3D Contents Understanding and Remodeling

Sai-Kit Yeung

CSE Research and Technology Forum

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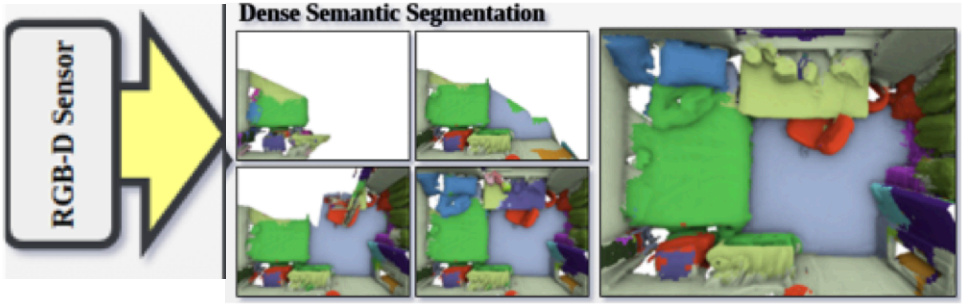
Research Interest

- Computer Vision
  - 3D content acquisition and understanding
- Computer Graphics and Computational Design
  - Develop algorithms for content generation
  - For Human to Co-Design with AI



COMPUTER VISION RESEARCH: OVERVIEW

Acquisition

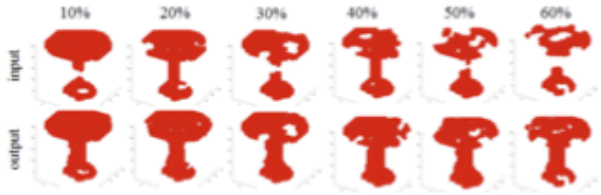
Geometric Approach

[CVPR 2010, TPAMI 2012, CVIU 2013, CVPR 2017, TPAMI 2017]

Photometric Approach

[CVPR 2011, ICCP 2013, CVPR 2013, 3DV 2014, TPAMI 2015, CVPR 2017, CVPR 2018]

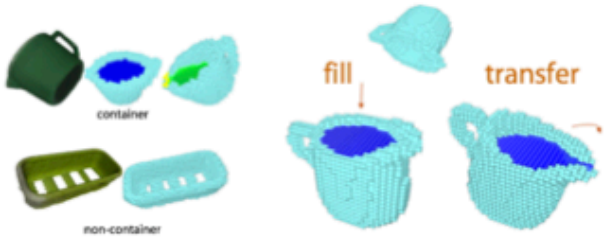
Machine Learning Approach



[CVPR 2016, WACV 2019, CVPR 2019]

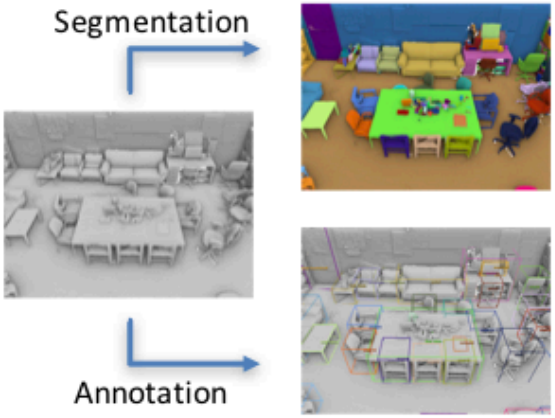
Understanding

Object



[ICCV 2015]

Scene



[TVCG 2017, CVPR 2018, ICCV 2019 submitted]

Dataset

Real-world 3D Scene Dataset

[3DV 2016 Best Paper Honorable Mention]

