

Research toward interactive digital twins

이가혜 (Gahye Lee)

PhD student at POSTECH

Computer Graphics Laboratory

Advisor: Prof. Seungyong Lee

Research interests

3D reconstruction, scene representations, physical AI

Email: gahye0509@postech.ac.kr

Website: <https://waldstein94.github.io/>

Updated: October 19, 2026

My research interest: interactive digital twins

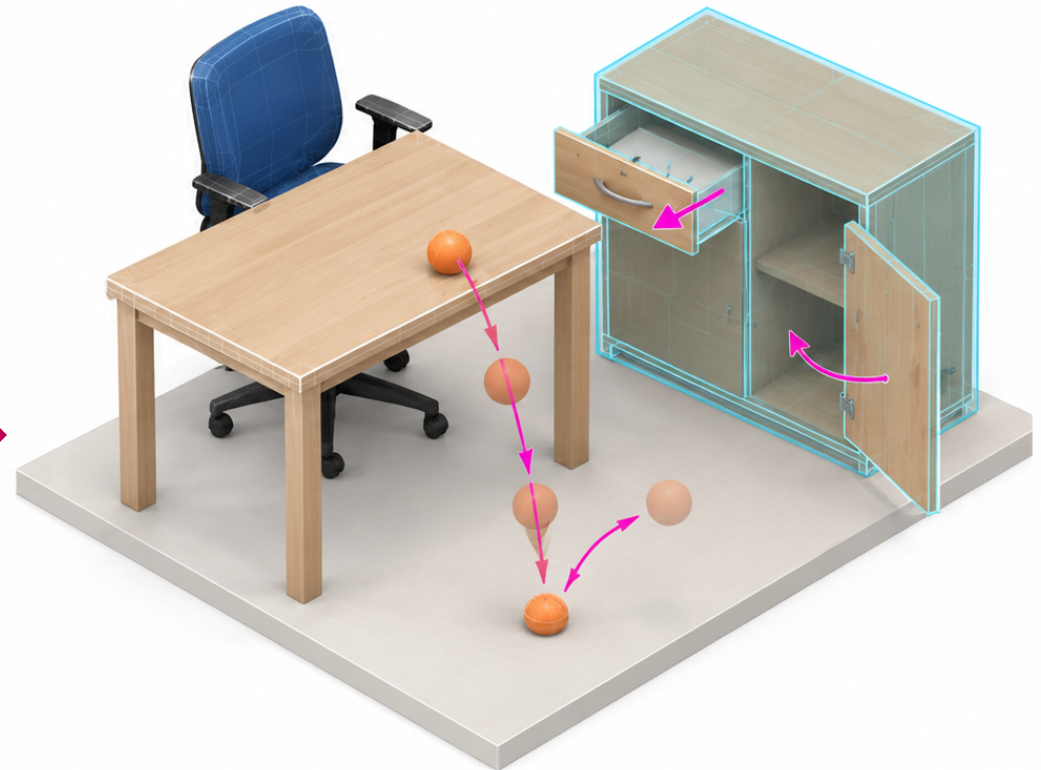
Everyday captures



RGB observations

Interactive digital twins

Recover
→

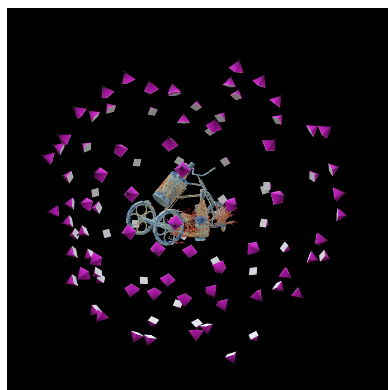


Select, edit and simulate

How can we reconstruct interactive digital twins?

