SIGGRAPH ASIA 2016 MACAO

Sponsored by

Relationship Template for Creating Scene Variations

Xi Zhao
Xi'an Jiaotong University

Ruizhen Hu
Shenzhen University

Paul Guerrero
Niloy Mitra
University College London

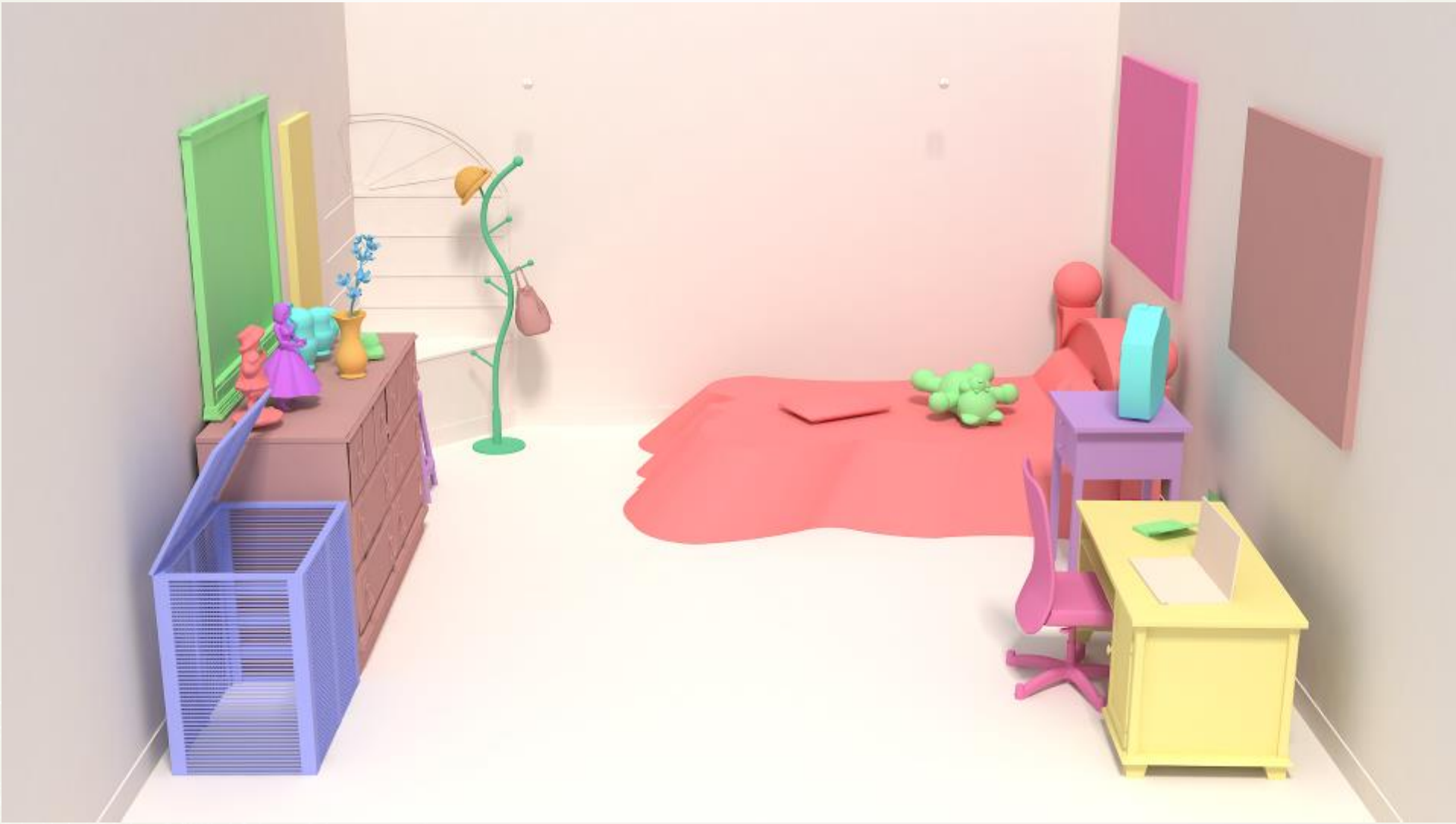
Taku Komura
Edinburgh University

SA2016.SIGGRAPH.ORG

CONFERENCE: 5 - 8 DECEMBER 2016 • EXHIBITION: 6 - 8 DECEMBER 2016 • THE VENETIAN MACAO, MACAO

SIGGRAPH ASIA 2016 MACAO

Relationships in a Scene



SIGGRAPH ASIA 2016 MACAO

How to make variations of complex relationship?

Existing Methods

L.-F. Yu, S.-K. Yeung, C.-K. Tang, D. Terzopoulos, T. F. Chan, and S. J. Osher, "**Make it home**" *SIGGRAPH 2011*

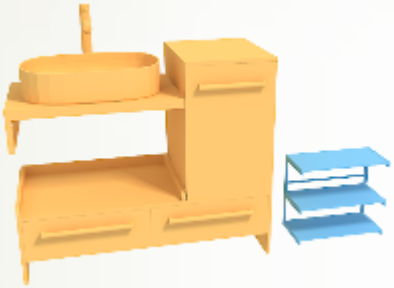
Y.-T. Yeh, L. Yang, M. Watson, N. D. Goodman, and P. Hanrahan, "**Synthesizing open worlds with constraints using locally annealed reversible jump MCMC**," *SIGGRAPH 2012*

M. Fisher, D. Ritchie, M. Savva, T. Funkhouser, and P. Hanrahan, "**Example-based Synthesis of 3D Object Arrangements**" *SIGGRAPH ASIA2012*

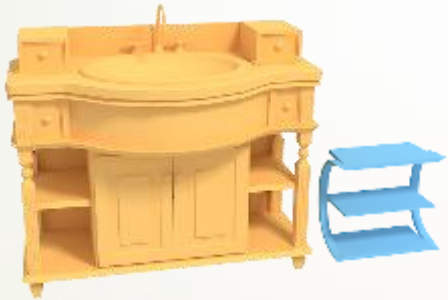
L. Majerowicz, A. Shamir, A. Sheffer, and H. H. Hoos, "**Filling your shelves: Synthesizing diverse style-preserving artifact arrangements**," *TVCG* 2014.