Scanned Objects

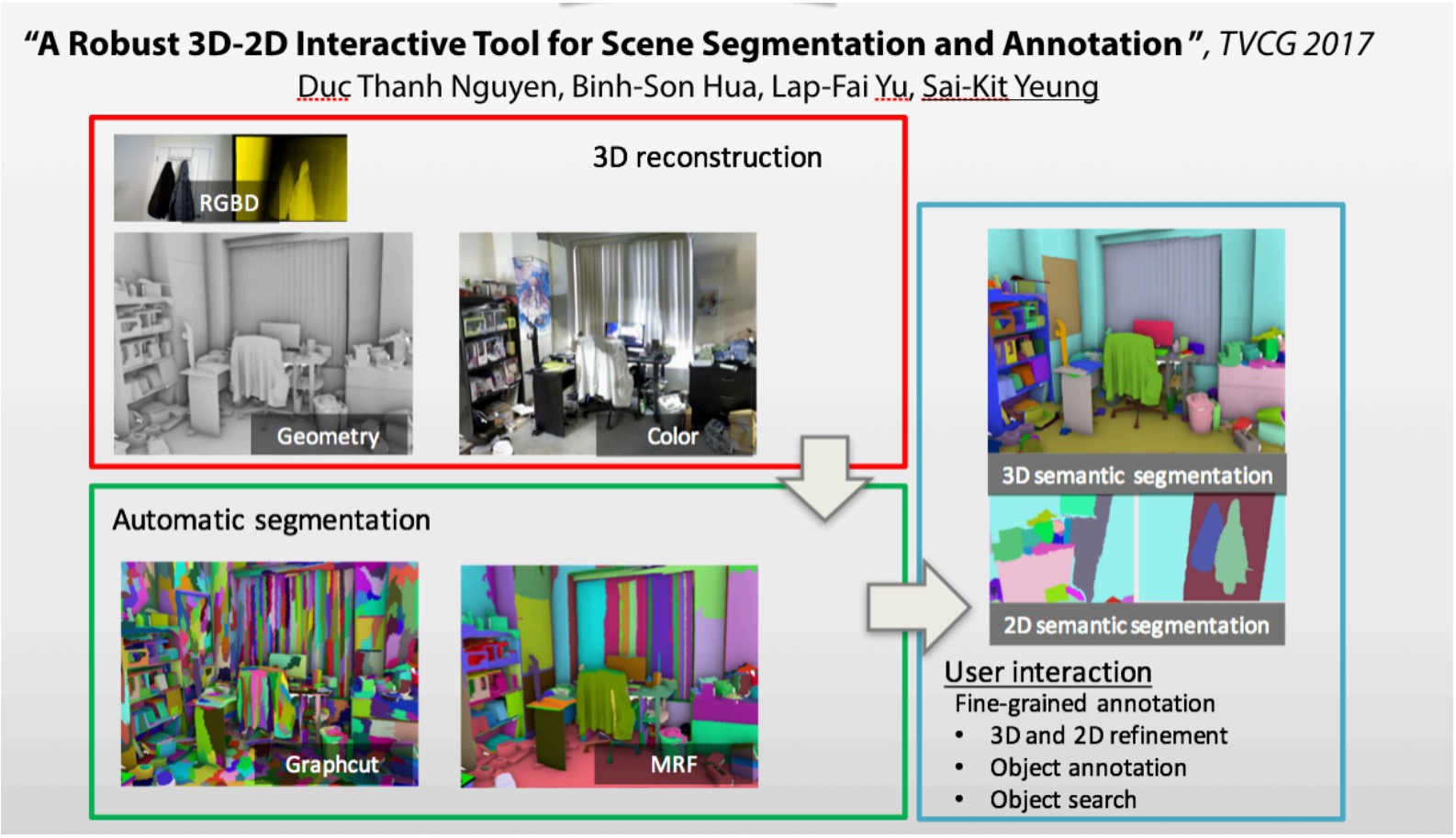
[SHREC 2017, 2018, ICCV 2019 submitted]

Photometric Stereo Benchmark

[CVPR 2016. TPAMI 2018]

