UniPart: Part-Level 3D Generation with Unified 3D Geom-Seg Latents

CVPR2026 HIGHLIGHT PAPER

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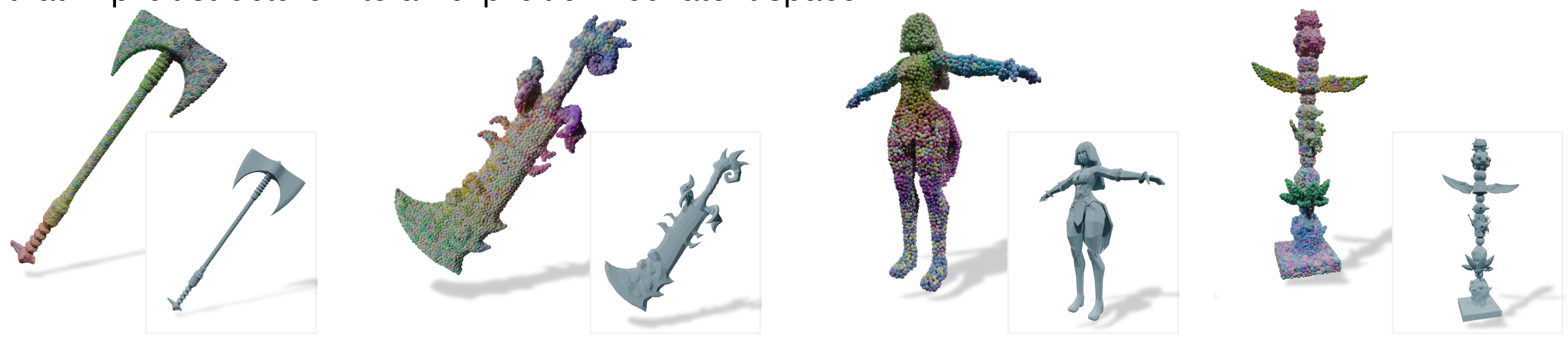
Motivation & Contributions

Problem. Part-level 3D generation needs both *good geometry* and *meaningful decomposition*. Existing methods usually either:

- segment implicitly, which weakens controllability over part granularity;
- or generate first and segment later, which depends on strong external segmenters and often damages geometry through decode–encode cycles.

Key idea. Part awareness already emerges inside whole-object geometry generation. UniPart turns that implicit structure into an explicit unified latent space.

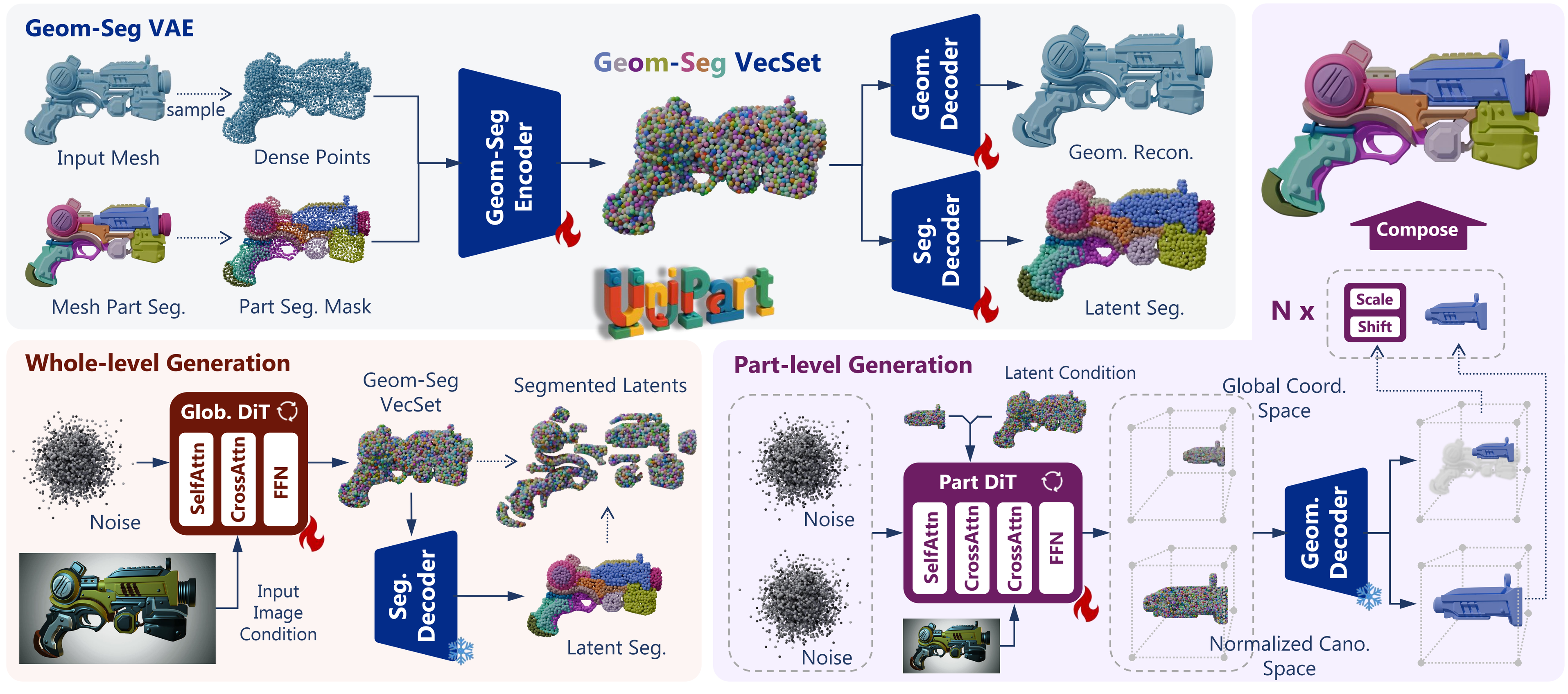


Latent correlation maps from Hunyuan3D-2.1 DiT attention at inference. Latents (points) correlate strongly within the same semantic part, suggesting implicit part awareness.