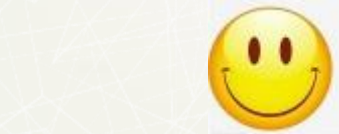
Limitation of Previous Representations

example scene



new scene



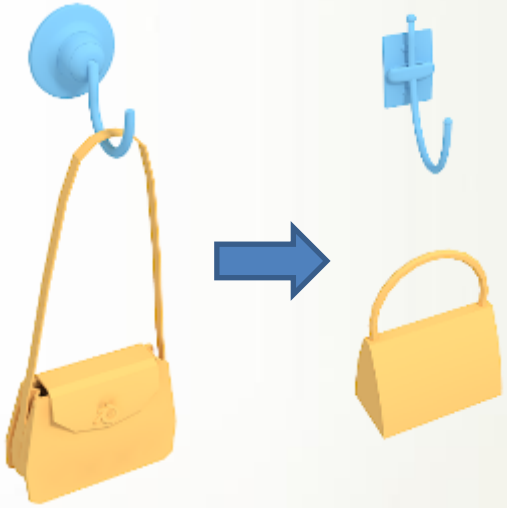


example scene

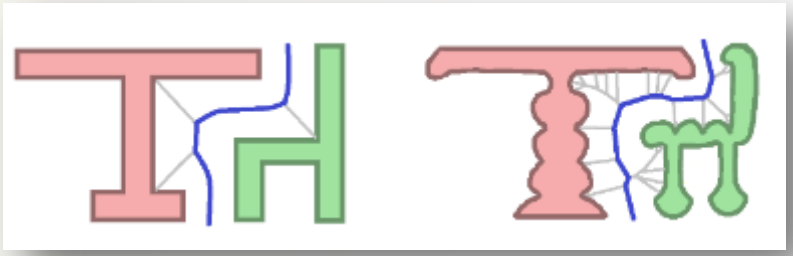
new scene

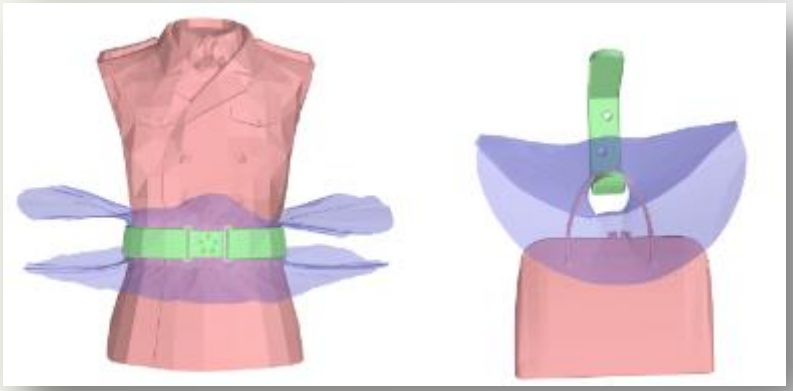
example scene

new scene



The Representation We Use: IBS





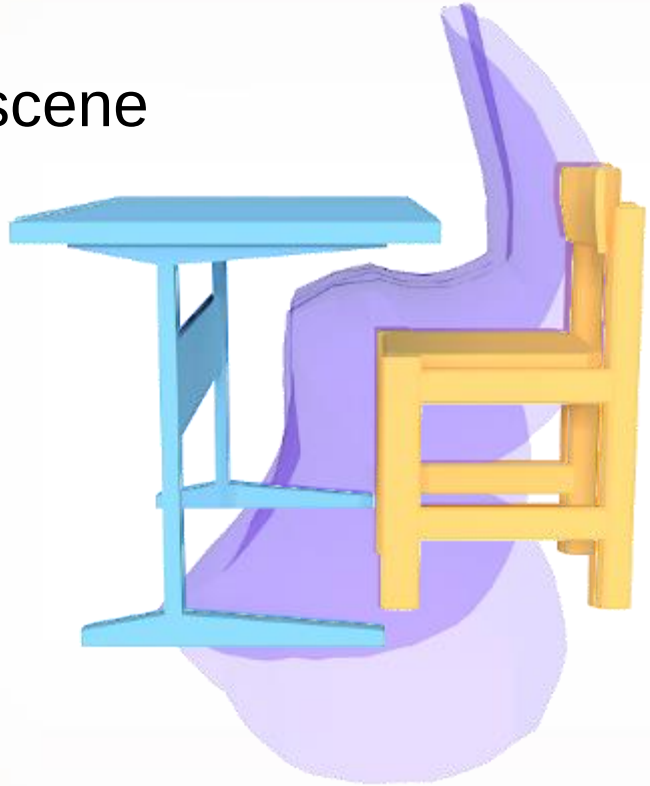
X. Zhao, H. Wang, and T. Komura, "**Interaction Bisector Surface**," *TOG2014*.

R. Hu, C. Zhu, O. van Kaick, L. Liu, A. Shamir, and H. Zhang, "**Interaction Context (ICON)**" *SIGGRAPH2015*

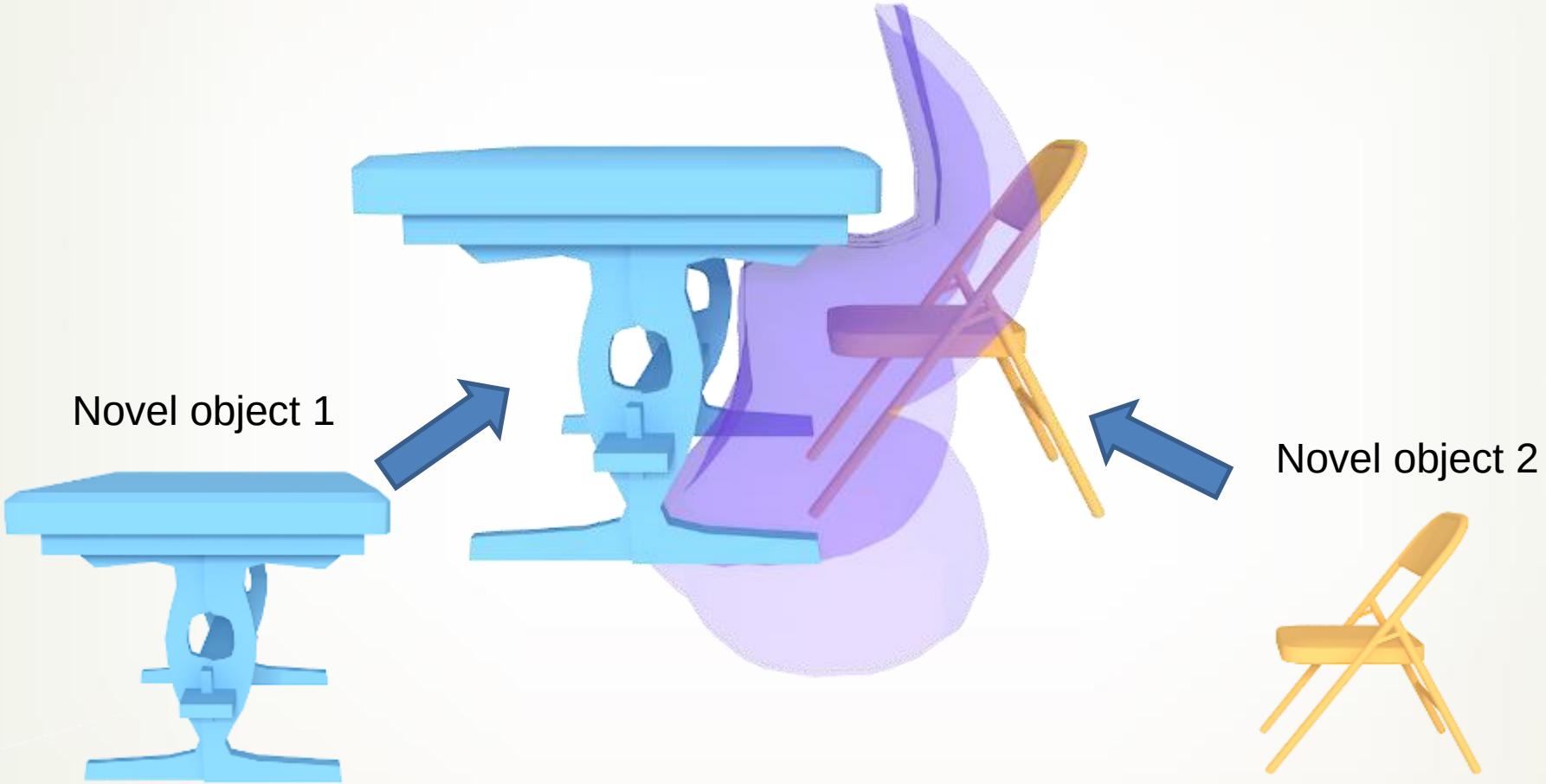
Our Method

Overview

Example scene



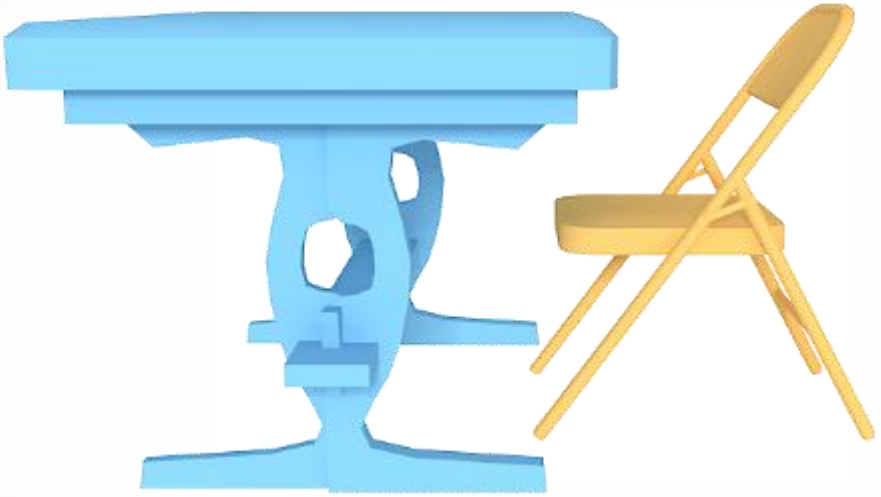
Overview



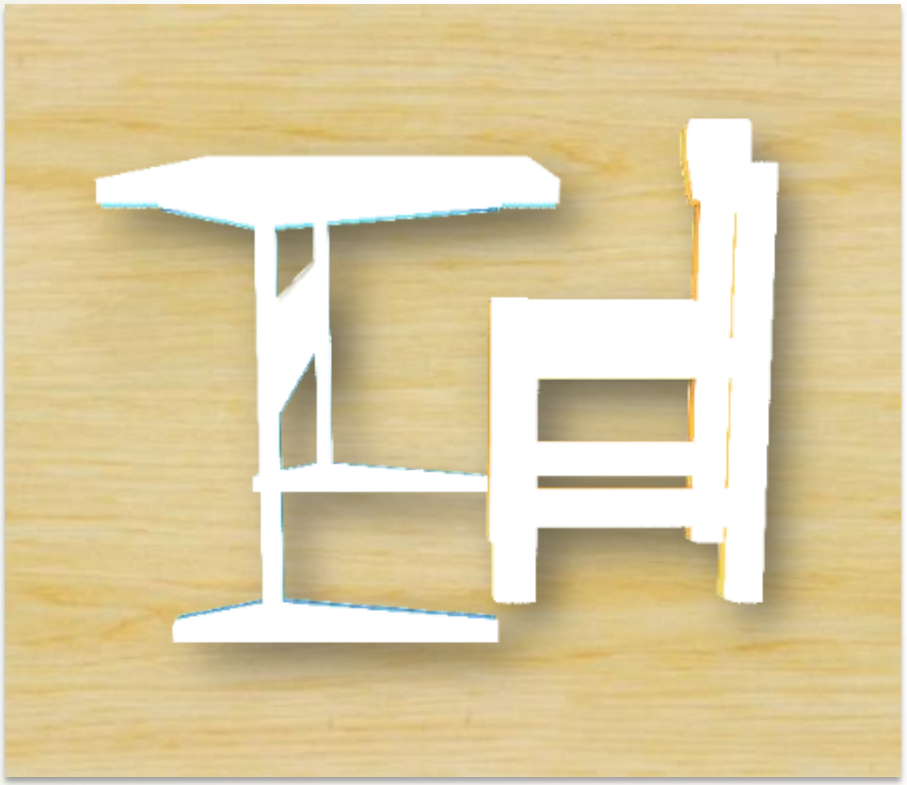
1.Template construction ——— 2. Object fitting

