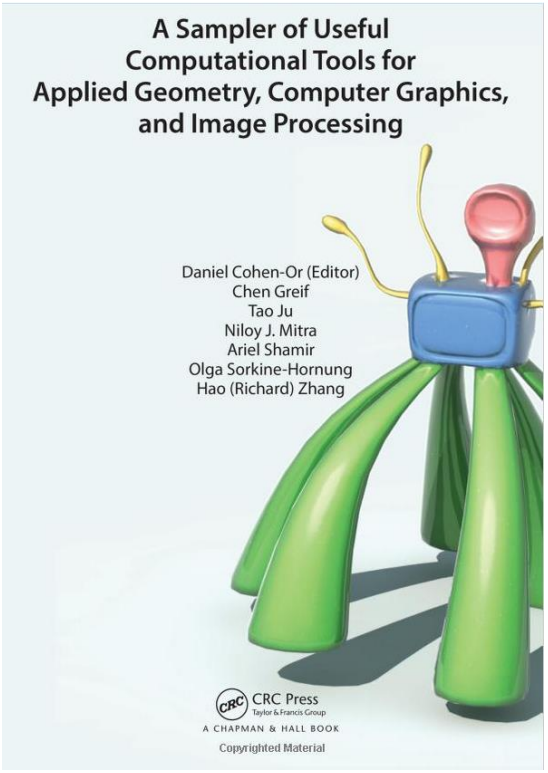
Pairwise matching

Multi-piece matching

Visual impact of the 3D restoration

Recommended Books

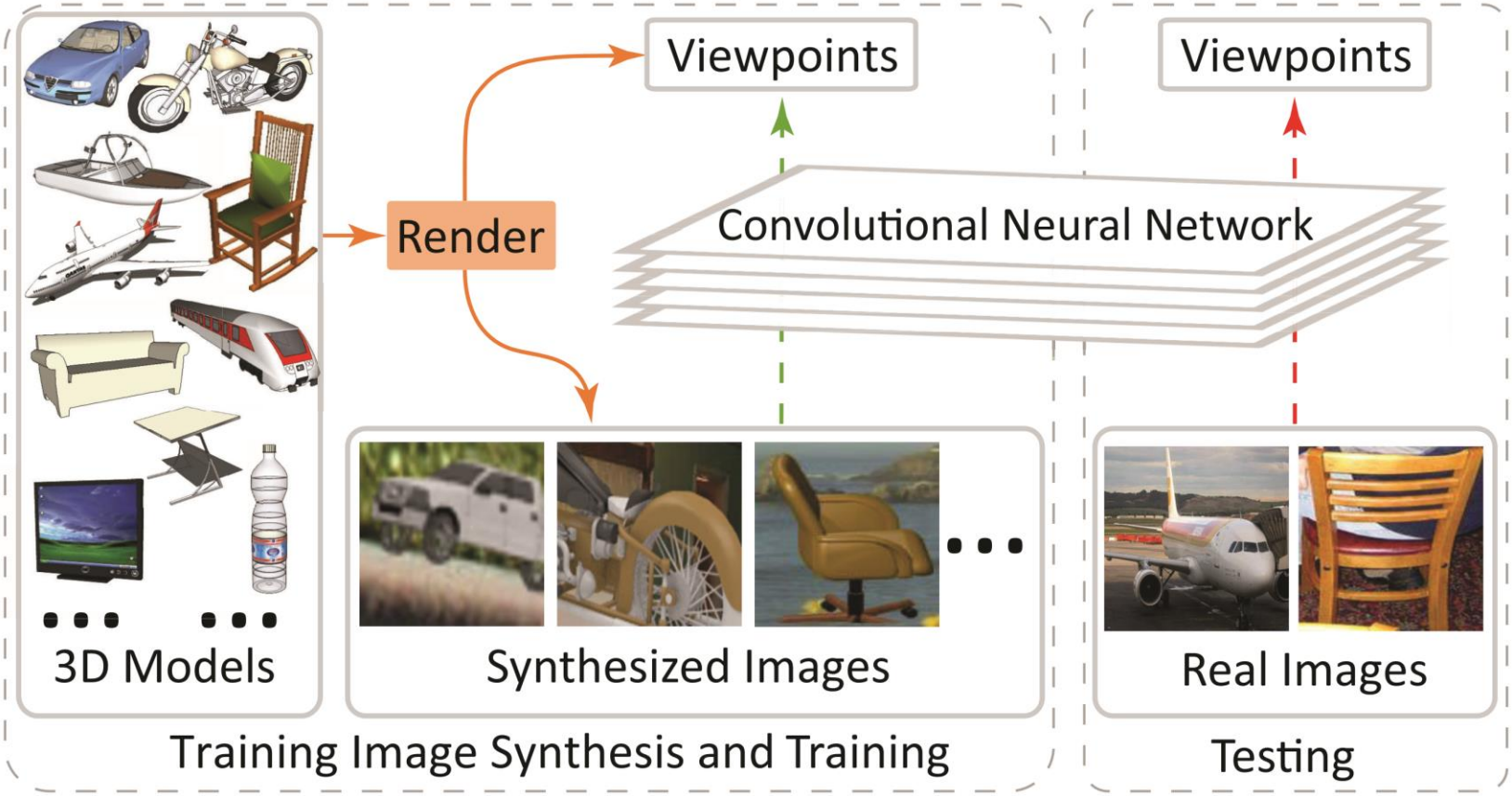




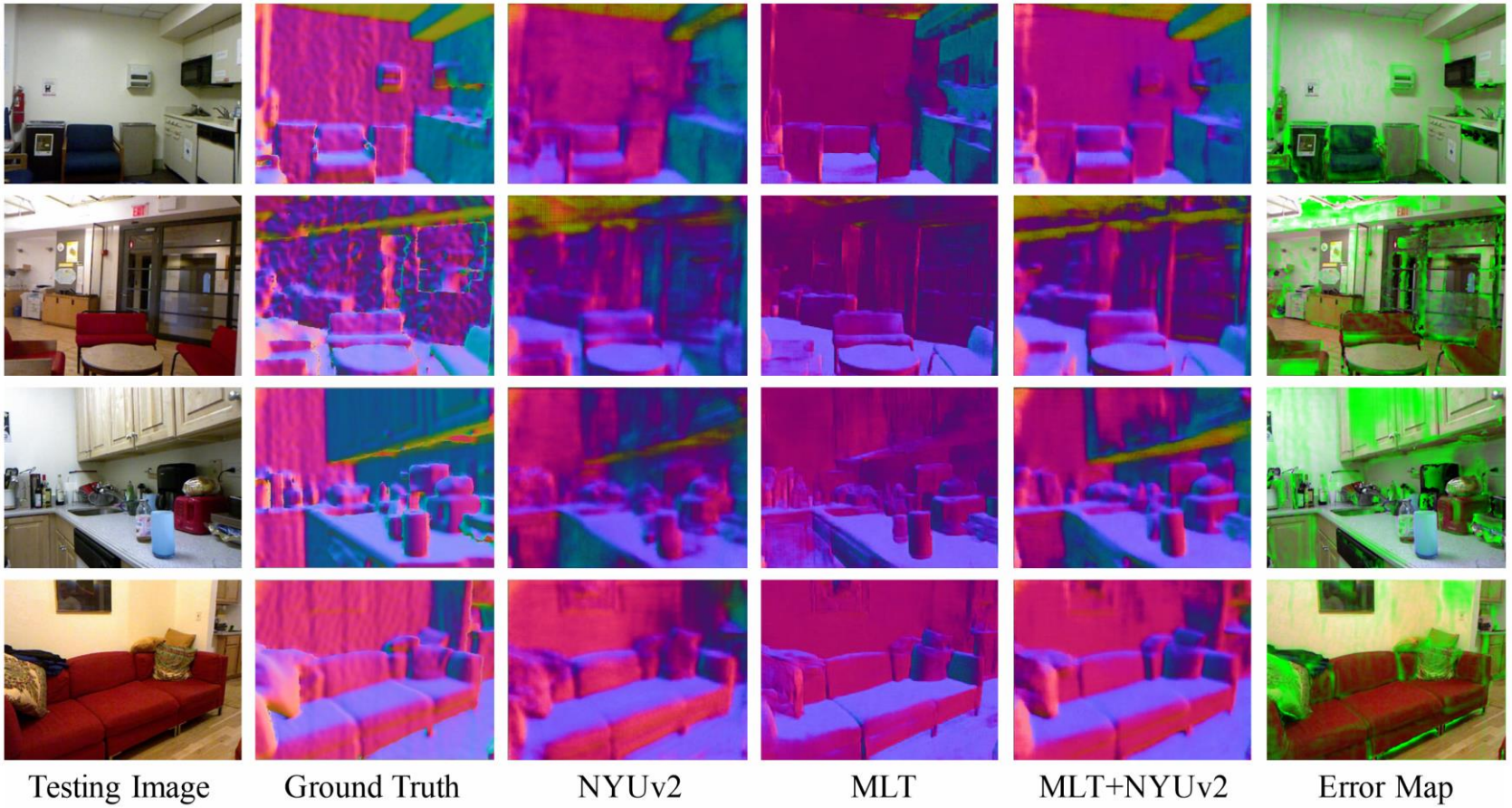
Data!

Learning from Synthetic Data

Render-for-CNN [Su et al. 15]



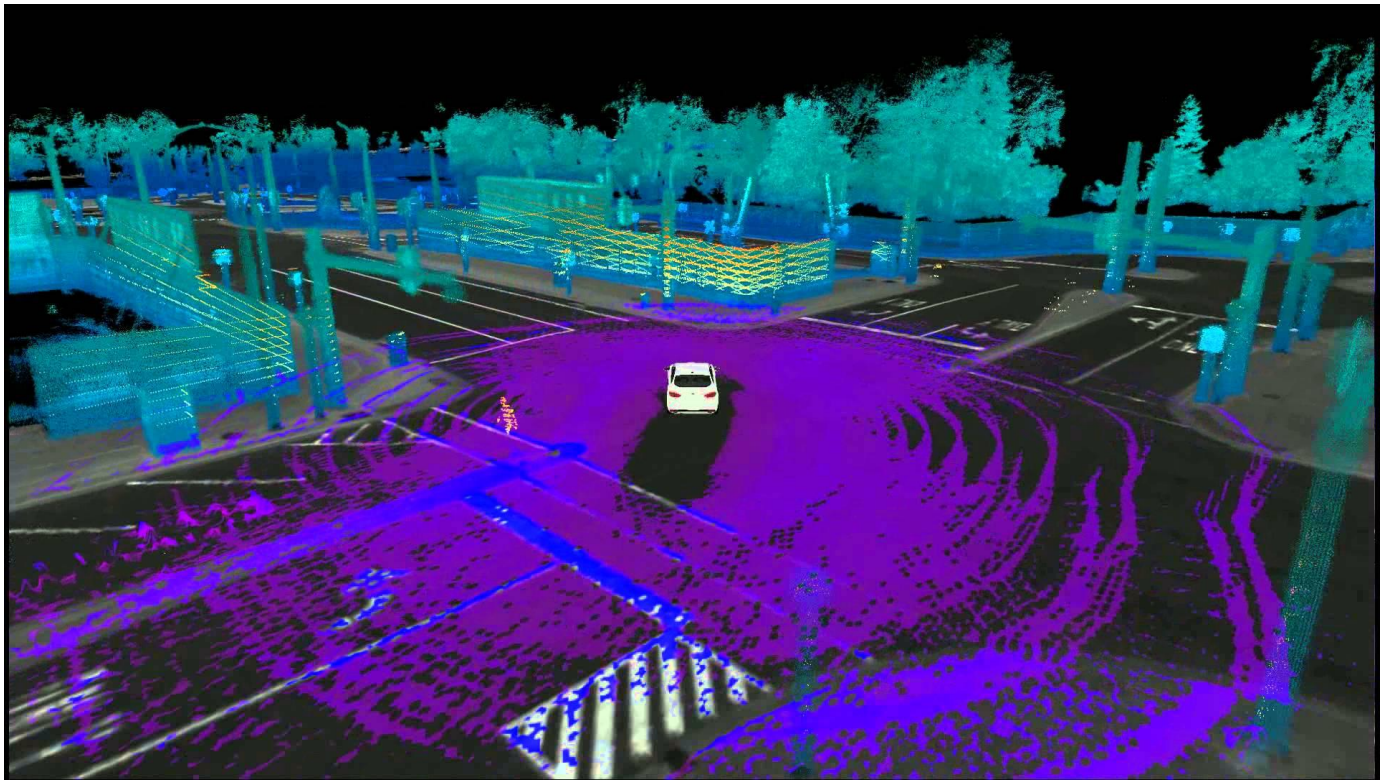
Physically-Based Rendering [Zhang et al. 16]