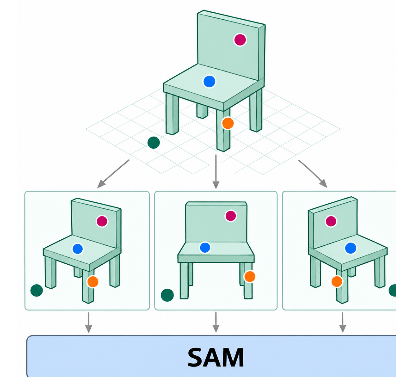
Where should we capture images?

"Camera Splatting", CGF 26'



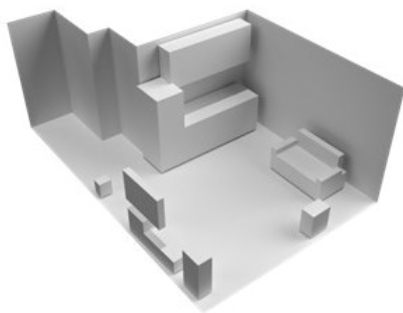
How do we segment the target object?

"3D Prompt Optimization", Ongoing work



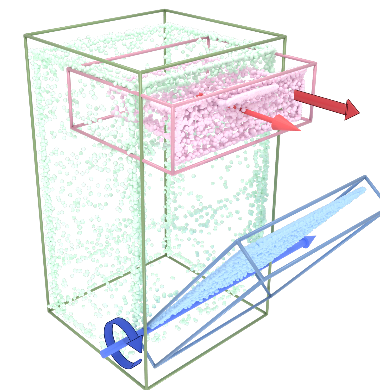
How can we make scene geometry controllable?

"Deep Polycuboid Fitting", 3DV 25'



How can we reconstruct interactable objects?

"StructureGS", ECCV 26'

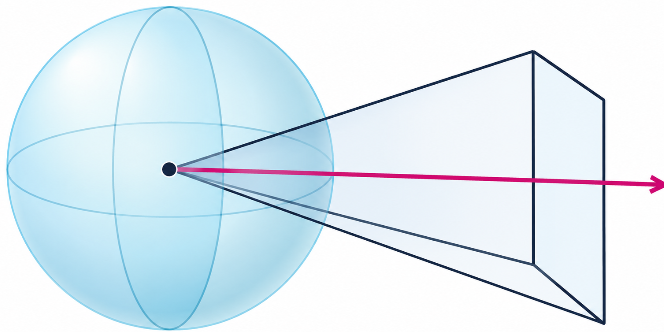


Where should we capture images?

Render cameras as specialized 3D Gaussians to evaluate and optimize their distribution