Overview

Result

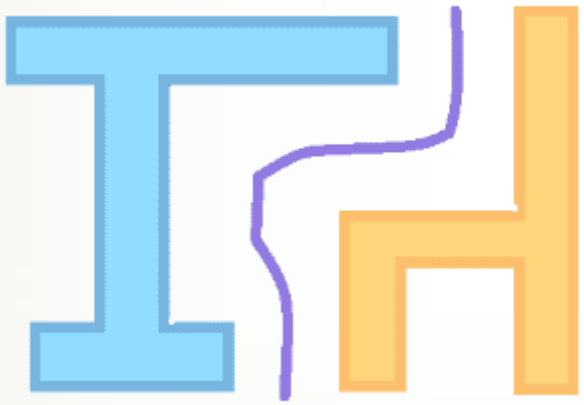


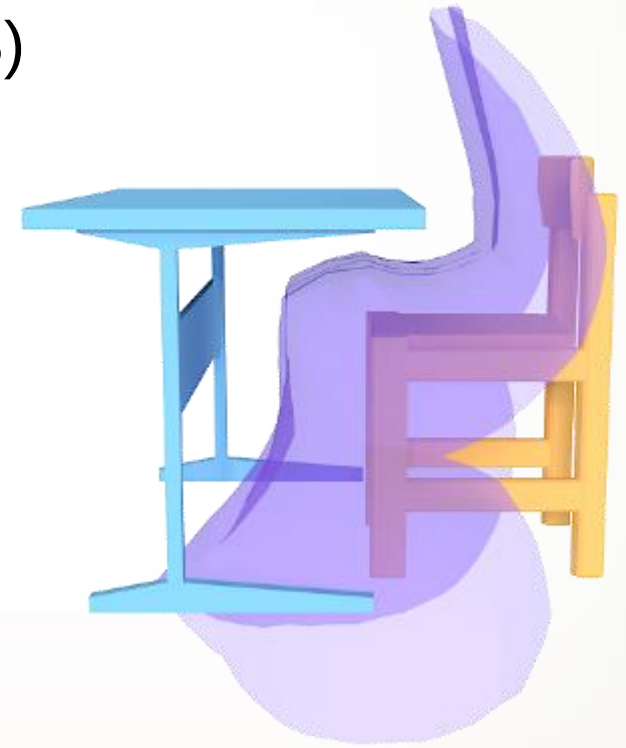
Relationship Template: Abstraction of The Open Space



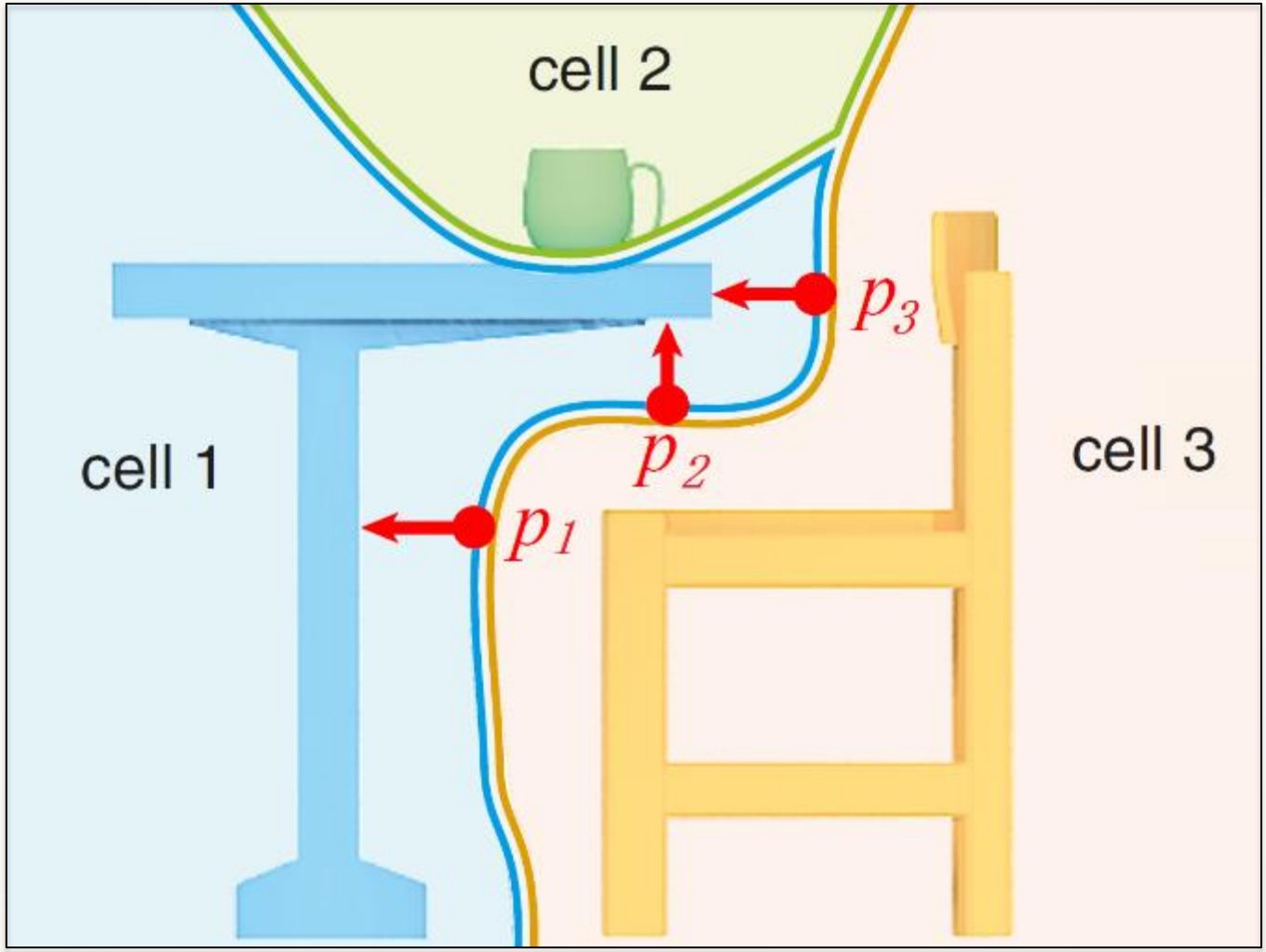
Template Construction: IBS

Interaction Bisector Surface(IBS)

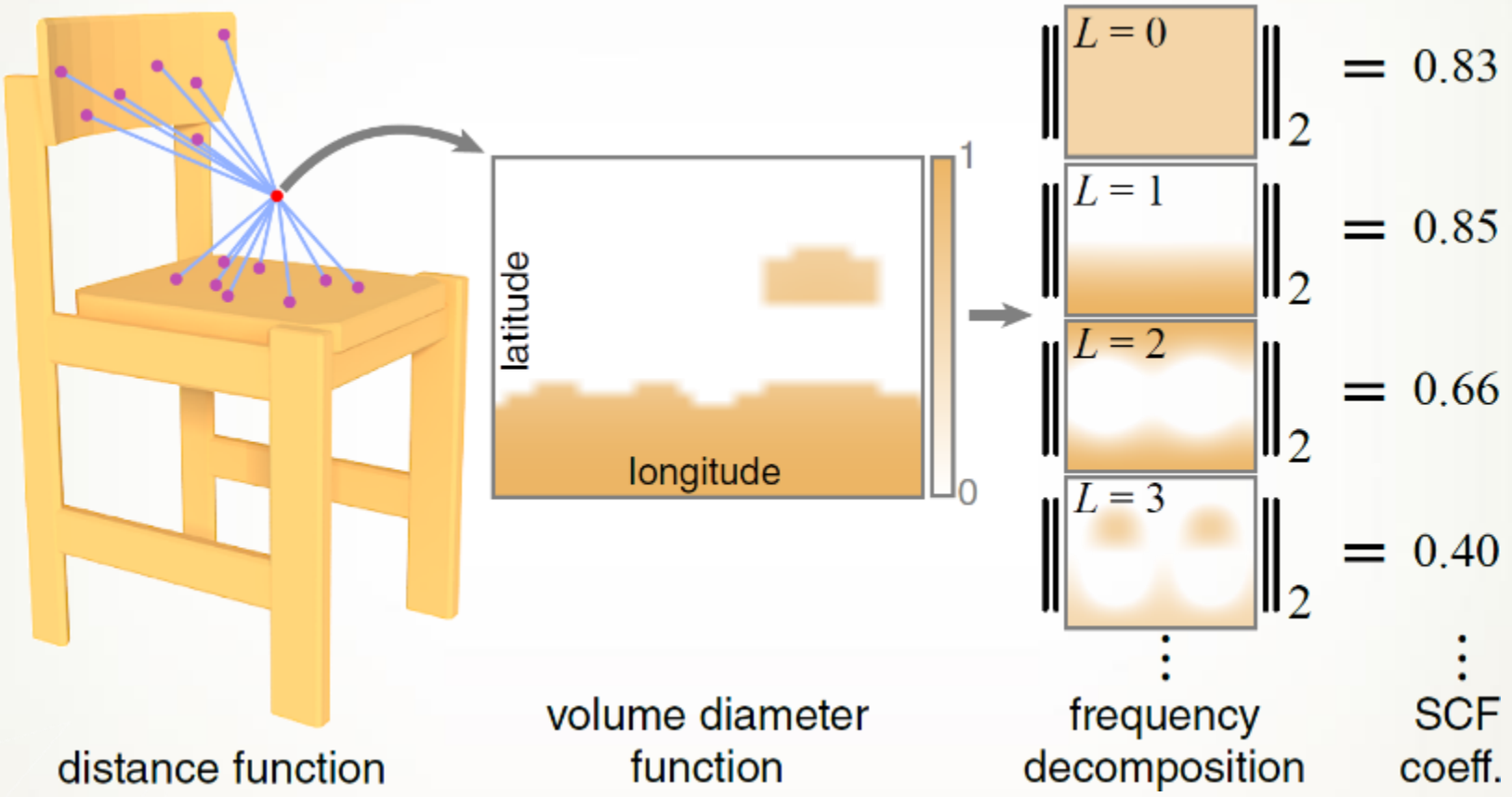




Template Construction: Cells and Features



Shape Coverage Feature (SCF)