Autonomous Driving

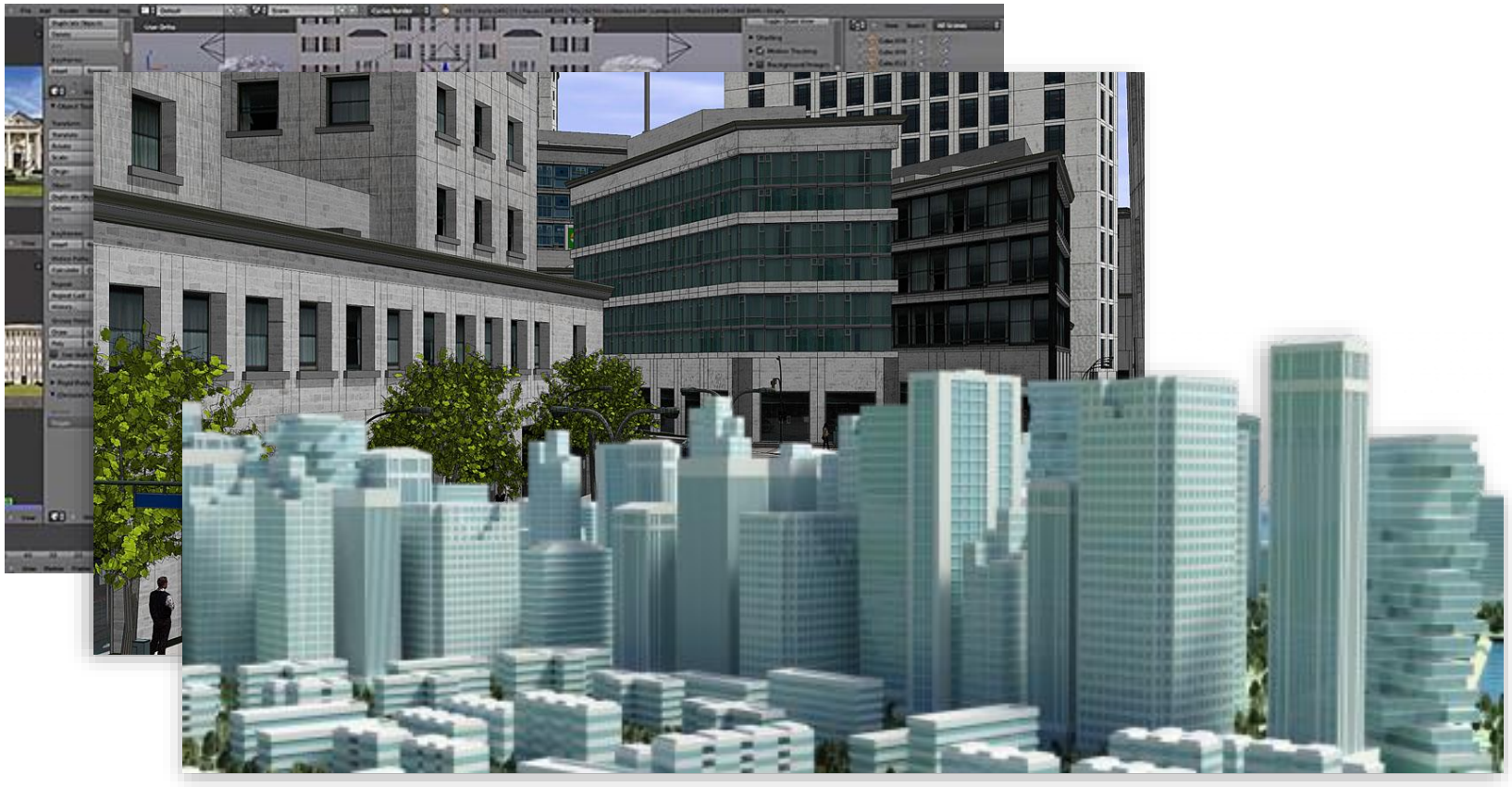
3D Sensors

3D Understanding

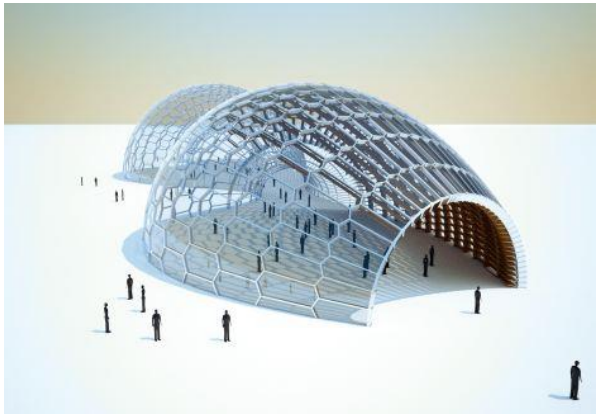


Architectural Design

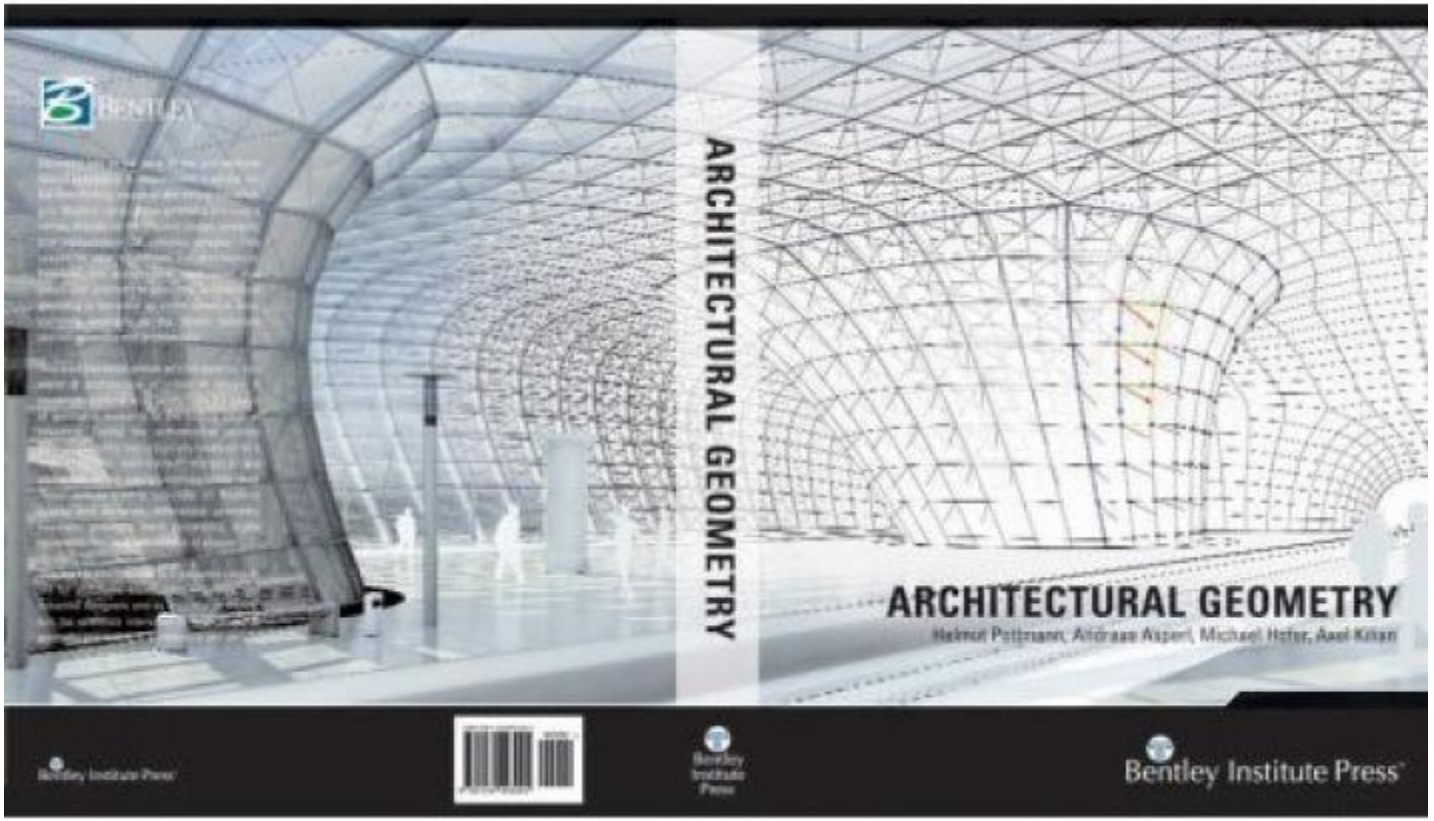
Procedural Modeling



Architectural Geometry



Architectural Geometry



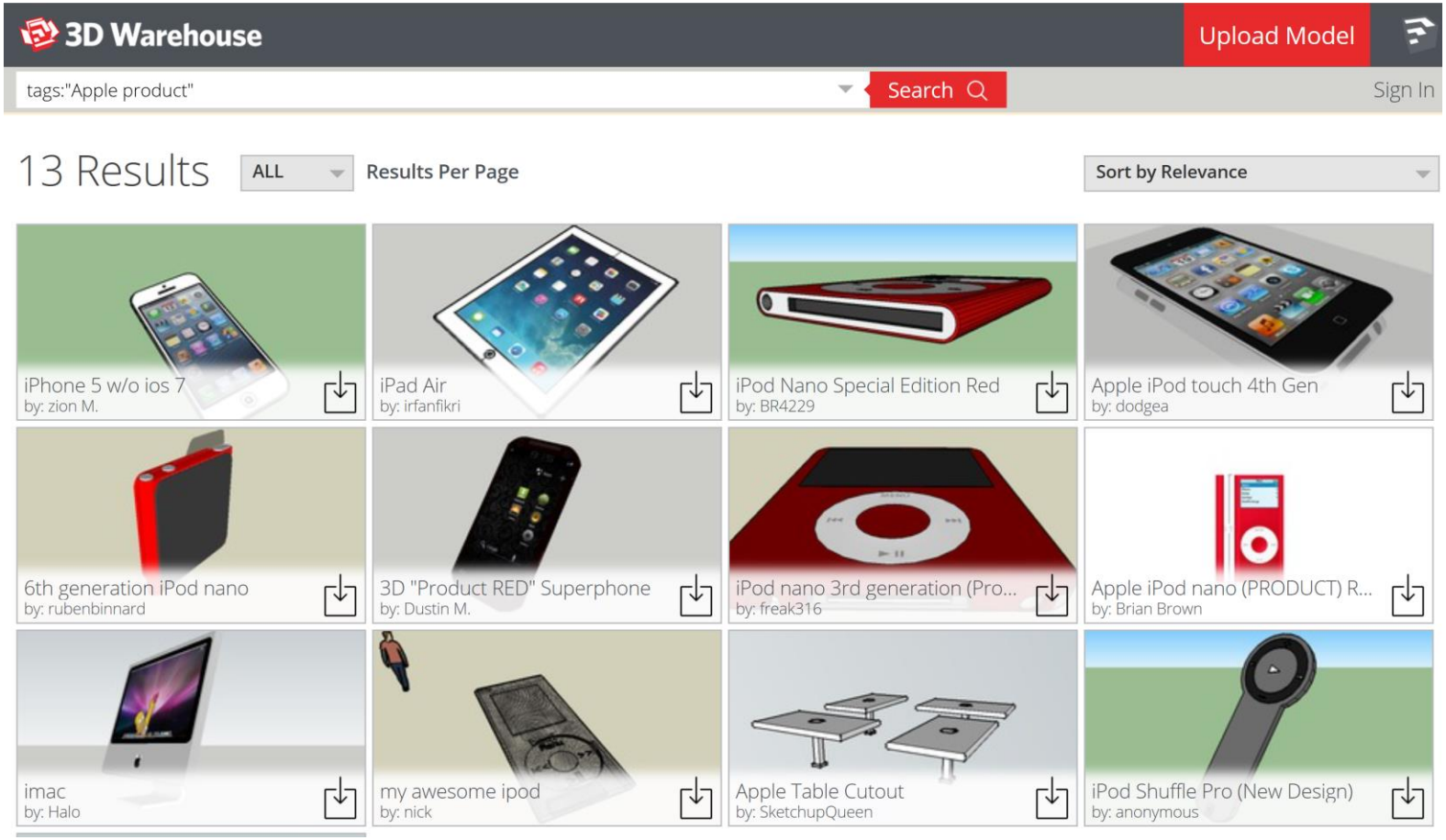
Movie Industry

Digital Characters --- Avatar

Virtual Reality

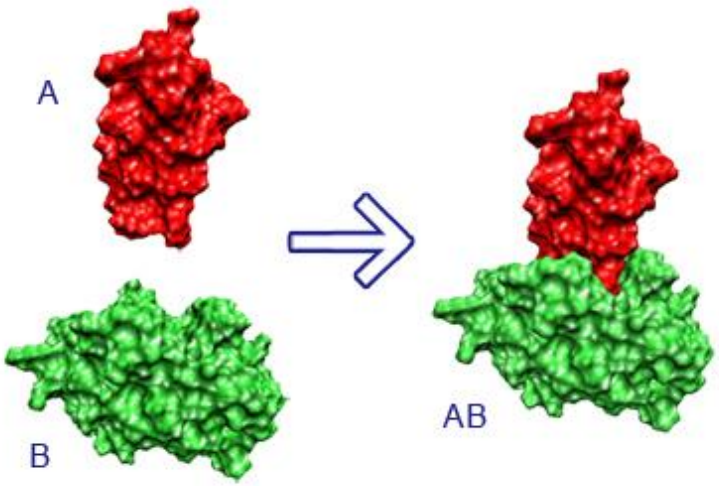
Matterport – Navigation of Indoor Environment

