



# GuideFlow3D: Optimization-Guided Rectified Flow For Appearance Transfer

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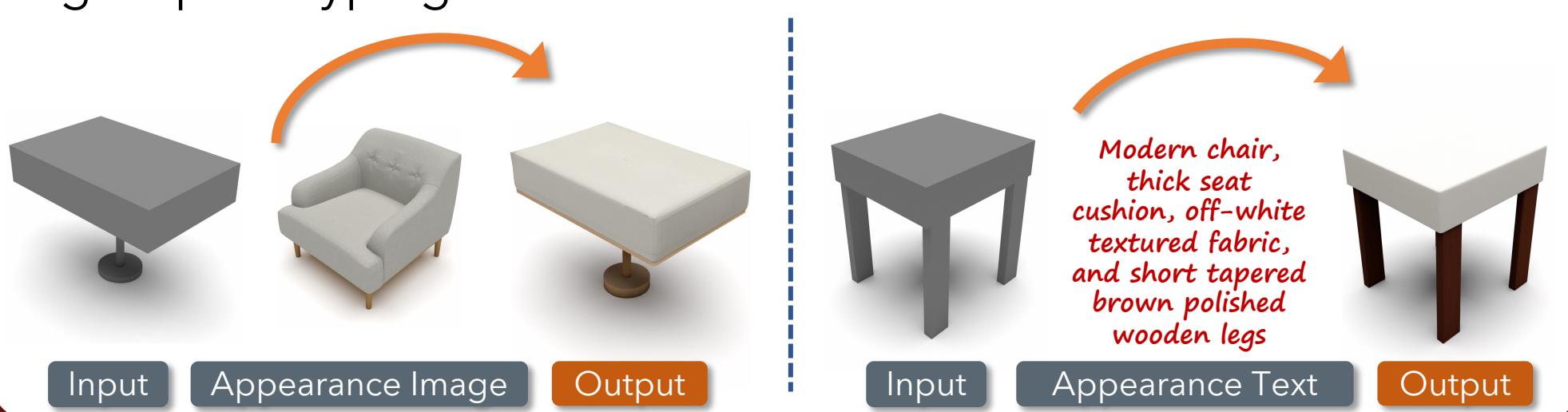


## Why 3D Appearance Transfer

**Input** Base 3D shape + appearance cue from image, mesh or text.

**Output** Geometry-preserving 3D model restyled with appearance.

**Goal** Accelerate stylized 3D asset creation for gaming, AR/VR and digital prototyping.



## Key Challenges

### Why is Appearance Transfer Really Hard?

— **Geometric irregularity** and absence of part-aware grounding disrupt texture alignment and structural consistency.



— **Large semantic gaps across categories** break matching correspondences causing style leakage and textures that fail to align with object geometry.

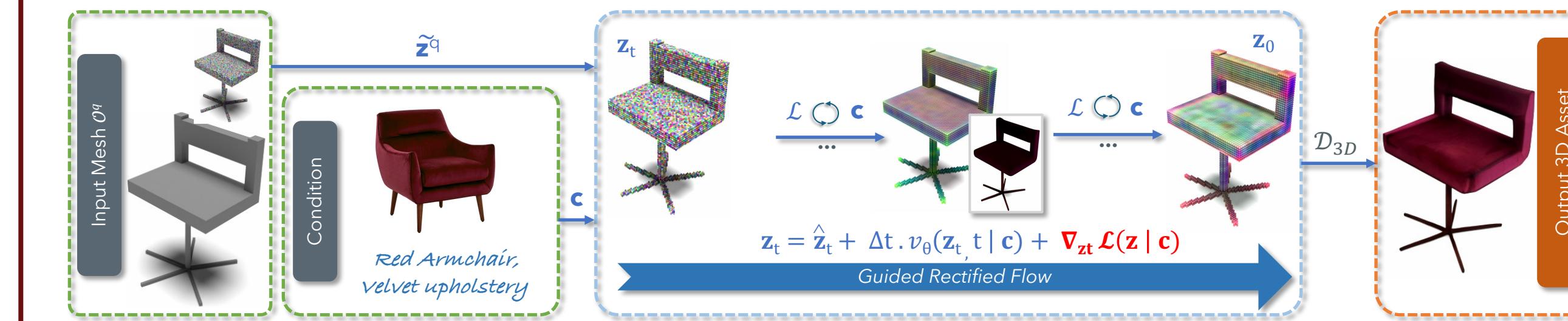


— 3D appearance transfer cannot be treated as a texture mapping or multi-view rendering problem.