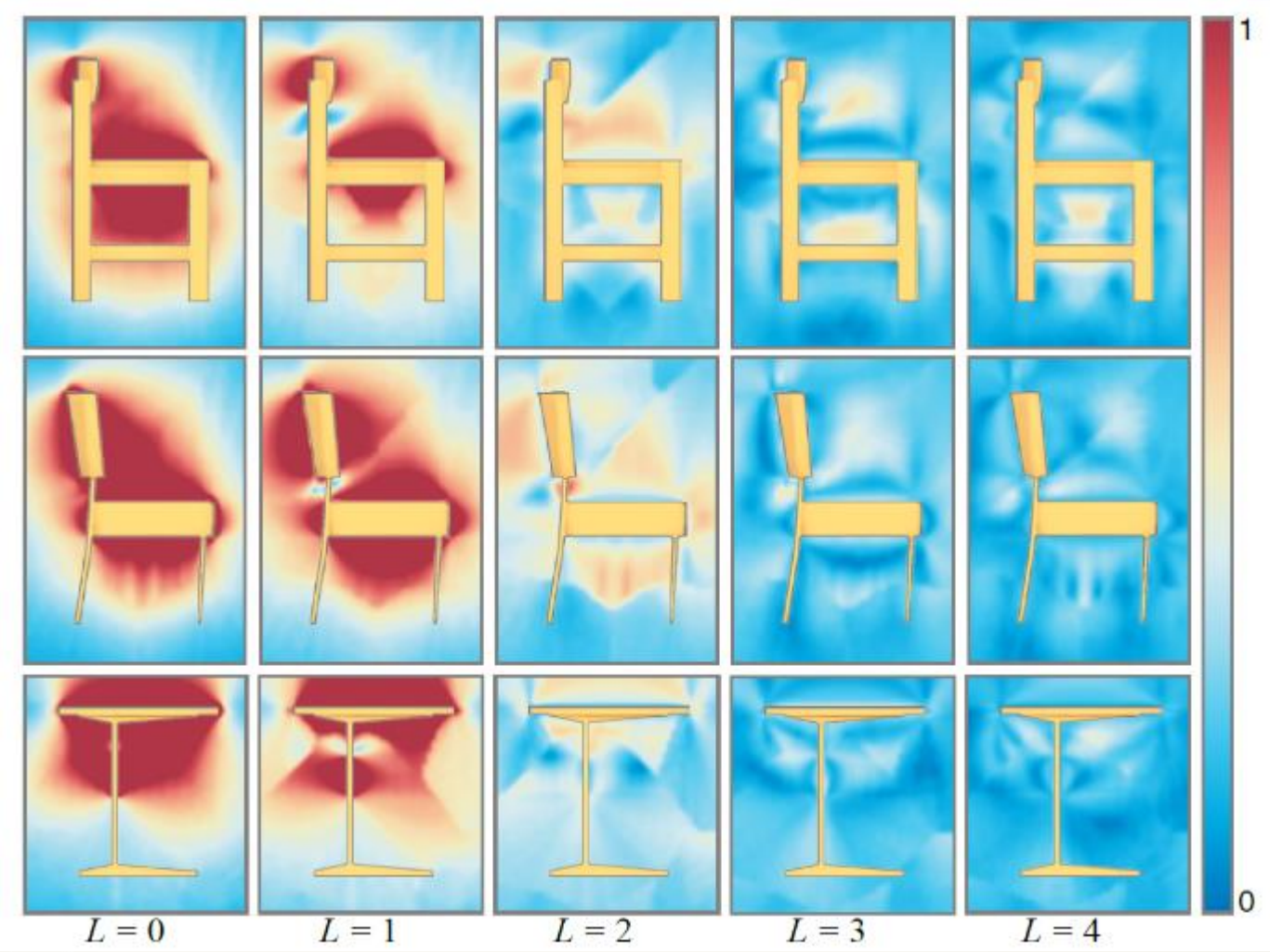


SCF Coefficients

Chair(1)

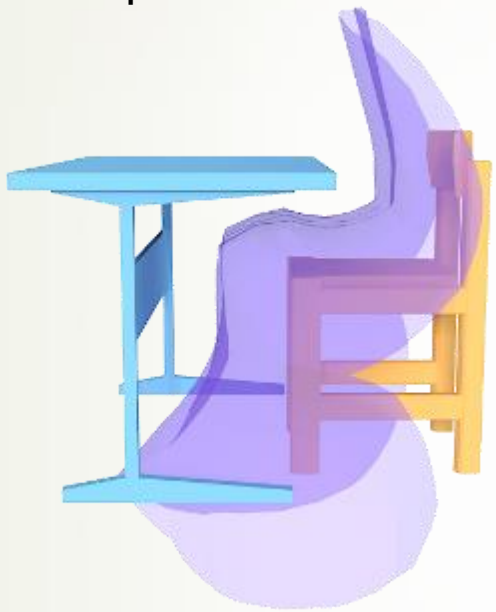
Chair(2)

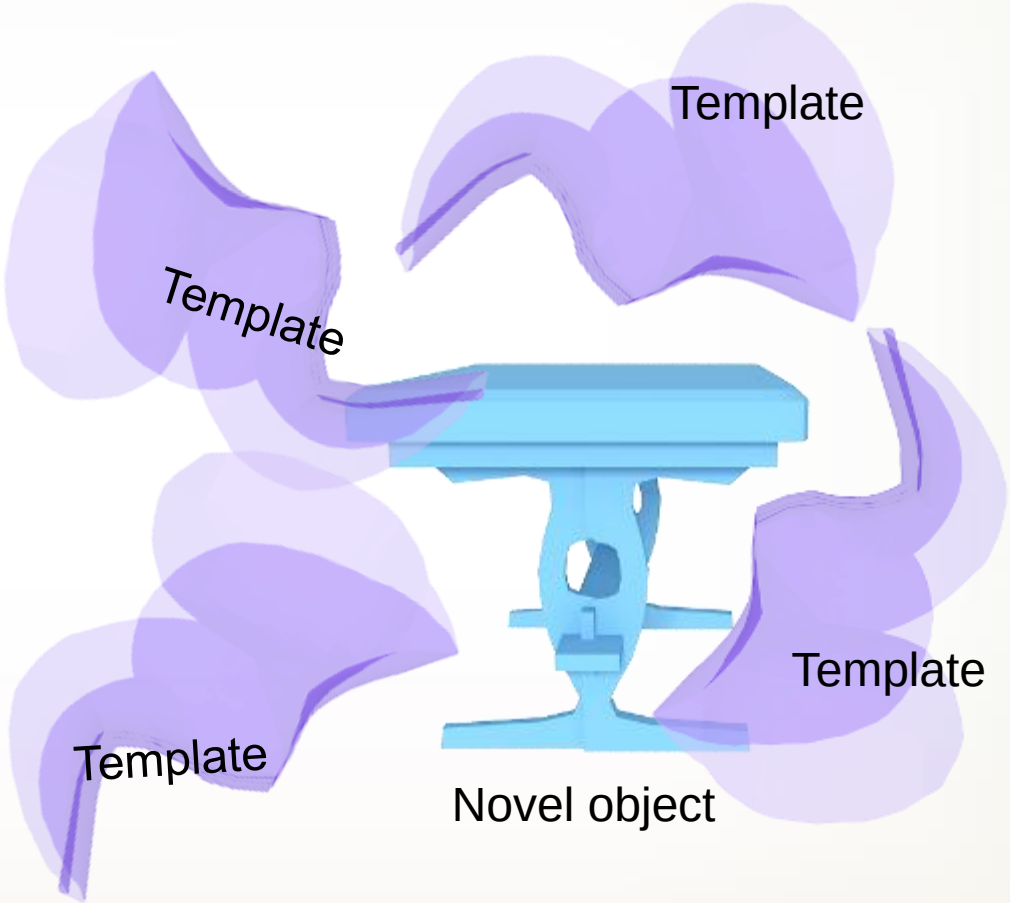
Desk



Object Fitting: the idea

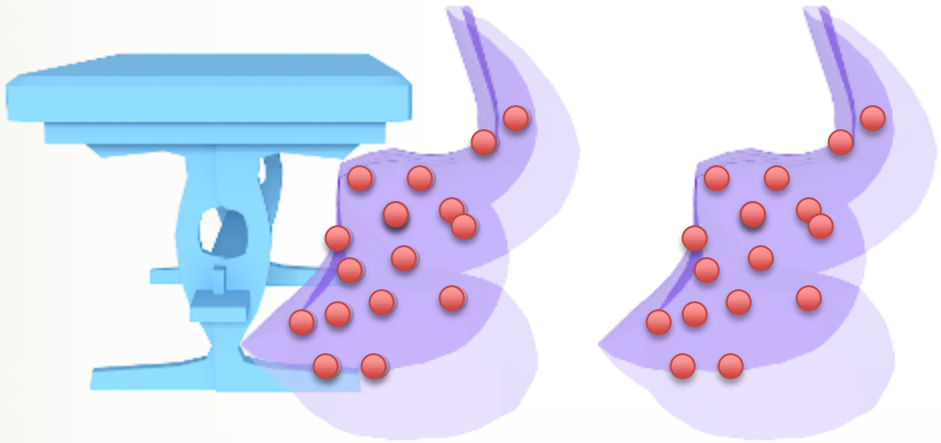
Example scene





What is a good fitting?

