NEURAL INFORMATION PROCESSING SYSTEMS

Tetrahedron Splatting for 3D Generation

NeurIPS 2024' Spotlight

Chun Gu[1] Zeyu Yang[1] Zijie Pan[1] Xiatian Zhu[2] Li Zhang[1]

https://fudan-zvg.github.io/tet-splatting/

[1]Fudan University [2]University of Surrey

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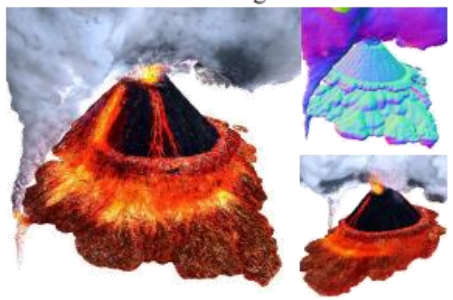
3D Generation

"a DSLR photo of the Imperial State Crown of England"

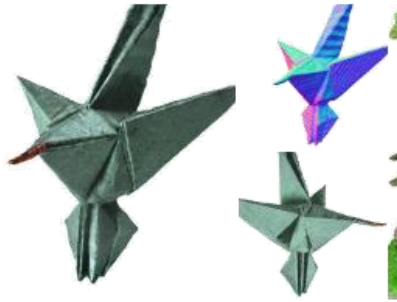
"a DSLR photo of a candelabra with many candles on a red velvet tablecloth"

"a DSLR photo of a roast turkey on a platter"

"a DSLR photo of a steaming basket full of dumplings"



"an erupting volcano, aerial view"



"a zoomed out DSLR photo of an origami crane"

"a zoomed out DSLR photo of a 3d model of an adorable cottage with a thatched roof"

"Wedding dress made of tentacles"

"a zoomed out DSLR photo of a recliner chair"

"a bald eagle carved out of wood"

"a DSLR photo of a pigeon reading a book"

"a ceramic lion"