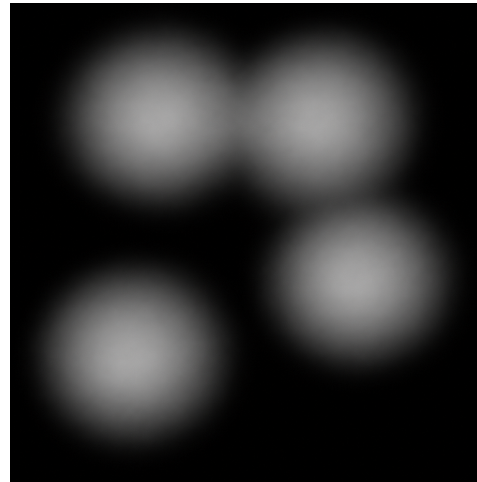
Camera distribution optimization

Camera representation

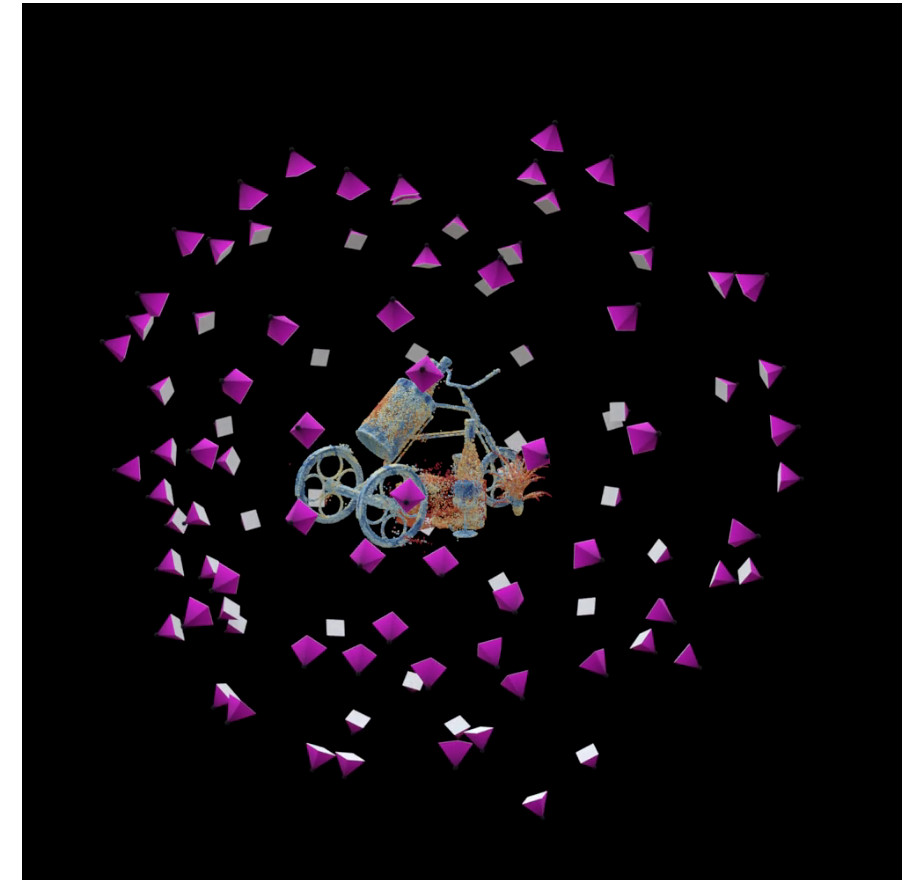


Specialized 3D Gaussian

Rendered sampling density



Differentiable evaluation

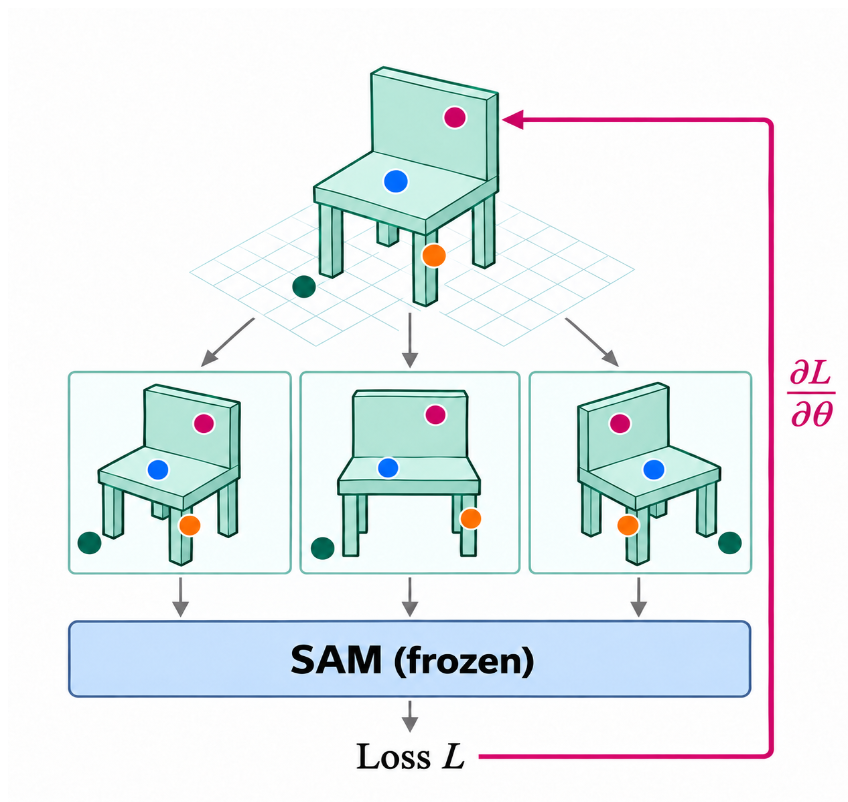


"Camera Splatting for Continuous View Optimization", G. Lee et al., Computer Graphics Forum 2026

How do we segment the target object?

Training-free: optimize shared 3D prompts across views with frozen SAM

Shared 3D prompts θ



Prompt and mask optimization



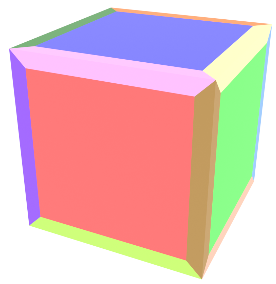
"Differentiable 3D Prompt Optimization for Zero-shot Multi-view Segmentation", Ongoing work

How can we make scene geometry controllable?

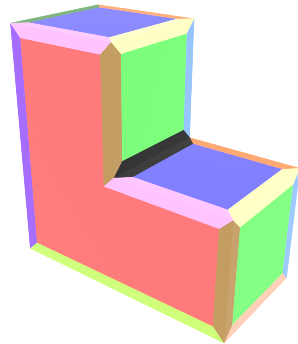
Predict face labels and relations, then reassemble polycuboids