Tool for Scene Understanding

- Annotation Tool for 3D Scenes Semantic Segmentation



Tool for Scene Understanding

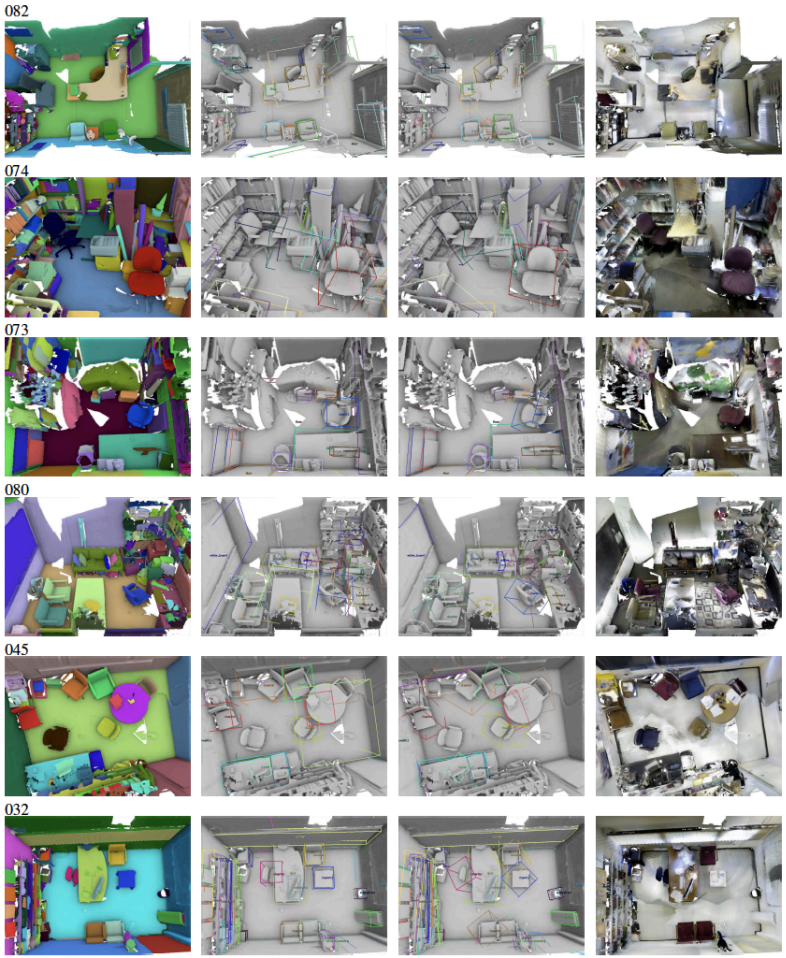
A Robust 3D-2D Interactive Tool for Scene Segmentation and Annotation

Duc Thanh Nguyen[1] Binh-Son Hua[1] Lap-Fai Yu[2] Sai-Kit Yeung[1]

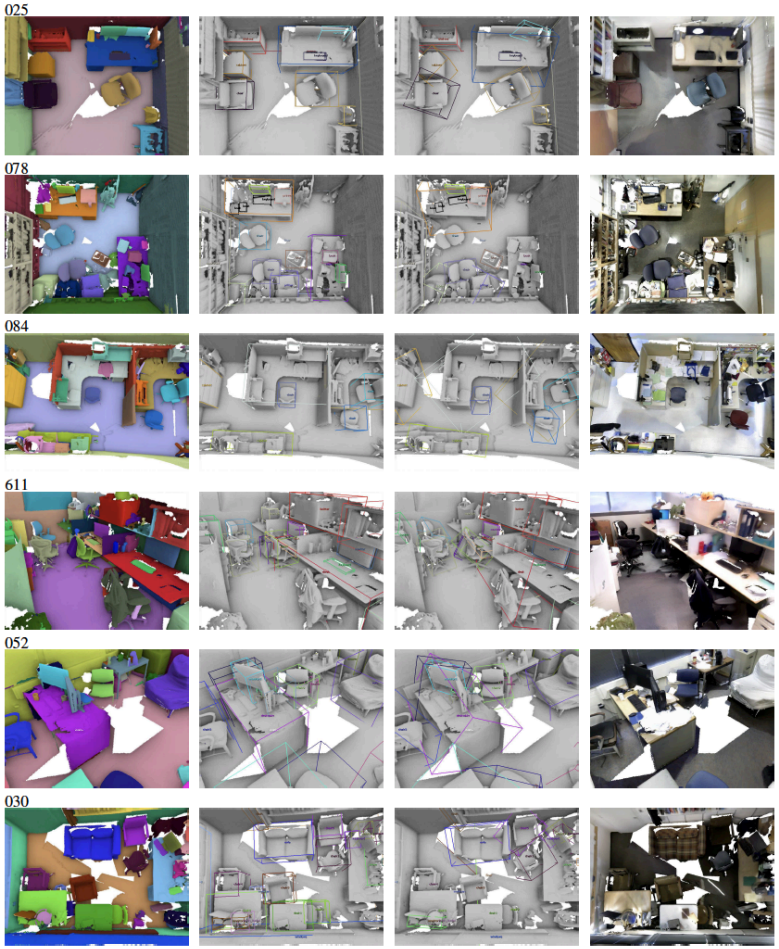
[1] Singapore University of Technology and Design