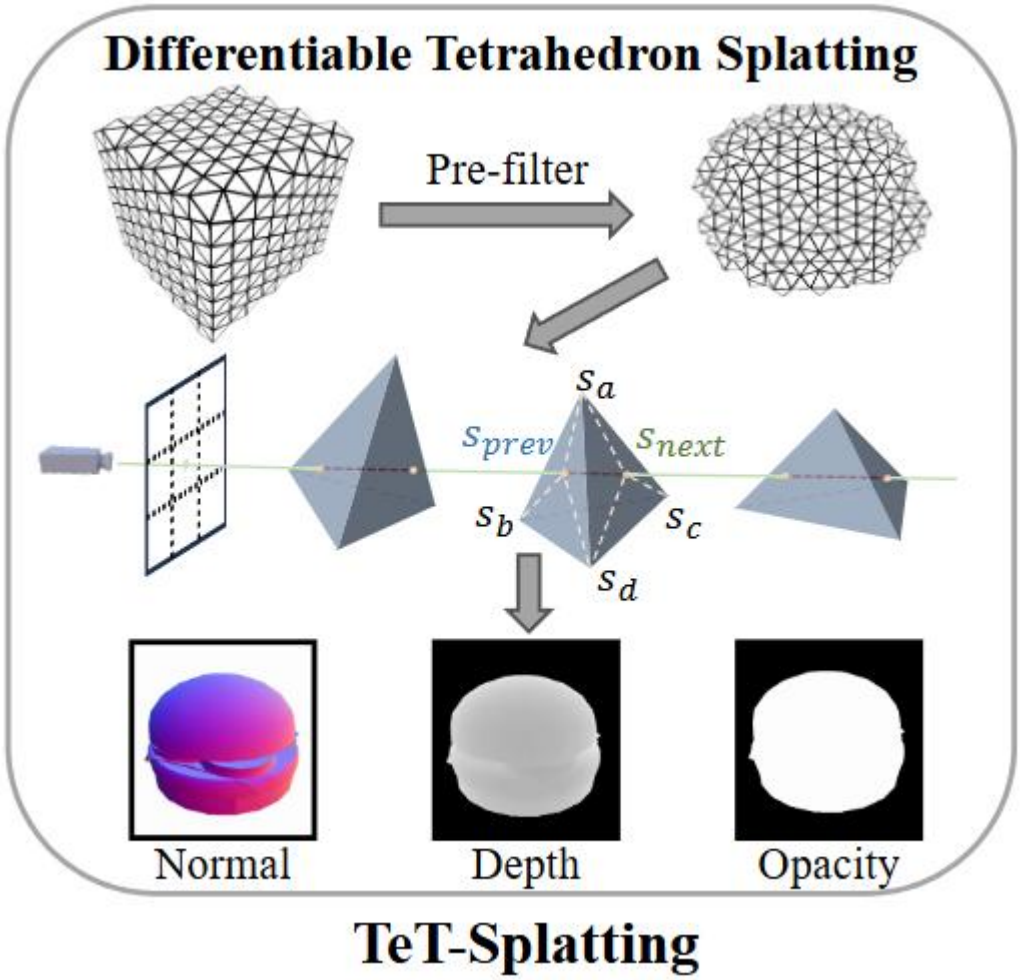
Previous 3D representations

Representation	NeRF [28]	3DGS [13]	DMTet [40]	TeT-Splatting (**Ours**)
Precise mesh extraction			✓	✓
Easy convergence	✓	✓		✓
Real-time rendering		✓	✓	✓
Representative method	*DreamFusion* [32], *Magic3D* [18]	*DreamGaussion* [46], *GSGEN* [5]	*Fantasia3D* [3], *RichDreamer* [34]	*Ours*

We propose, Tetrahedron Splatting (TeT-Splatting), a unified 3D representation that simultaneously supports:

1. Easy convergence during optimization.
2. Precise mesh extraction.
3. Real-time rendering.

Tetrahedron Splatting



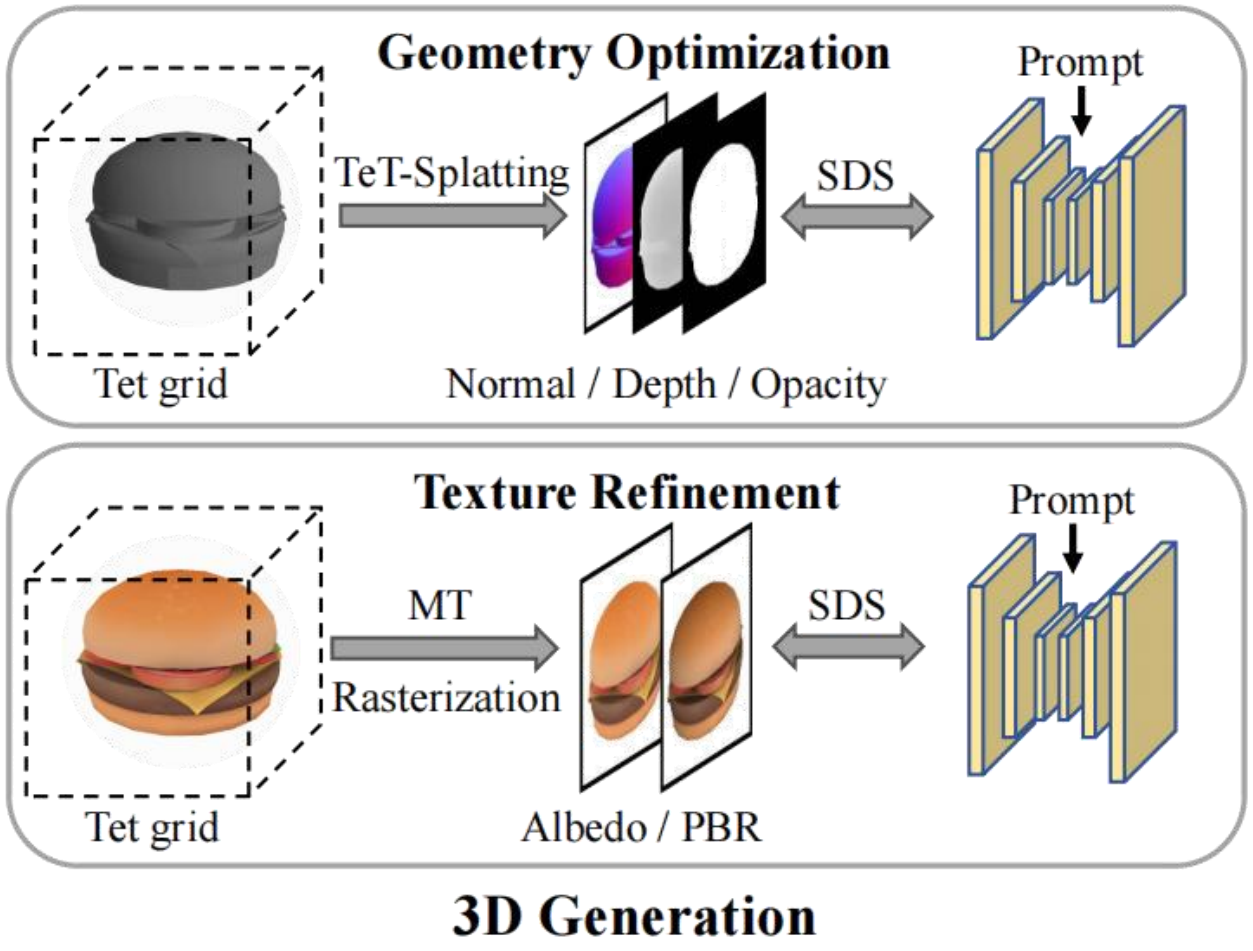
1. Pre-filter nearly transparent tetrahedra
2. Project and calculate the opacity of each tetrahedron

$$\alpha = \max\left(\frac{\Phi_s(f_{\text{prev}}) - \Phi_s(f_{\text{next}})}{\Phi_s(f_{\text{prev}})}, 0\right)$$

3. Alpha-blending

$$\{\mathcal{N}, \mathcal{D}, \mathcal{O}\} = \sum_{i \in N} T_i \alpha_i \{\boldsymbol{n}_i, \boldsymbol{z}_i, 1\}, \quad T_i = \prod_{j=1}^{i-1} (1 - \alpha_j).$$