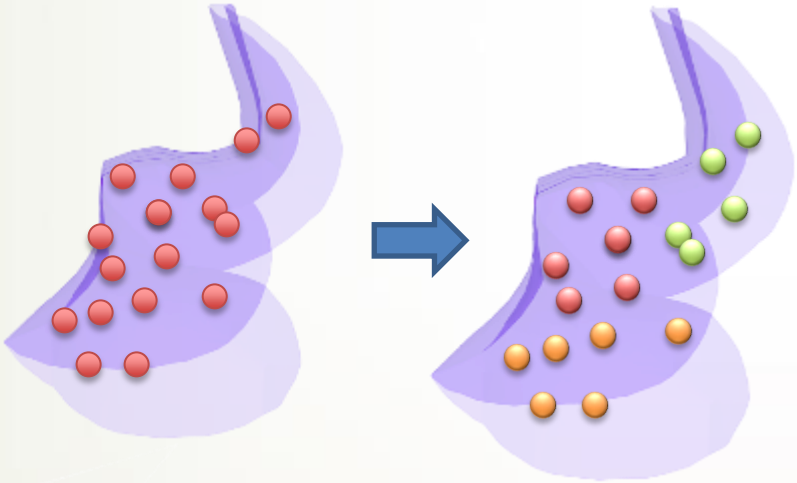
Similarity measurement (fitting score)

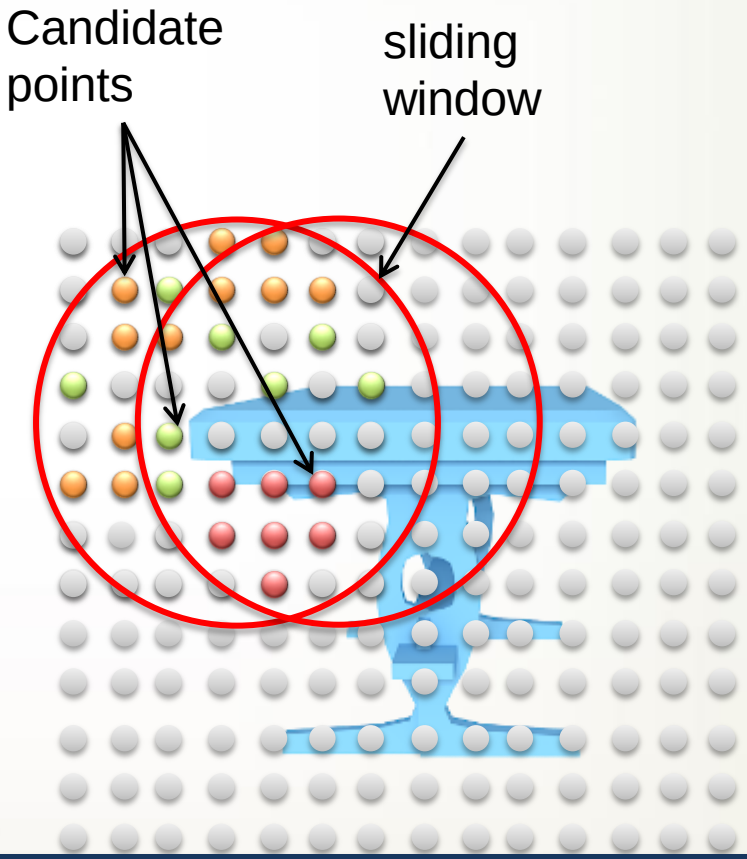


$$S_{final} := (1 - d_{dis})(1 - d_{dir})(1 - d_{scf})$$

Reduce the Search Space

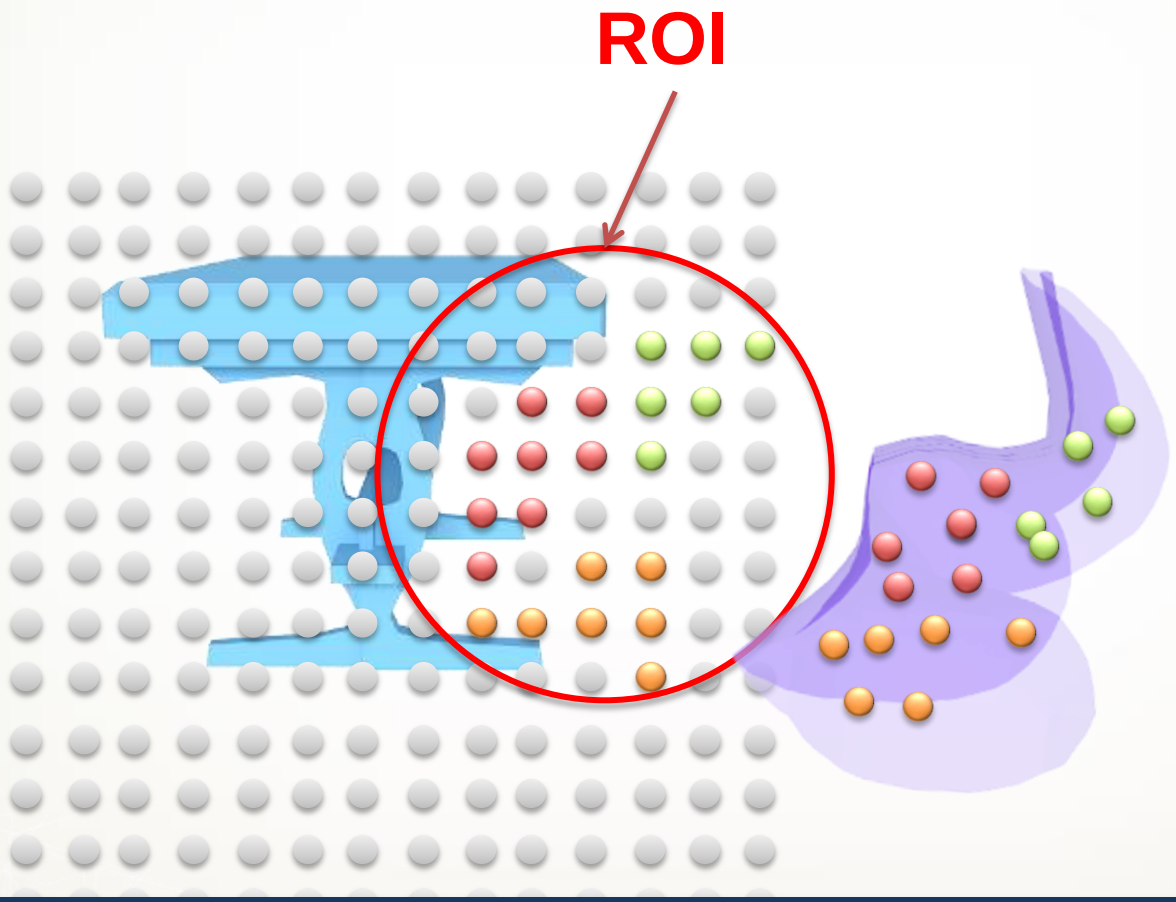
Find the region of interest (ROI)