Face labels and relations

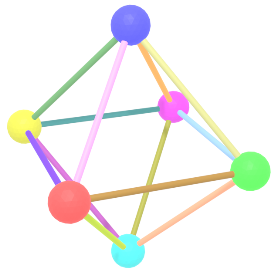
Polycuboid reconstruction



Cuboid



Polycuboid



6 face labels: $\pm x, \pm y, \pm z$

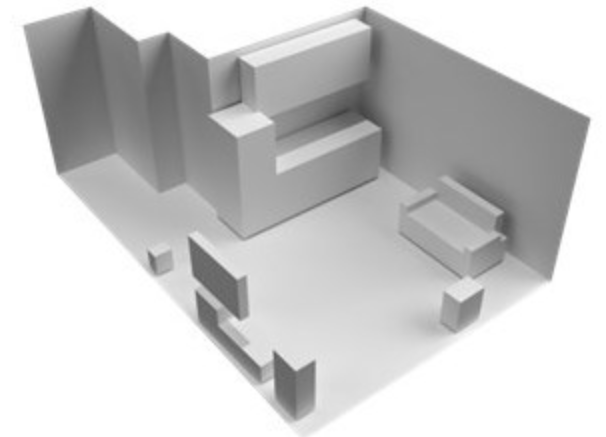
12 convex relations

+ concave / disconnected

Nodes are faces



Scanned point cloud

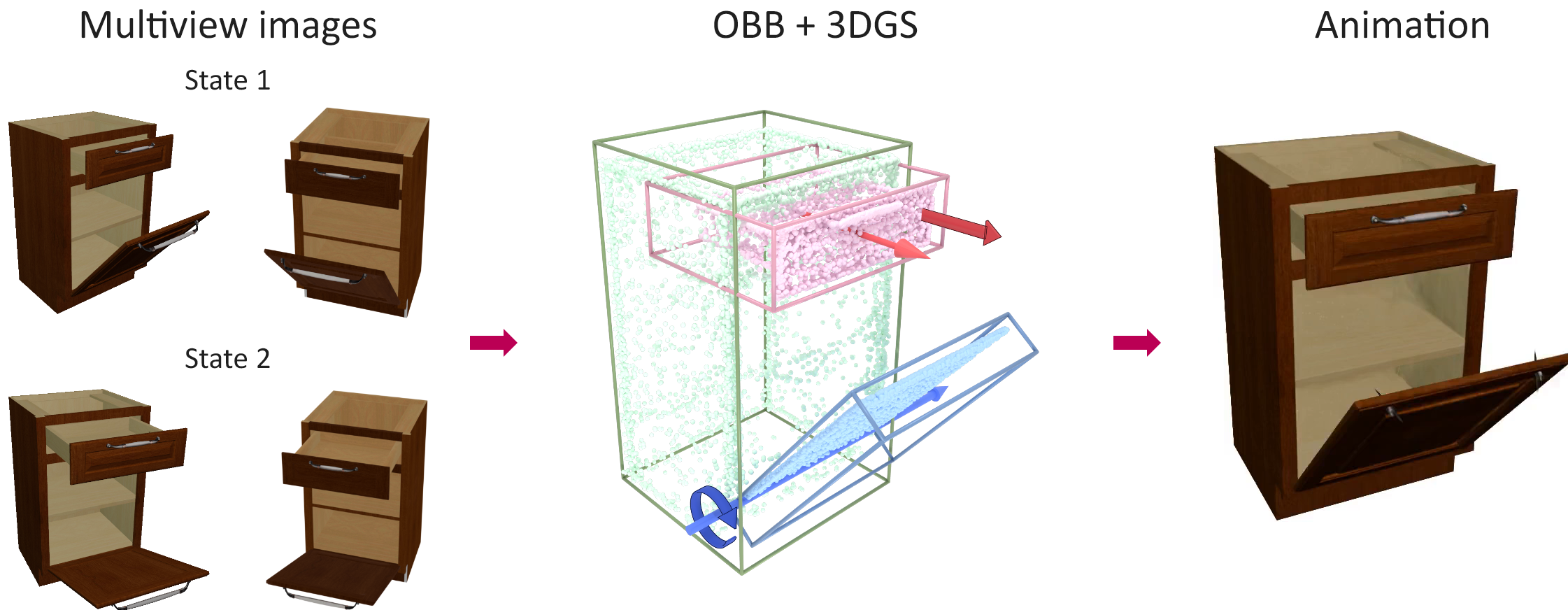


Reconstructed polycuboids

"Deep Polycuboid Fitting for Compact 3D Representation of Indoor Scenes", G. Lee et al., 3DV 2025

How can we reconstruct interactable objects?

Represent structure with OBBs and optimize it jointly with 3D Gaussians

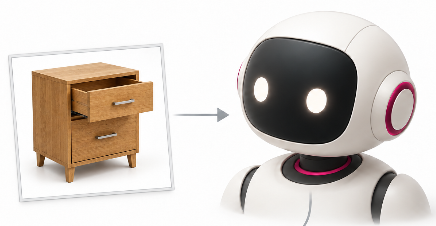


"StructureGS: Structure-aware Gaussian Splatting for Articulated Object Reconstruction", G. Lee et al., ECCV 2026

Recent thoughts: LLMs in the optimization loop

LLMs / VLMs

Semantic reasoning



Which parts?

How are they connected?

*Propose and revise
structural hypotheses*

Representation

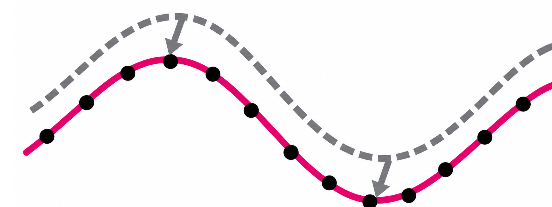
How can the two communicate effectively?



*Geometry, appearance, structure
Motion, physical properties, ...*

Optimization

Fitting to observations



● Observations

— Initial

— Optimized

*Fit parameters and
evaluate hypotheses*