Main contributions.

- **Geom-Seg VecSet**: a unified latent that jointly encodes geometry and part segmentation.
- **Two-stage generation**: whole-level diffusion predicts geometry plus latent segmentation; part-level diffusion refines each part.
- **Dual-space part synthesis**: parts are generated in both global and normalized canonical spaces for better fidelity and cleaner composition.

Pipeline



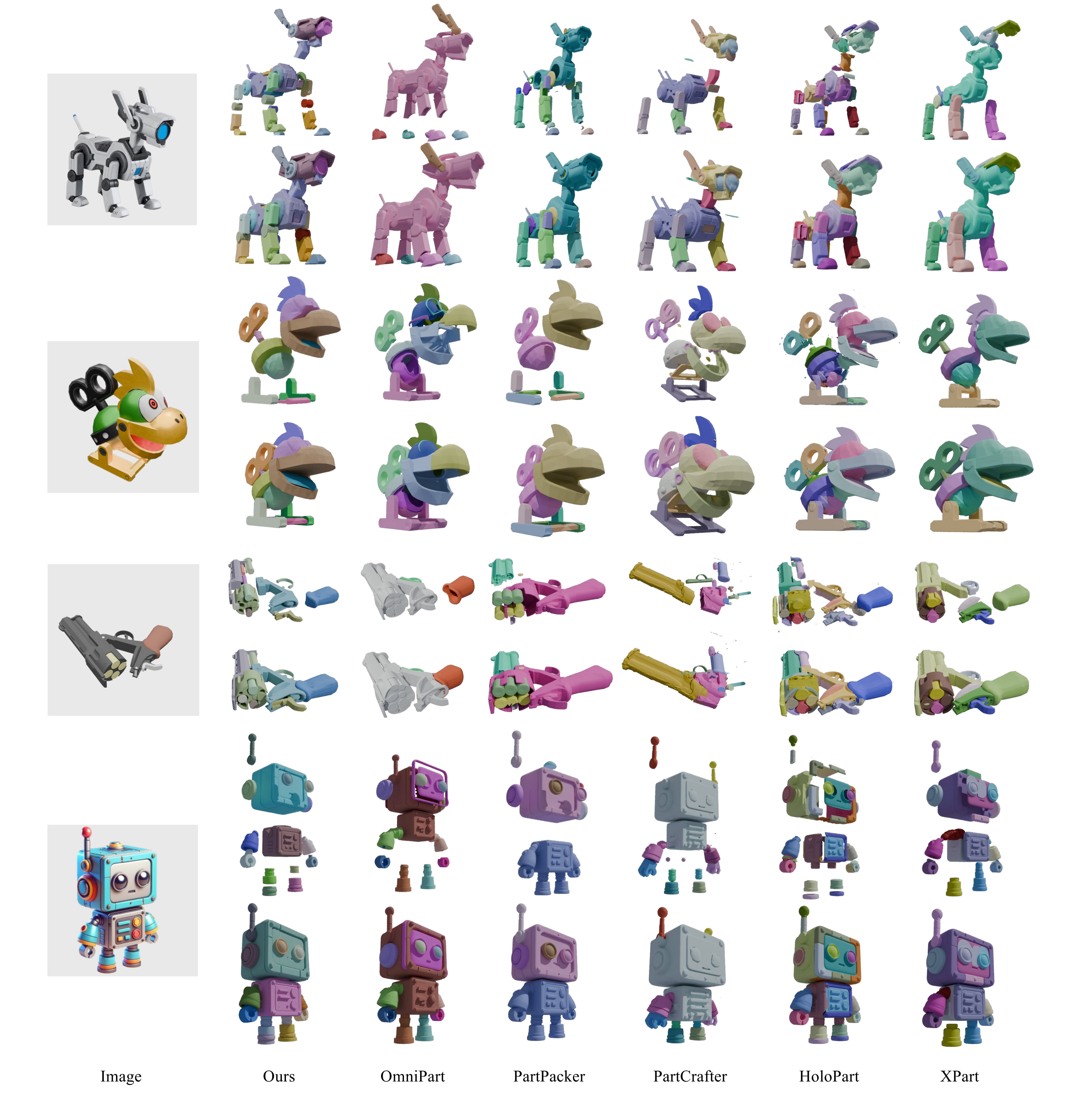
- **Stage 1:** image-guided whole-level DiT predicts a Geom-Seg latent for the full object.
- **Stage 2:** a part-level DiT takes the input image, global latent, and part latent to generate each part in two spaces.

Gallery

Geom-Seg VAE Reconstruction

Reconstruction results of our Geom-Seg VAE. (a) Input mesh with part segmentation masks; (b) Reconstructed geometry; (c) Reconstructed part latent segmentation visualization; (d) Reconstructed geometry of Hunyuan3D-2.1 for reference.

Part-Level Results



Qualitative results of part-level 3D generation for a given image. We visualize the exploded parts in the first line of each mesh pair for better illustration of part generation.

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