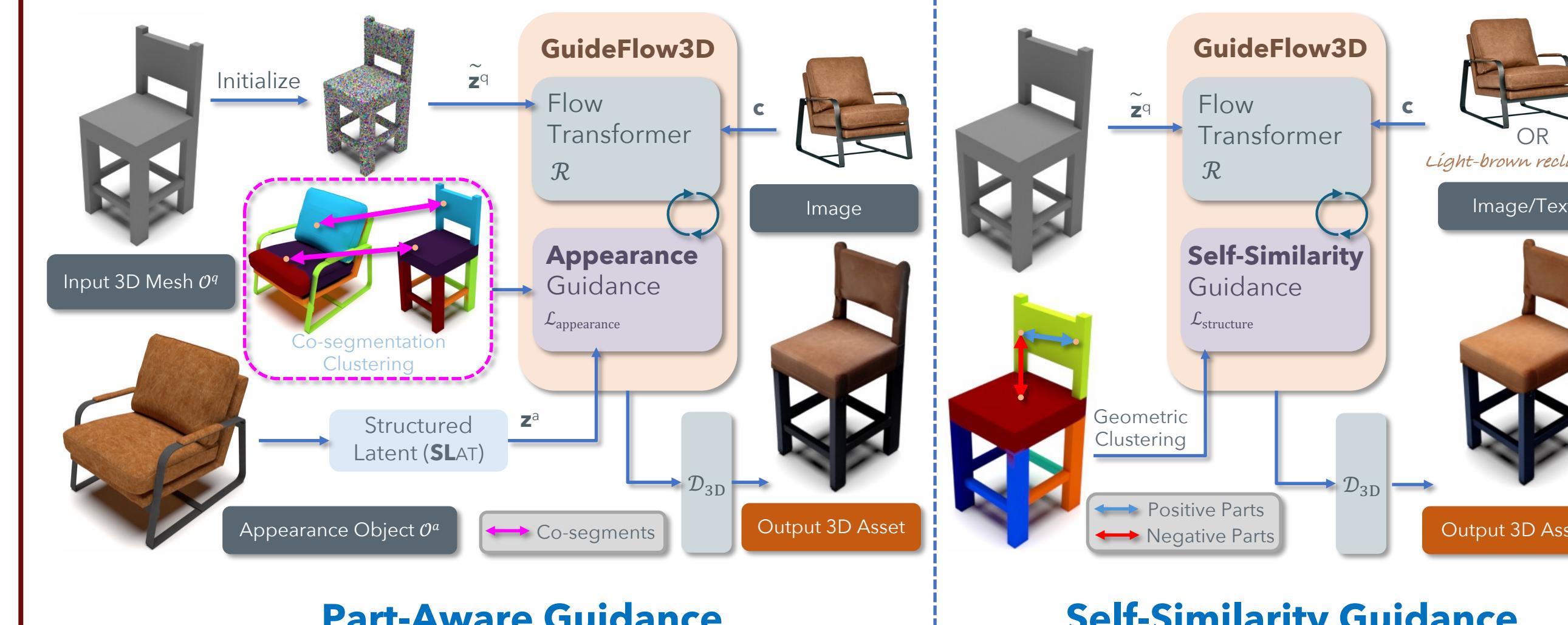
## Guided Flow For Appearance Transfer

### Our Approach

### Differentiable Guidance During Sampling



- Training-free framework, interleaving rectified flow sampling and semantic + geometric prior as guidance objective.
- **Part-Aware Guidance:** Matches input and appearance latents through part-based co-segmentation and encourage semantically consistent style transfer.
- **Self-Similarity Guidance:** Promotes local consistency using geometric clustering without homogenizing appearance globally.