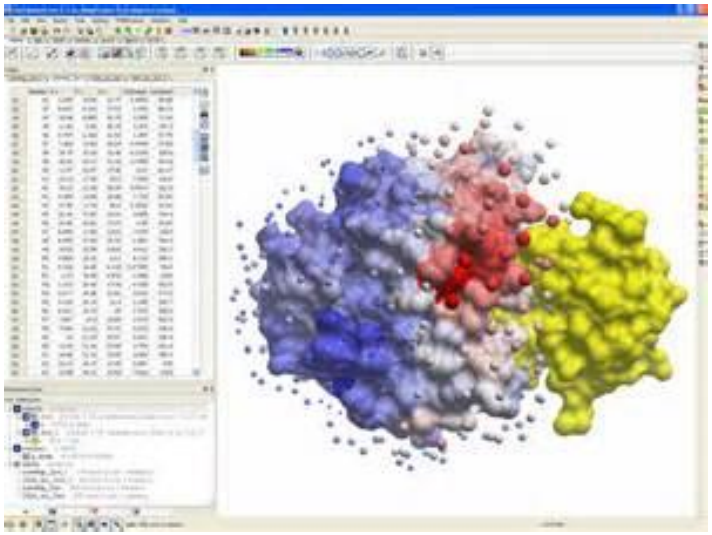
3D Product Search



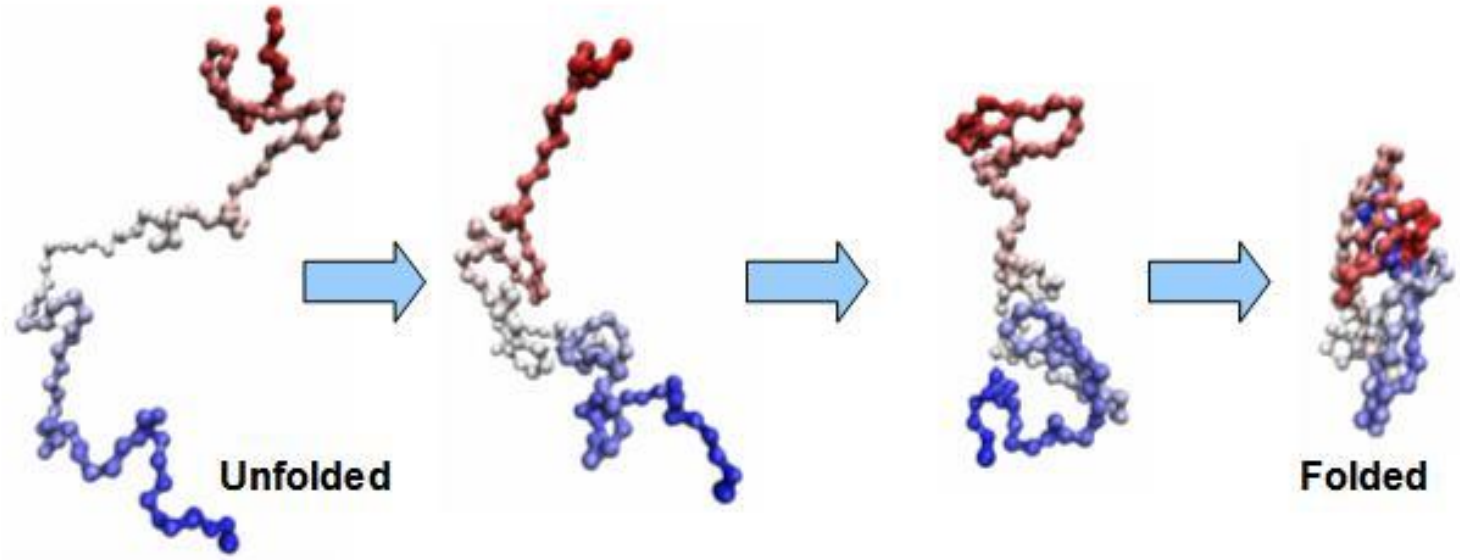
Computational Biology

Protein Docking

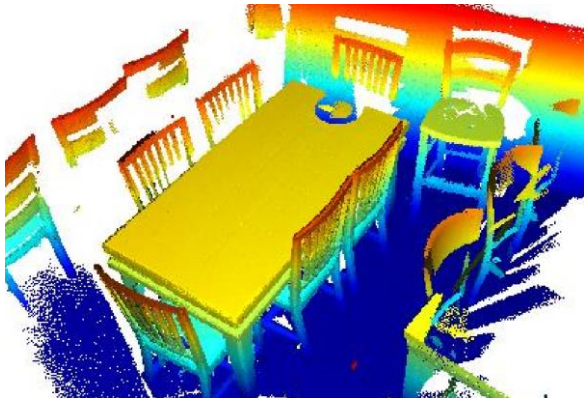




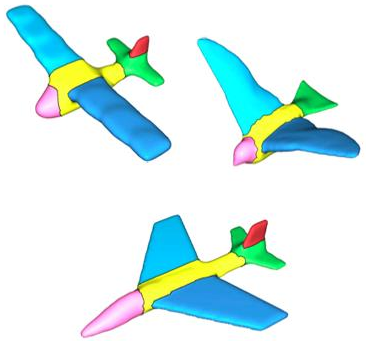
Protein Folding



Three Major Topics



Reconstruction

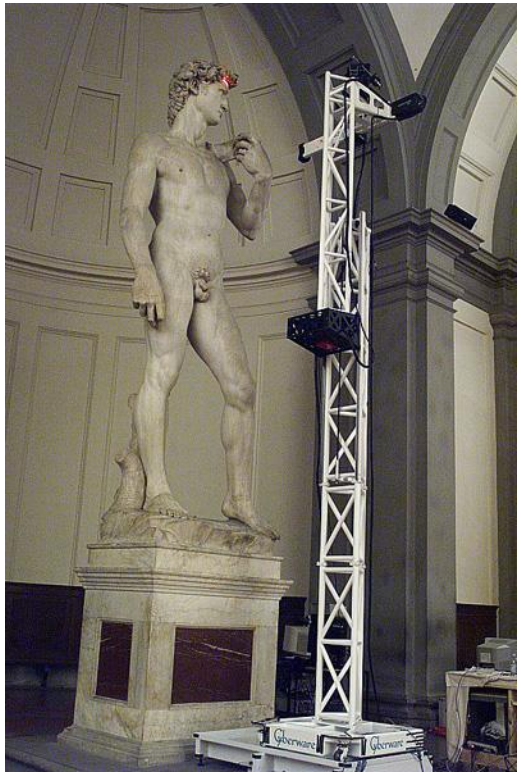


Analysis

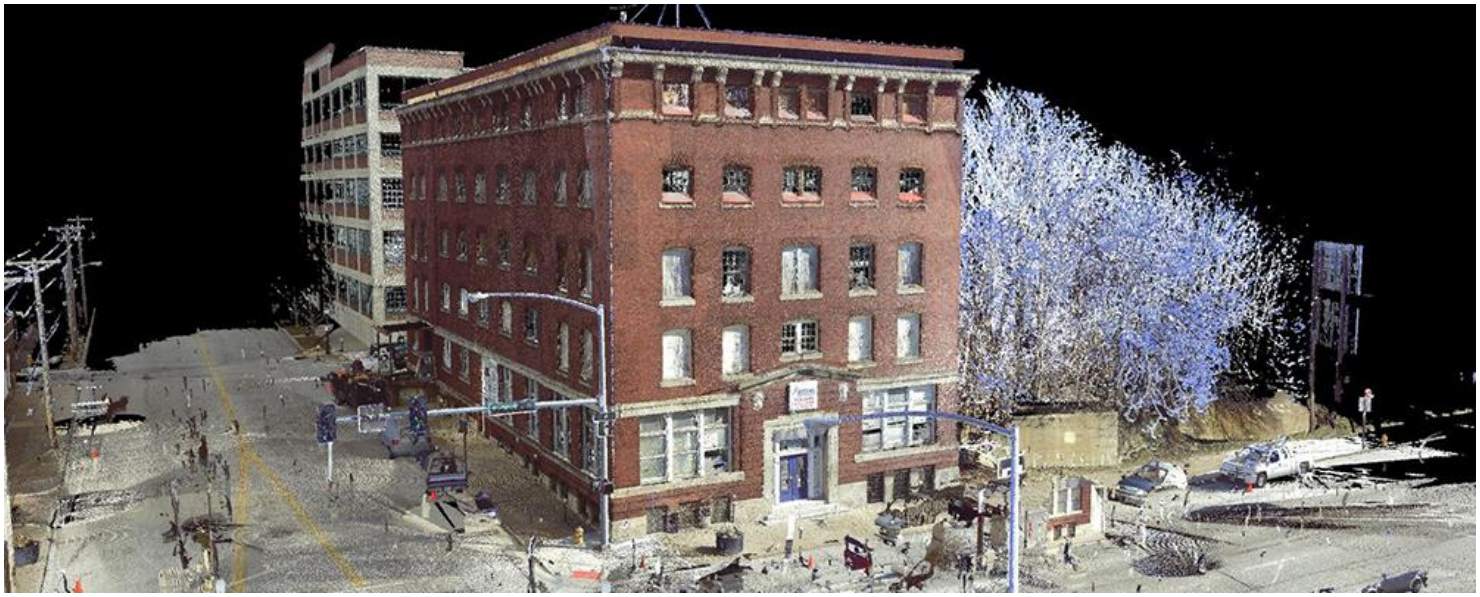
Synthesis

Geometry Reconstruction

Topic one – Geometry Reconstruction



Topic one – Geometry Reconstruction



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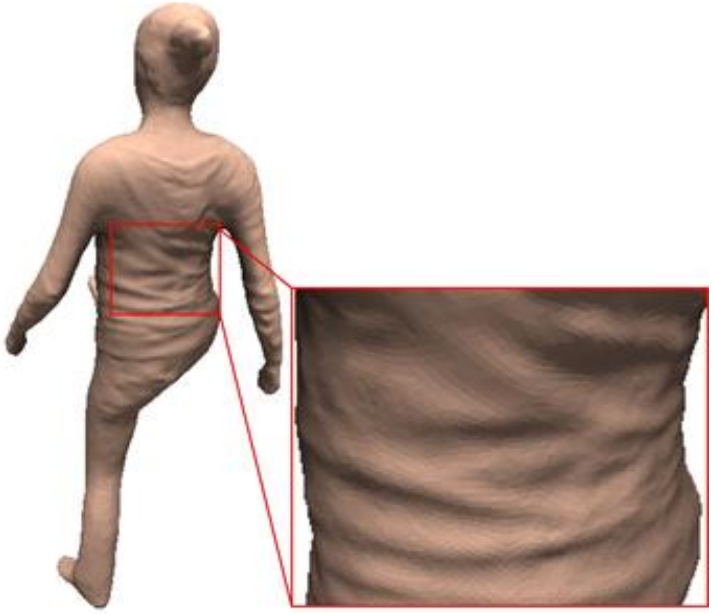
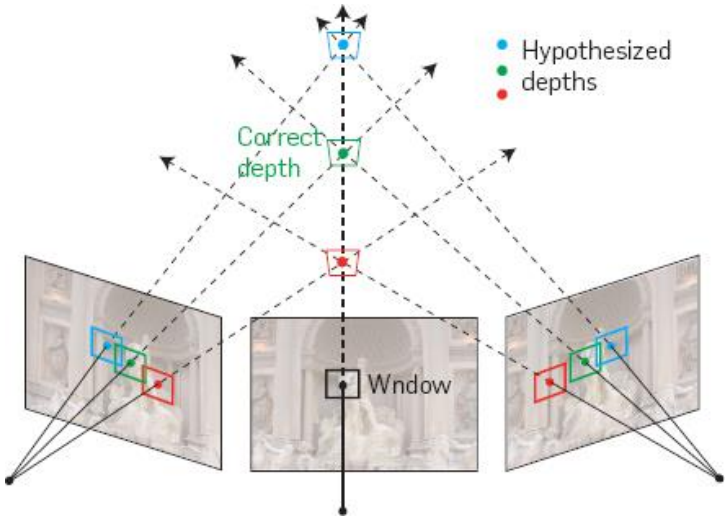
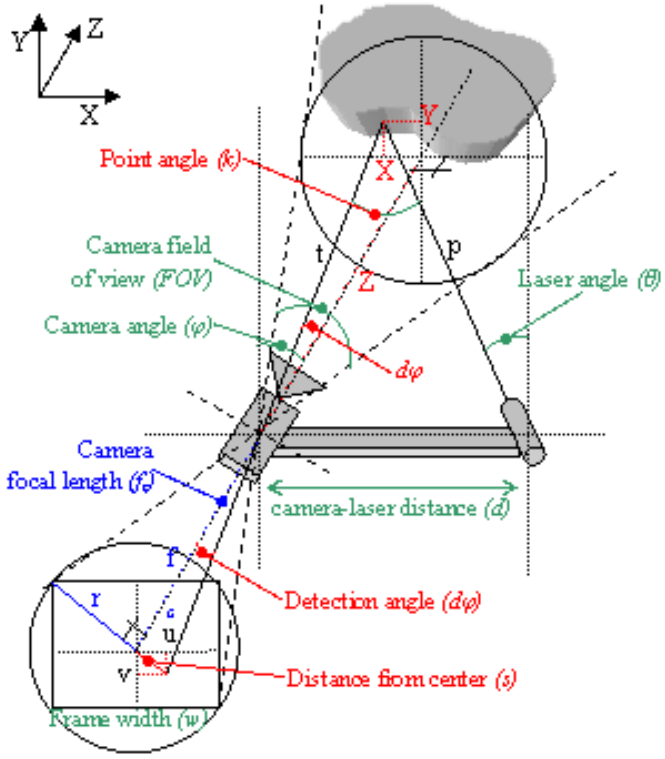


Multi-view Stereo Reconstruction



Multi-view Stereo Reconstruction

Scanning-Based Reconstruction



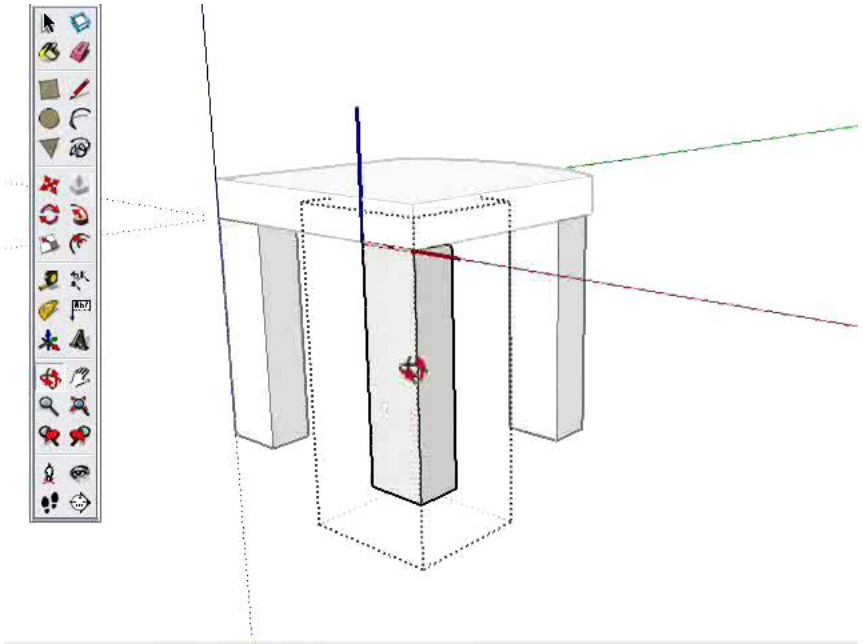
The process of triangulation for an unknown point in 3D space