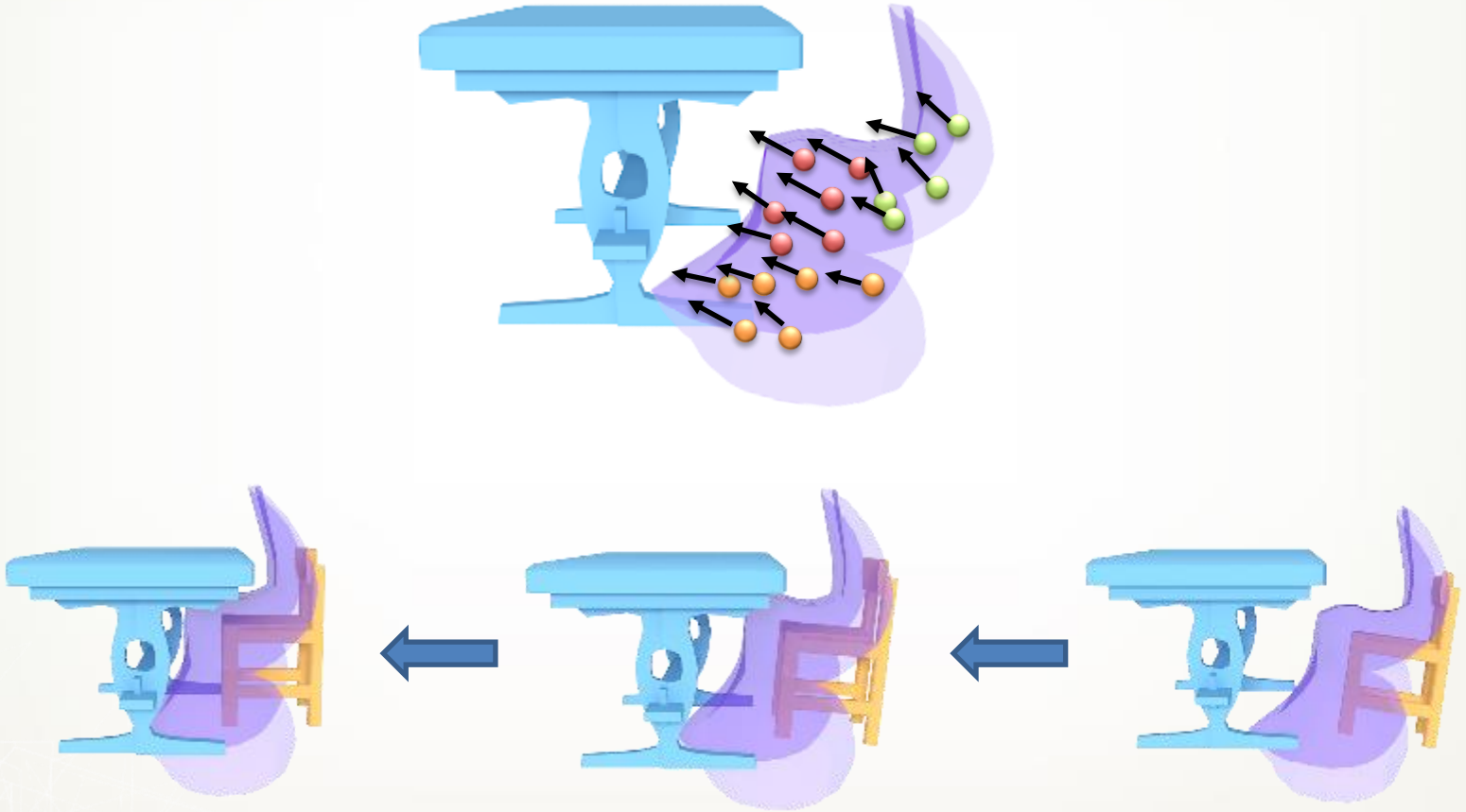
Initial Matching

Geometric hashing



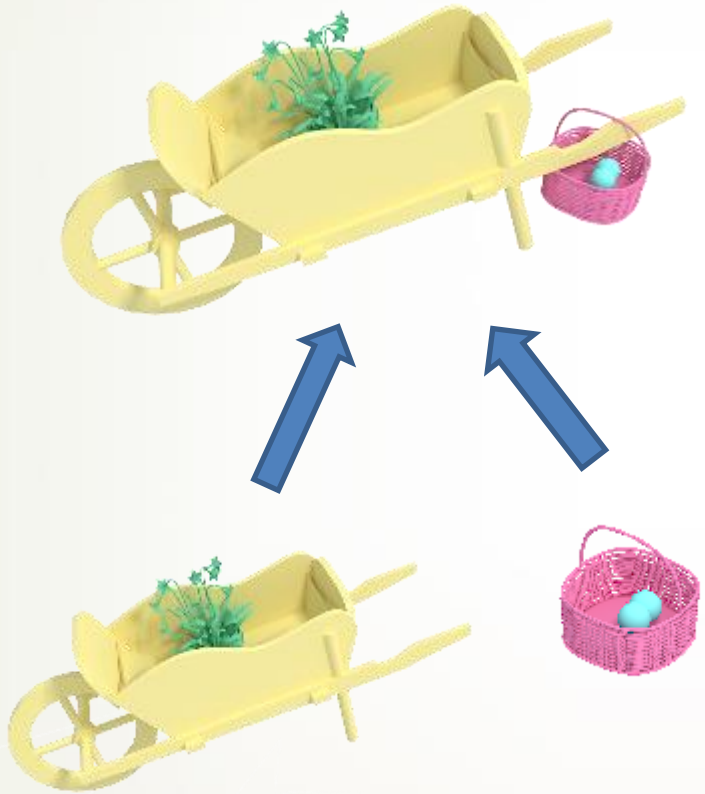
Refinement

ICP style refinement

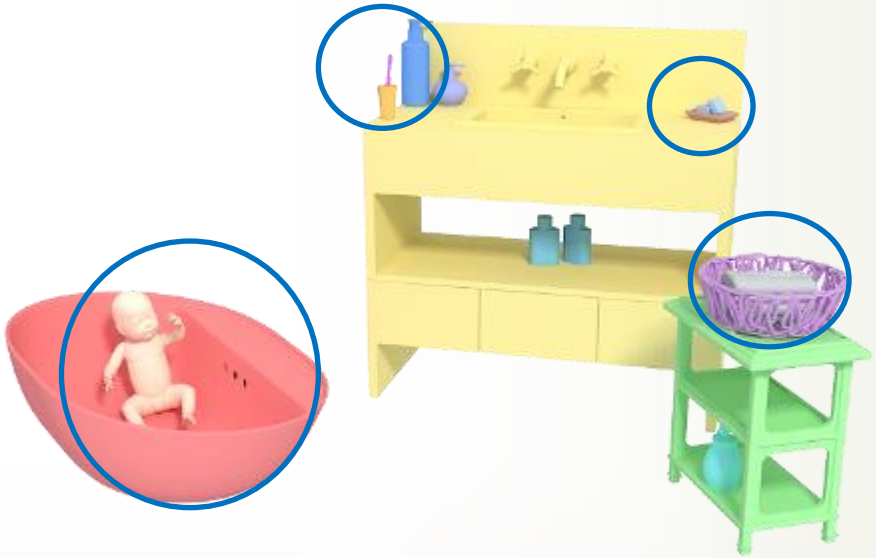


Larger Scenes

Scene hierarchy



Combine with other scene synthesis system

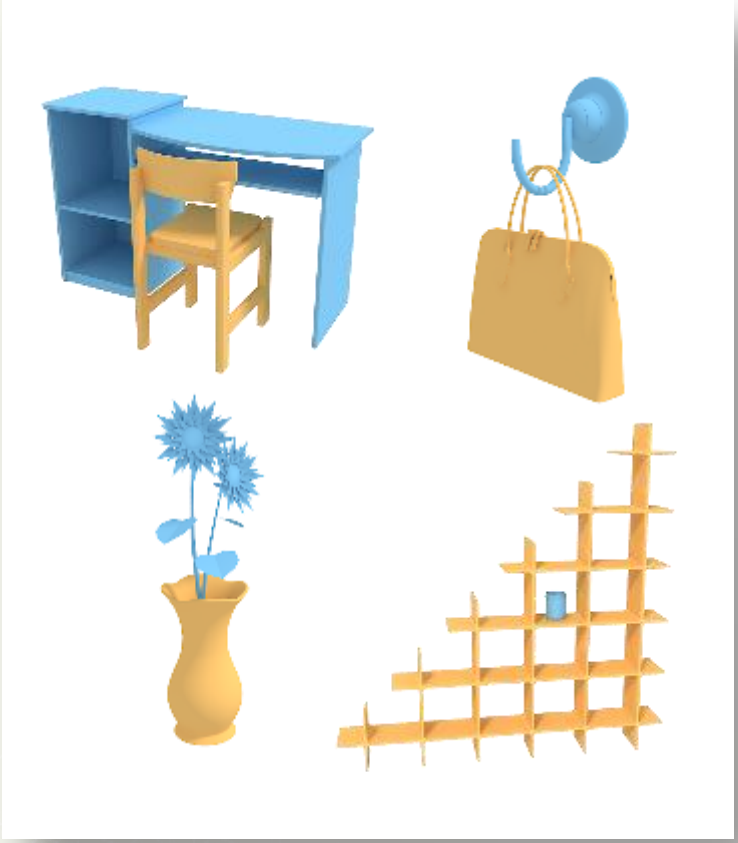


M. Fisher, D. Ritchie, M. Savva, T. Funkhouser, and P. Hanrahan, "**Example-based Synthesis of 3D Object Arrangements**" *SIGGRAPH ASIA2012*