[2] University of Massachusetts Boston

Dataset for Scene Understanding



(a) Cluttered office



(b) Cluttered office

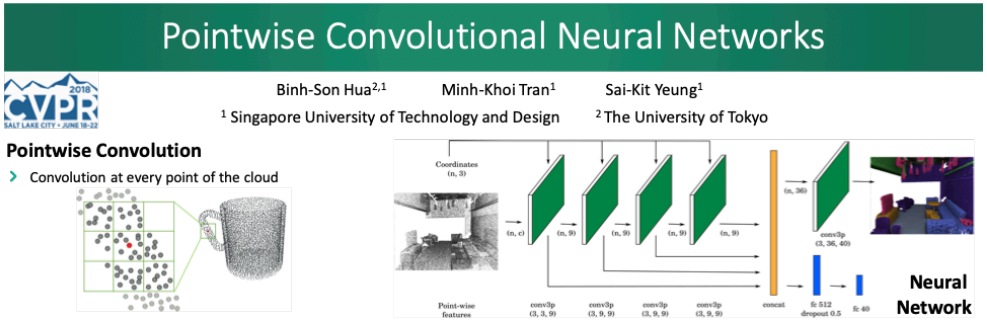
First Real-World scene meshes dataset for scene understanding

3DV 2016 Best Paper Honorable Mension

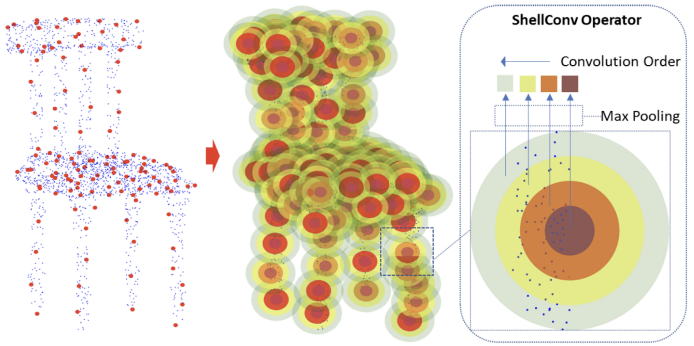
Real-time Semantic 3-D Reconstruction

Deep learning on 3-D Point cloud

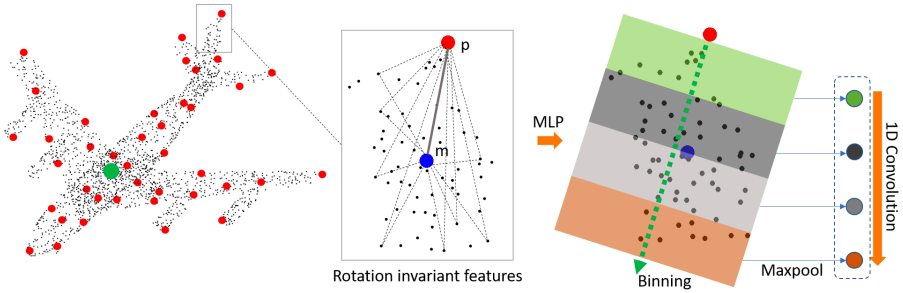
Develop different convolutional operators
for 3-D Point cloud:



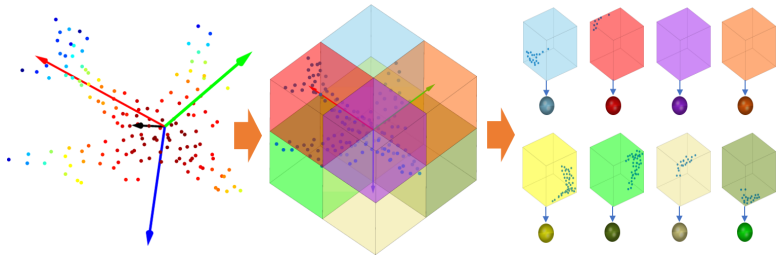
Simple implementation
CVPR 2018



Fast to train network
ICCV 2019 oral



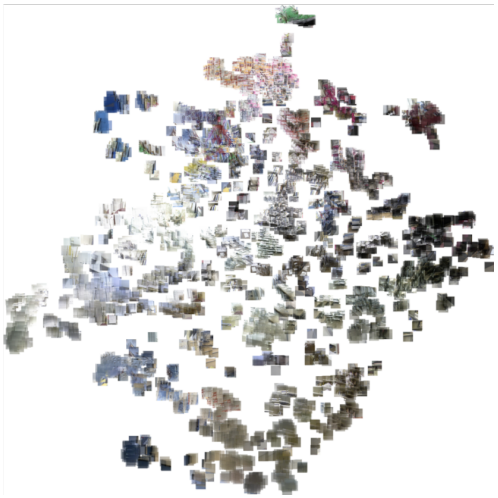
Rotational Invariant operator
3DV 2019



Global context aware operator
3DV 2020 oral

Deep learning on 3-D Point cloud

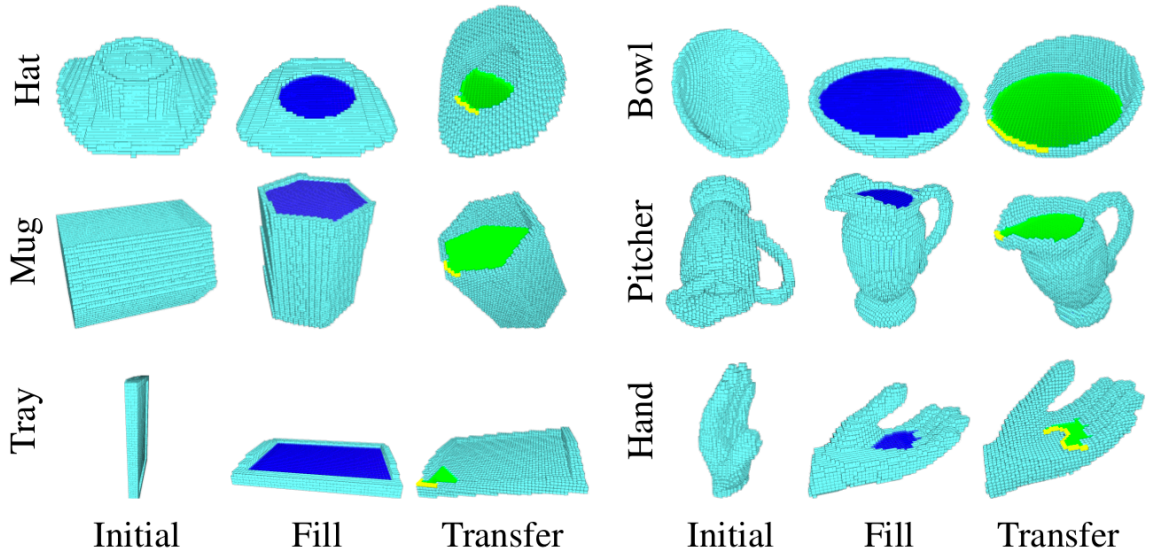
3D Point cloud instance segmentation
CVPR 2019 Oral