Scanning-Based Reconstruction

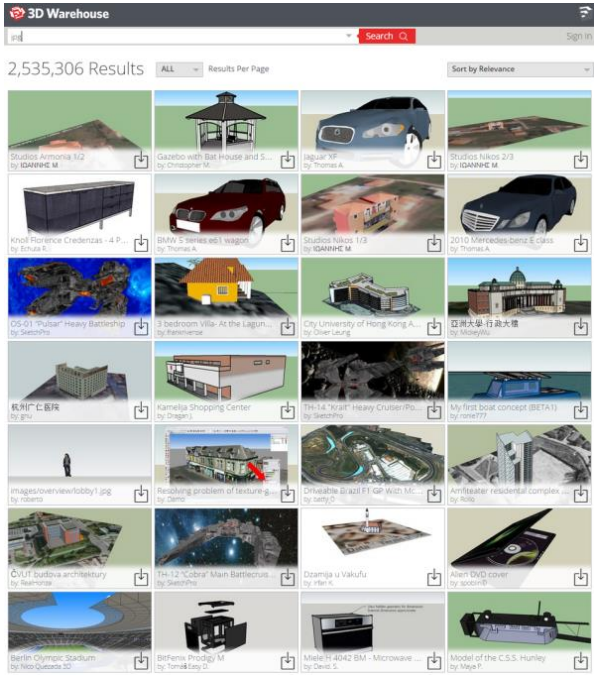
Scanning-Based Reconstruction

Kinect Fusion

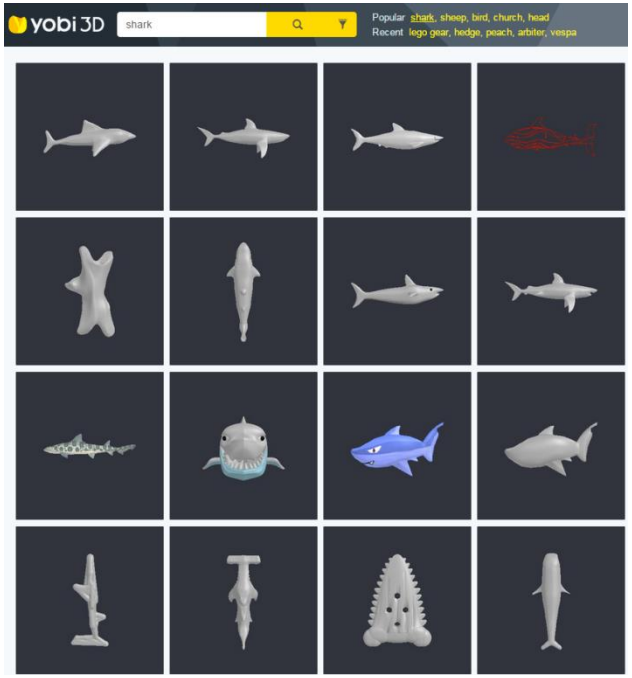
Interactive Modeling



ShapeNet3D



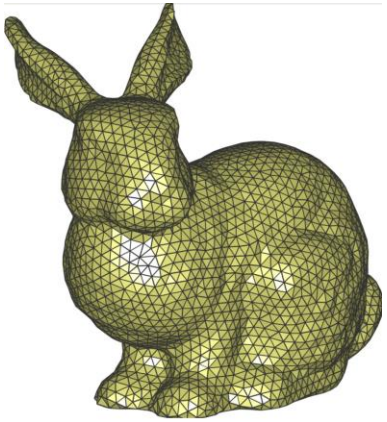
3D Warehouse



Yobi3D

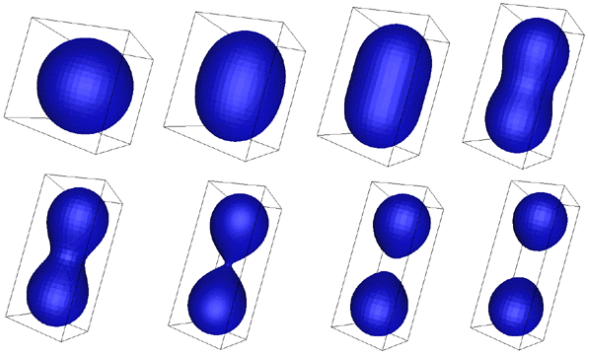
3M models in more than 4K categories

Data Representation

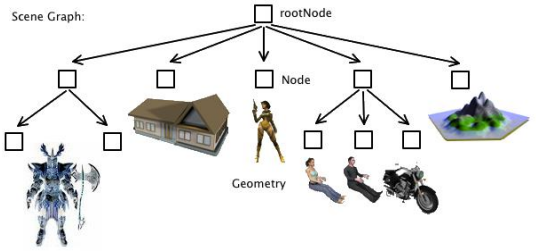


Triangular mesh

Point cloud



Implicit surface

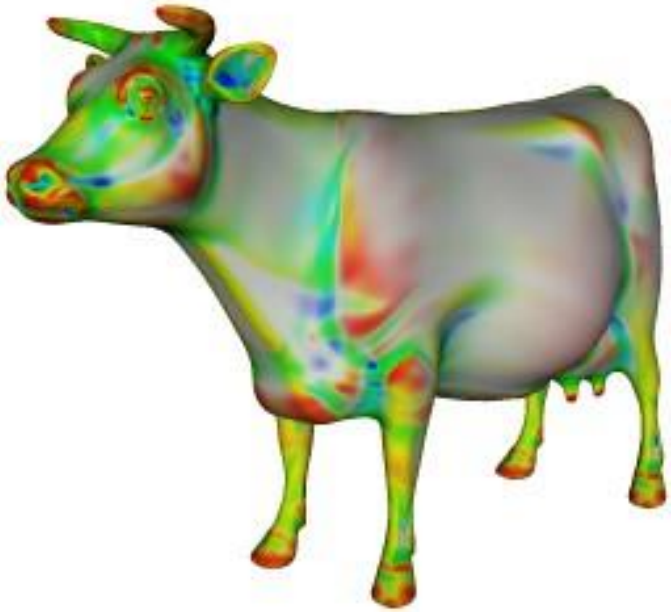


Part-based models

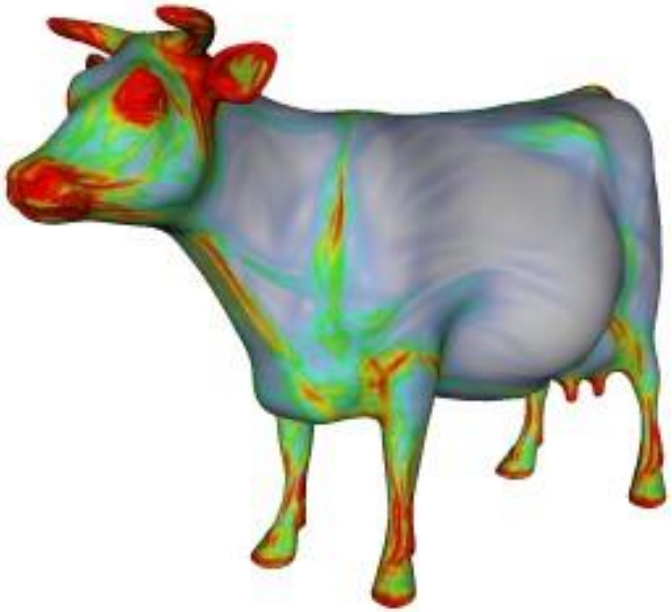
Discussion

Geometric Data Analysis

Curvature



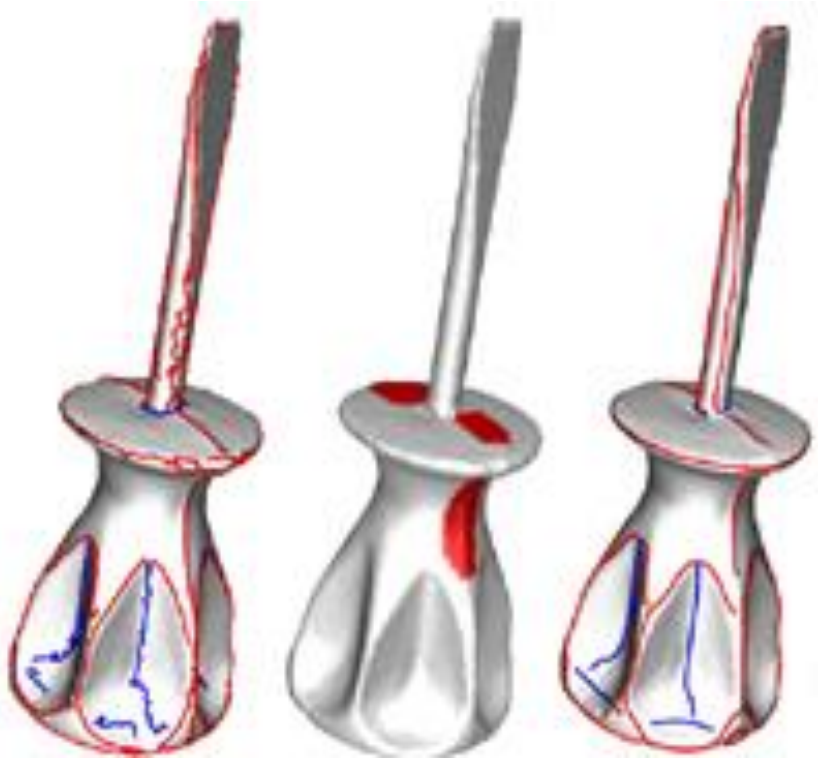
Curvature



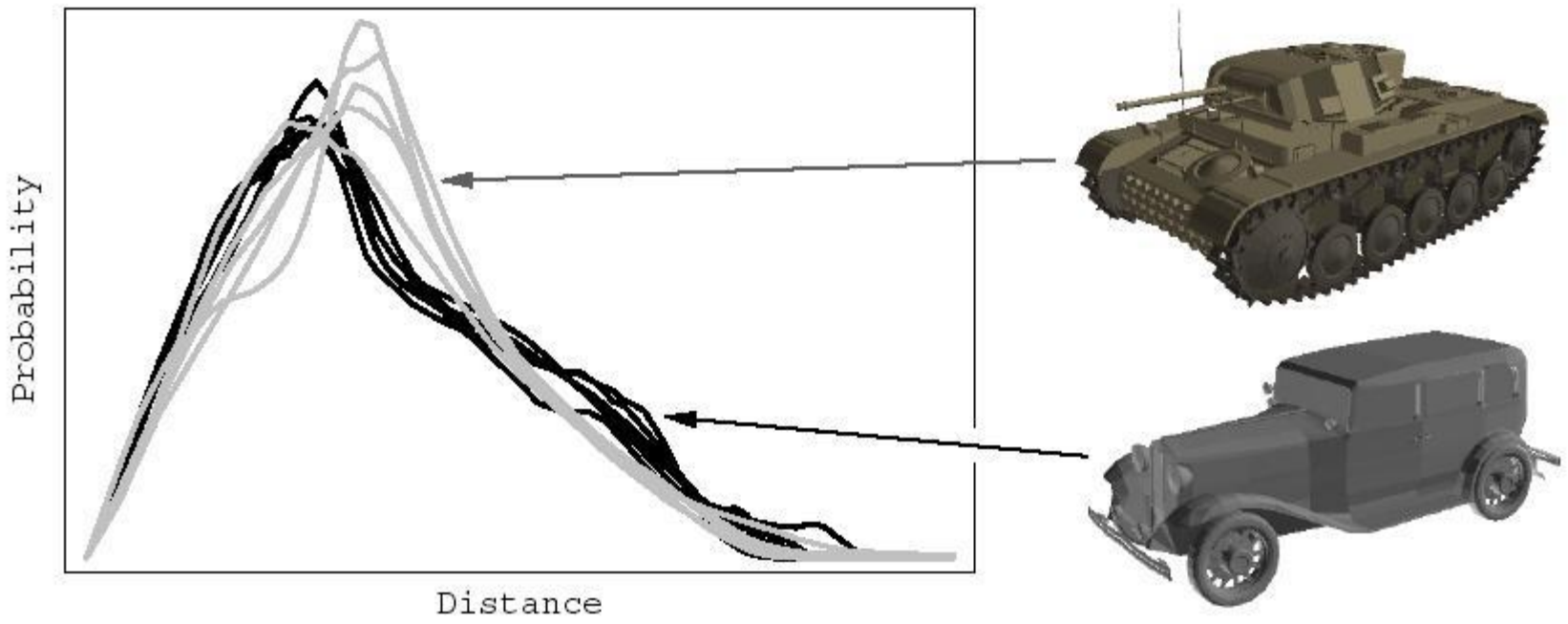
Curvature Derivatives

Feature Lines

[Hildebrandt et al. 05]



