SceneNN: A Scene Meshes Dataset with aNNotations

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Motivation

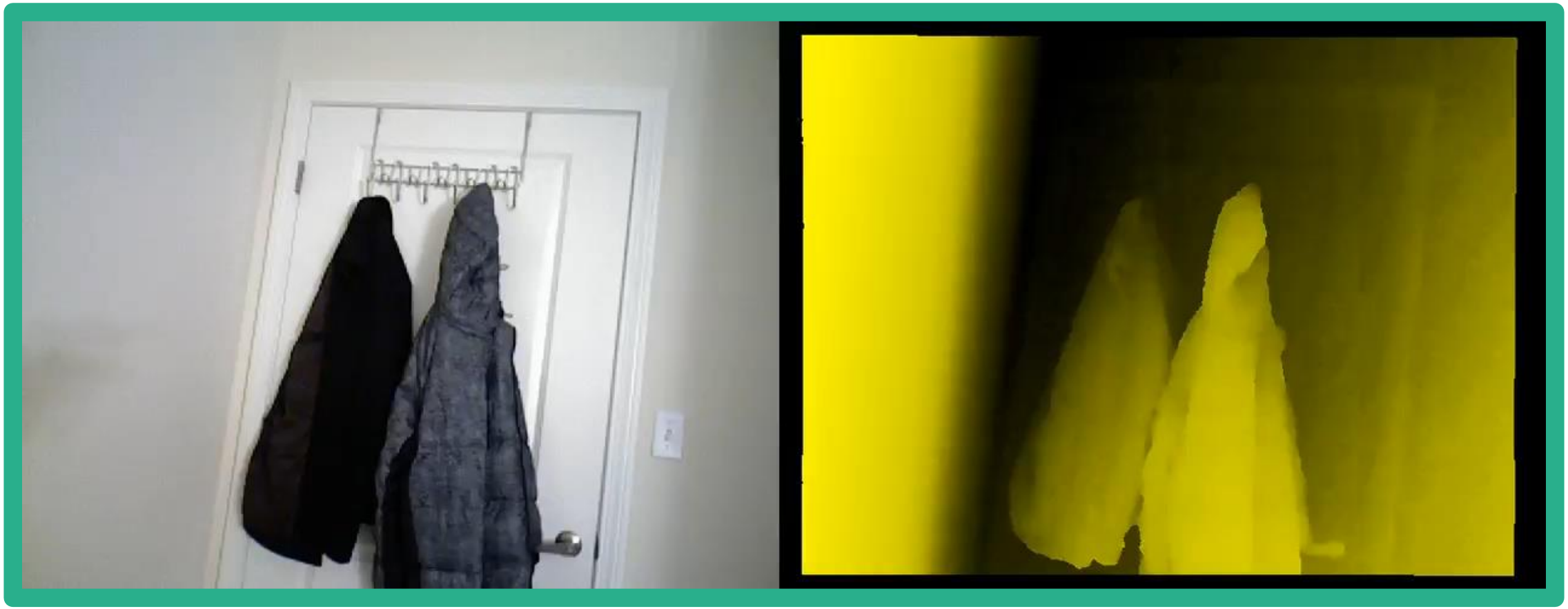
Dataset	Quantity	Annotation	Format	Pose
NYU v2	1449 frames	All	Image	N
SUN RGB-D	10K frames	All	Image	N
RGB-D v2	17 scenes	All	Cloud	Y
TUM	47 scenes	N.A.	Image	Y
SUN3D	254 scenes	8 scenes	Cloud	Y
Ours	100 scenes	All	Mesh	Y

SceneNN dataset

http://www.scenenn.net

- **100+** RGBD scenes
- Raw videos from 2,000 to more than 10,000 frames
- Reconstructed triangle meshes in PLY format
- Per-frame camera poses
- Per-vertex and per-pixel labelling
- Annotated bounding boxes, object poses
- Categories: Workplace (27) Bedroom (19) Living room (8) Kitchen (11) Study space (9) Meeting space (3) Lounge (8) Other (10), Asus Xtion and Kinect v2 comparison (6)