Results and Evaluations

Pairwise Experiment: Our Method vs. ShapeSPH*

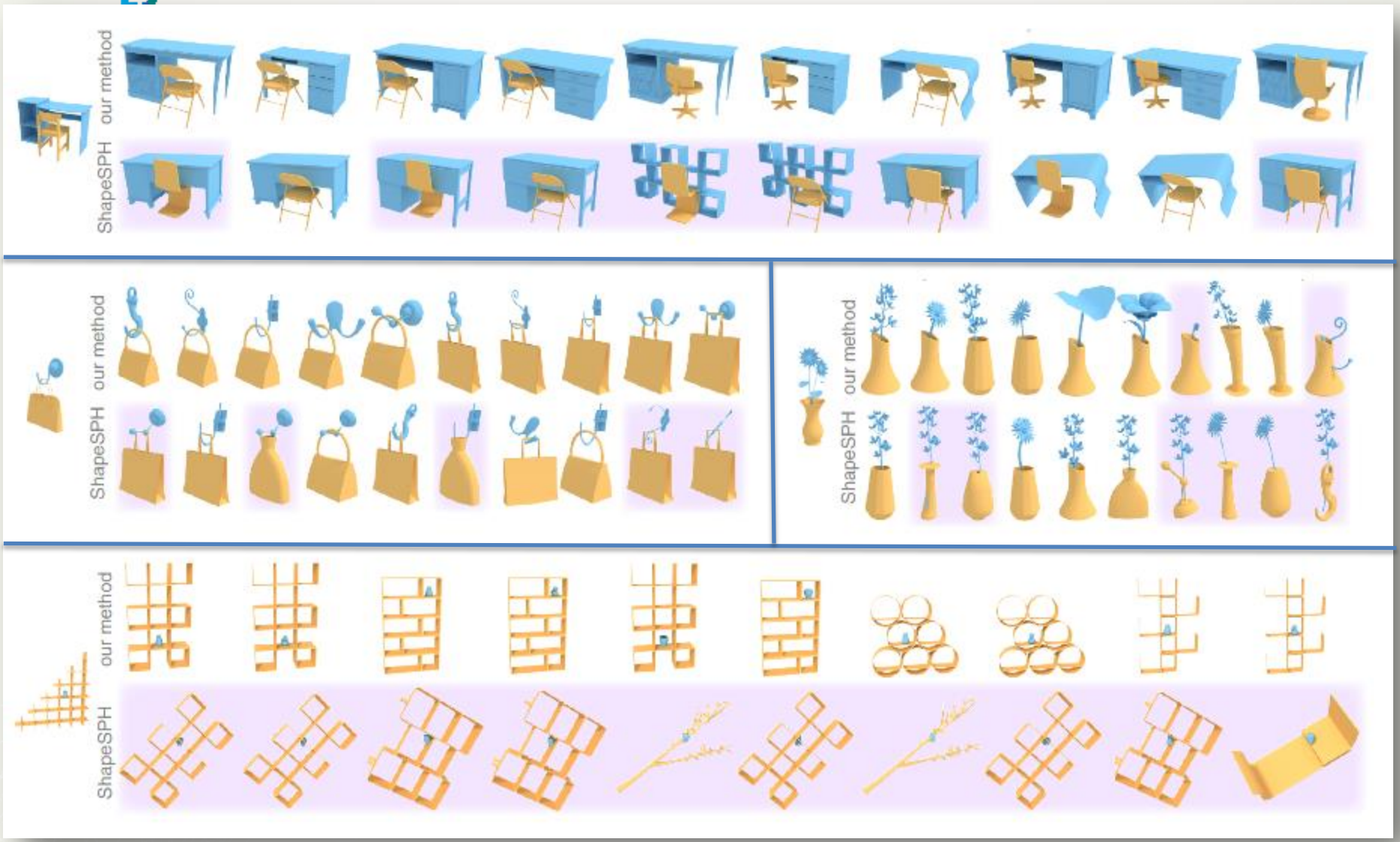
Input



*T. Funkhouser *et al.*, “Modeling by example,” in *ACM Transactions on Graphics (TOG)*, 2004, vol. 23, pp. 652–663.

SIGGRAPH ASIA 2016 MACAO

Pairwise Experiment: Results

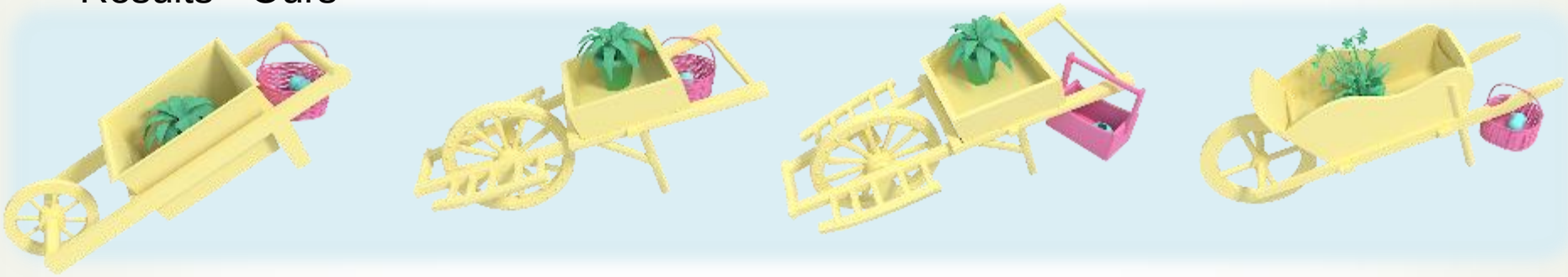


SIGGRAPH ASIA 2016 MACAO

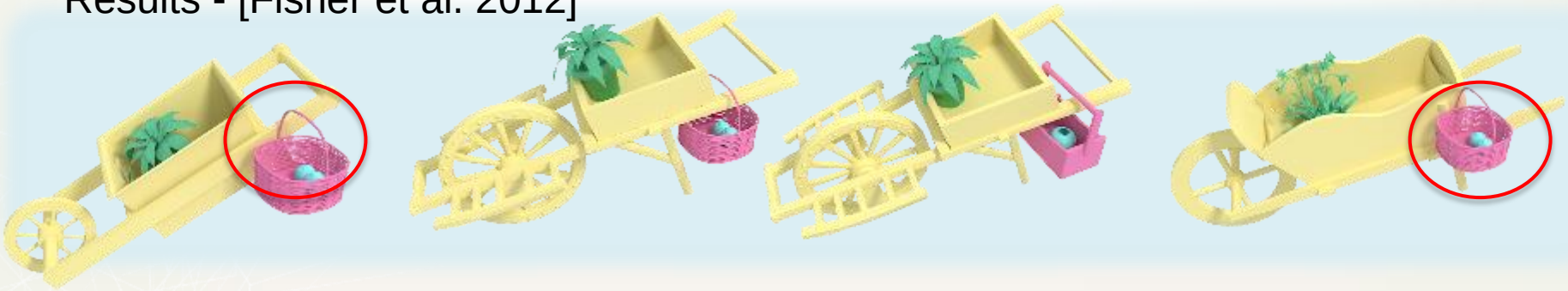
Larger Scene Experiment

Input scene

Results - Ours



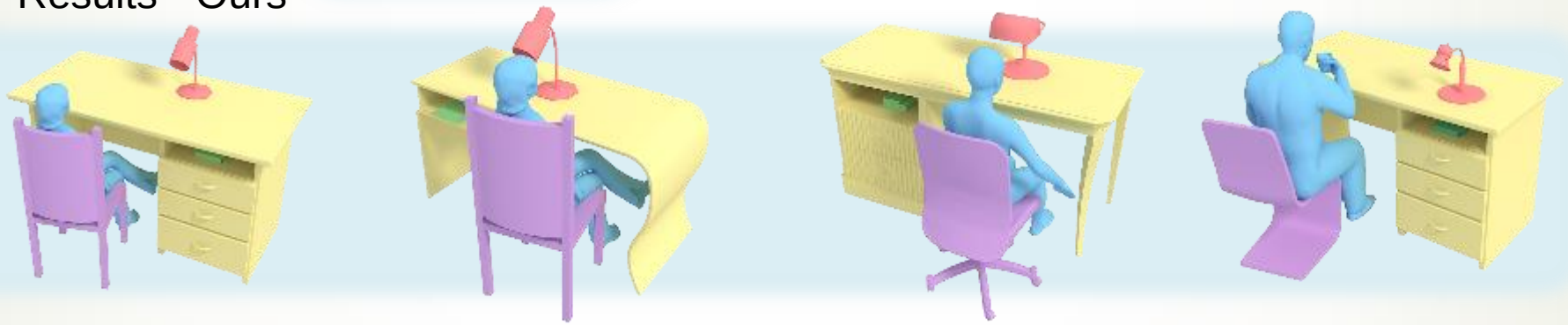
Results - [Fisher et al. 2012]



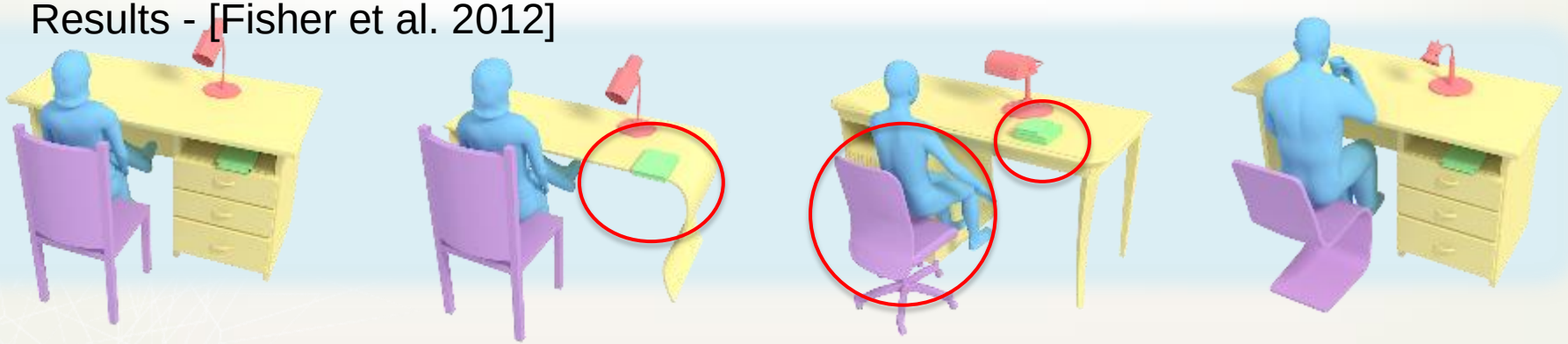
Larger Scene Experiment

Input scene

Results - Ours

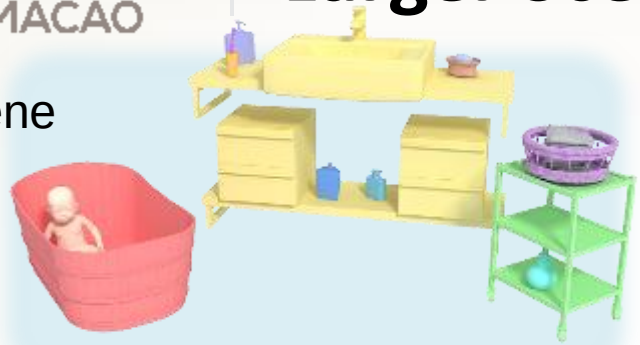


Results - [Fisher et al. 2012]