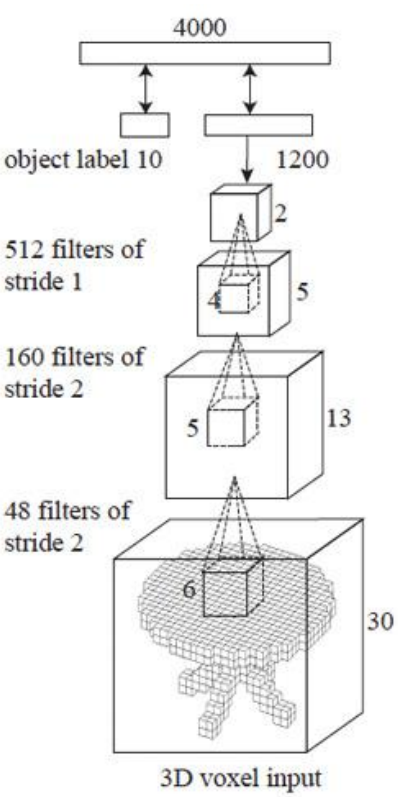
Shape Descriptors

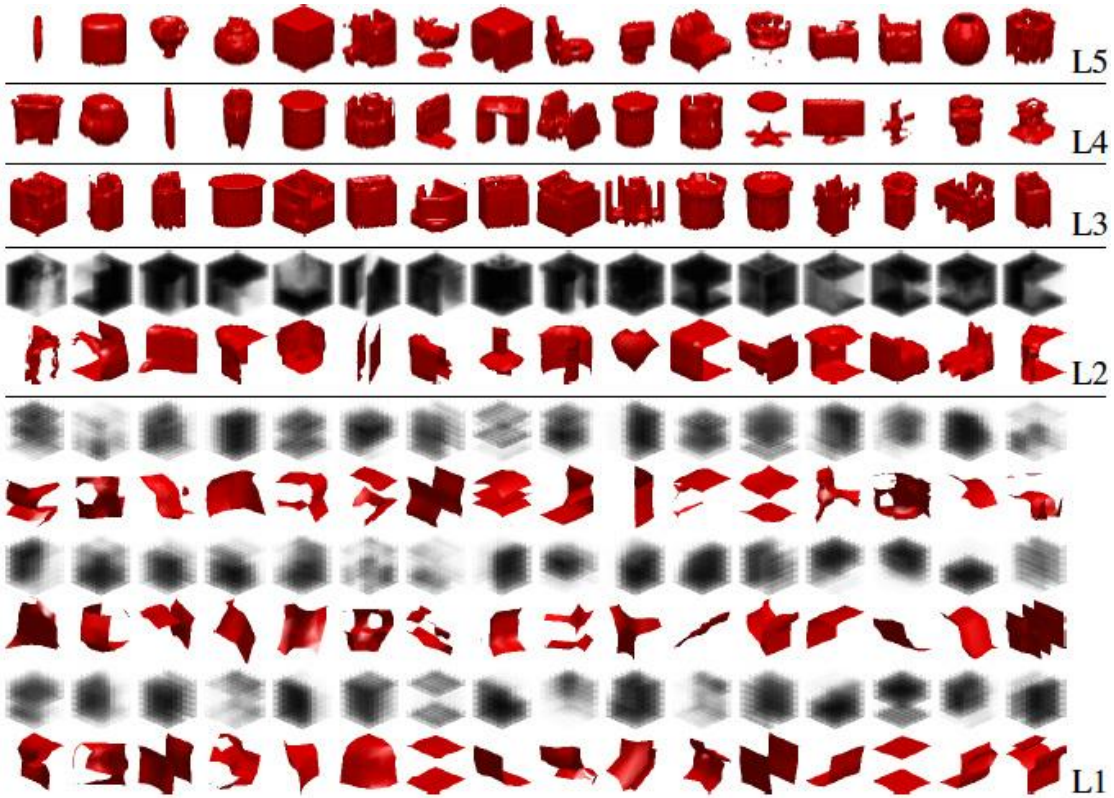


Shape Distributions Spherical Harmonics Light Field Descriptors

Shape Classification

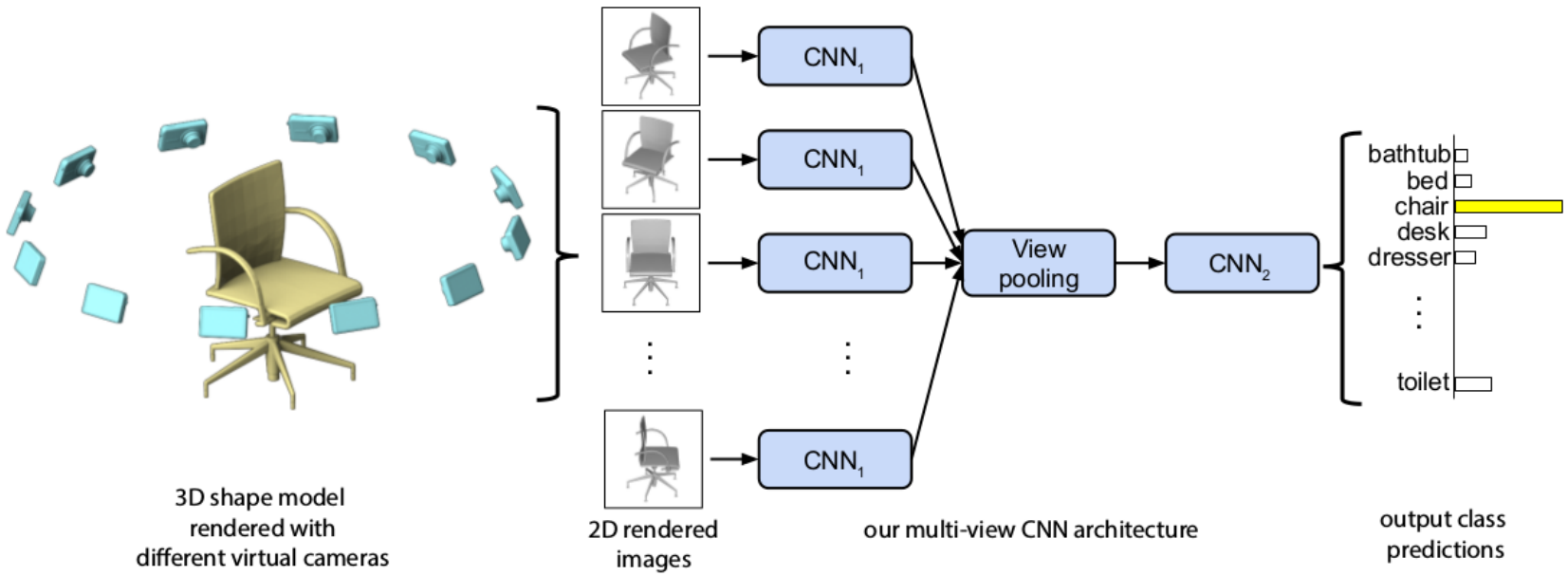
[Wu et al. 15]





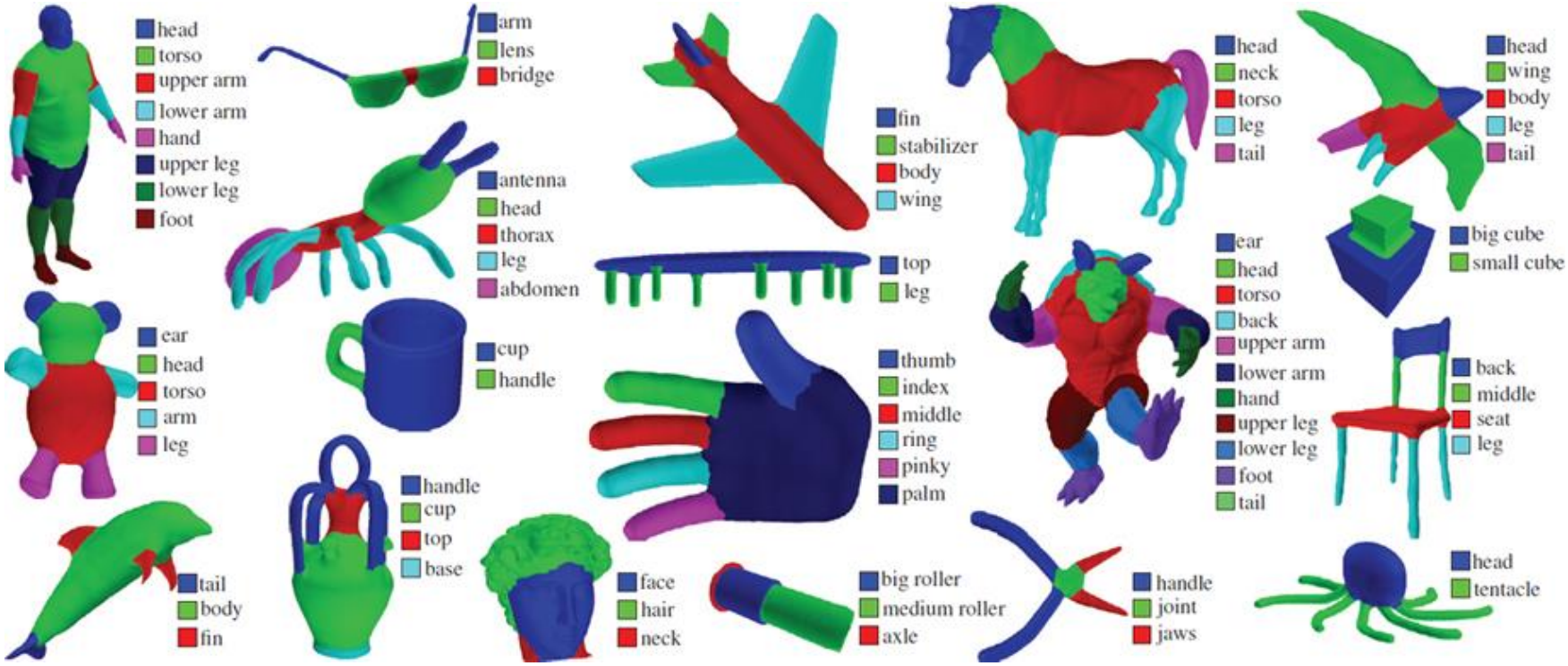
Shape Classification

[Su et al. 15]



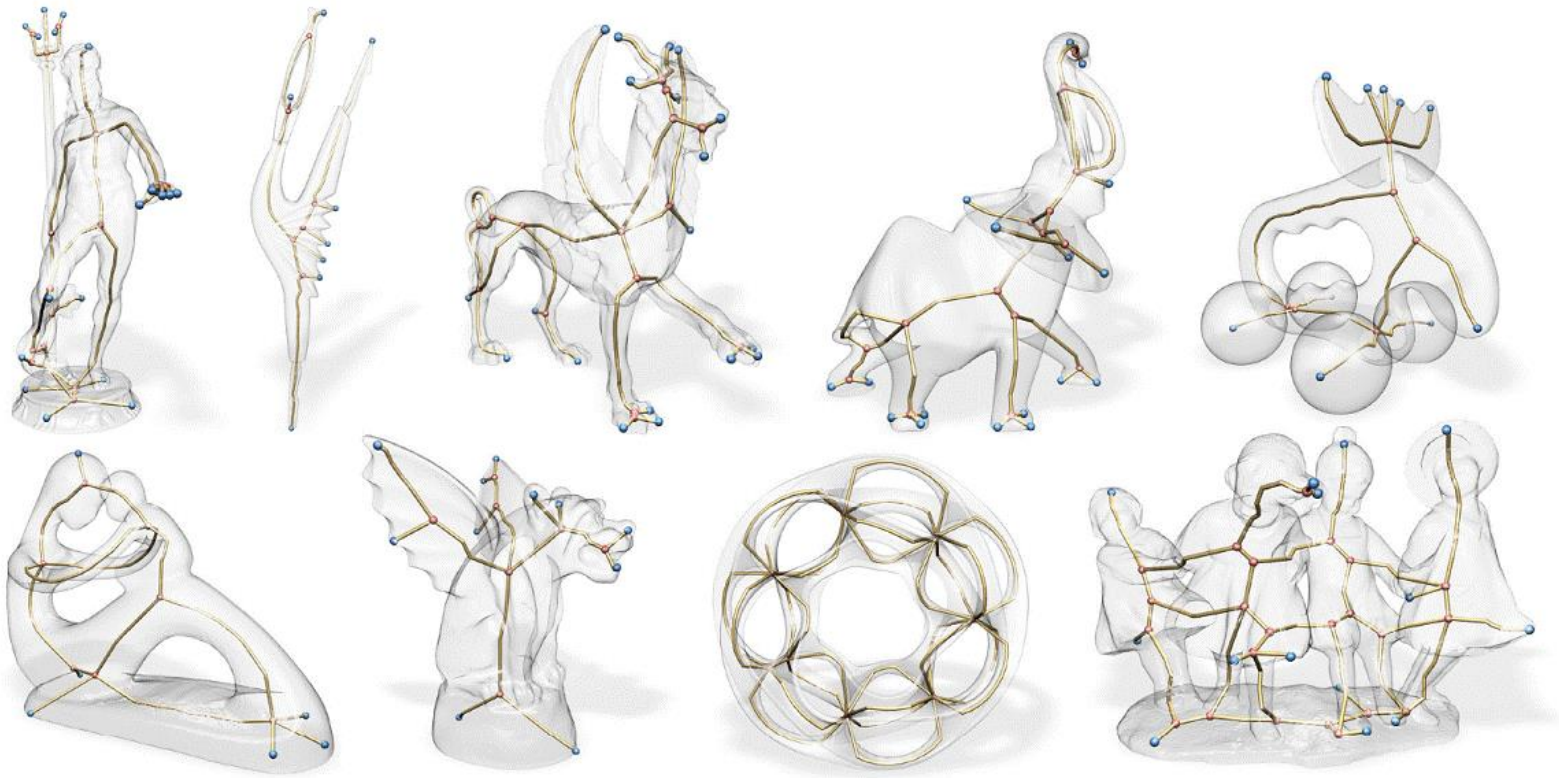
Shape Segmentation

[Kalogerakis' 10]