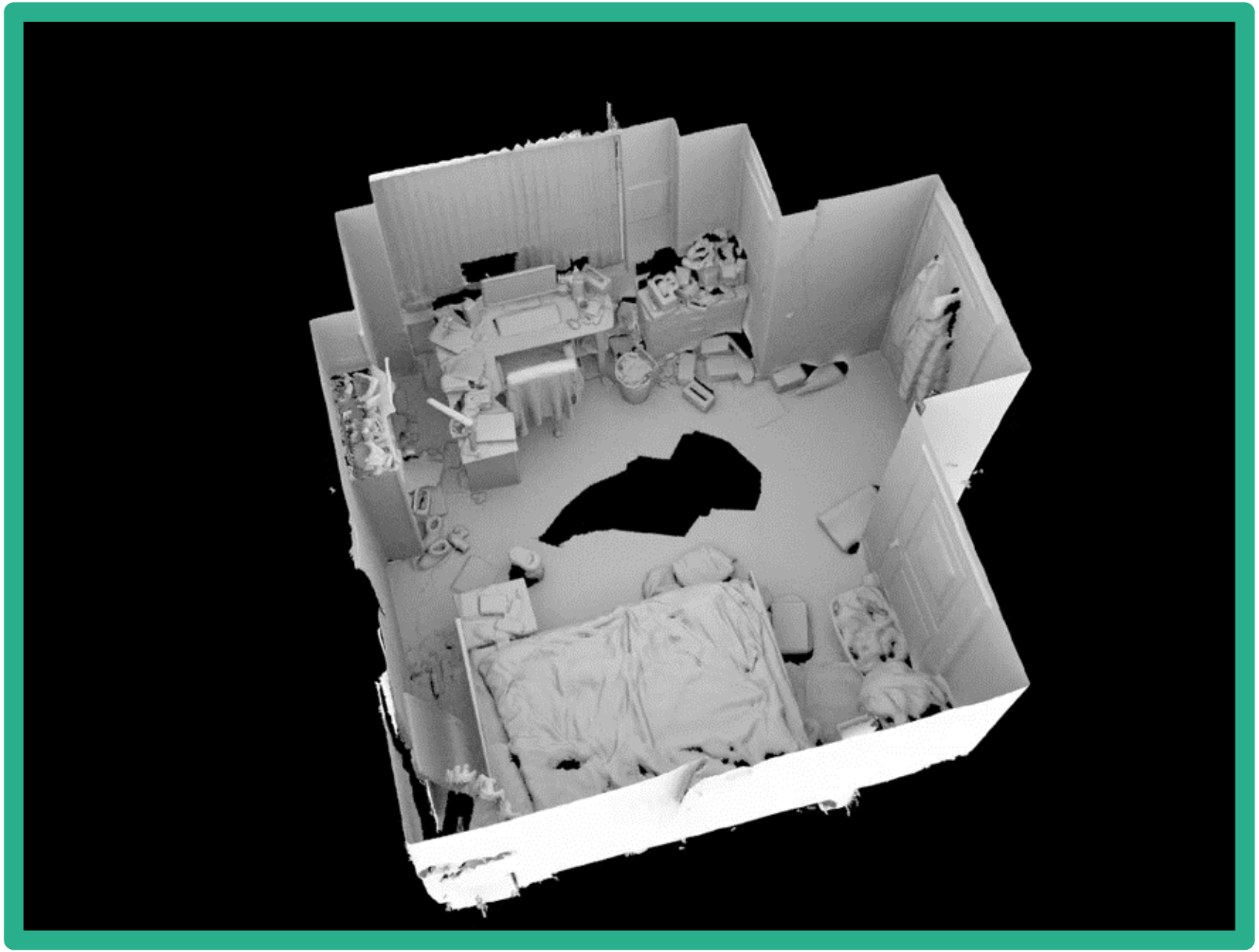
Input



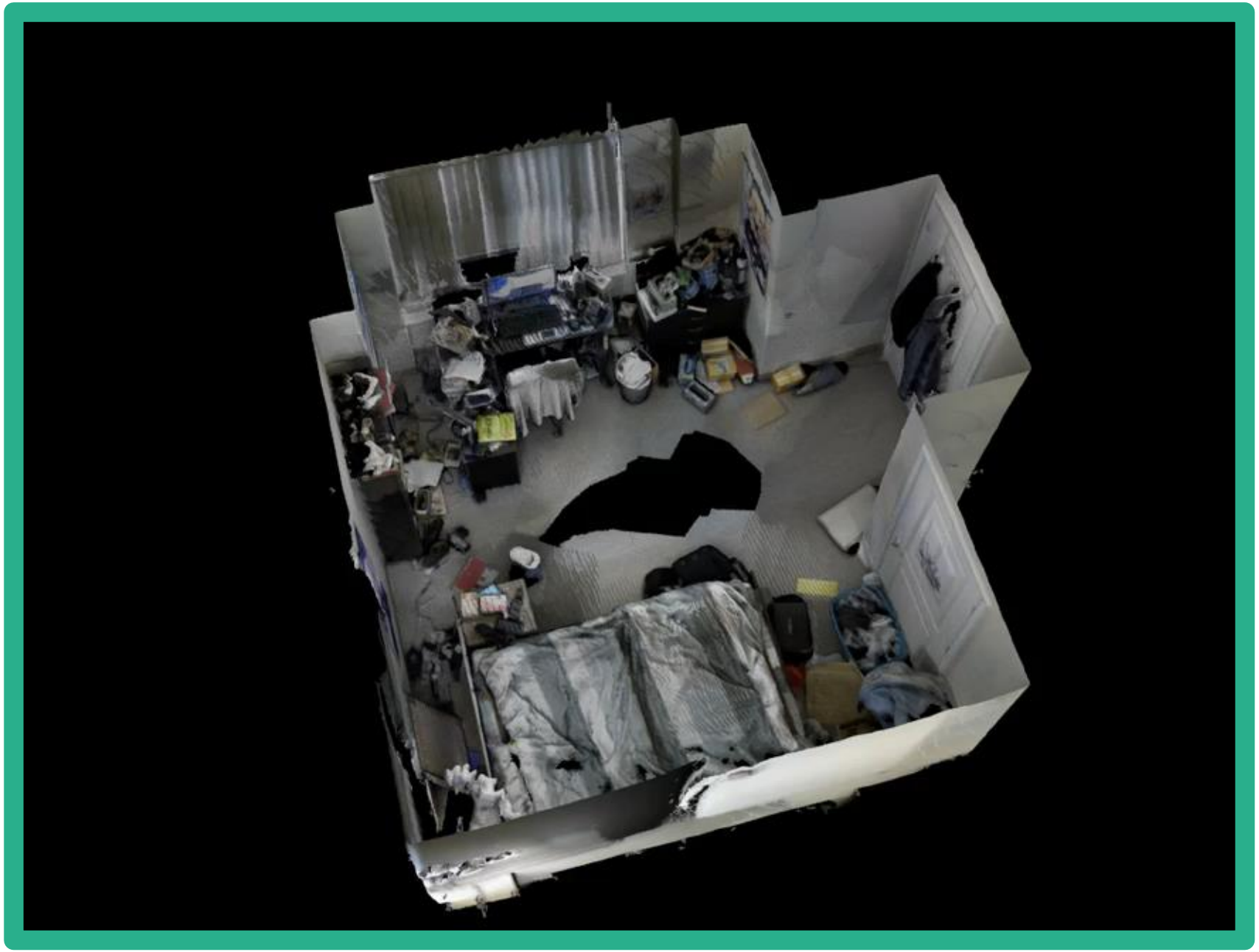
RGB

Depth

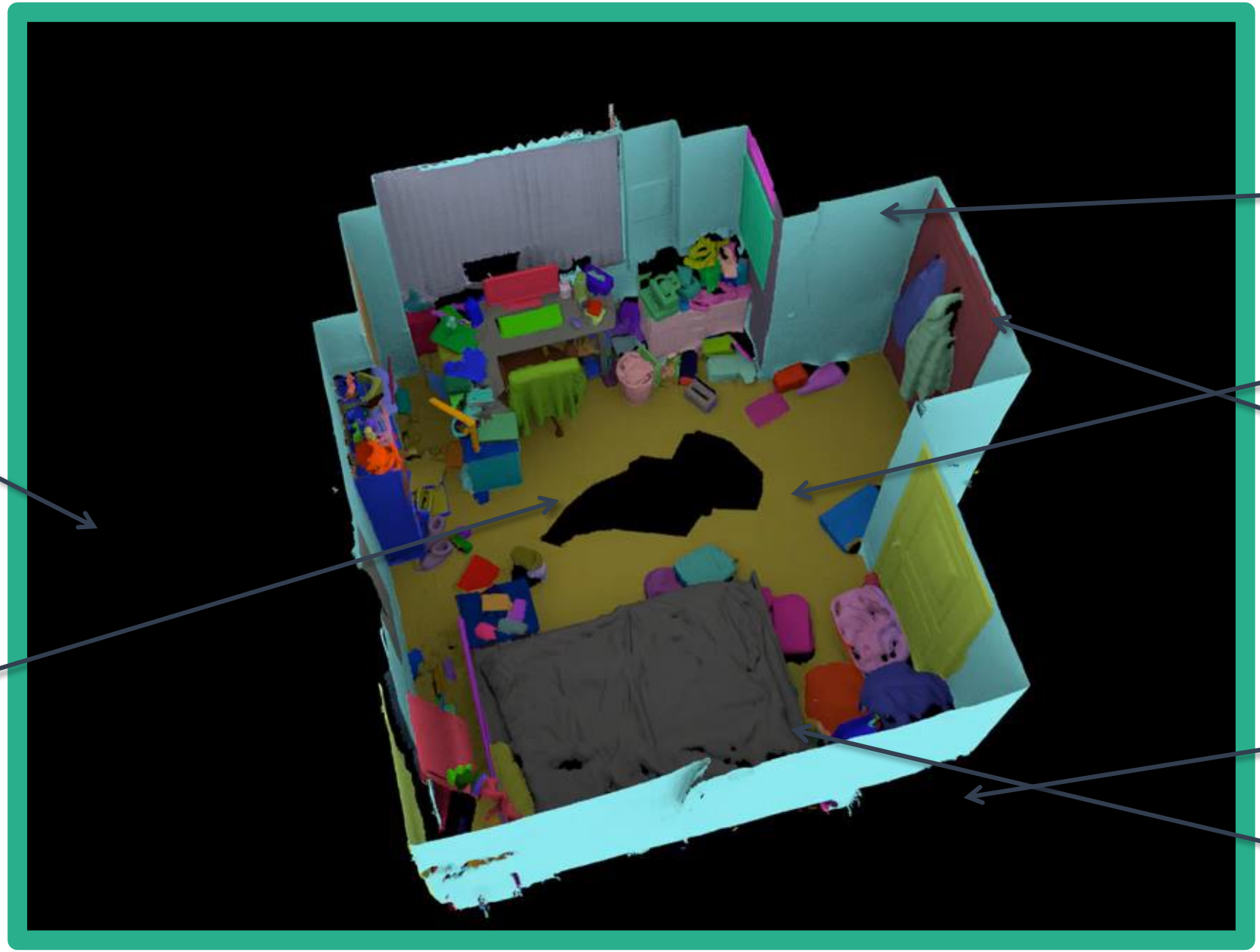
3D reconstruction



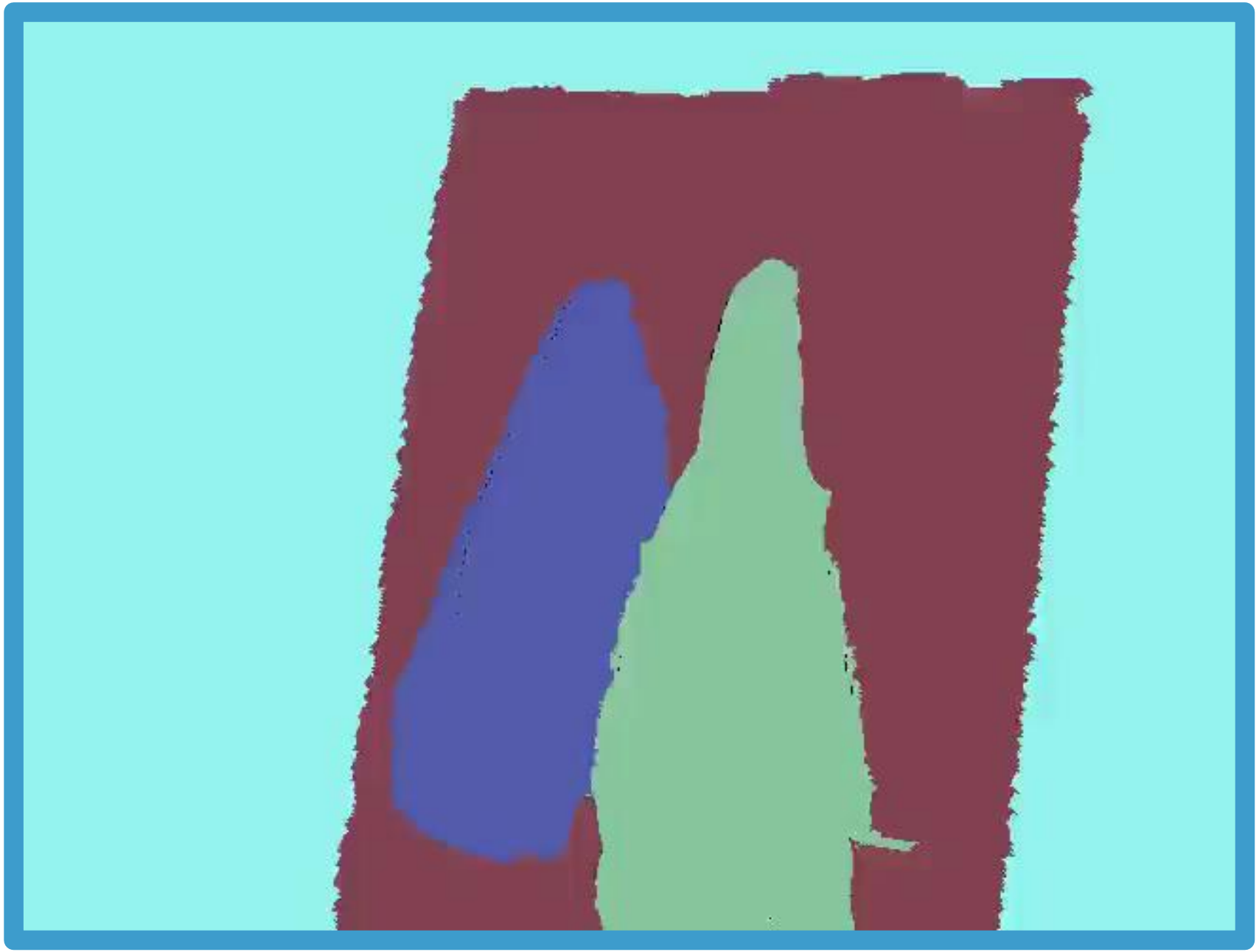
3D reconstruction



Output: 3D segmentation and annotation



Output: 2D segmentation and annotation



Workflow summary

Capture

Reconstruct

Annotate in 3D

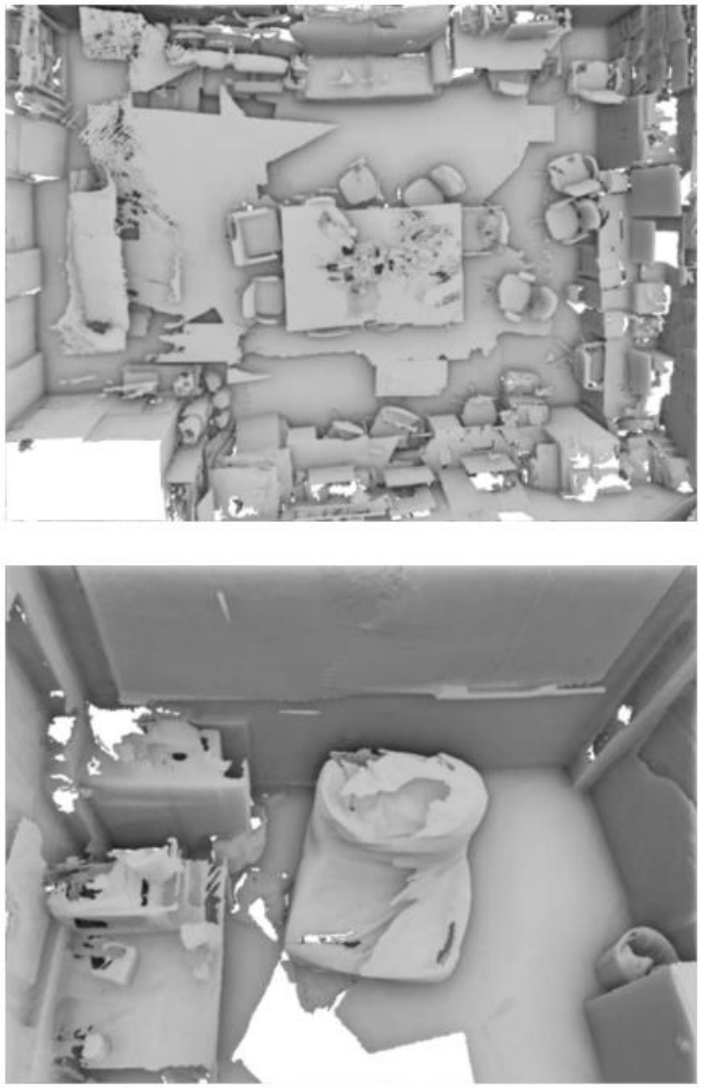
- Triangle mesh
- Camera poses

monitor
keyboard
poster
cabine
bookshelves
trash bin

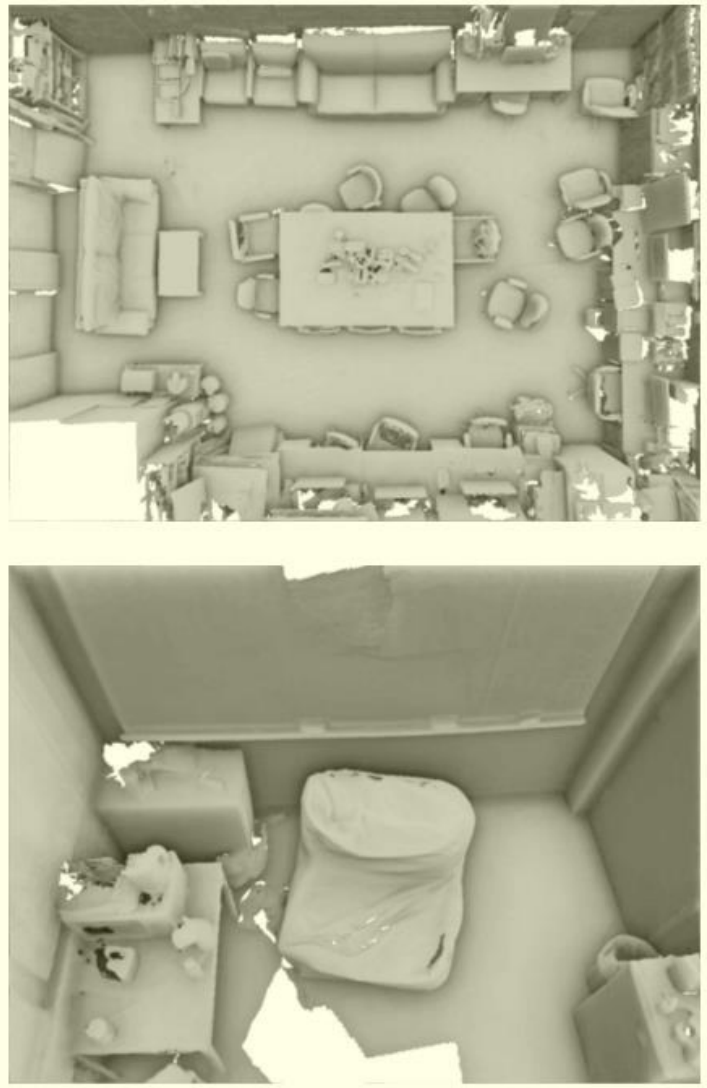
- Per-vertex and per-pixel labels
- Bounding boxes, object poses

RGBD Reconstruction

DVO SLAM
[Kerl et al., IROS 2013]

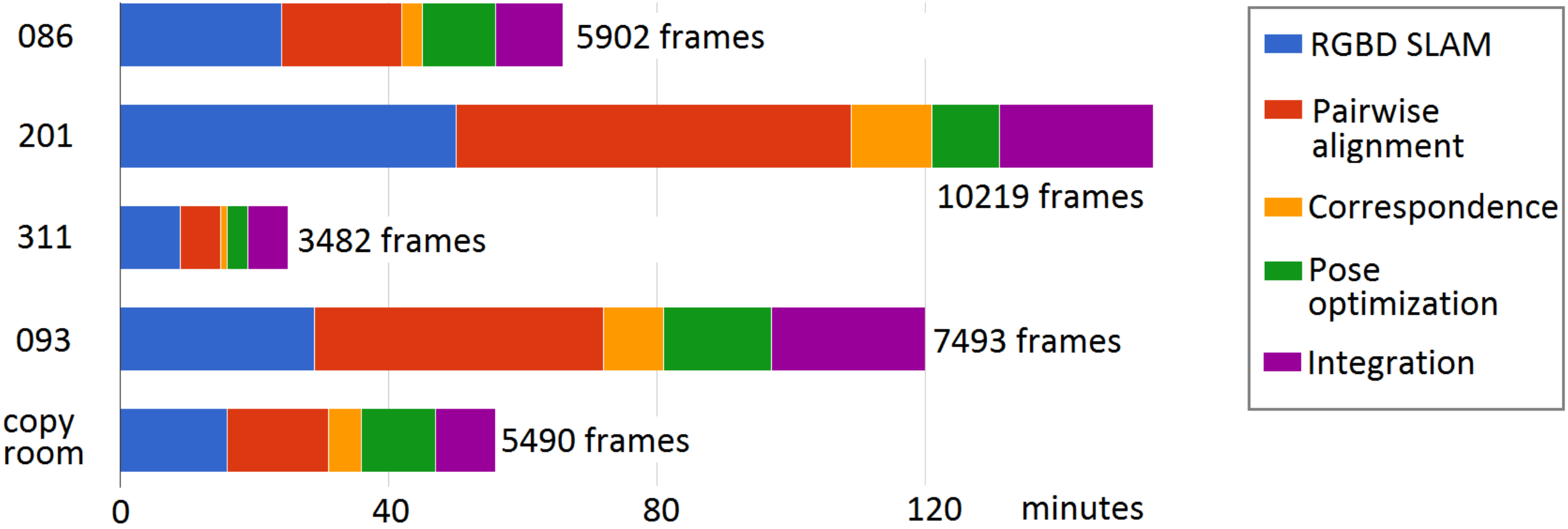


Elastic Fusion
[Whelan et al., RSS 2015]



Elastic Reconstruction
[Choi et al., CVPR 2015]