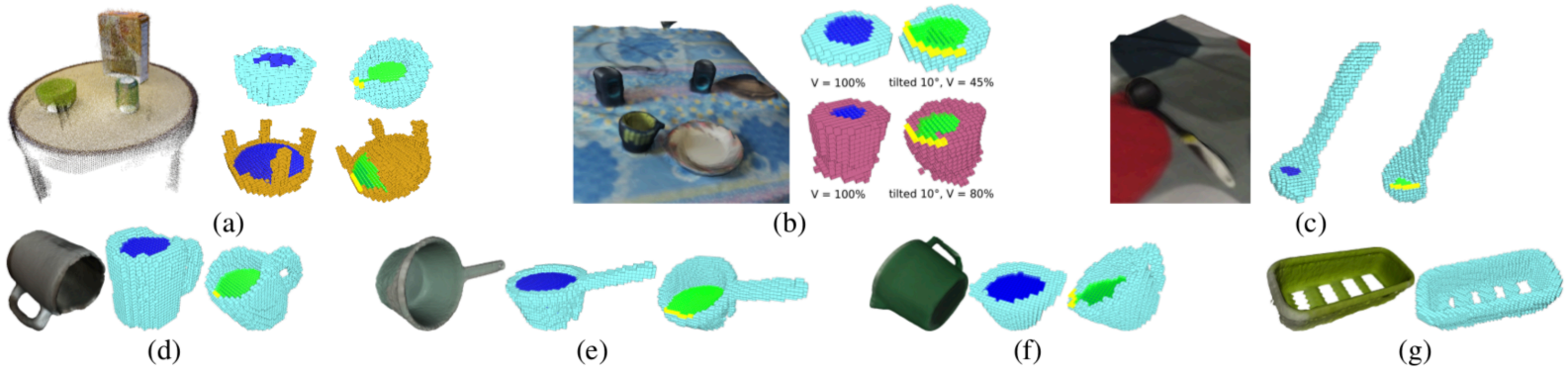


2D-3D Cross-Domain Descriptors
AAAI 2020 Oral

First Real-World Object Dataset
for object understanding
ICCV 2019 Oral

Object affordance understanding





Containability understanding of 3D Shape
ICCV 2015

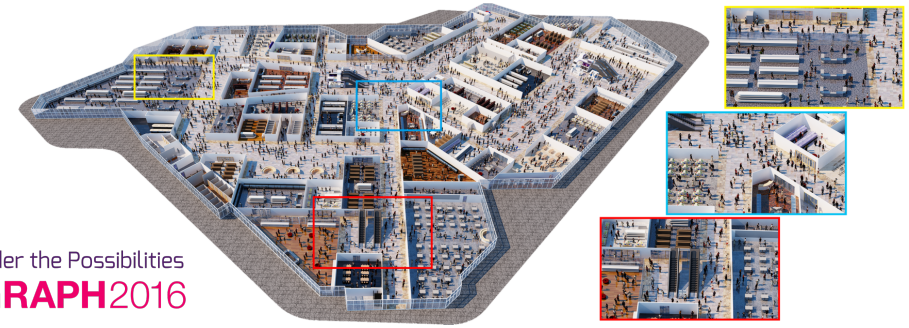
Object affordance understanding

Recent research activities: apply latest CV algorithms to robotics application, e.g., Autonomous fine-grained operation

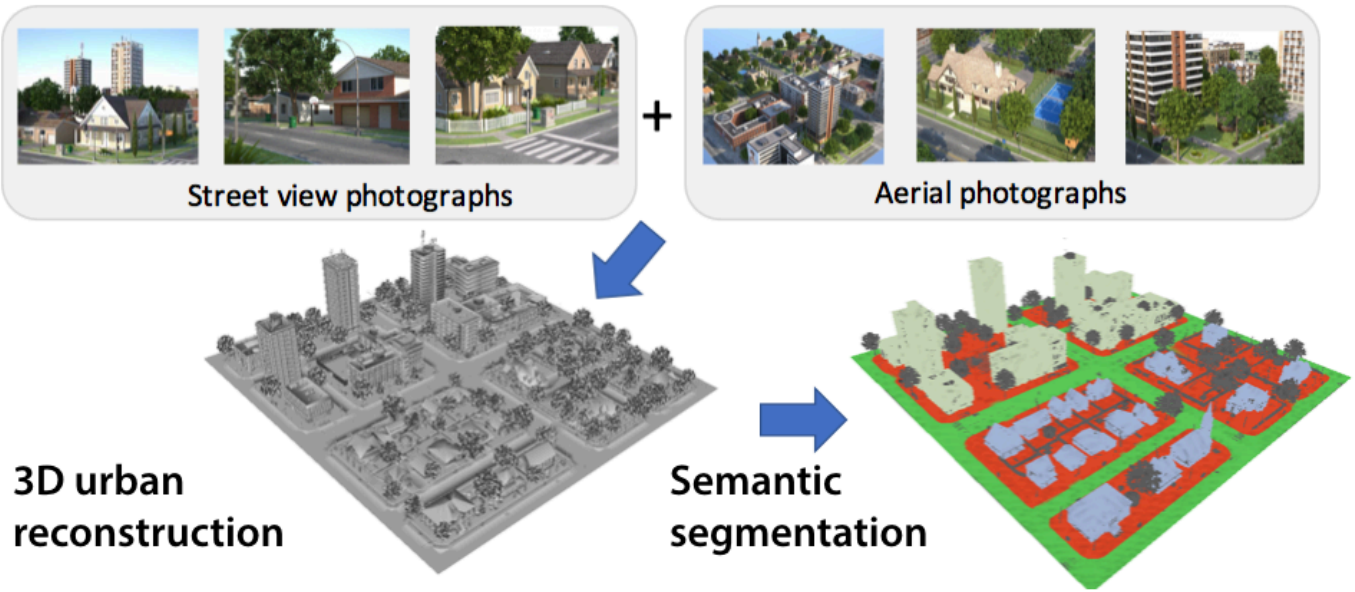
Demo by HaptX in 2019 Jan

Research – Computer Graphics and Computational Design

- Scene and Layout Design
  - Make It Home: Automatic furniture arrangement – SIGGRAPH 2011
  - Crowd Driven Mid-Scale Layout Design – SIGGRAPH 2016
  - Language-Driven Synthesis of 3D Scenes – SIGGRAPHAsia 2018