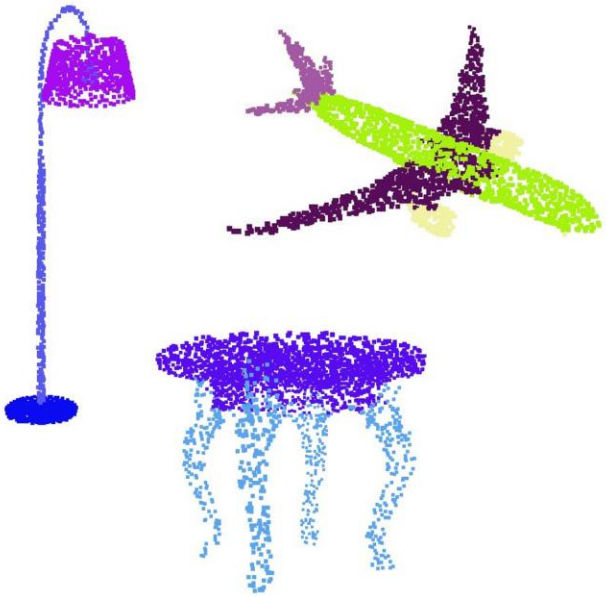
Texton-Boost in 3D

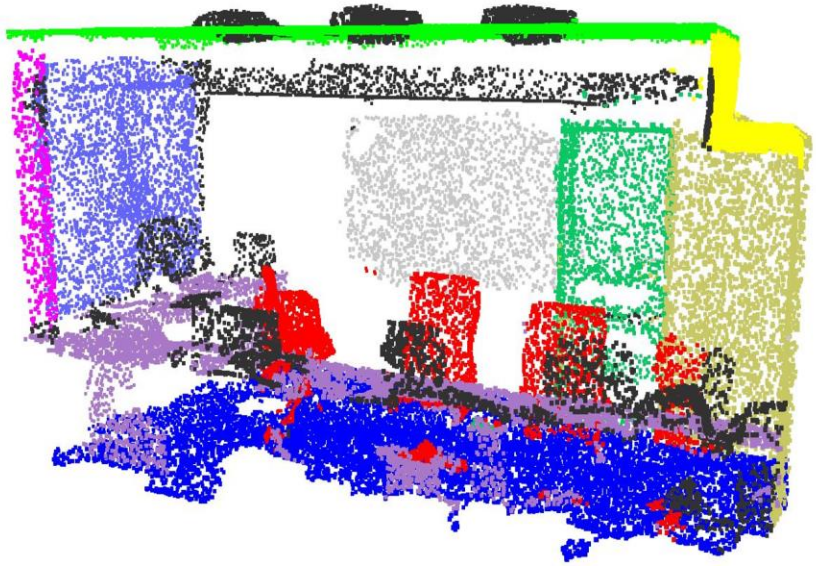
Skeleton Extraction



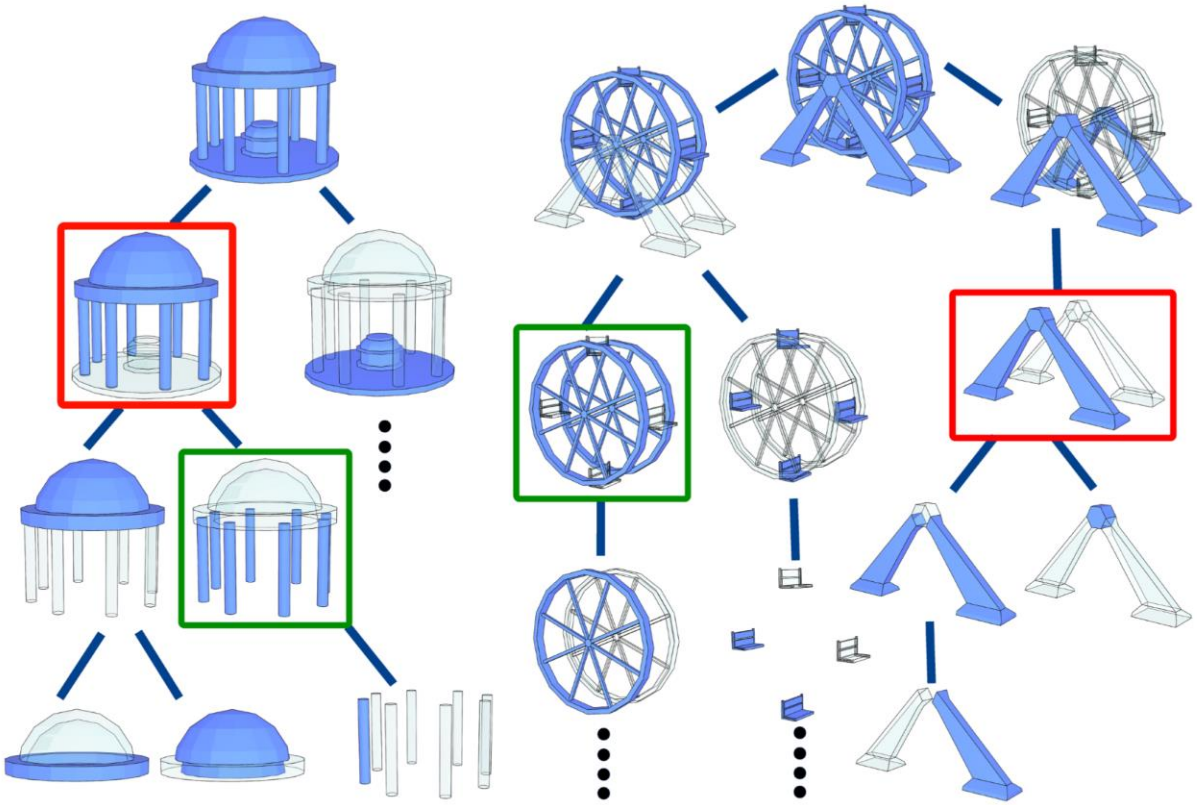
Shape Segmentation

[Su et al. 16]



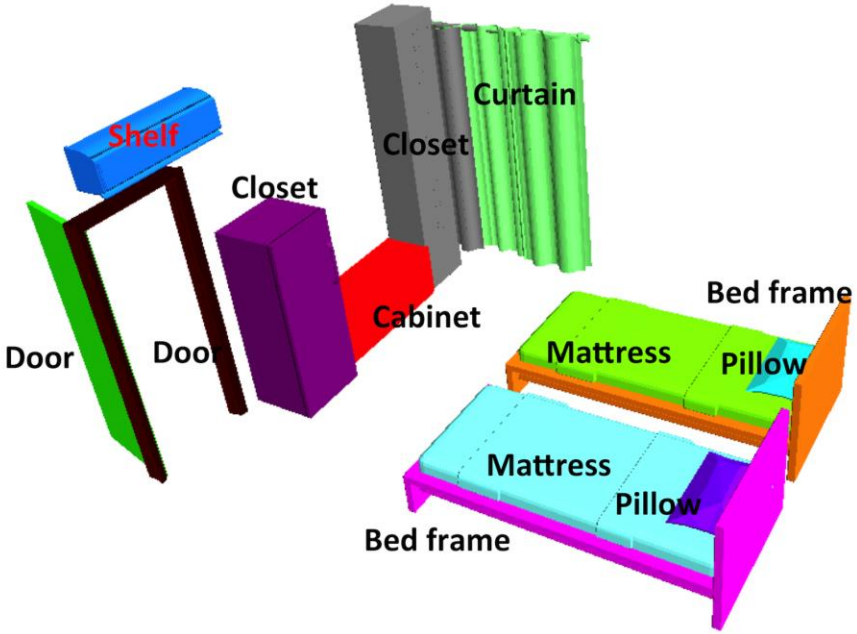


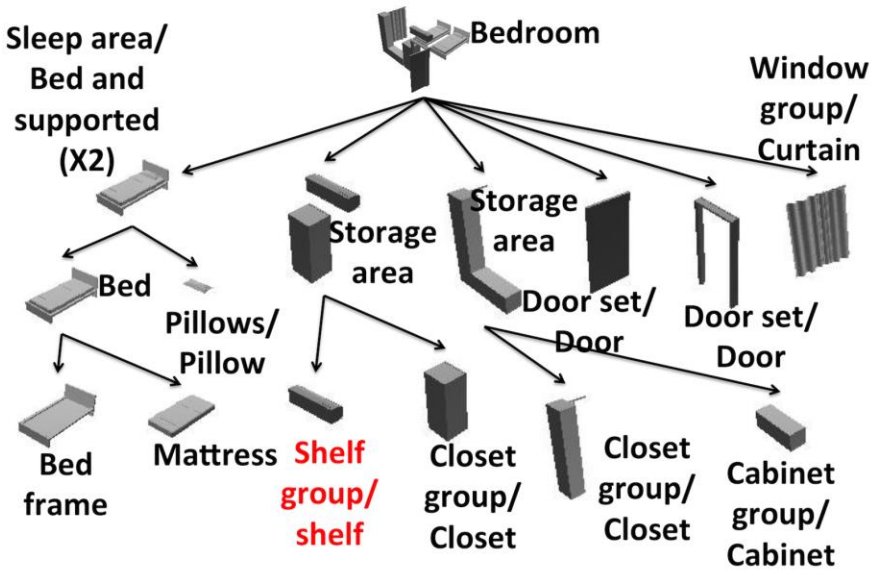
Hierarchical Decomposition



Hierarchical Decomposition

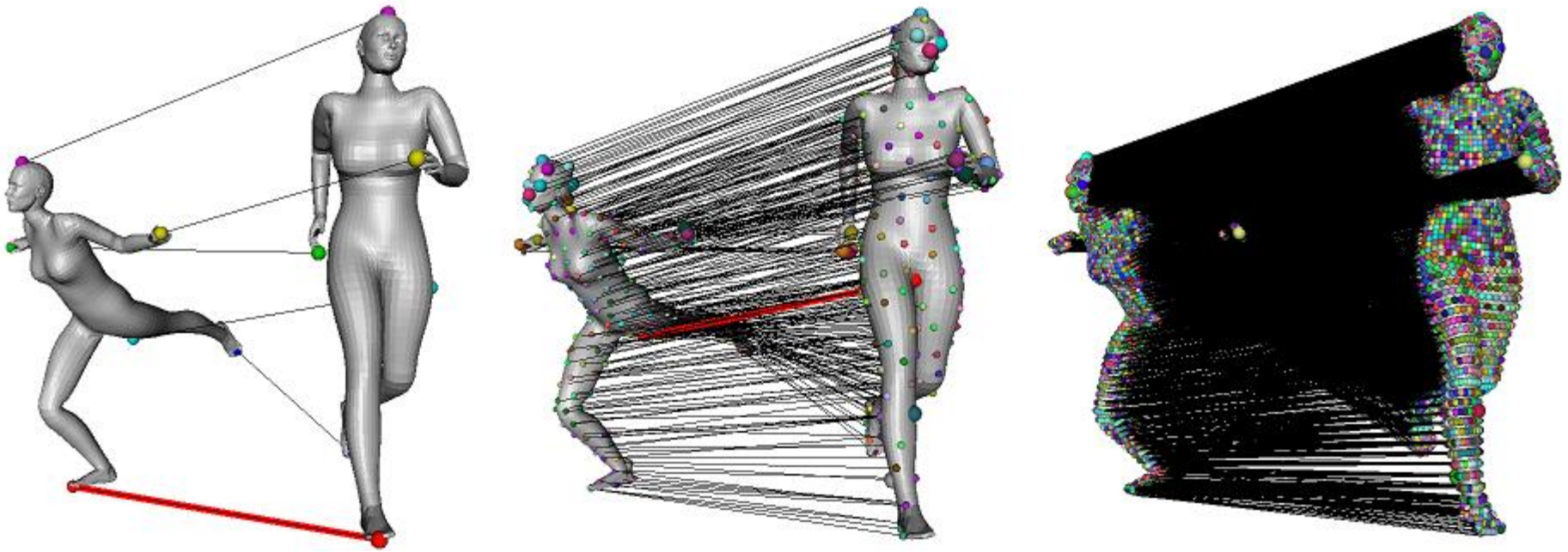
[Liu et al. 14]





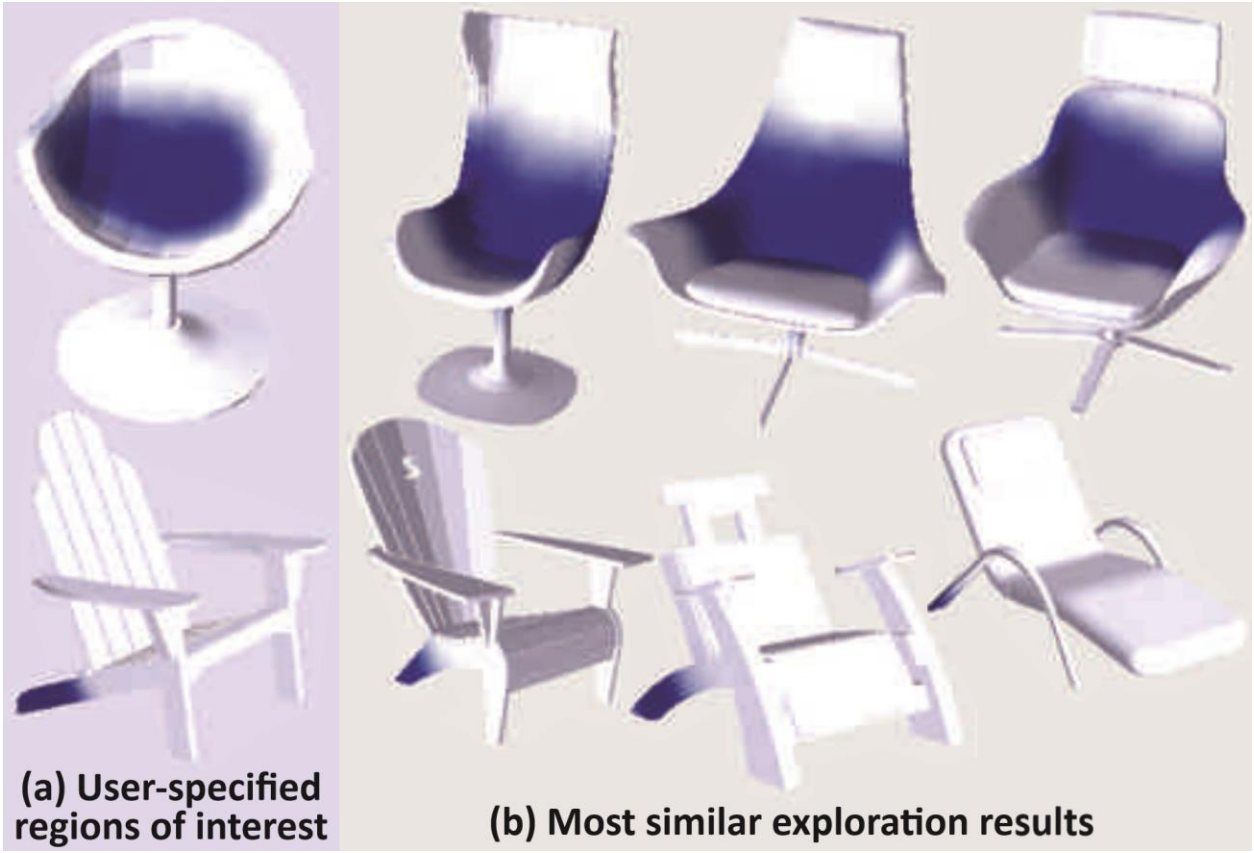
Shape Matching

[Sahillioglu et al. 11]