Reconstruction statistics



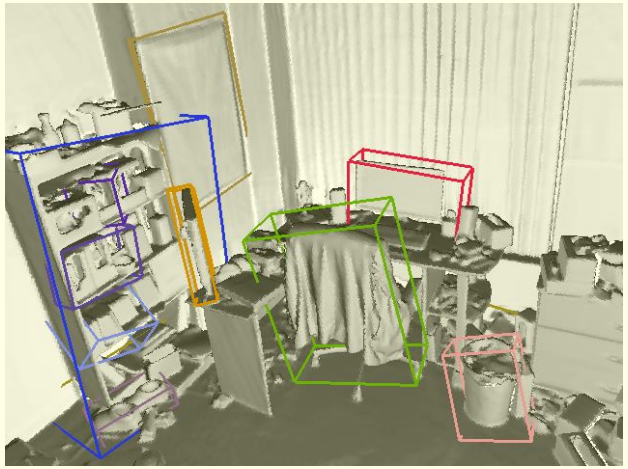
CPU Intel Core i7 5960X @3Ghz, 32GB RAM

Annotation

Capture

Reconstruct

Annotate in 3D



- Triangle mesh
- Camera poses

monitor
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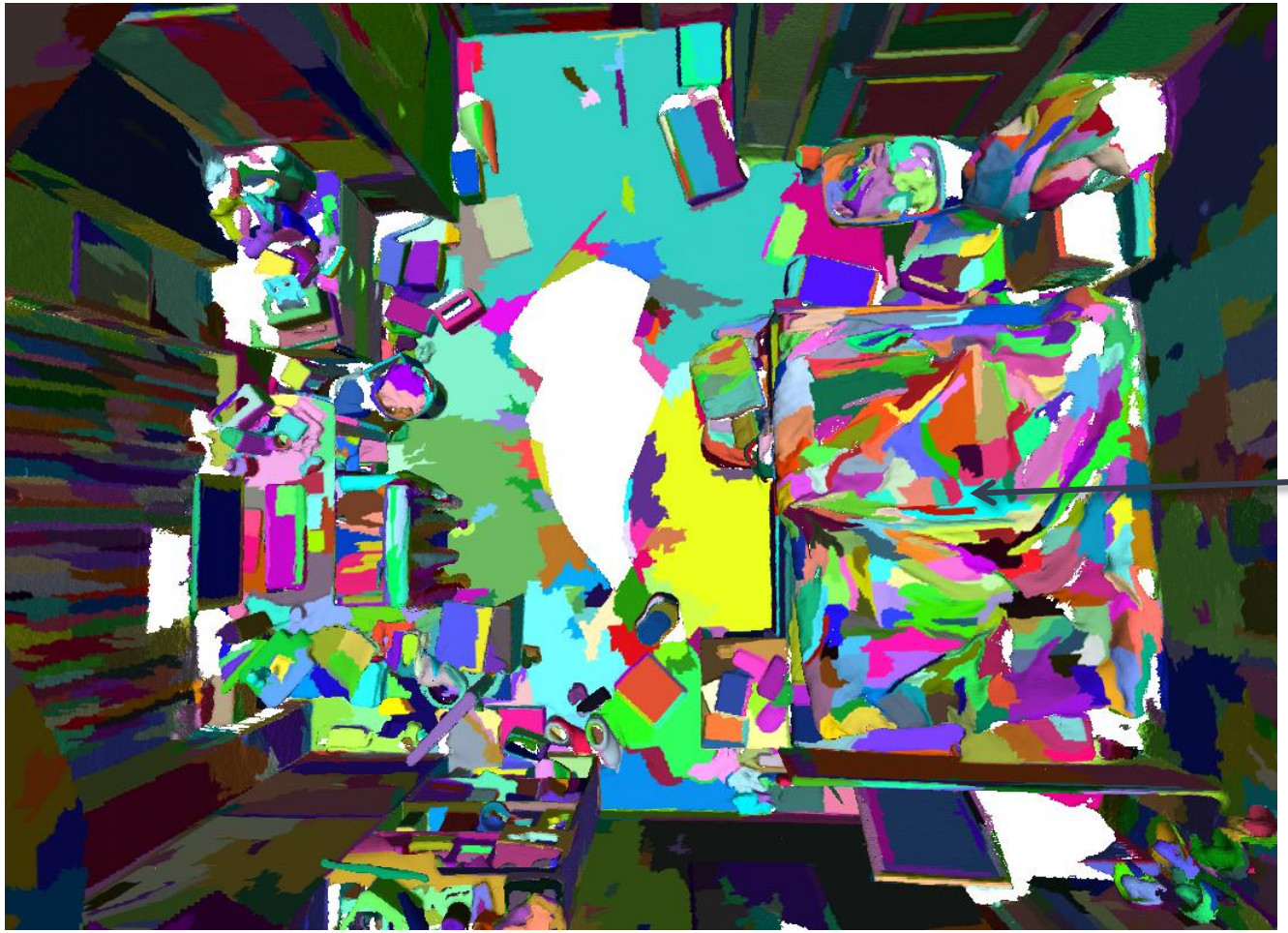
- Per-vertex and per-pixel labels
- Bounding boxes, object poses

