



GuideFlow3D: Optimization-Guided Rectified Flow For Appearance Transfer

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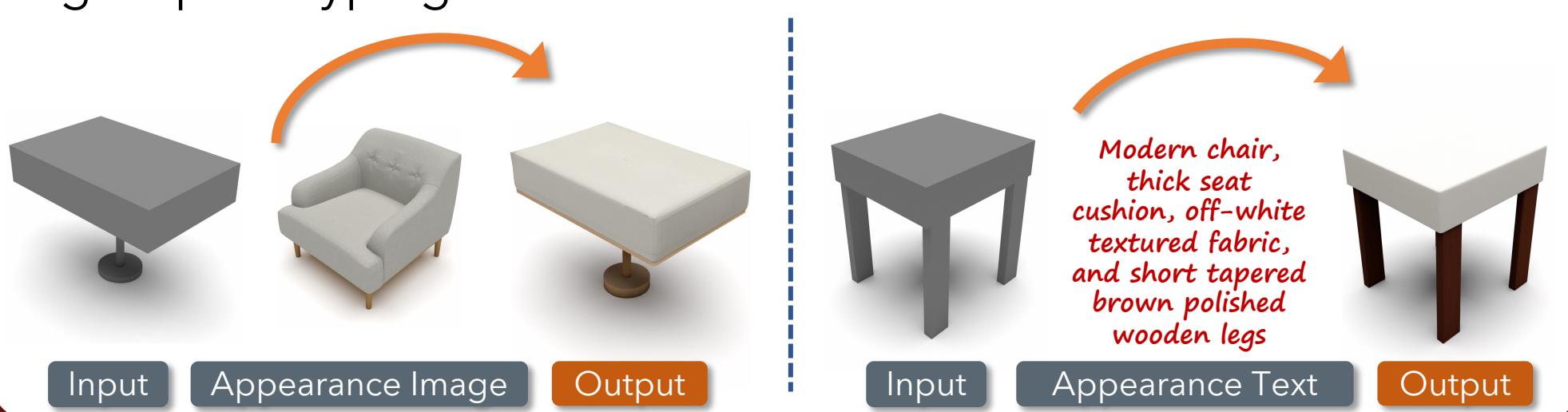


Why 3D Appearance Transfer

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.

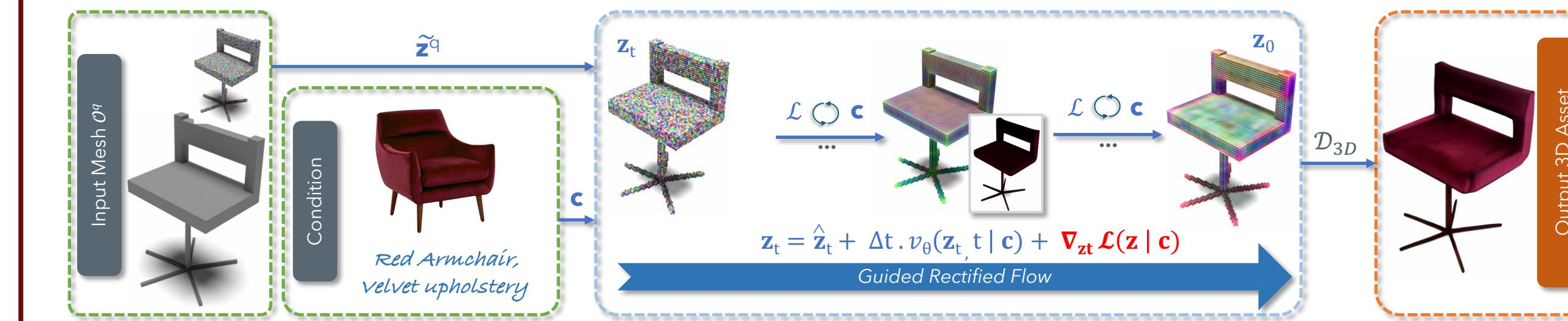


— 3D appearance transfer cannot be treated as a texture mapping or multi-view rendering problem.