Shape Matching

[Kim et al. 12]



Symmetry Detection

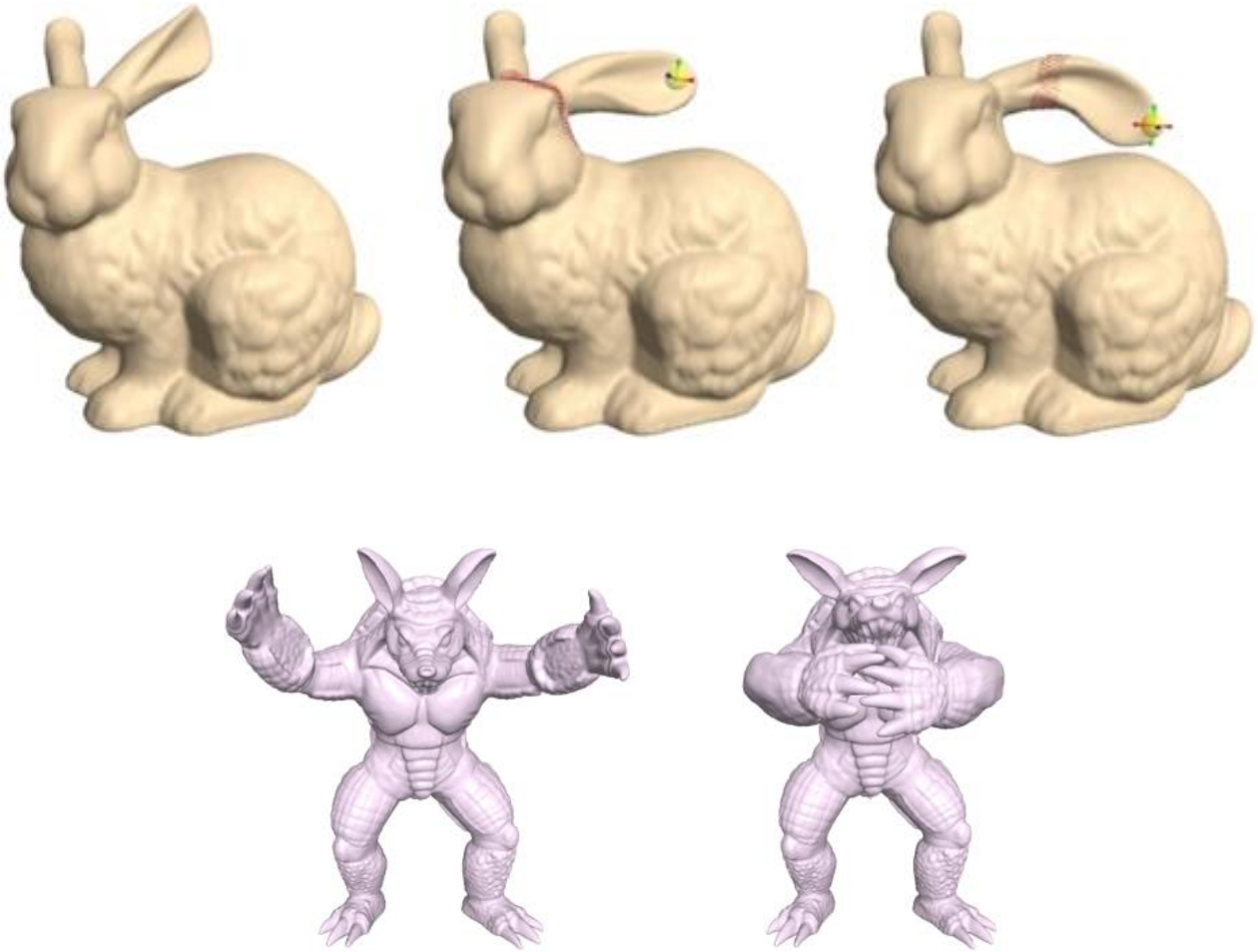
[Mitra et al. 06]

Discussion

Deformation/Editing/Synthesis/Modeling

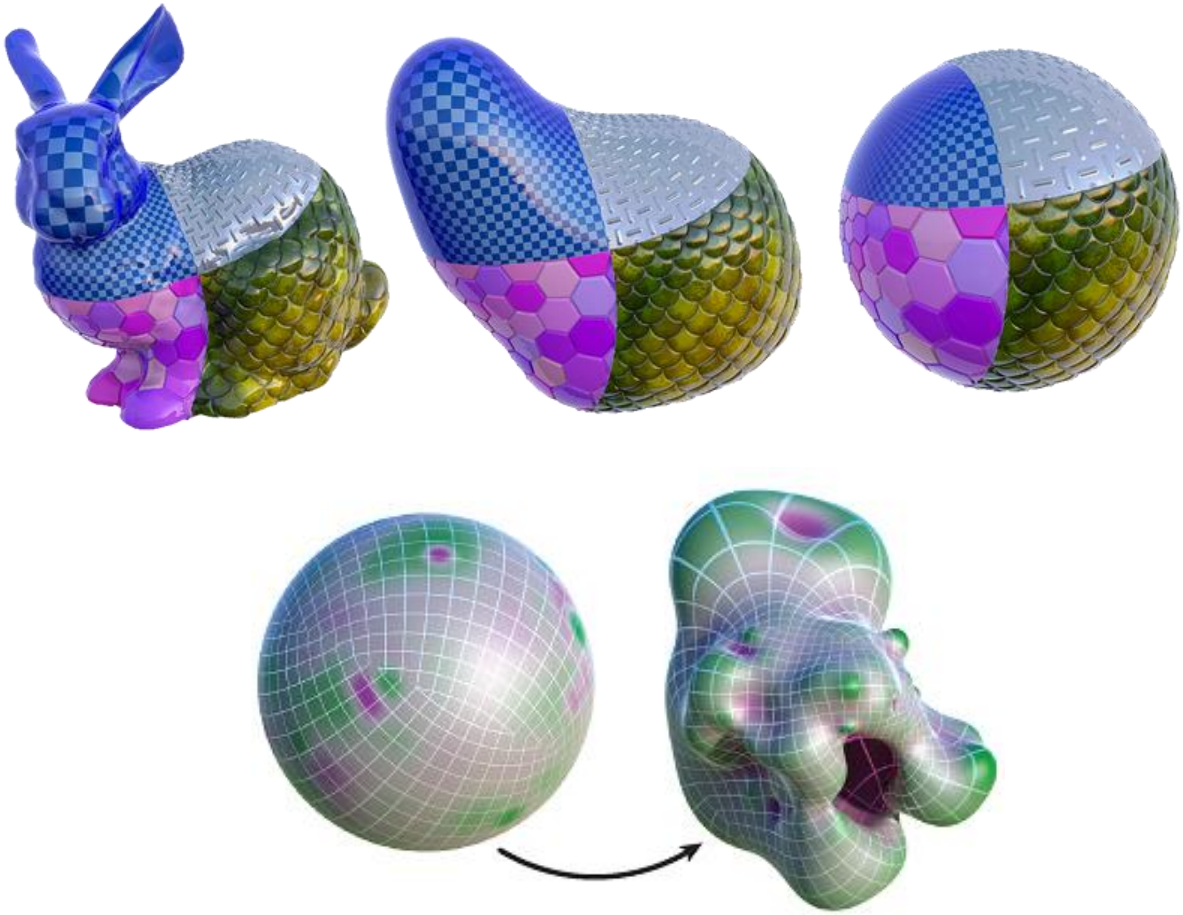
Shape Editing

[Sorkine et al. 04]



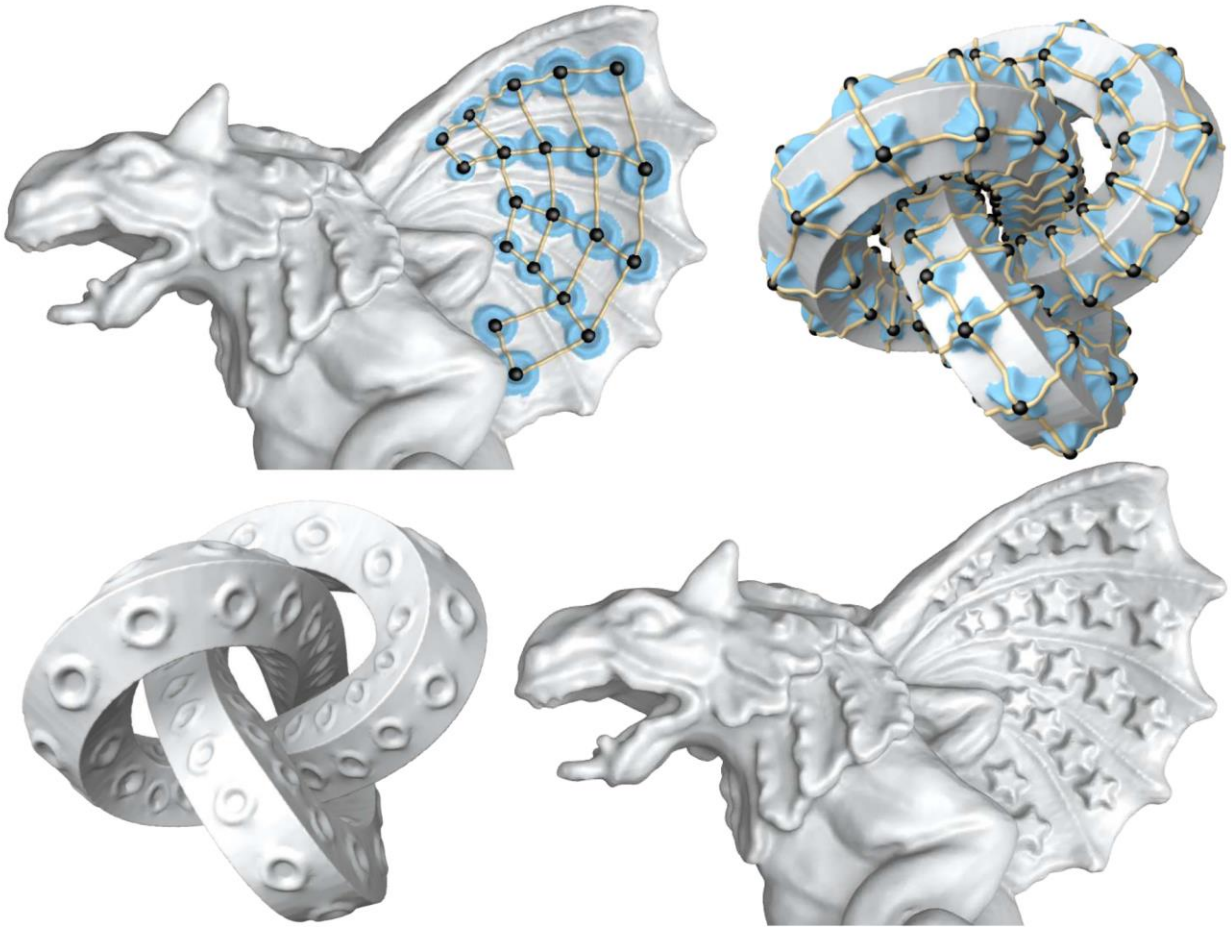
Shape Deformation

[Crane et al. 11,13]



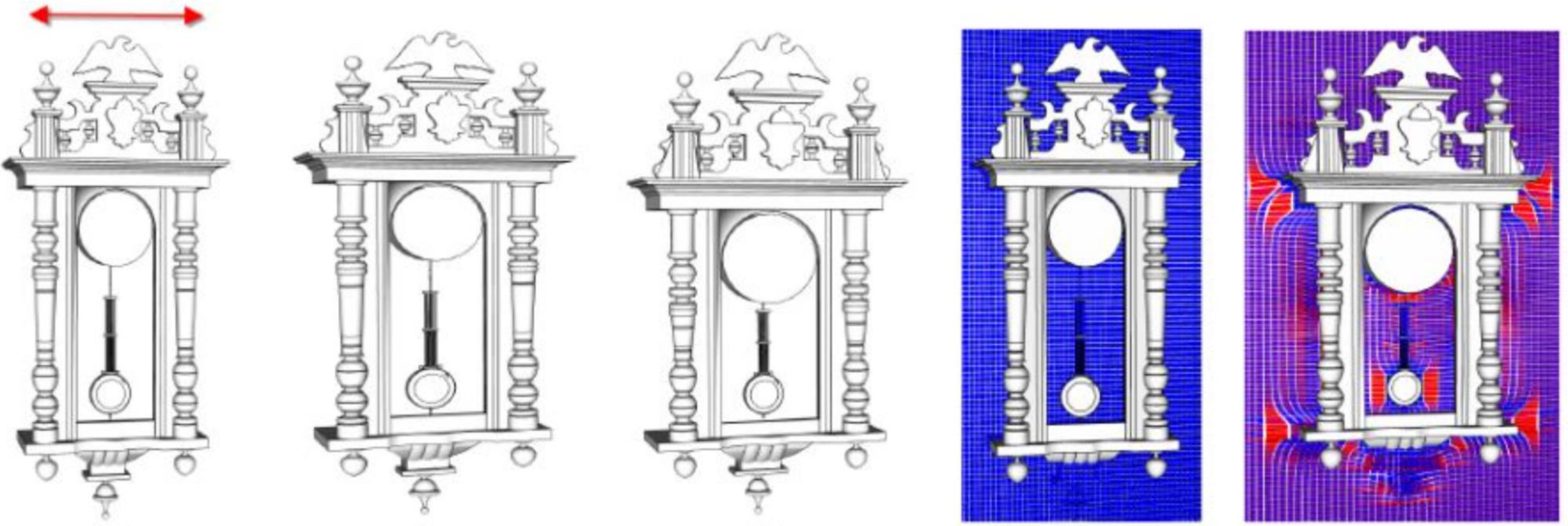
Shape Editing

[Huang et al. 12]