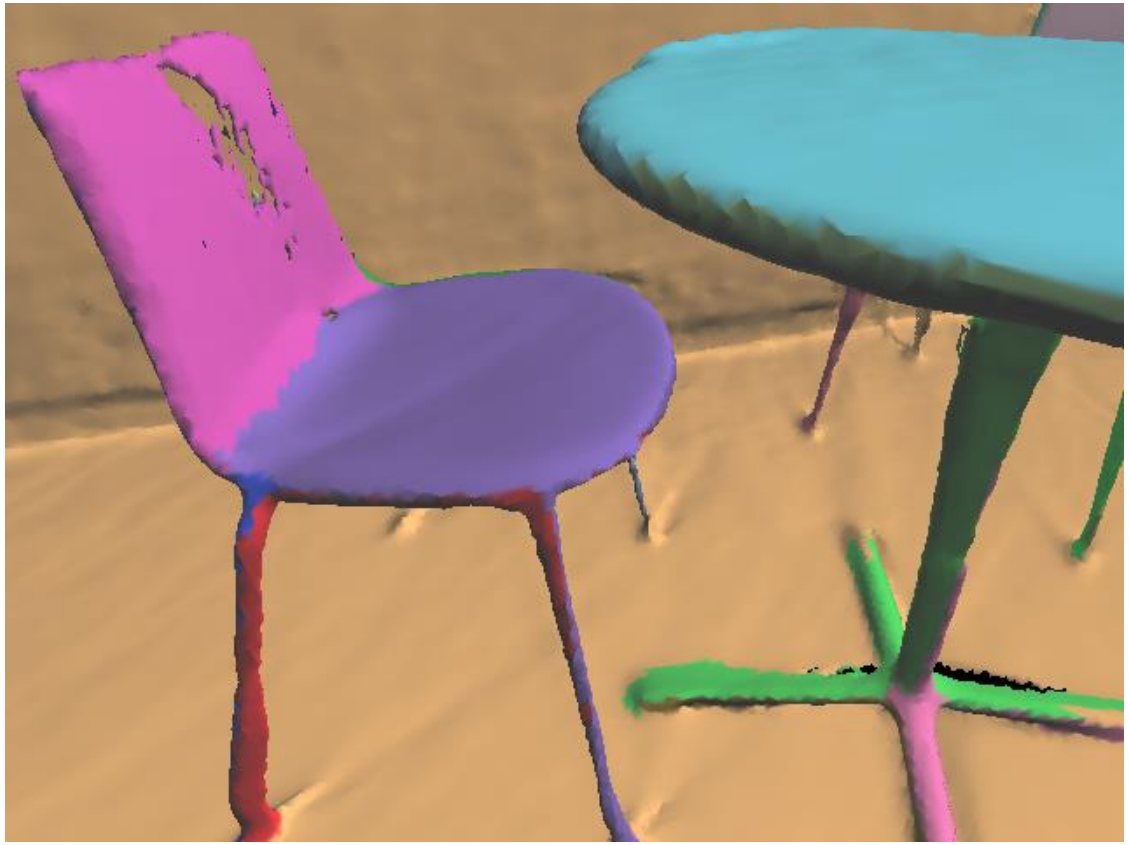
Graph-based segmentation



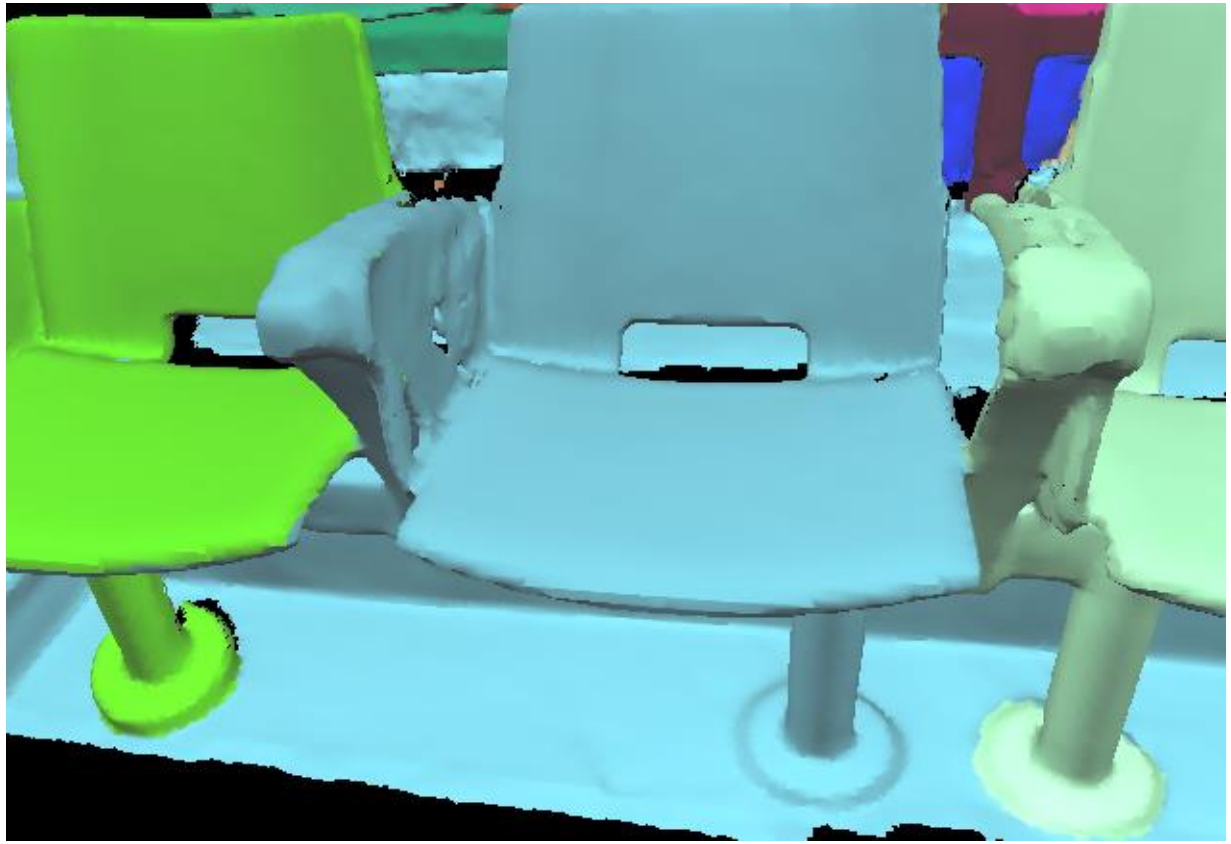
Supervertices

Markov random field

Imperfect segmentation



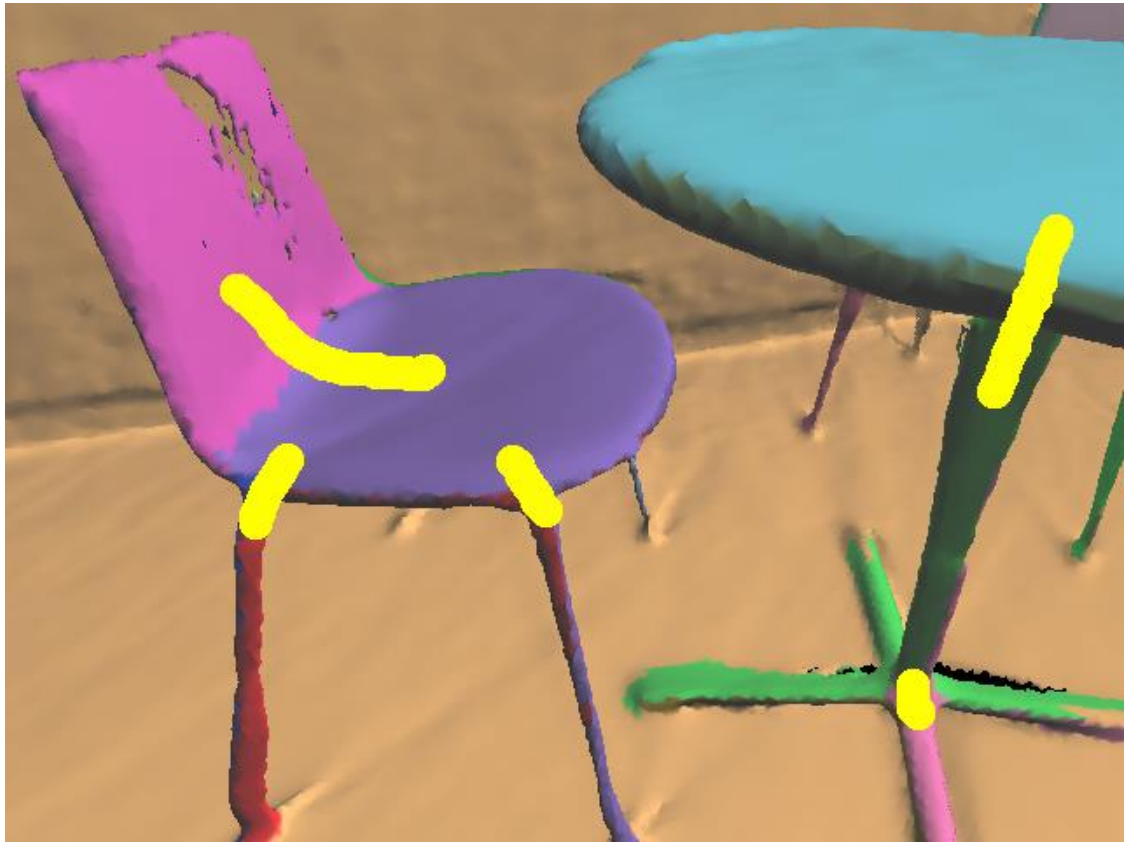
Over-segmentation



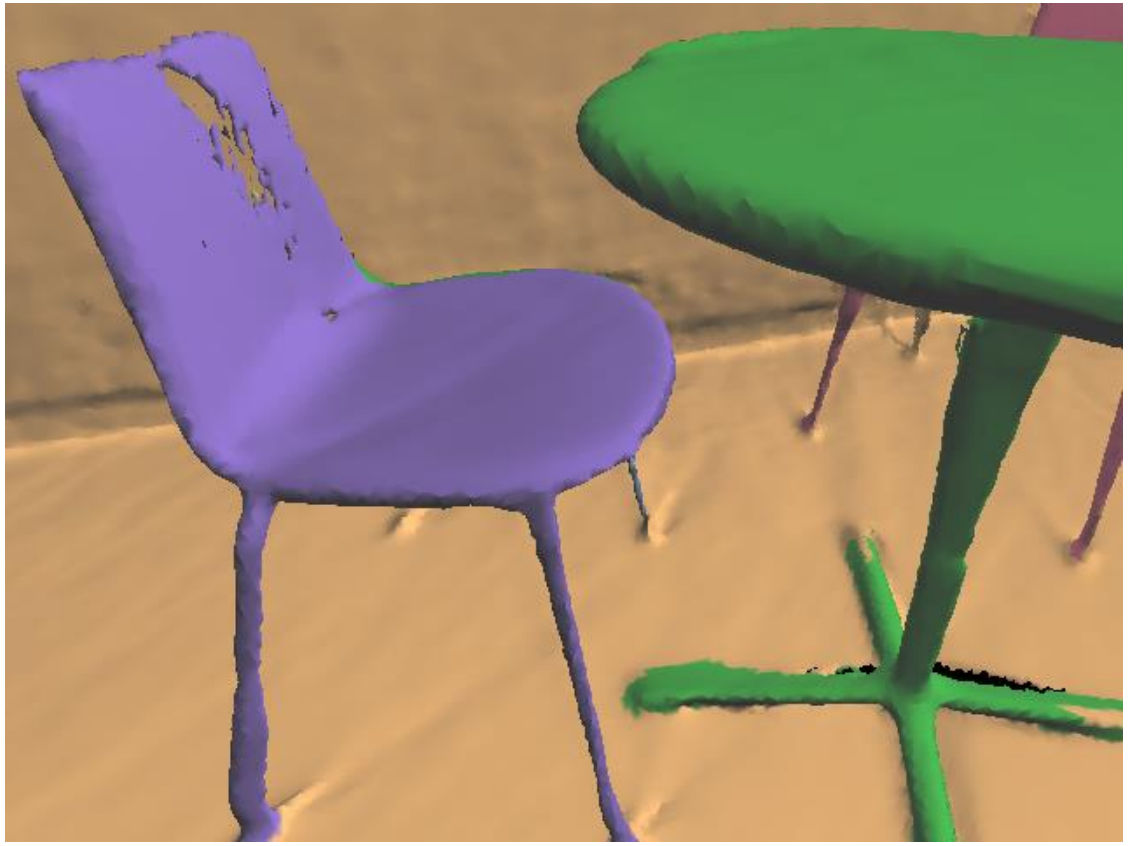
Under-segmentation

User interaction

Merge

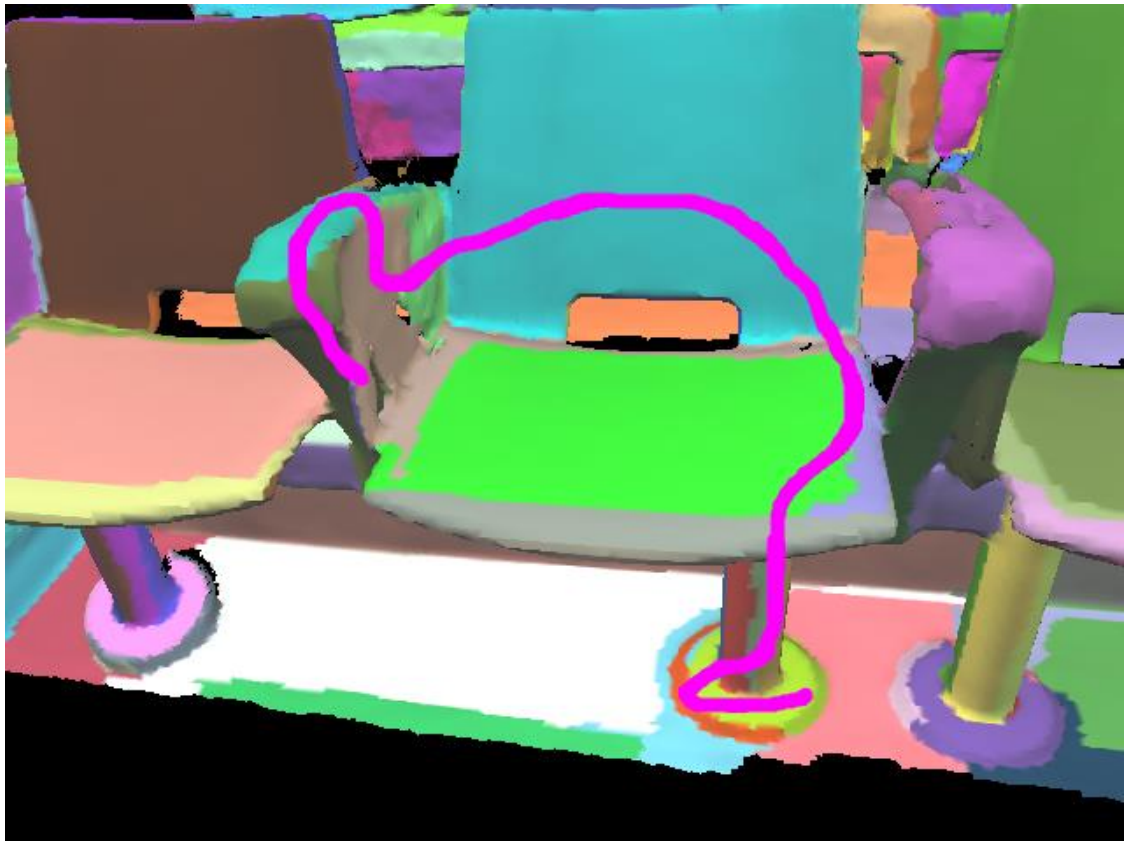


Before



After

Extract



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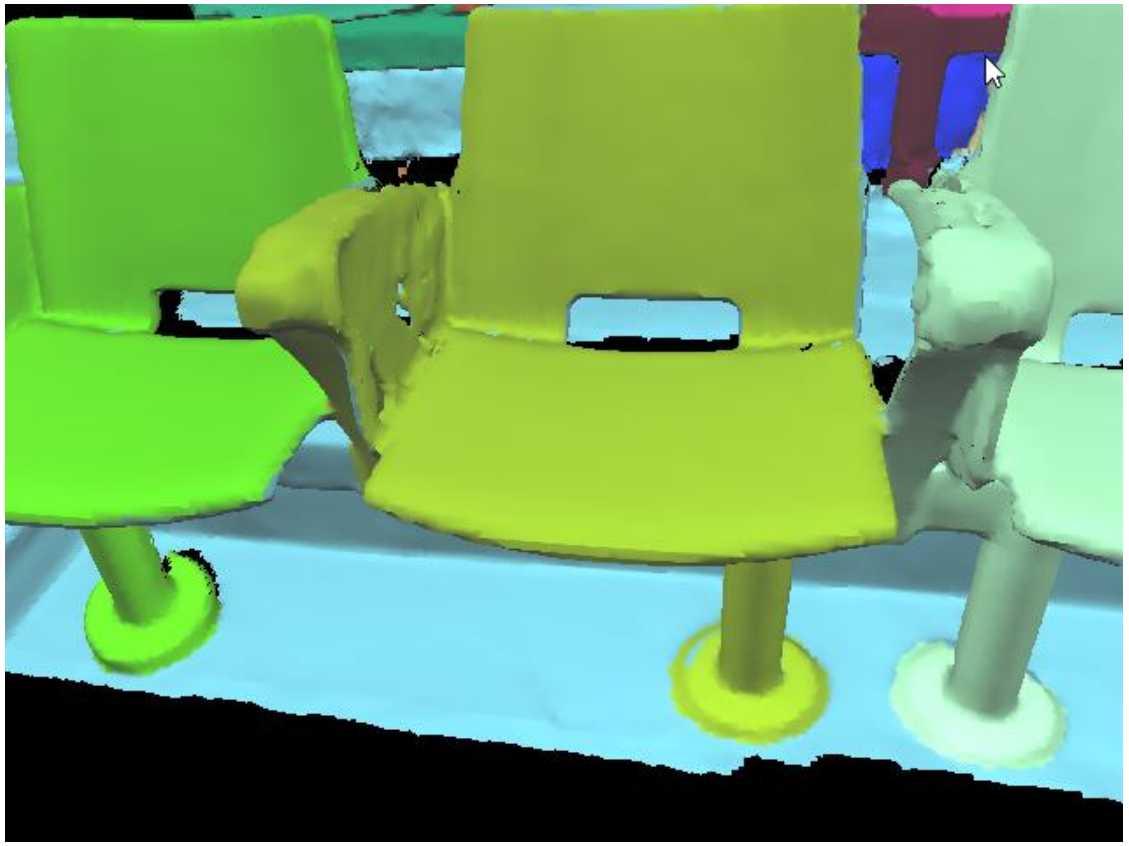
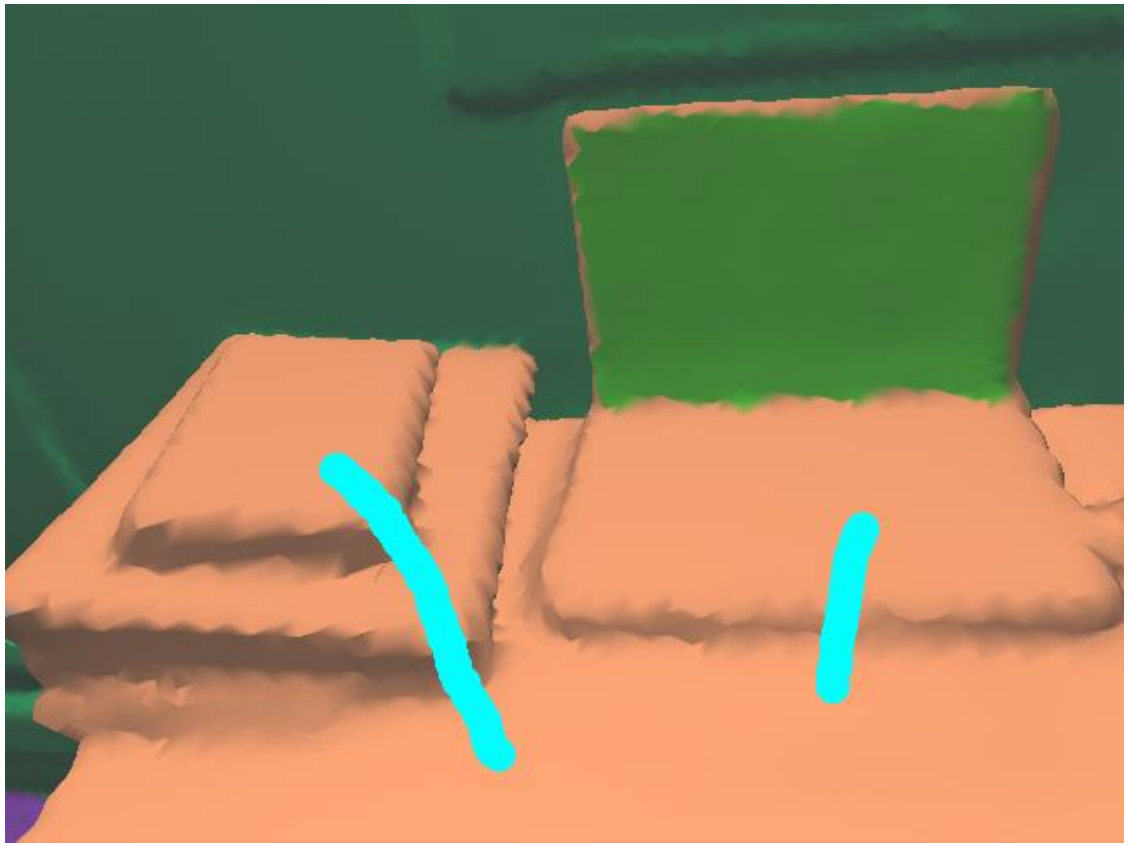
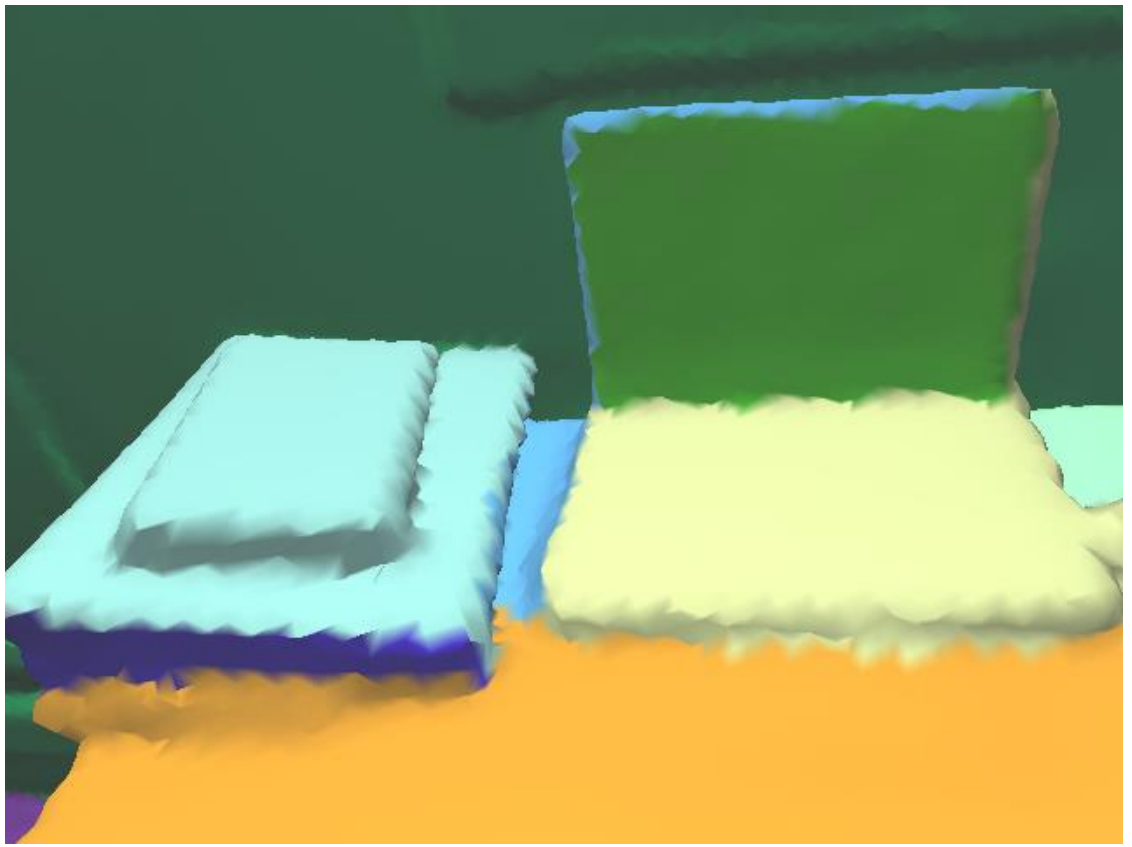