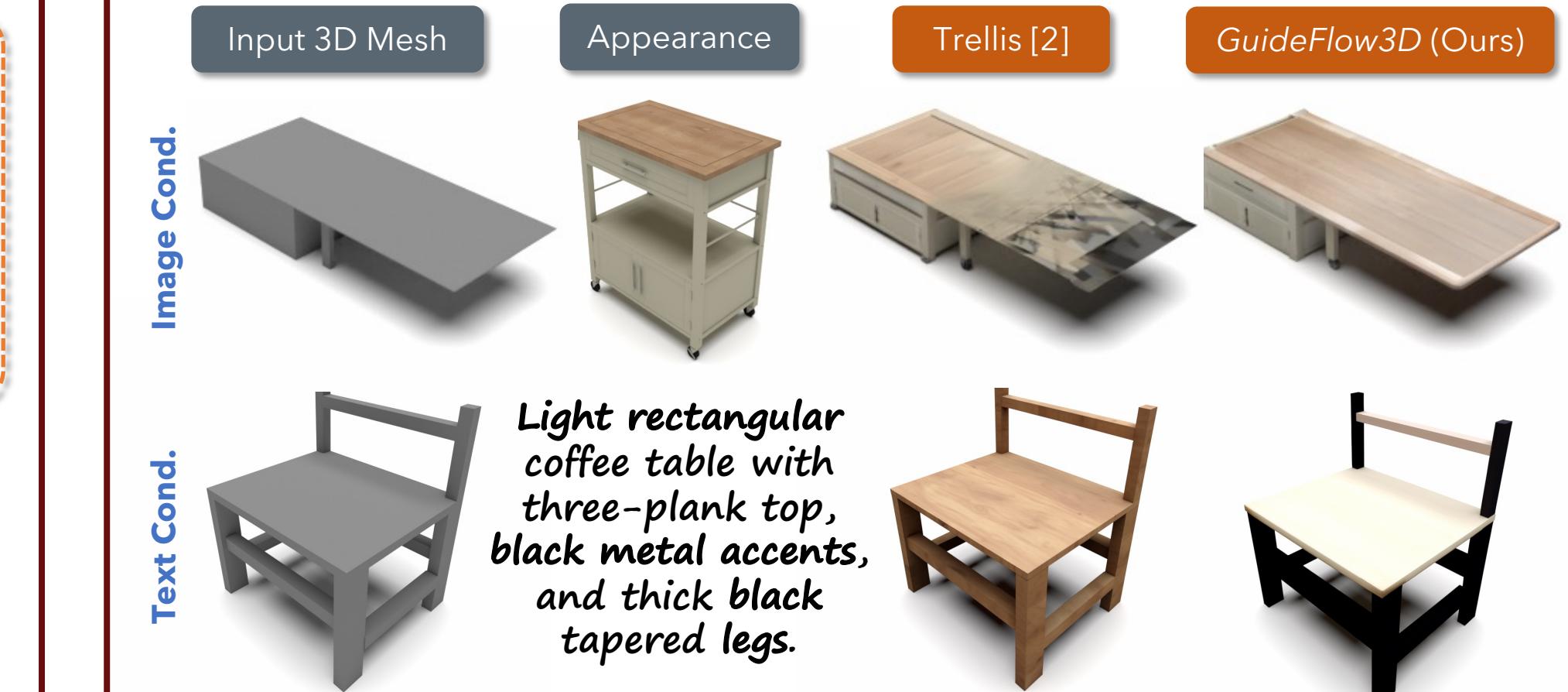


### How does guiding structured latents help?



## Experimental Results

### Furniture-To-Furniture Transfer



- Preserves geometric detail and delivers coherent transfer.
- Interprets cross-category textual cues with generalizability.

### In-The-Wild Transfer

Robustly transfers appearance and generalizes to unseen shape categories and object styles, reinforcing the adaptability.



Our method shows superior texture fidelity and structural preservation.