Content-Preserving Deformation

[Kraevoy et al. 08]

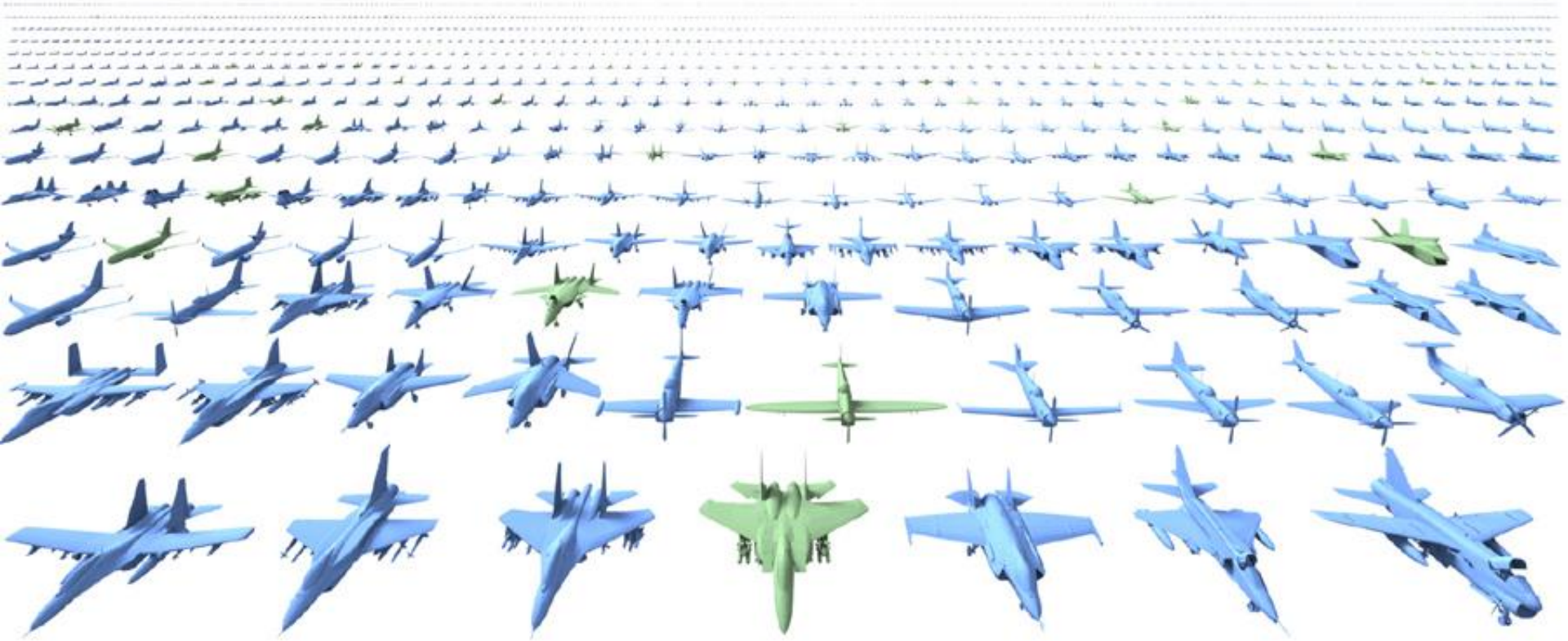


Shape Modeling

Modeling by example

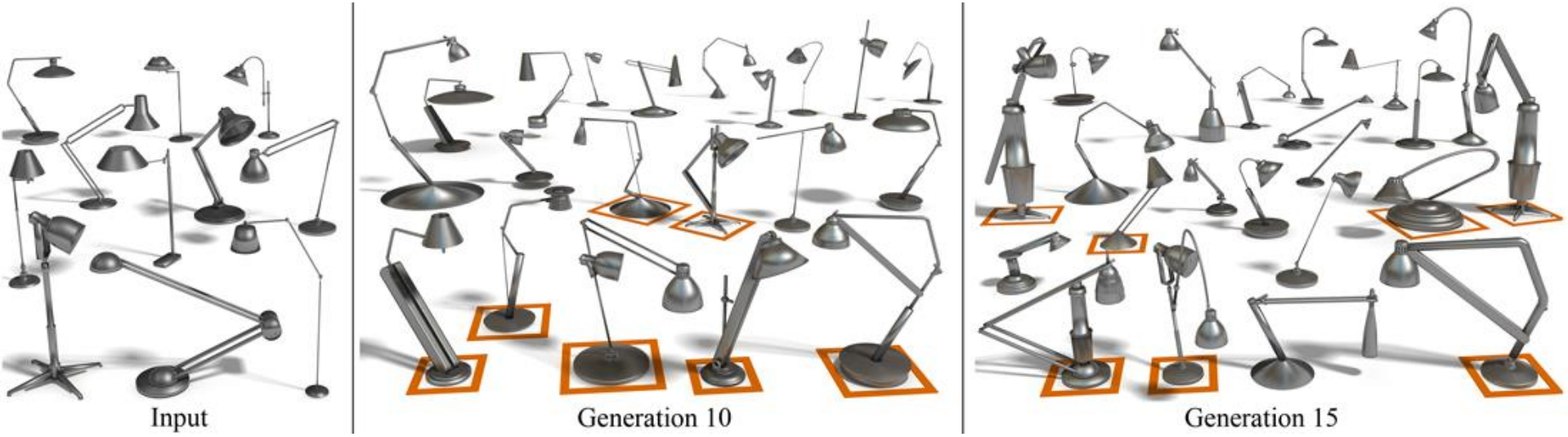
Shape Synthesis

[Xu et al. 12]



Shape Synthesis

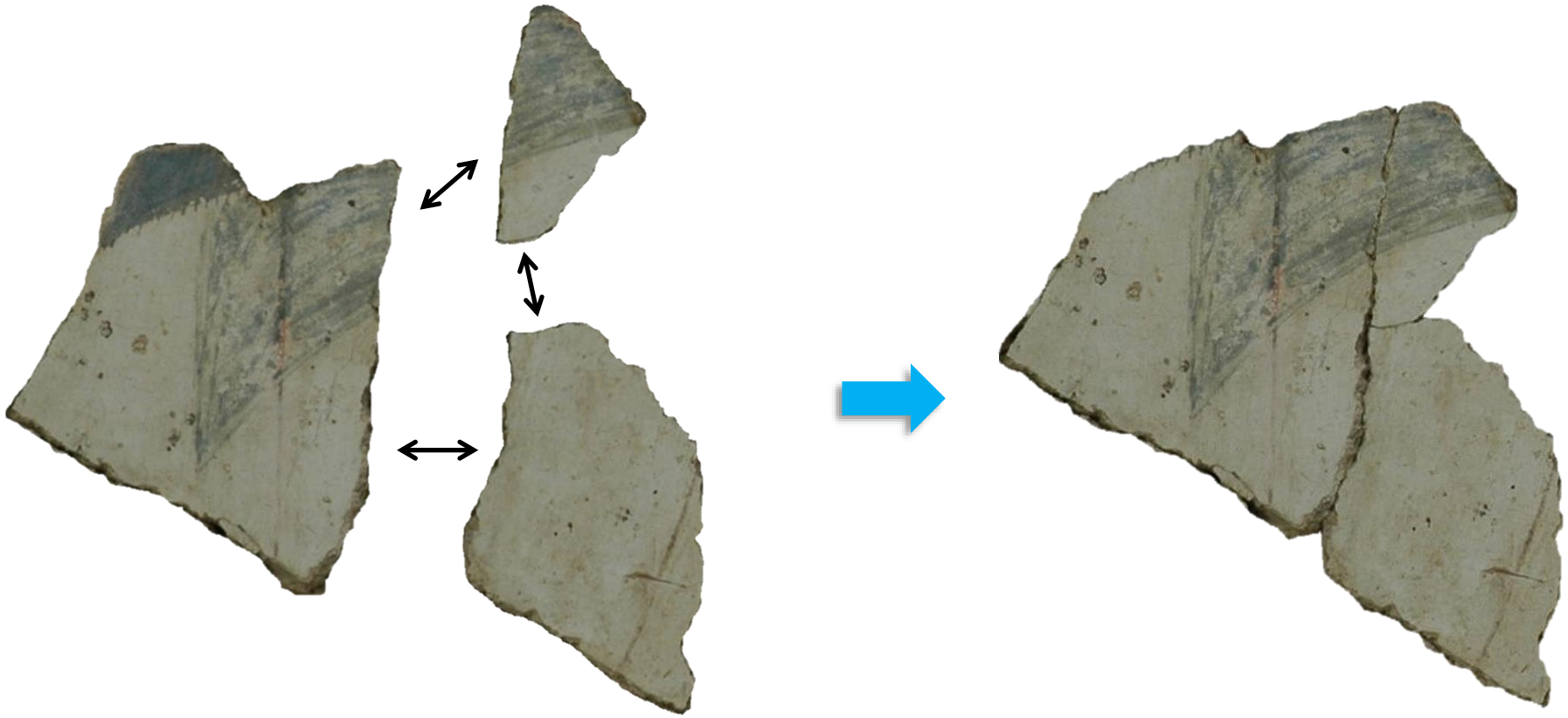
[Xu et al. 12]



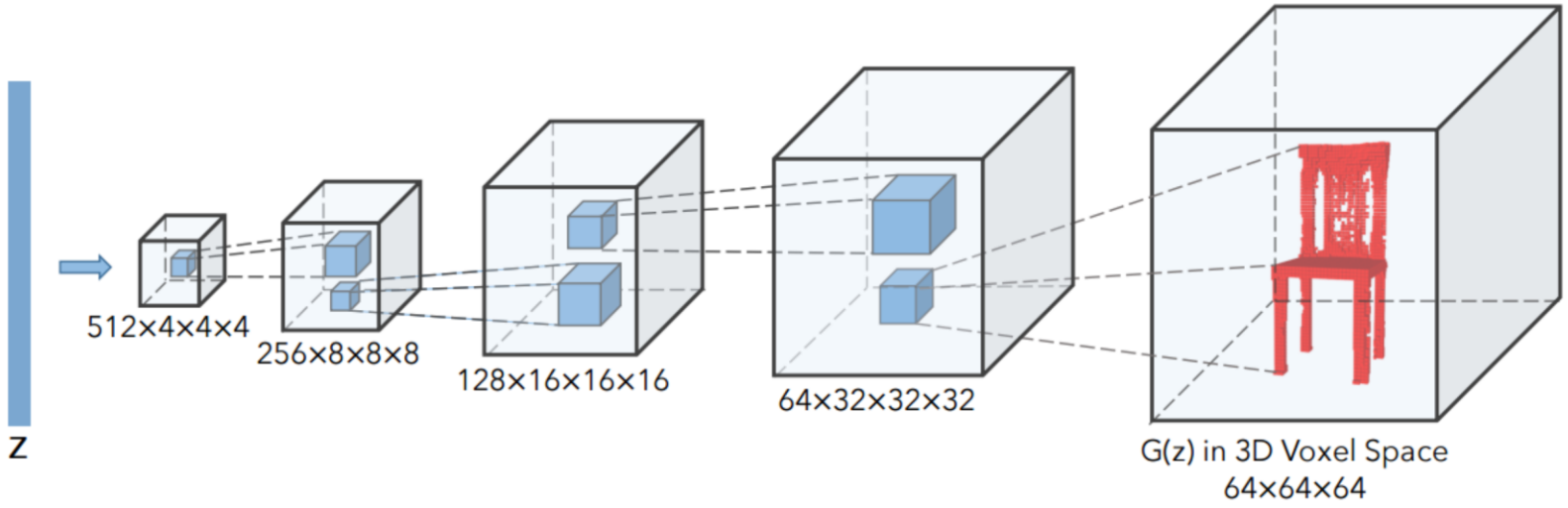
Geometry Processing
Meets Big-data and Deep Learning

Ambiguities in assembling pieces

Resolving ambiguities by looking at additional pieces



Generative Adversarial Shape Generation [Wu et al. 16]



Detailed Syllabus

Date	Topics
Jan. 17	Introduction
Jan. 19	Overview of Geometry Reconstruction and Acquisition
Jan. 24	Overview of Geometric Data Analysis
Jan. 26	Overview of Geometric Modeling, Synthesis and Fabrication
Jan. 31	Multi-View Geometry I
Feb. 2	Multi-View Geometry II
Feb. 7	**Paper Presentations I** (Multi-View Geometry)
Feb. 9	3D Scanning
Feb. 14	Geometric Alignment
Feb. 16	Mesh Generation
Feb. 21	**Paper Presentations II** (Geometry Reconstruction)
Feb. 23	Mesh Simplification and Smoothing
Feb. 28	Discrete Differential Geometry I
Mar. 2	Discrete Differential Geometry II
Mar. 7	Shape Deformation and Non-Rigid Alignment

Detailed Syllabus

Mar. 7	Shape Deformation and Non-Rigid Alignment
Mar. 9	**Paper Presentation III** (Mesh Processing)
Mar. 14	Shape Analysis I (Retrieval/Recognition/Correspondence/Segmentation)
Mar. 16	Shape Analysis II (Data-Driven Object Matching)
Mar. 21	Shape Analysis III (Data-driven Shape Segmentation)
Mar. 23	Shape Analysis IV (3D Deep Learning I)
Mar. 28	Shape Analysis V (3D Deep Learning II)
Mar. 30	**Paper presentations IV** (Shape Analysis)
Apr. 4	Shape Reconstruction, Modeling and Synthesis I (Assembly-Based)
Apr. 6	Shape Reconstruction, Modeling and Synthesis II (Deep Learning)
Apr. 11	**Paper presentations V** (Reconstruction, Modeling and Synthesis)
Apr. 13	3D Printing
Apr. 18	**Paper presentations VI** (3D Printing)
Apr. 20	Graphics Meets AI (Overview)
Apr. 25	**Paper presentations VII** (Autonomous Geometry Reconstruction)
Apr. 27	**Paper presentations VIII** (Text-Based Geometry Synthesis)
May 2	**Paper presentations IX** (Learning to Generate Synthetic Data)
May 4	Final Project Presentations

Questions?