After

Split



Before

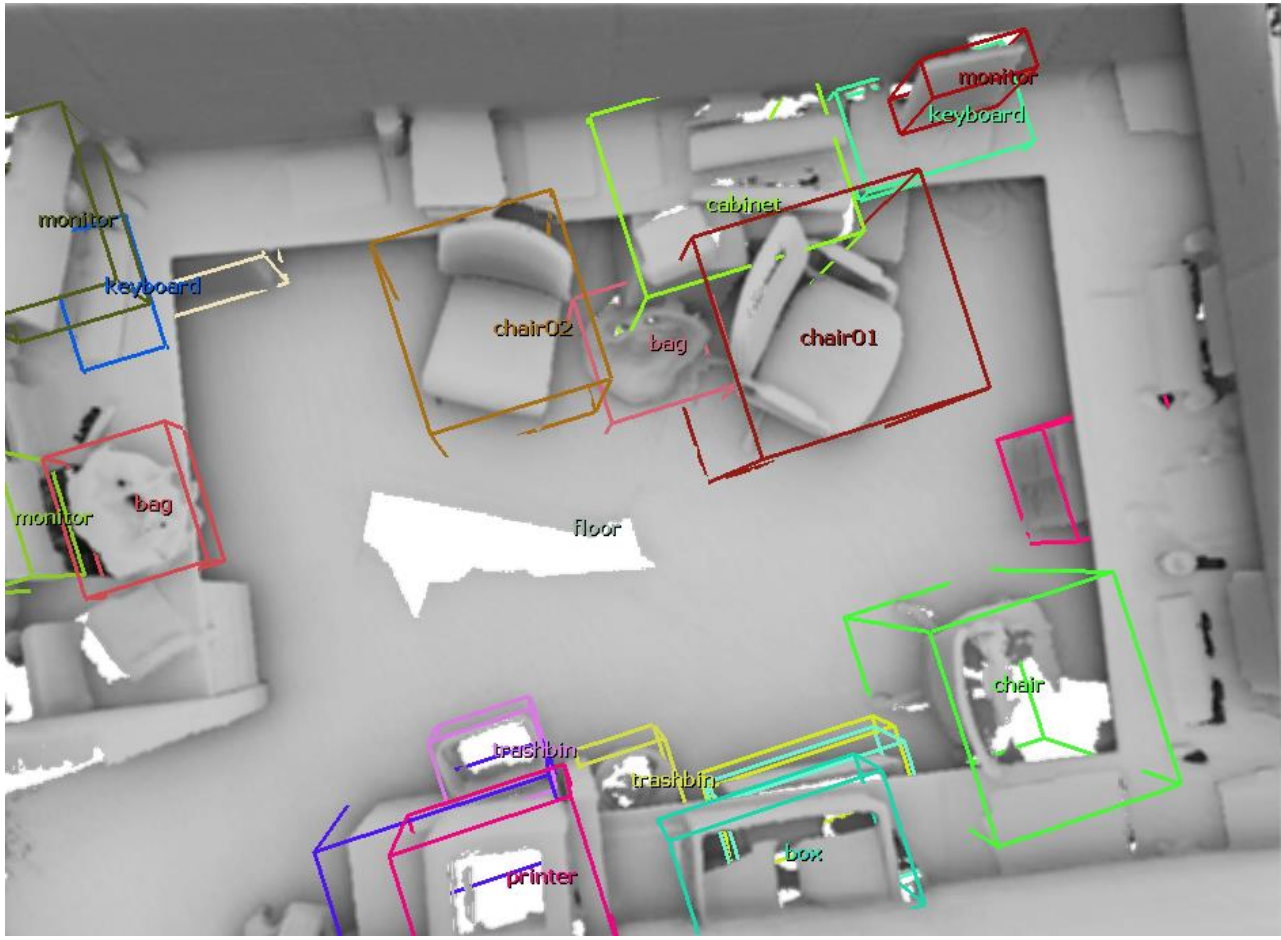


After

Example

Final results

Refined segmentation

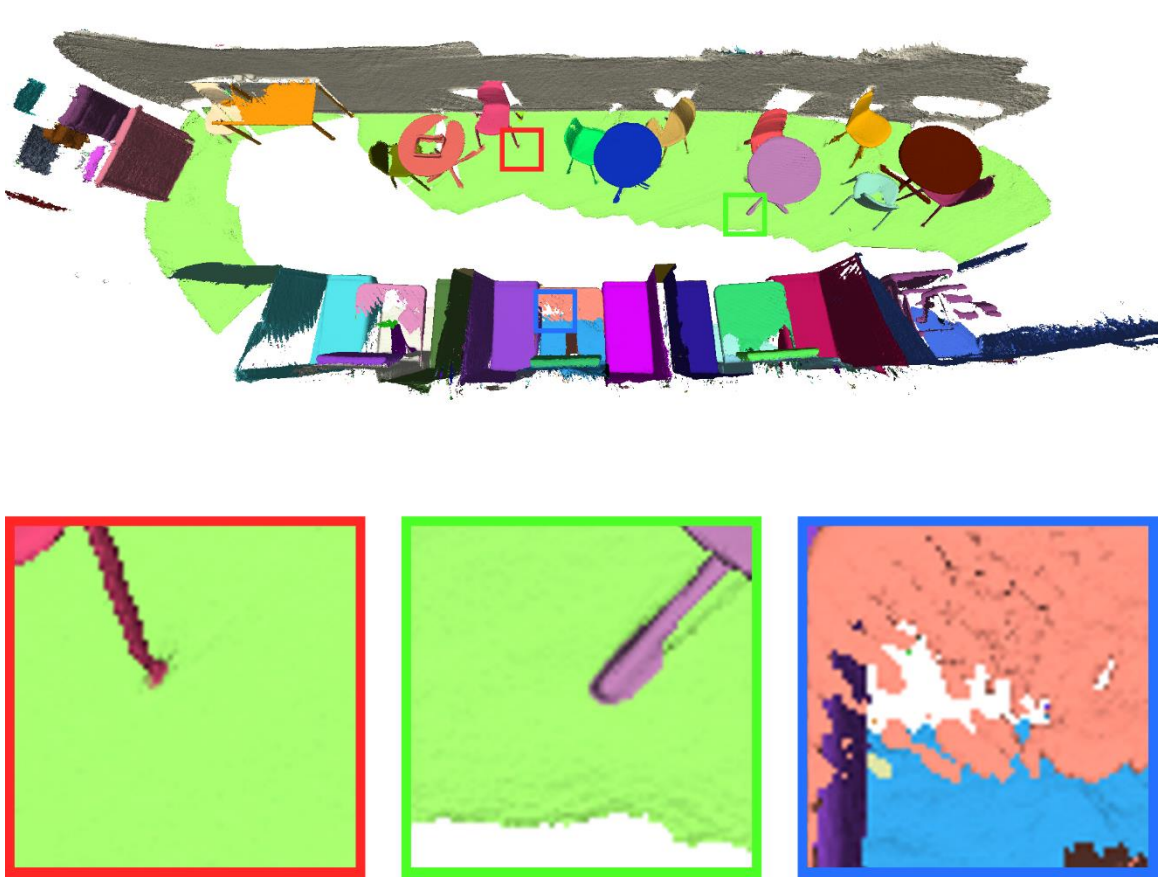


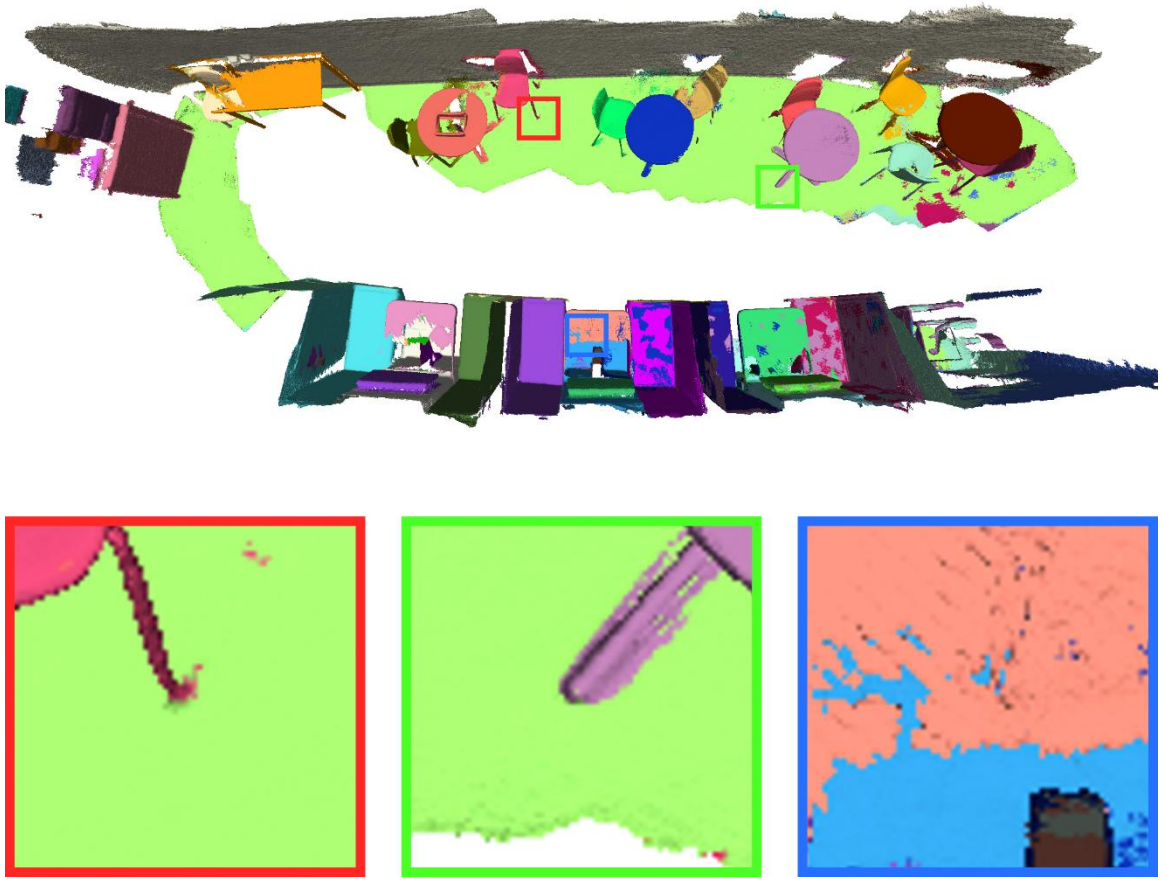
Annotation and bounding boxes

Proof-of-concept applications

- Annotation transfer
- Shape completion
- Scene relighting
- CAD scene synthesis
- Novel view synthesis