Tetrahedron Splatting for 3D generation

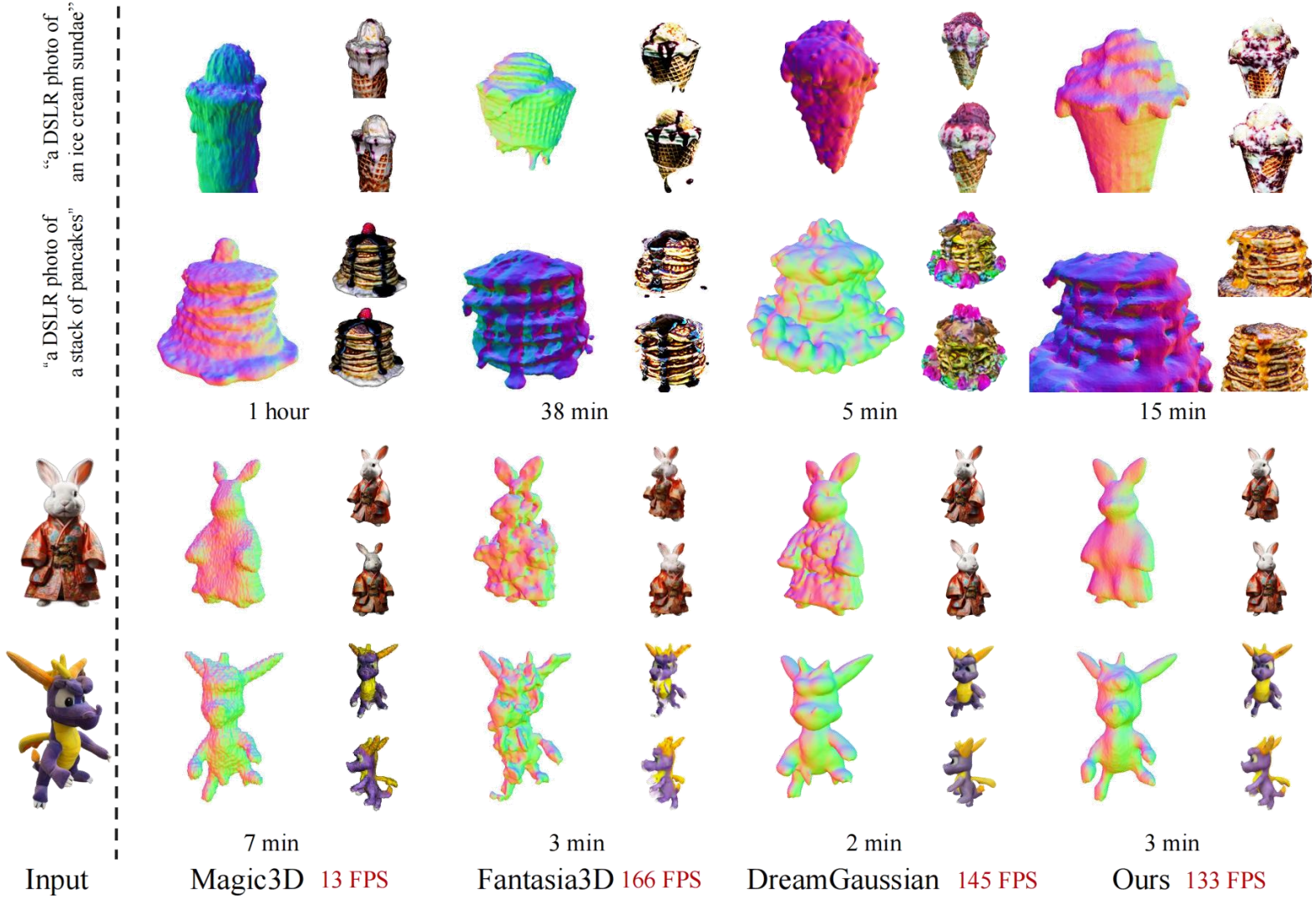


3D generation pipeline

1. Get detailed geometry with TeT-Splatting using SDS loss
2. Transition to polygonal mesh through Marching Tetrahedra
3. Get detailed texture with rasterization using SDS loss