RESEARCH GRANT: VIRTUAL SINGAPORE PROJECT



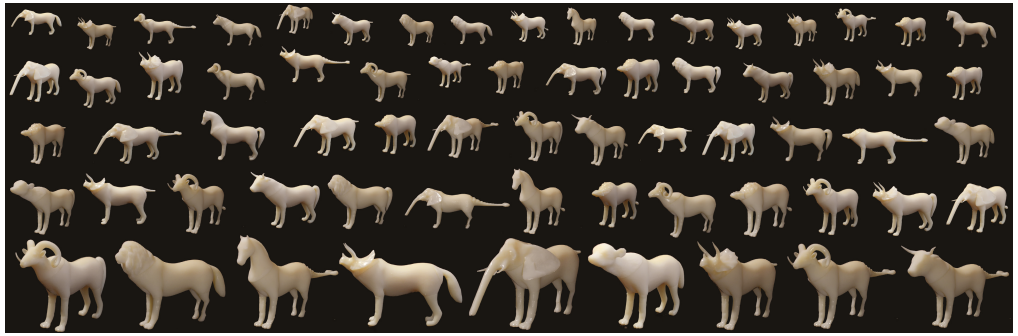
Computational Design

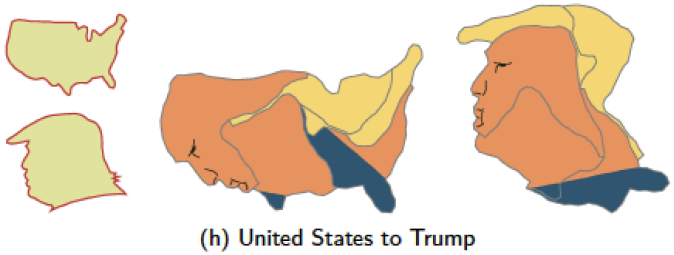
A Multi-Source Semantic 3D Modeling Platform for Virtual Singapore.

The Virtual Singapore R&D Programme, SGD$ 919,200

Research – Computer Graphics and Computational Design

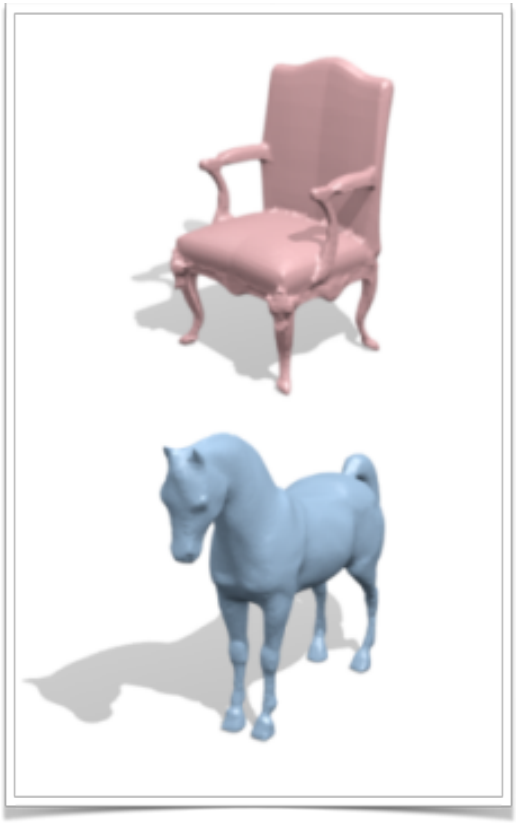
- Product/Geometry Design/Modeling
  - Zoomorphic Design – SIGGRAPH 2015
  - Interchangeable Components for Hands-On Assembly Based Modelling – SIGGRAPHAsia 2016
  - Approximate Dissections – SIGGRAPHAsia 2017