Annotation transfer

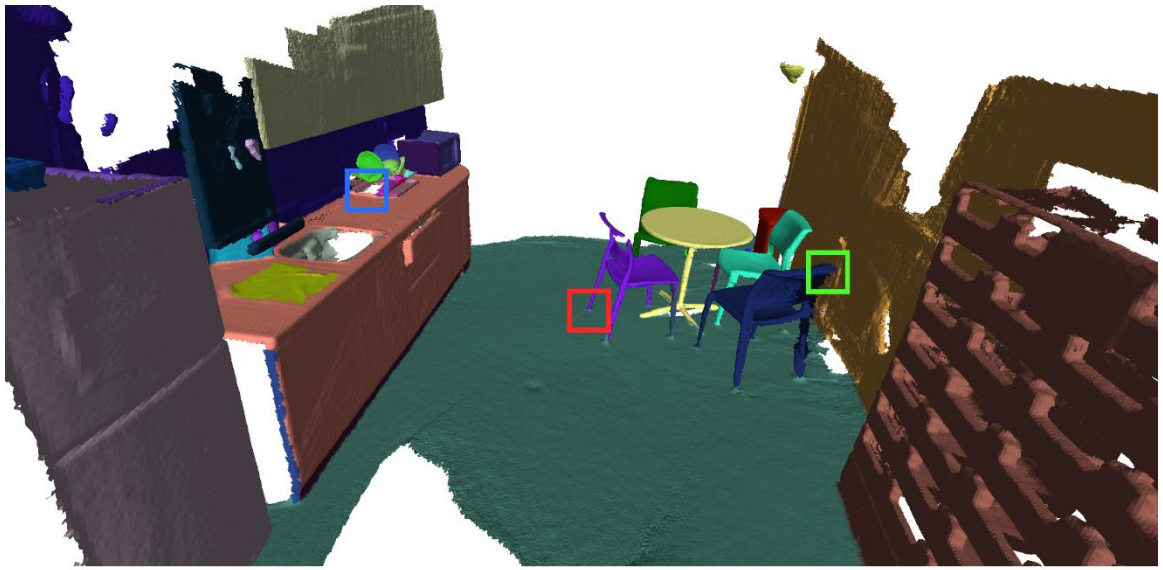


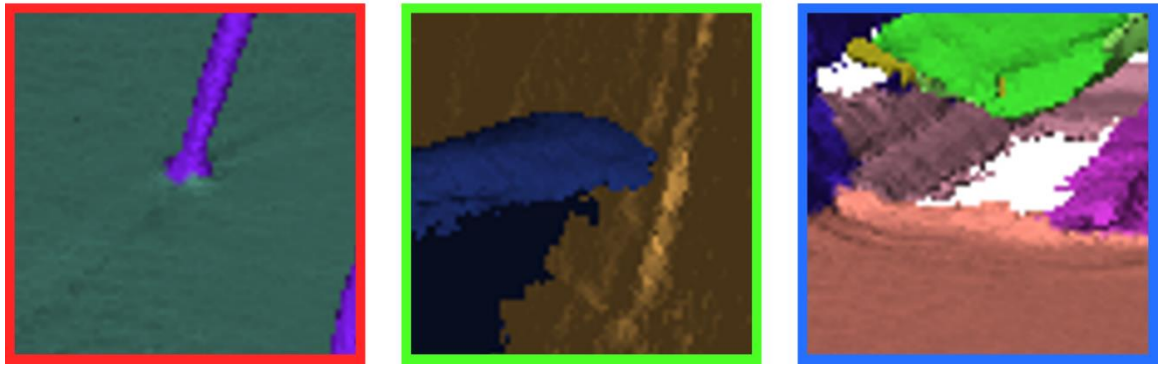


Input

Nearest neighbour label propagated

Annotation transfer





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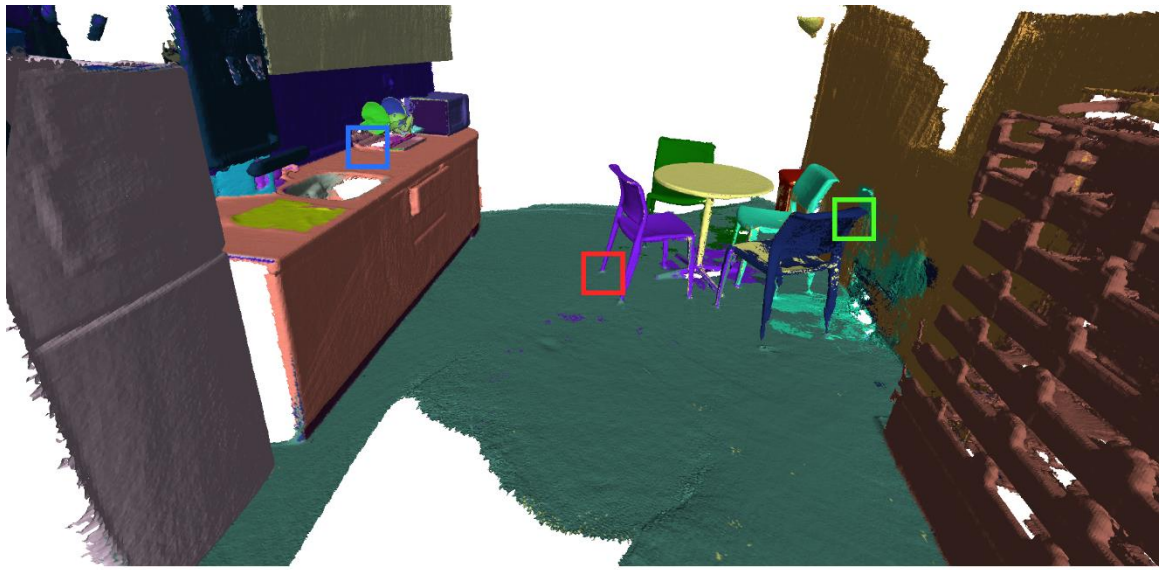
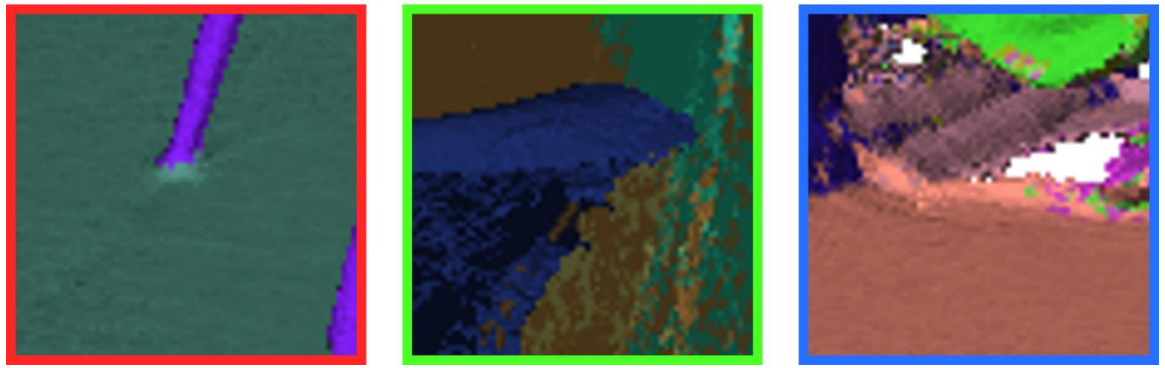
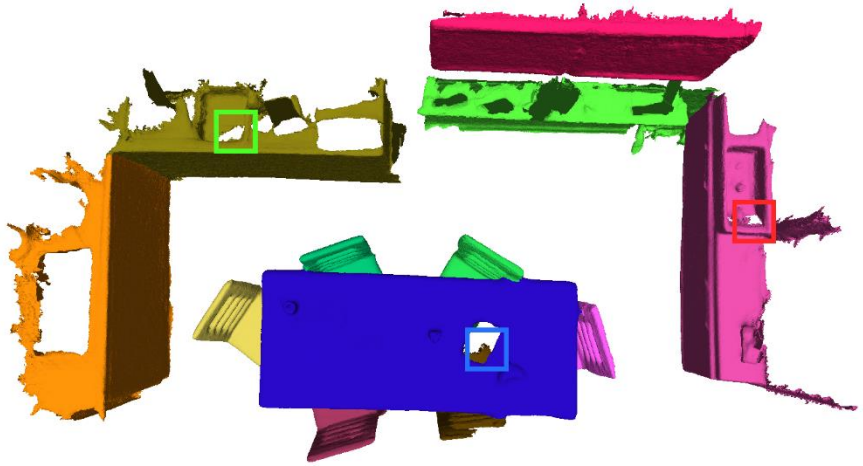
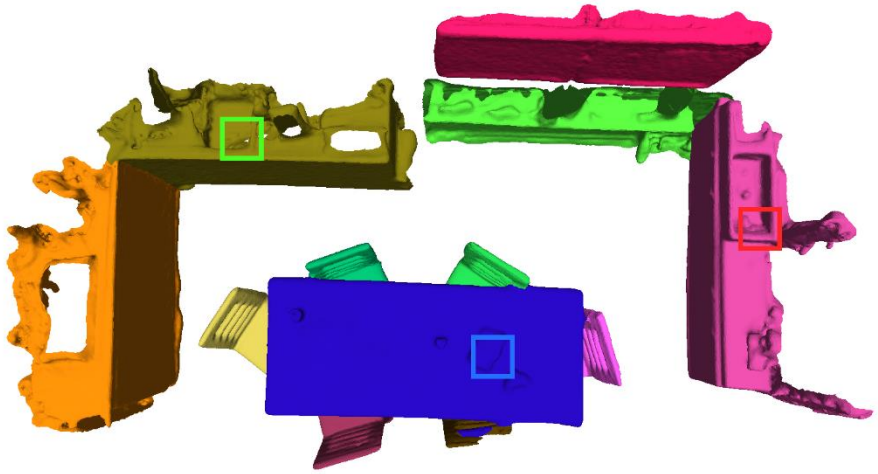