Results with vanilla RGB-based diffusion priors

Qualitative comparison with competitors

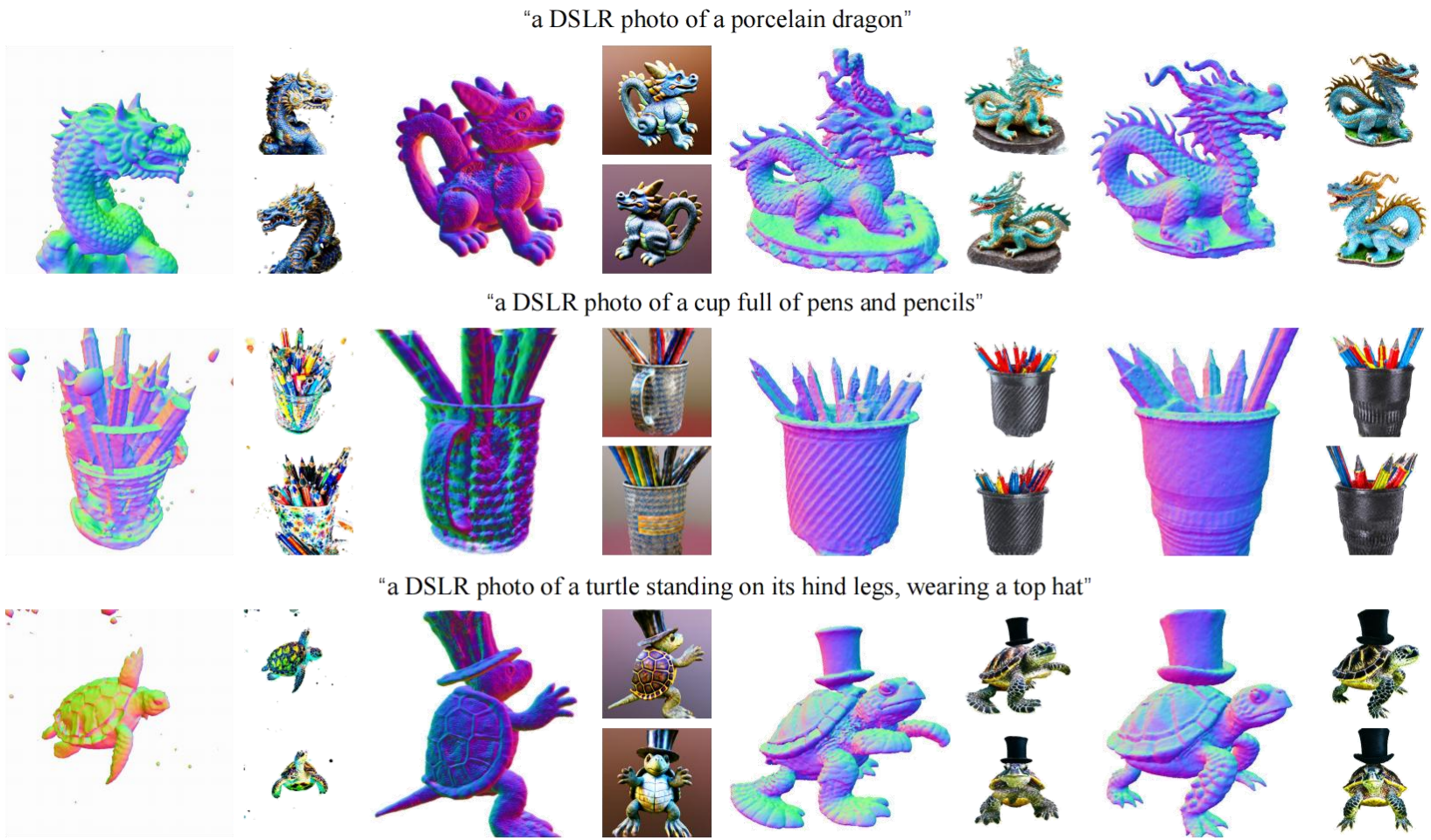


Results with vanilla RGB-based diffusion priors

Mesh exportation

Results with rich diffusion priors

Qualitative comparison with competitors