Larger Scene Experiment

Input scene



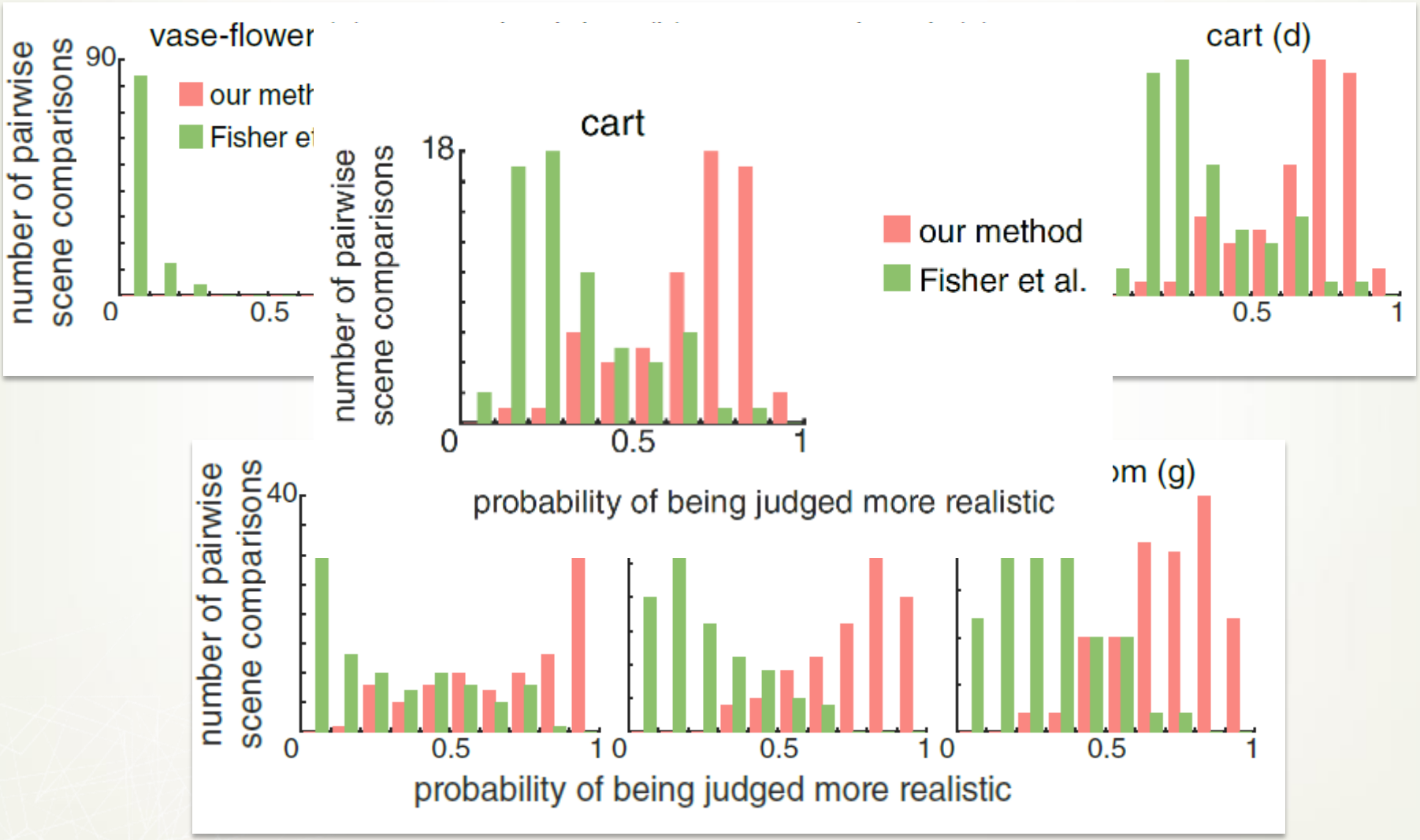
Results - Ours

Results – [Fisher et al. 2012]

Larger Scene Experiment: Evaluation

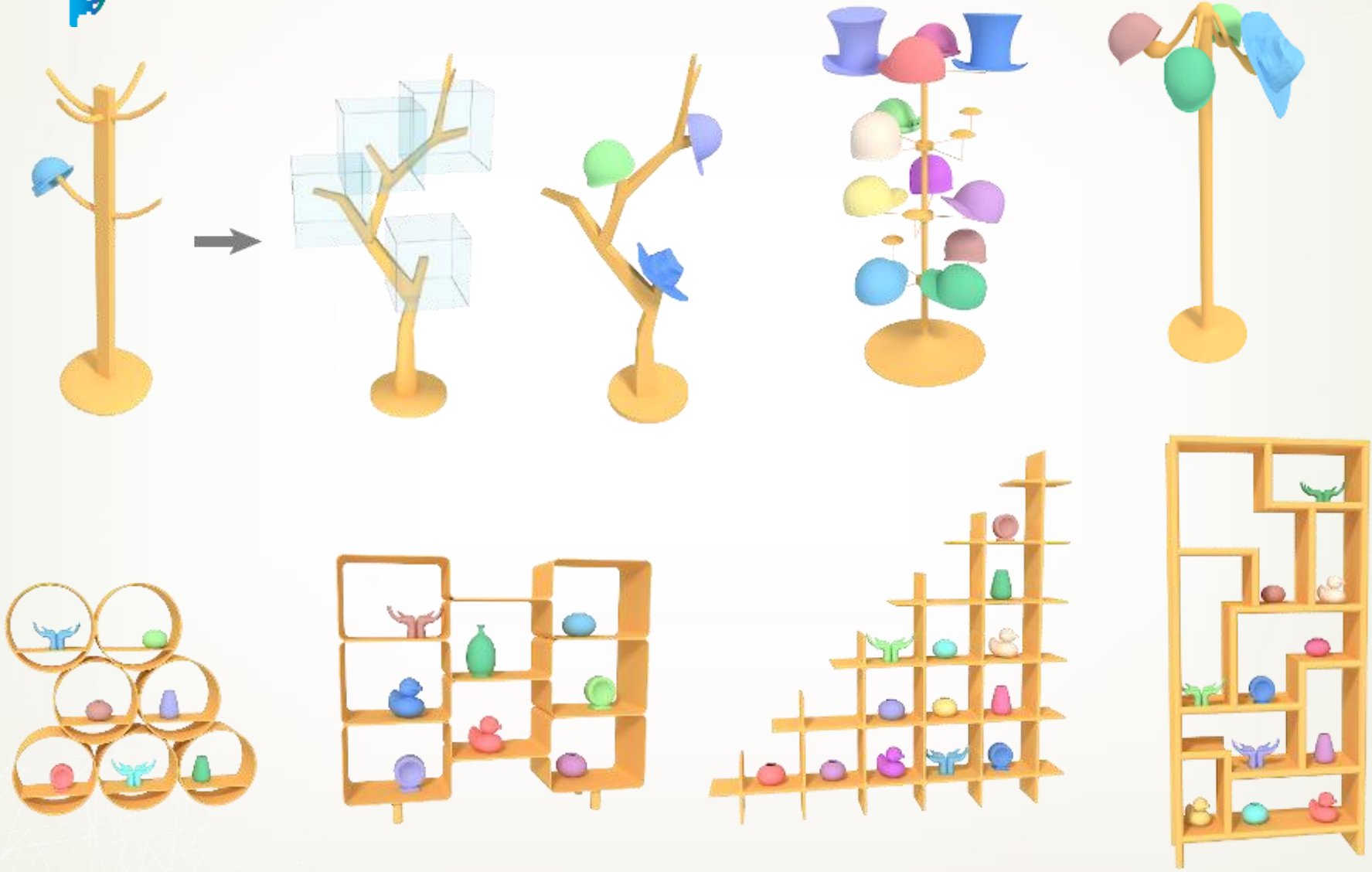
User study interface

Larger Scene Experiment: Evaluation



SIGGRAPH ASIA 2016 MACAO

Spatially Repeated Objects



Conclusion

- We propose a method for synthesis of scenes with complex relationships.
- We propose a novel feature “SCF” to encode open space.
- Our method can be used to augment existing methods.

Limitations and Future Work

- Only consider rigid IBS

- Future work:
  - Add flexibility to the relationship template
  - Learn a parametric model of the relationship template

Acknowledgement

Anonymous reviewers
Anonymous Mechanical Turk users
Ylab in XJTU

China Postdoctoral Science Foundation
National Science Foundation of China
Guangdong Science and Technology Program
Shenzhen Innovation Program
The ERC starting Grant SmartGeometry
Marie Curie CIG
EPSRC Grant
FP7 TOMSY