Nearest neighbour label propagated

Geometry-level shape completion

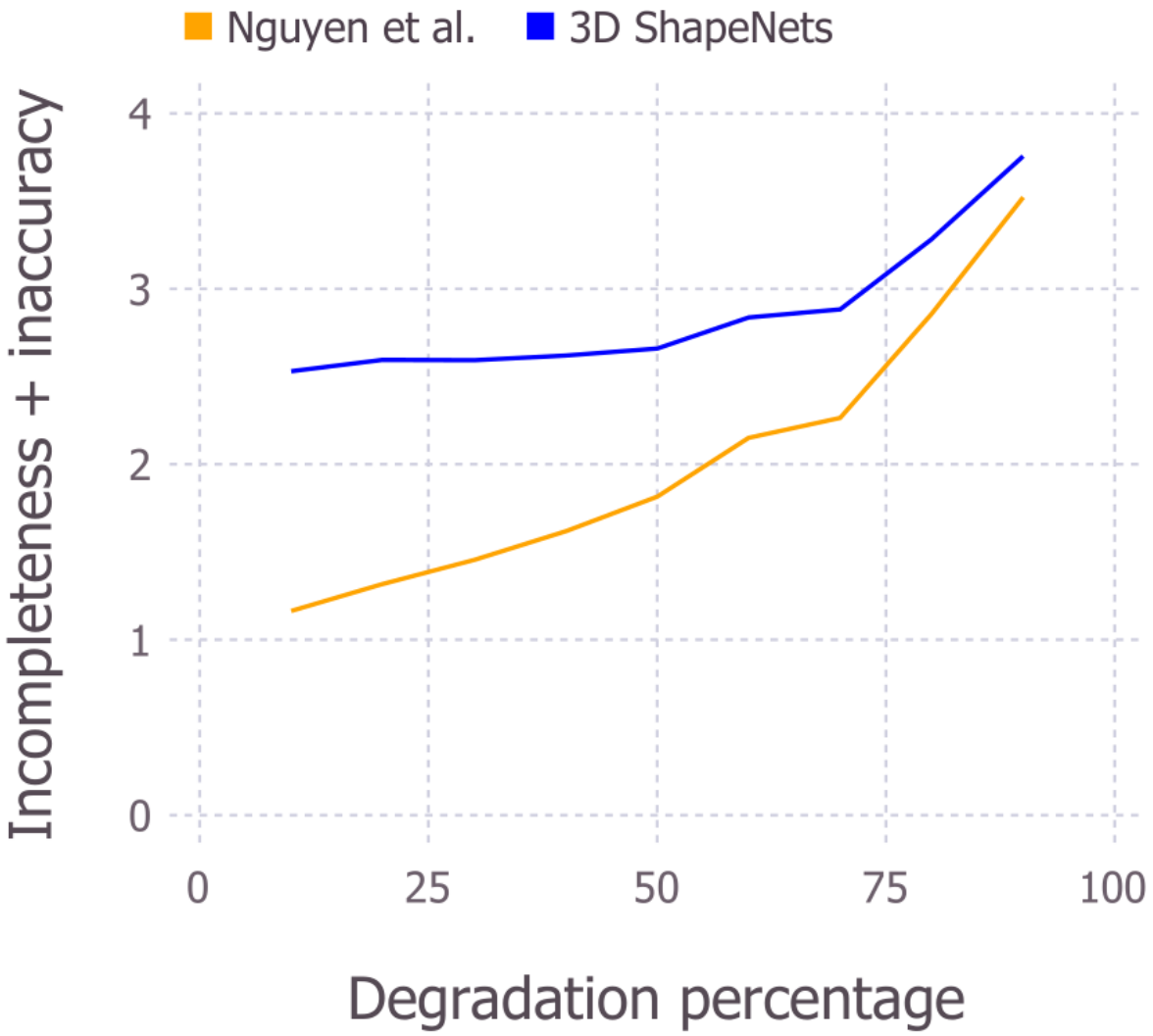


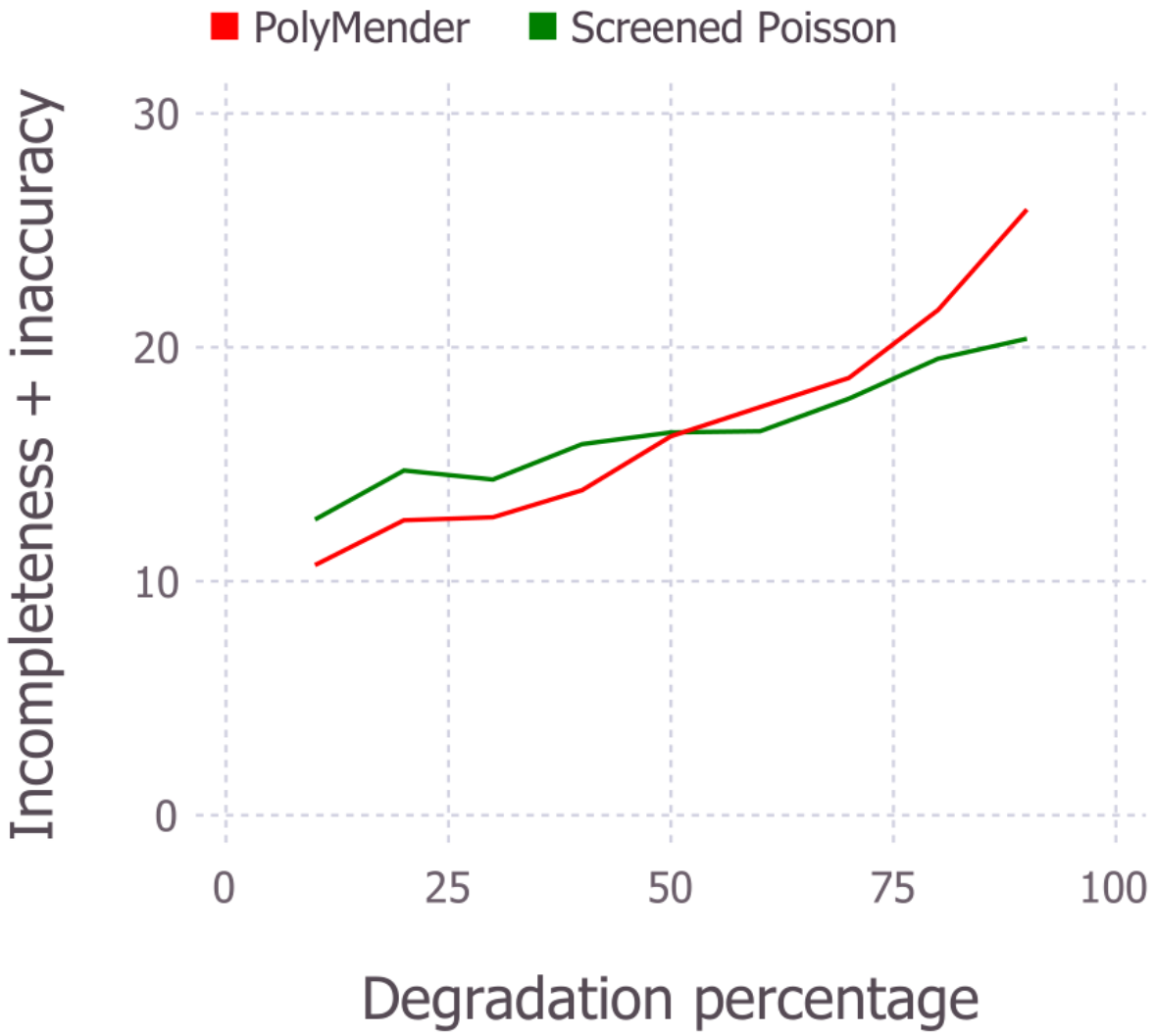


Input

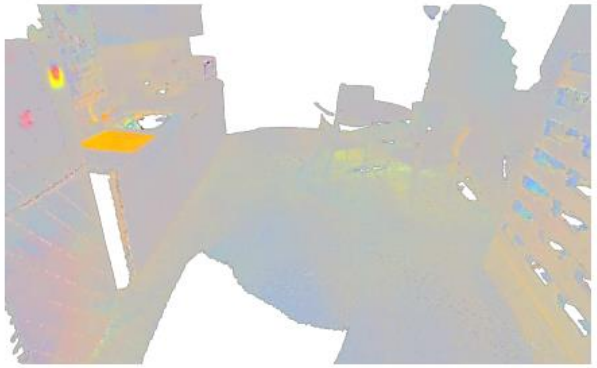
Screened Poisson reconstruction
[Kazhdan and Hoppe, SGP 2013]

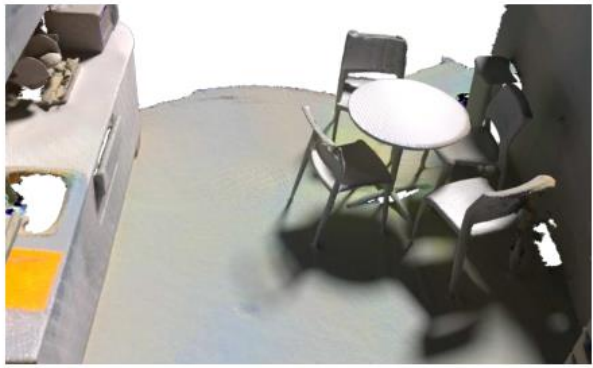
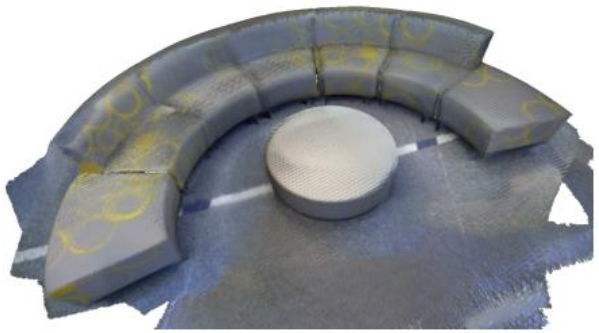
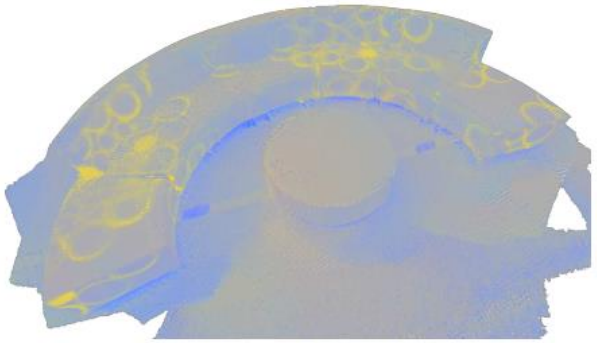
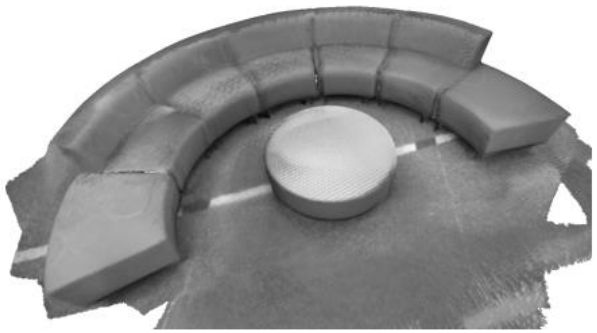
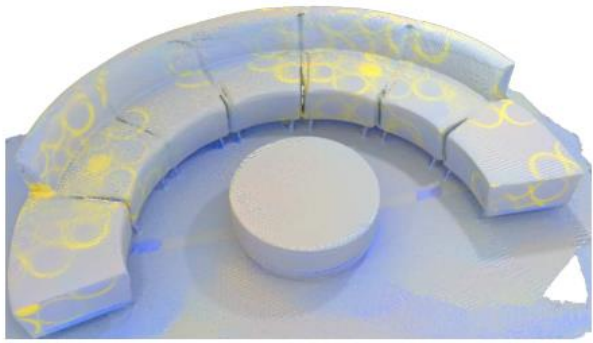
Semantic-level object completion





Scene relighting



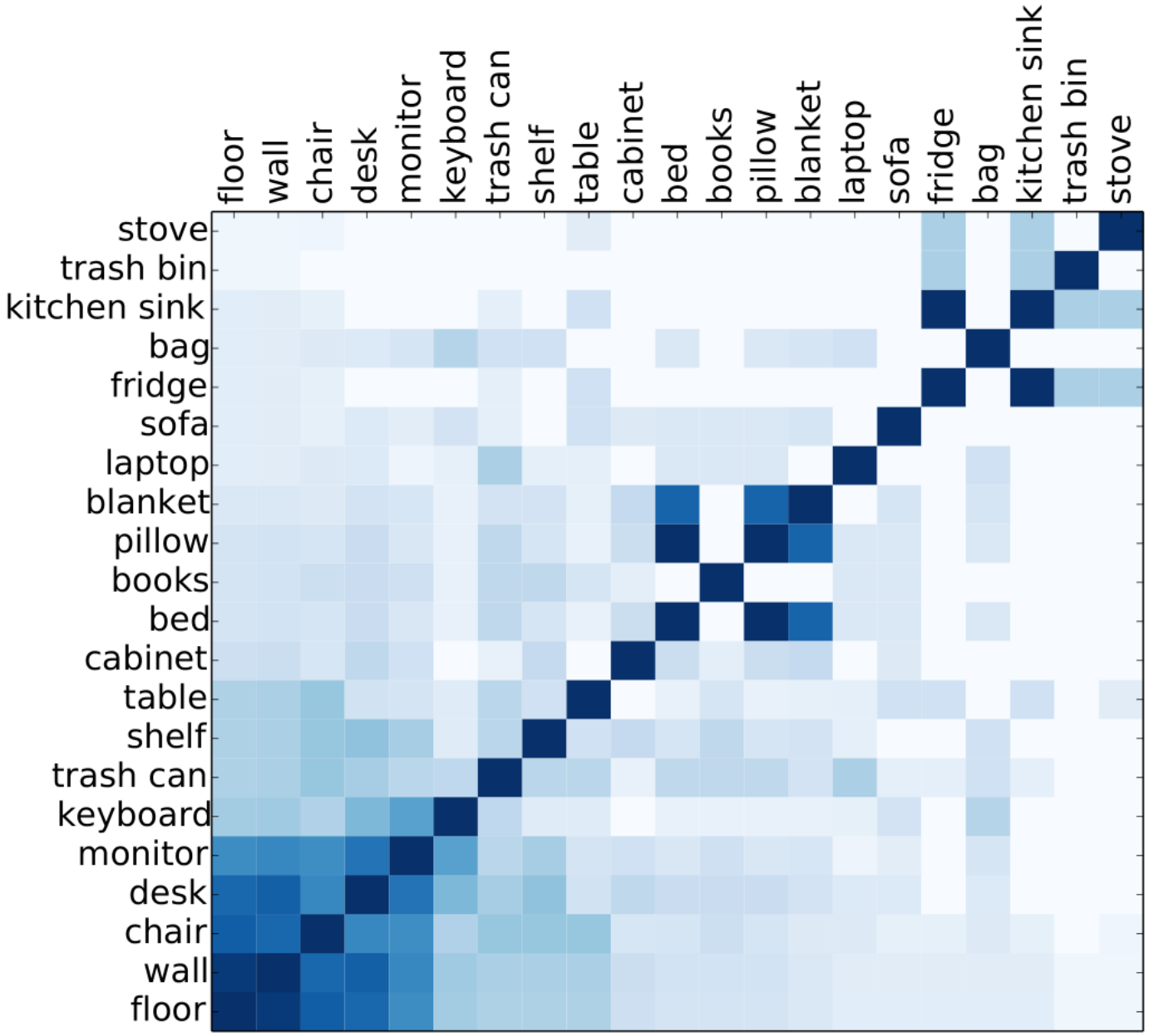
Input Reflectance Shading Relighting

Scene synthesis

desk

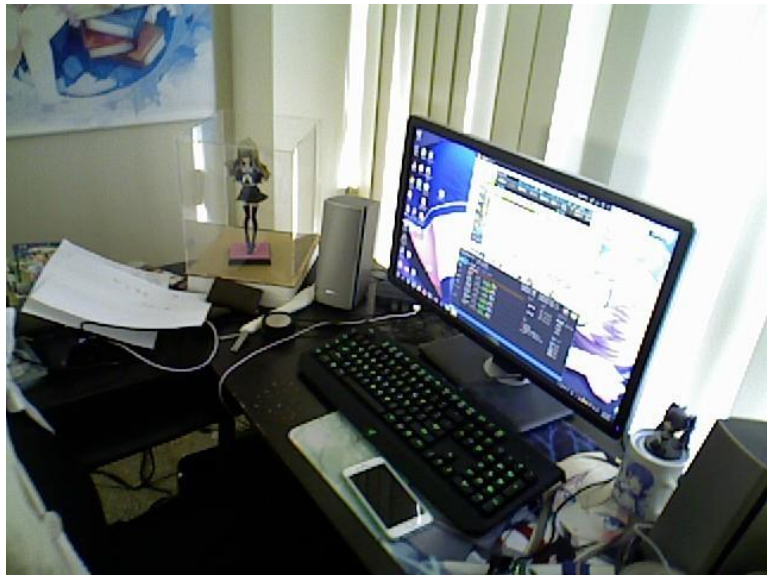
chair

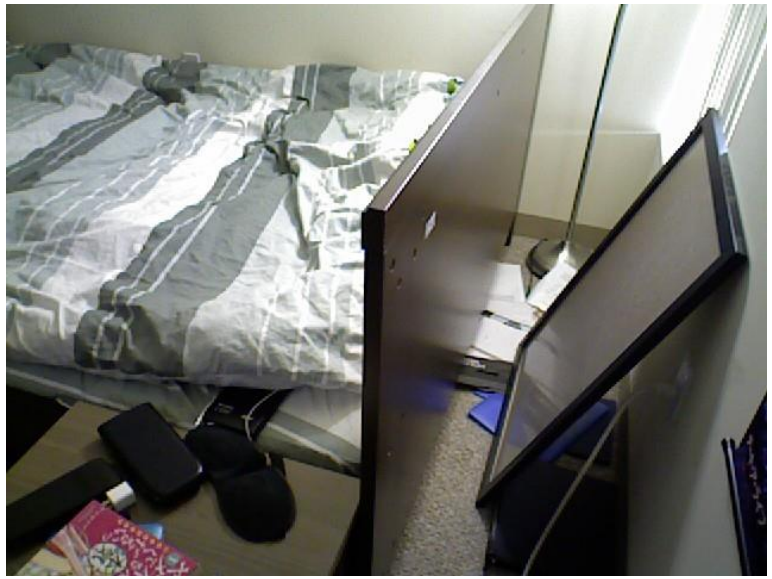
Placement probabilities
[Chen et al., MM 2015]



Co-occurrence
[Xu et al., TOG 2013]

Novel view: widening FOV

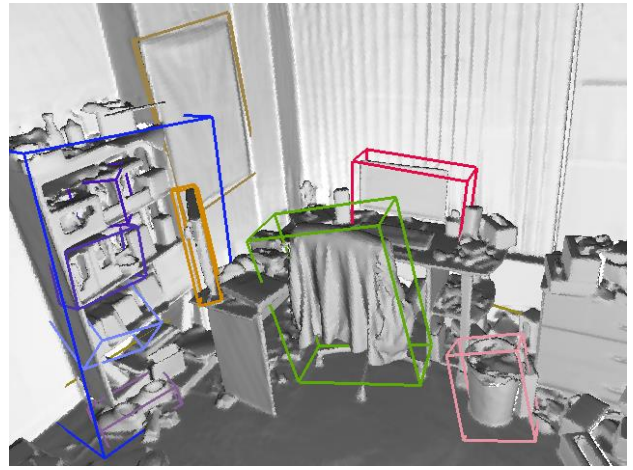




Novel view: widening FOV / near plane clipping

Conclusions

- **100+** RGBD scenes with fine-grained annotation.
- Potential applications
  - Annotation transfer
  - Shape completion
  - Scene relighting
  - Scene analysis and synthesis
  - Novel view synthesis
- Future works
  - Online platform for benchmarking, e.g., object detection and recognition.
  - Extend and maintain the dataset with help from community.