Methods	Ranking metrics				
	Fidelity ↓	Clarity ↓	Adaptation ↓	Fidelity ↓	Clarity ↓
Intra-Category			Inter-Category		
Simple-Complex					
UV Nearest Neighbor	4.12	3.84	4.43	4.06	3.51
MambaST [8]	4.94	3.55	4.42	4.87	3.57
Cross Image Attention [2]	3.56	3.48	3.47	3.54	3.55
EasiTex [52]	3.18	4.30	4.18	3.25	4.21
Trellis [72]	2.51	2.58	2.61	2.64	2.85
GuideFlow3D (Ours)	<b>1.89</b>	<b>2.41</b>	<b>2.28</b>	<b>1.99</b>	<b>2.75</b>
					<b>2.45</b>

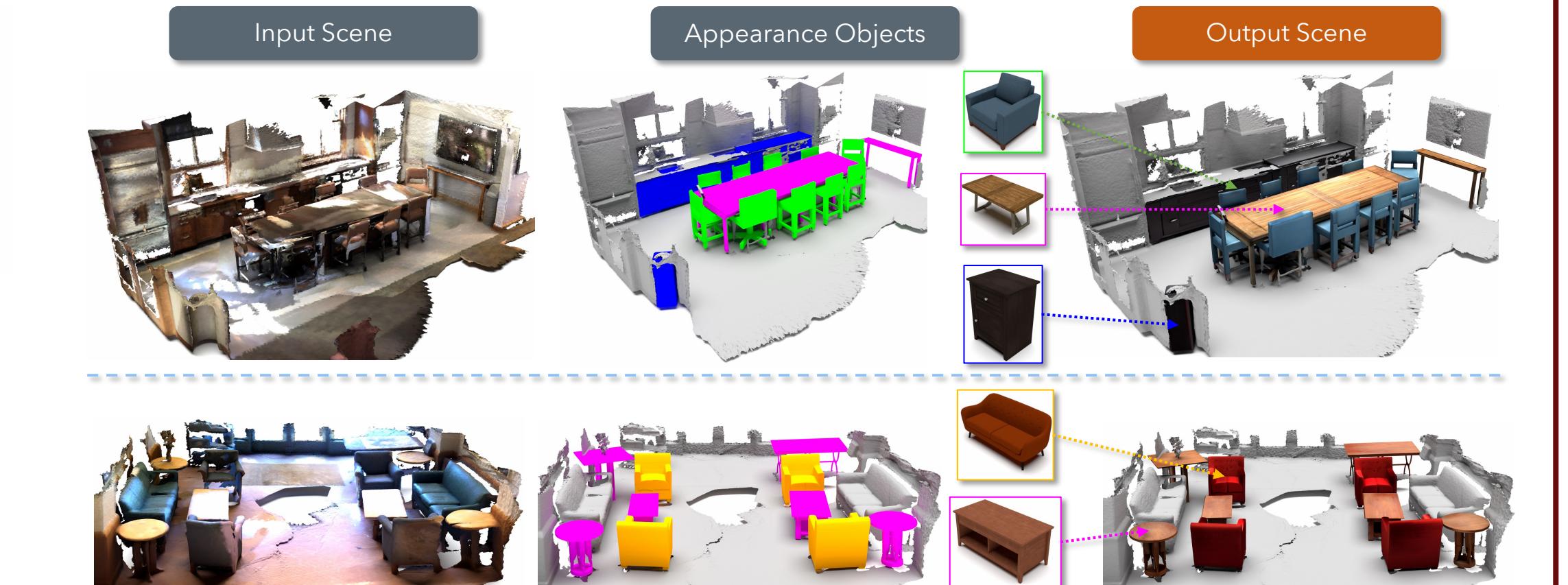
### Failure Case

Interpreting abstract semantics without ambiguity remains an open challenge.



### 3D Scene Editing

Seamlessly stylizes objects while preserving their geometry and spatial layout for interactive context-aware 3D scene restyling.



### Key Takeaways

- Novel framework for 3D appearance transfer that applies differentiable guidance to a pretrained rectified flow model.
- Training-free approach, generalizable to different appearance representations.