Research – Computational Design: Develop algorithms to co-design with AI

Input



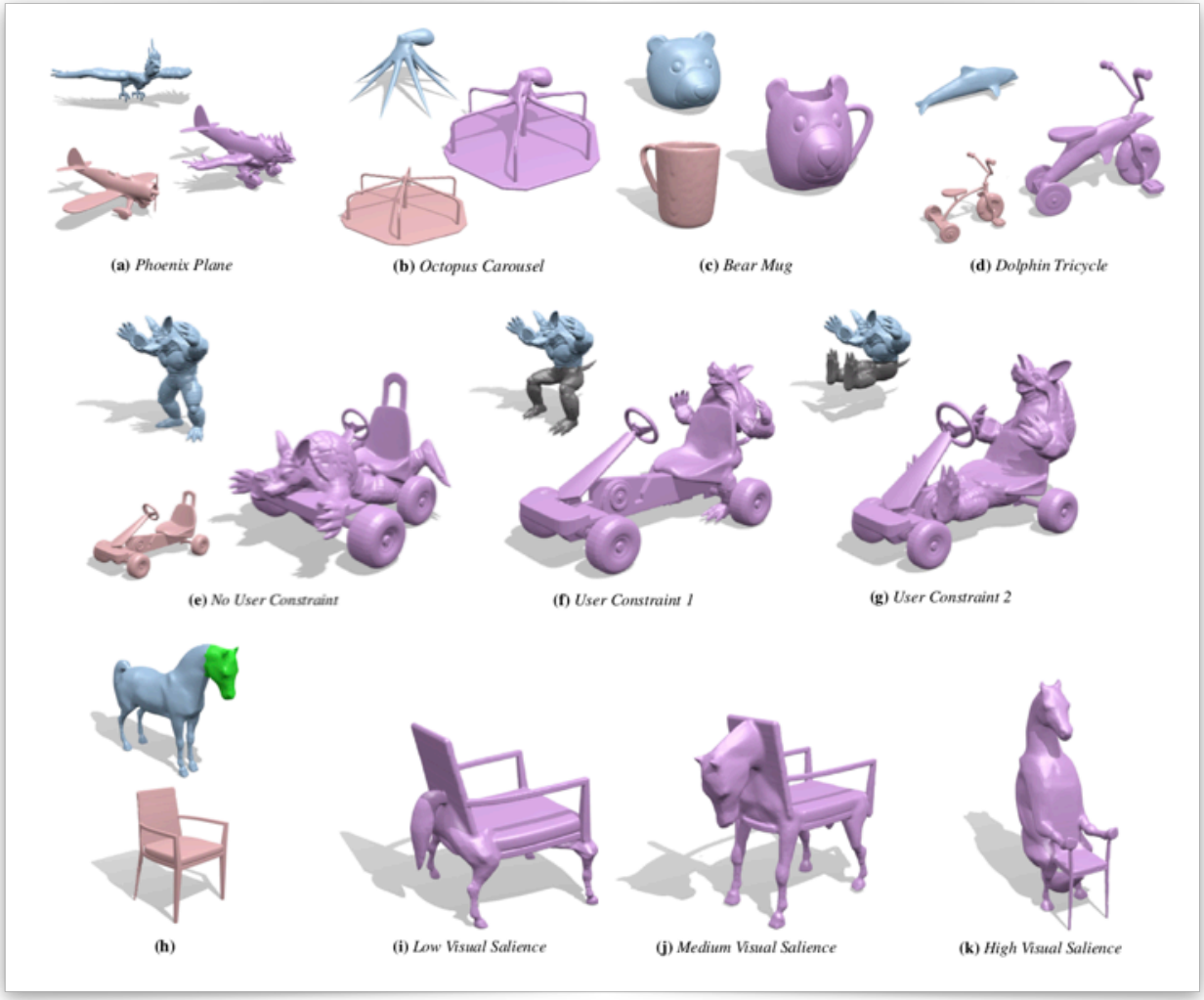
Possible Solutions

Zoomorphic Design. SIGGRAPH 2015

Research – Computational Design: Develop algorithms to co-design with AI

Zoomorphic Design. SIGGRAPH 2015

Research – Computational Design: Develop algorithms to co-design with AI



Zoomorphic Design. SIGGRAPH 2015