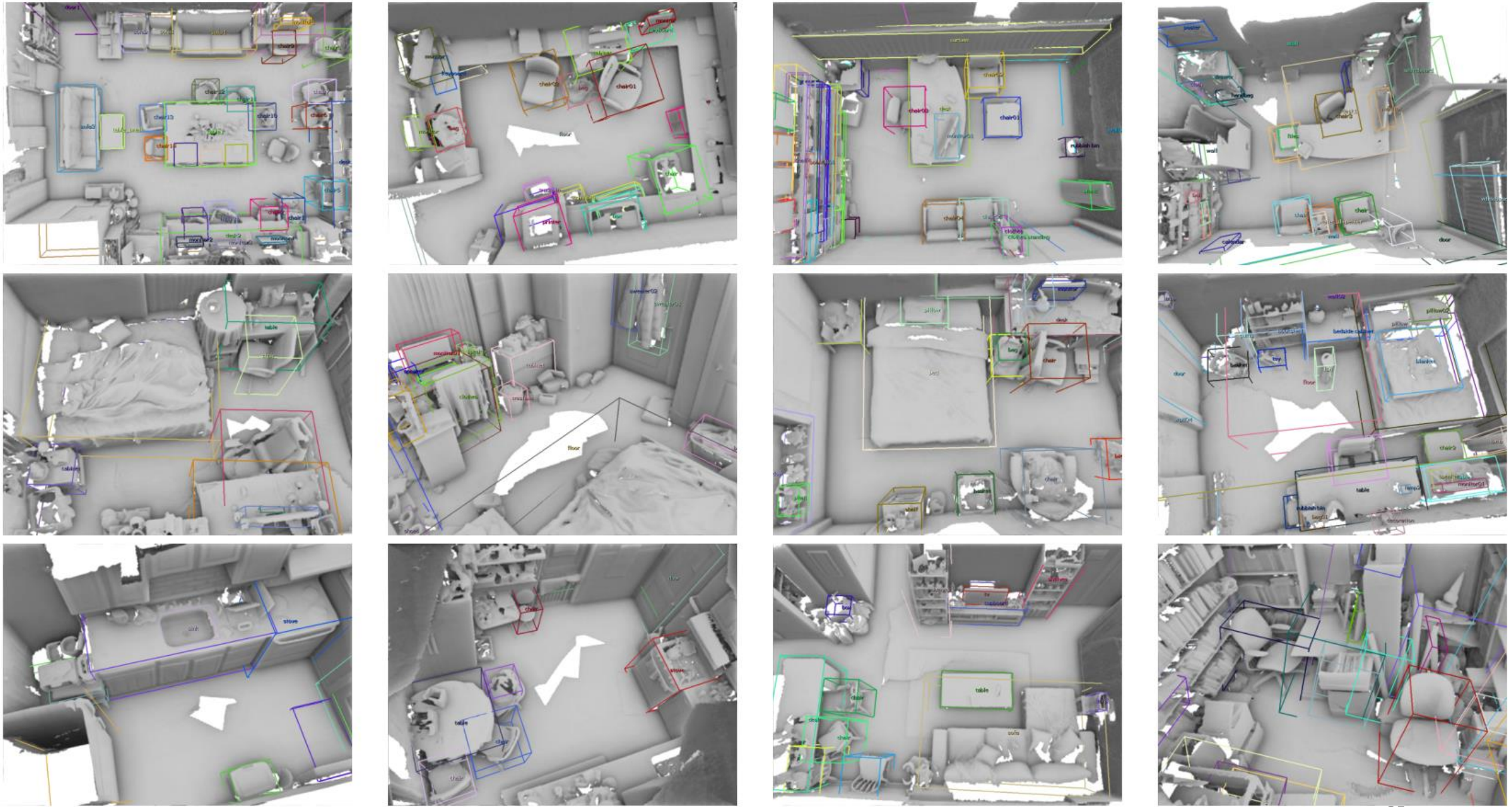
Challenges

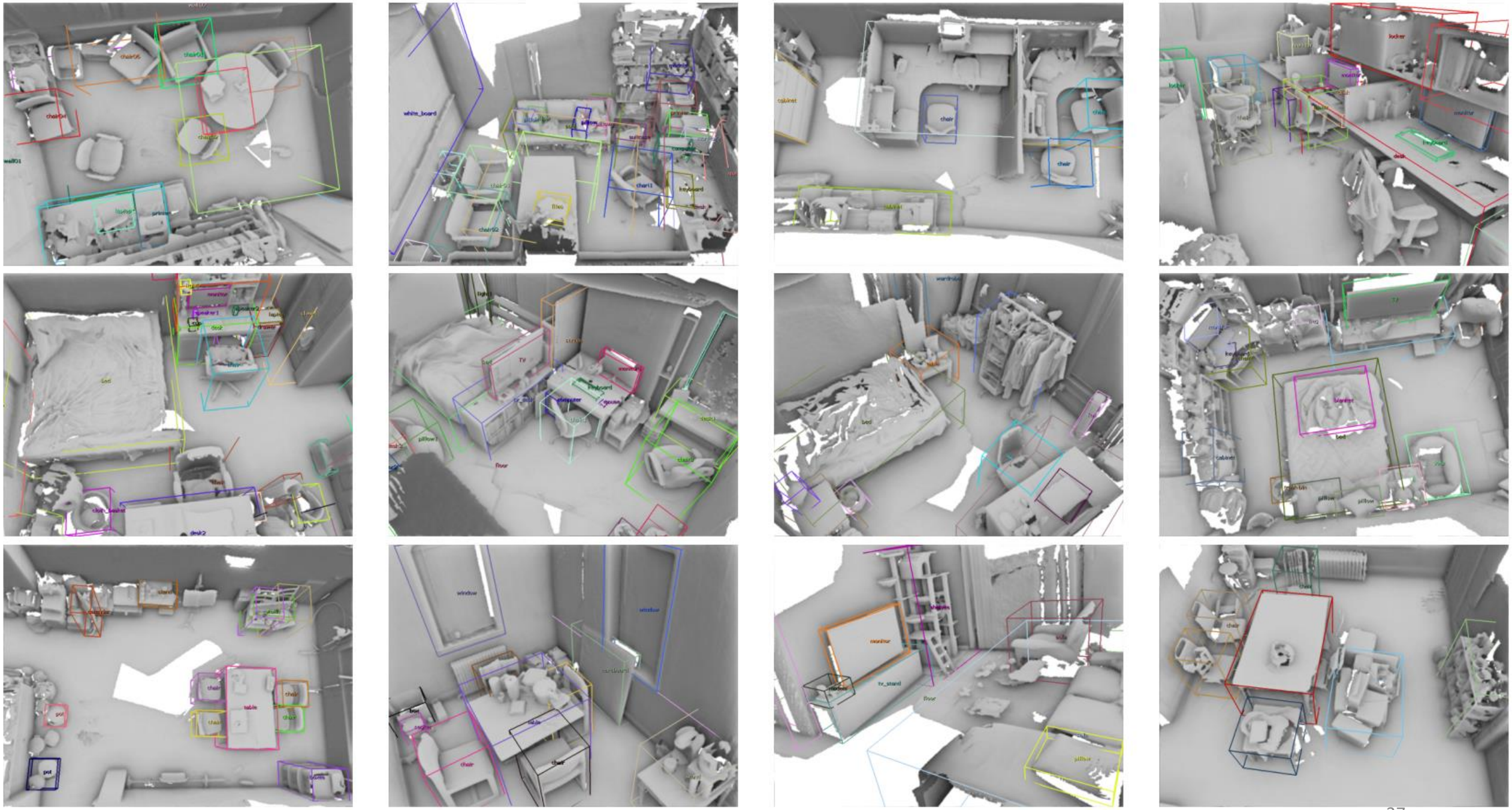
- Current reconstruction takes 1 – 2 hours to complete.
- Current annotation technique requires 30 – 45 minutes per scene for refining segmentation and annotation.
- Texture is generated using a baseline method.
- Resolution 640 x 480 is limited but no better consumer-grade RGBD camera is available.

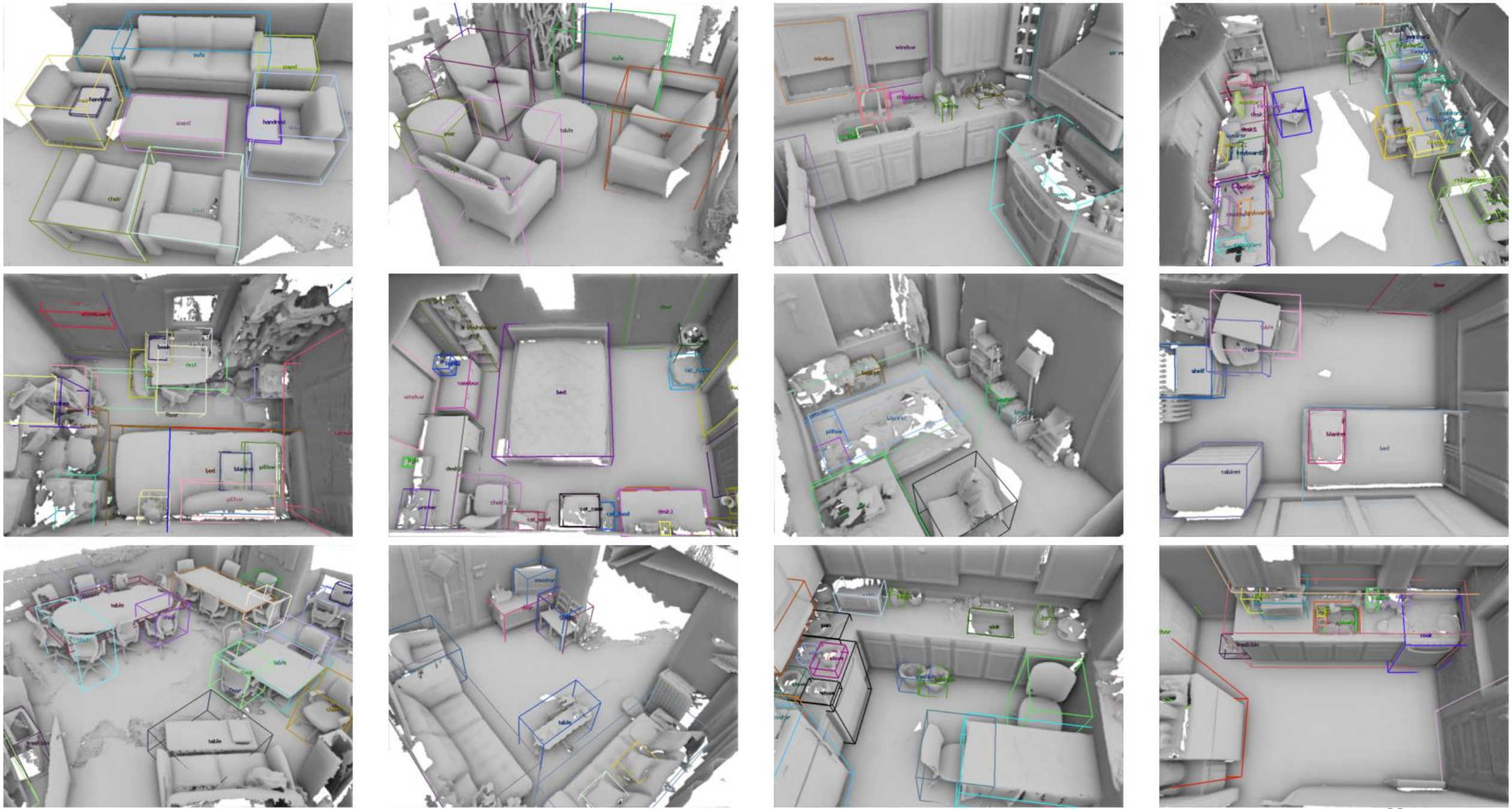
Before we end…

More segmentation and annotation from some popular categories:

- Workplace
- Bedroom
- Livingroom
- Kitchen
- Lounge







Acknowledgement

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- The anonymous reviewers for their constructive comments.
- Jamie Shotton (Microsoft Research) for the Kitchen scene data.
- NVIDIA for graphics card donation.
- Singapore National Research Foundation (NRF) and the U.S. National Science Foundation (NSF) for funding support.

The team

Thank you!

http://www.scenenn.net

- Dataset download script (Python)
- Annotation tool (Windows and Linux)
  Code available upon request.
- Supplemental and technical reports
- Contact: scenenn@gmail.com