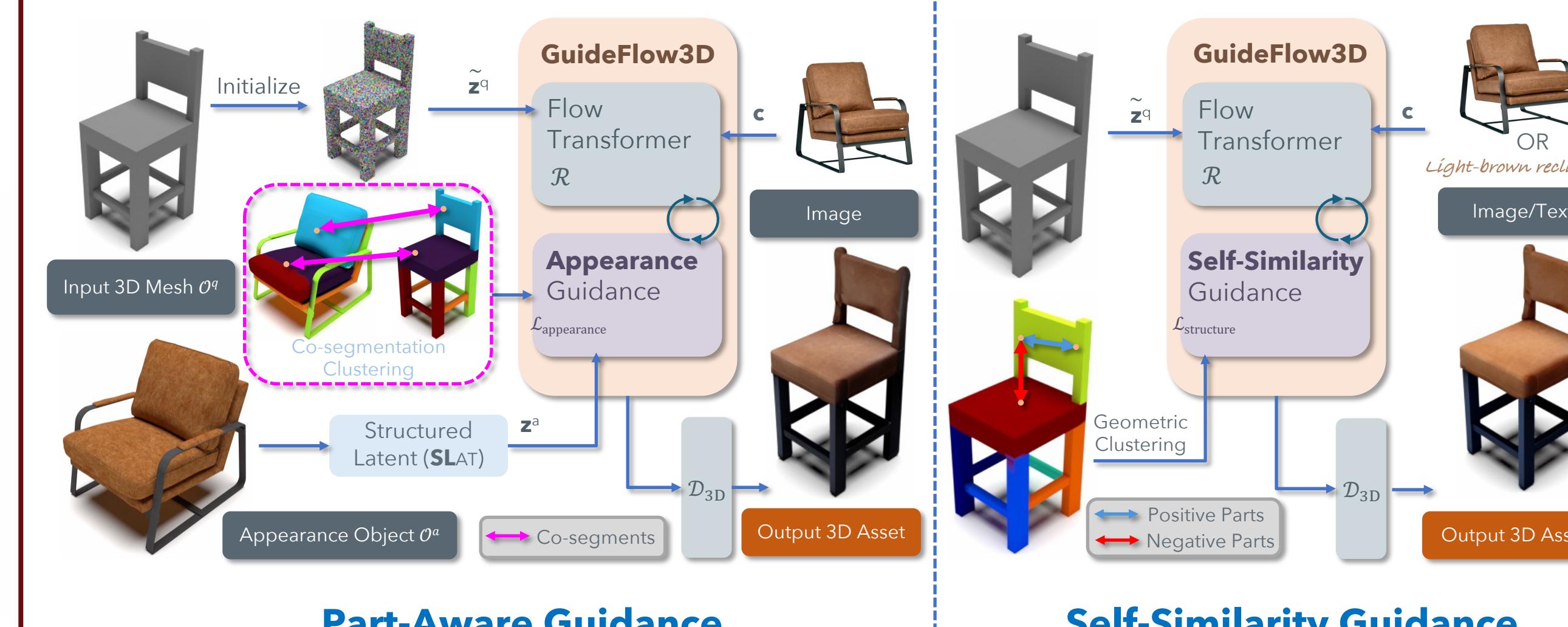
Guided Flow For Appearance Transfer

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.



Part-Aware Guidance

Self-Similarity Guidance

How does guiding structured latents help?



Experimental Results

Our method shows superior texture fidelity and structural preservation.

Methods	Ranking metrics					
	Fidelity ↓	Clarity ↓	Adaptation ↓	Fidelity ↓	Clarity ↓	Adaptation ↓
Simple-Complex						
UV Nearest Neighbor	4.12	3.84	4.43	4.06	3.51	4.17
MambaST [8]	4.94	3.55	4.42	4.87	3.57	4.38
Cross Image Attention [2]	3.56	3.48	3.47	3.54	3.55	3.52
EasiTex [52]	3.18	4.30	4.18	3.25	4.21	4.10
Trellis [72]	2.51	2.58	2.61	2.64	2.85	2.76
GuideFlow3D (Ours)	1.89	2.41	2.28	1.99	2.75	2.45

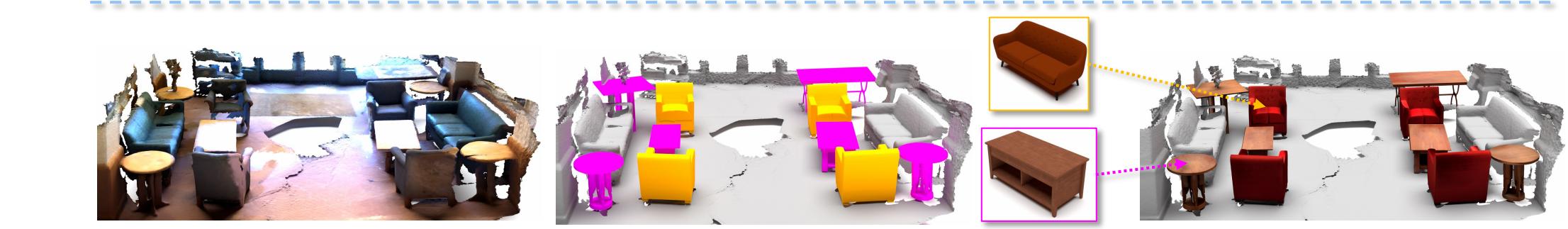
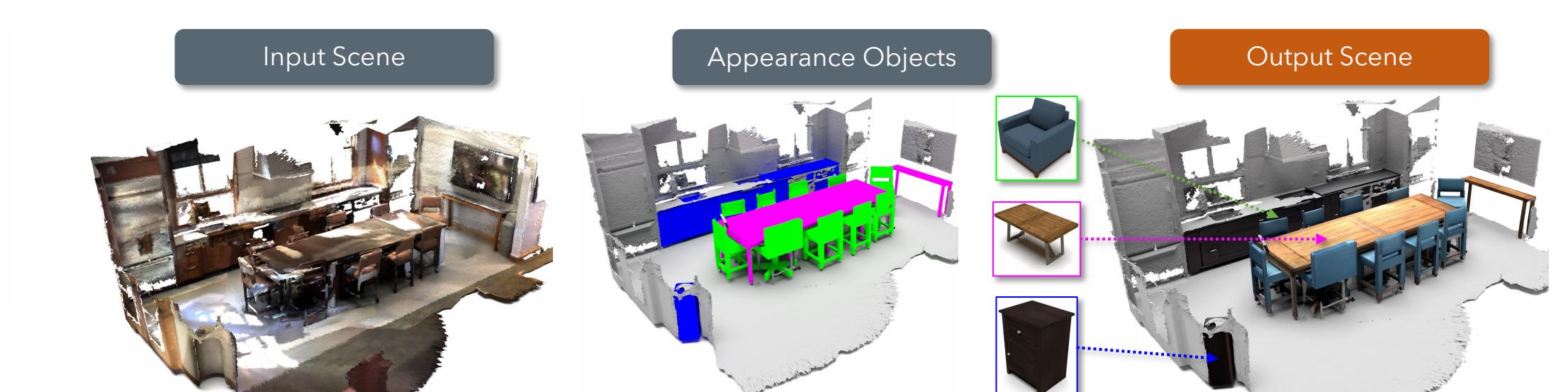
Failure Case

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.