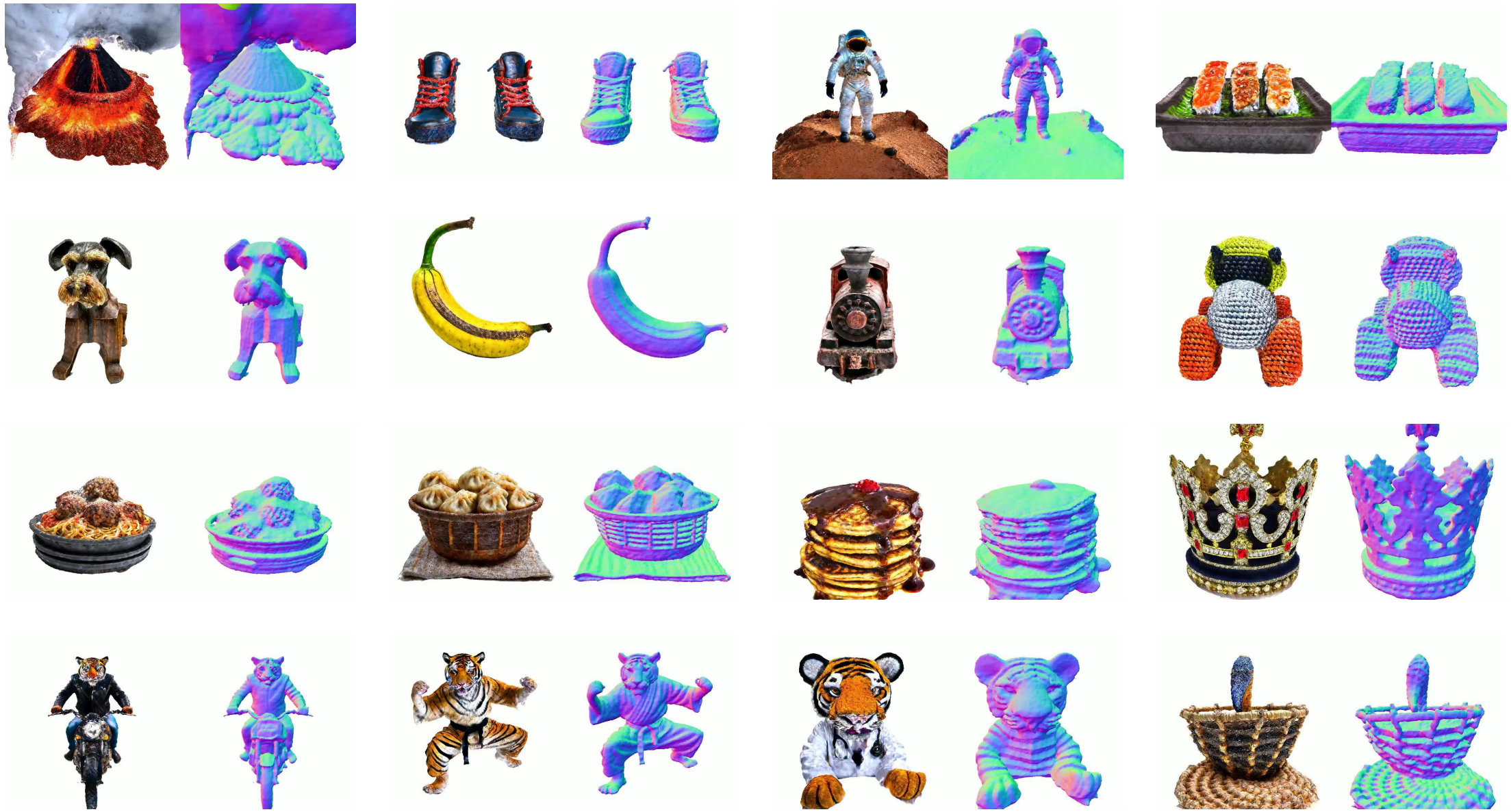
Results with rich diffusion priors

Quantitative CLIP score Comparison

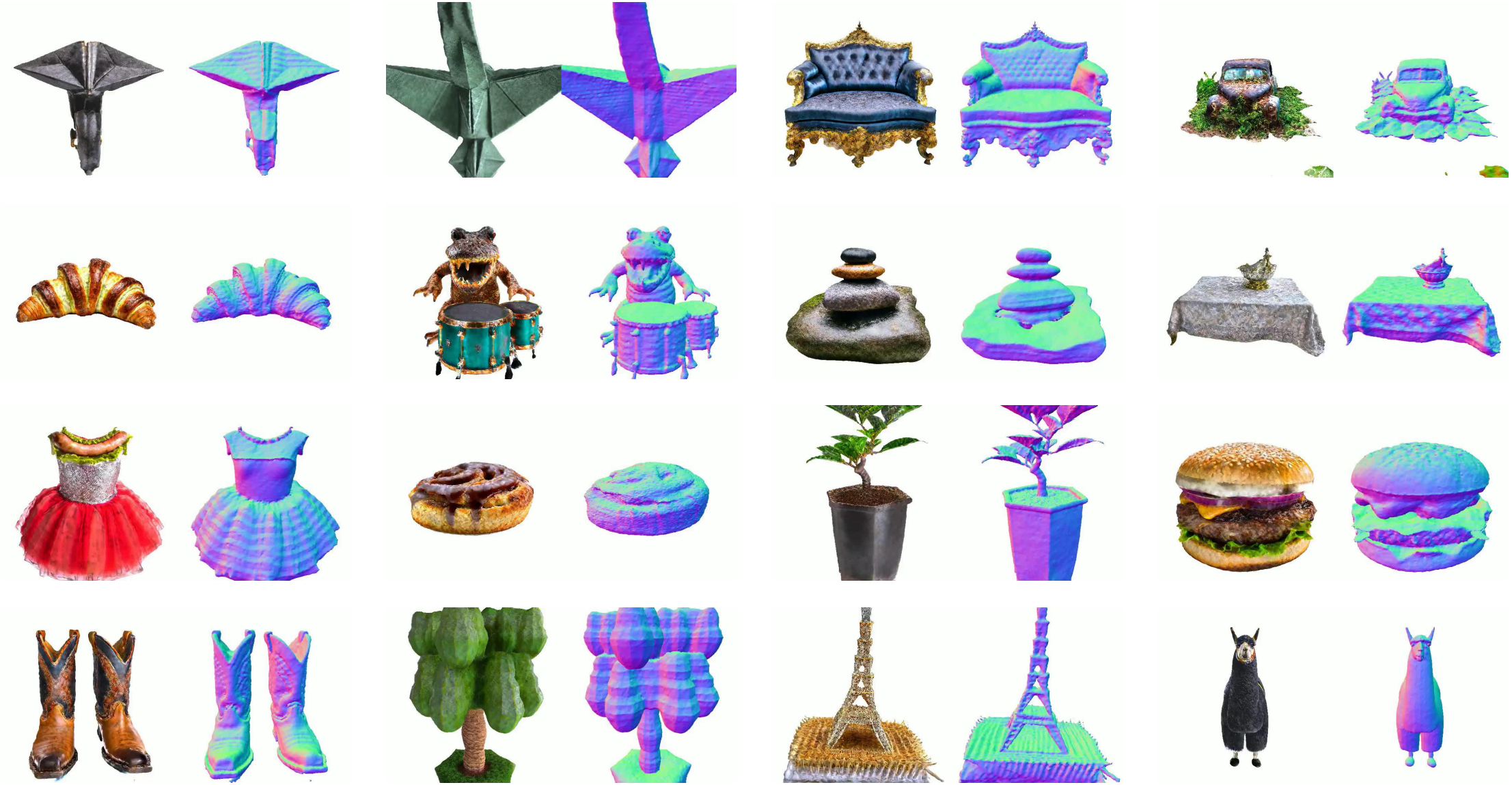
	Prolificdreamer [51]	MVDream [42]	RichDreamer [34]	RichDreamer [34]	Ours
Geometry CLIP score ↑	23.3818*	24.8003*	25.8820*	23.0143	**23.1641**
Appearance CLIP score ↑	31.8022*	28.7331*	31.7099*	29.2198	**29.4197**

Results marked with "*" are taken from RichDreamer.
Since RichDreamer did not release their prompt list (113 objects), we use our own prompt list (183 objects) for evaluation.

Results with rich diffusion priors

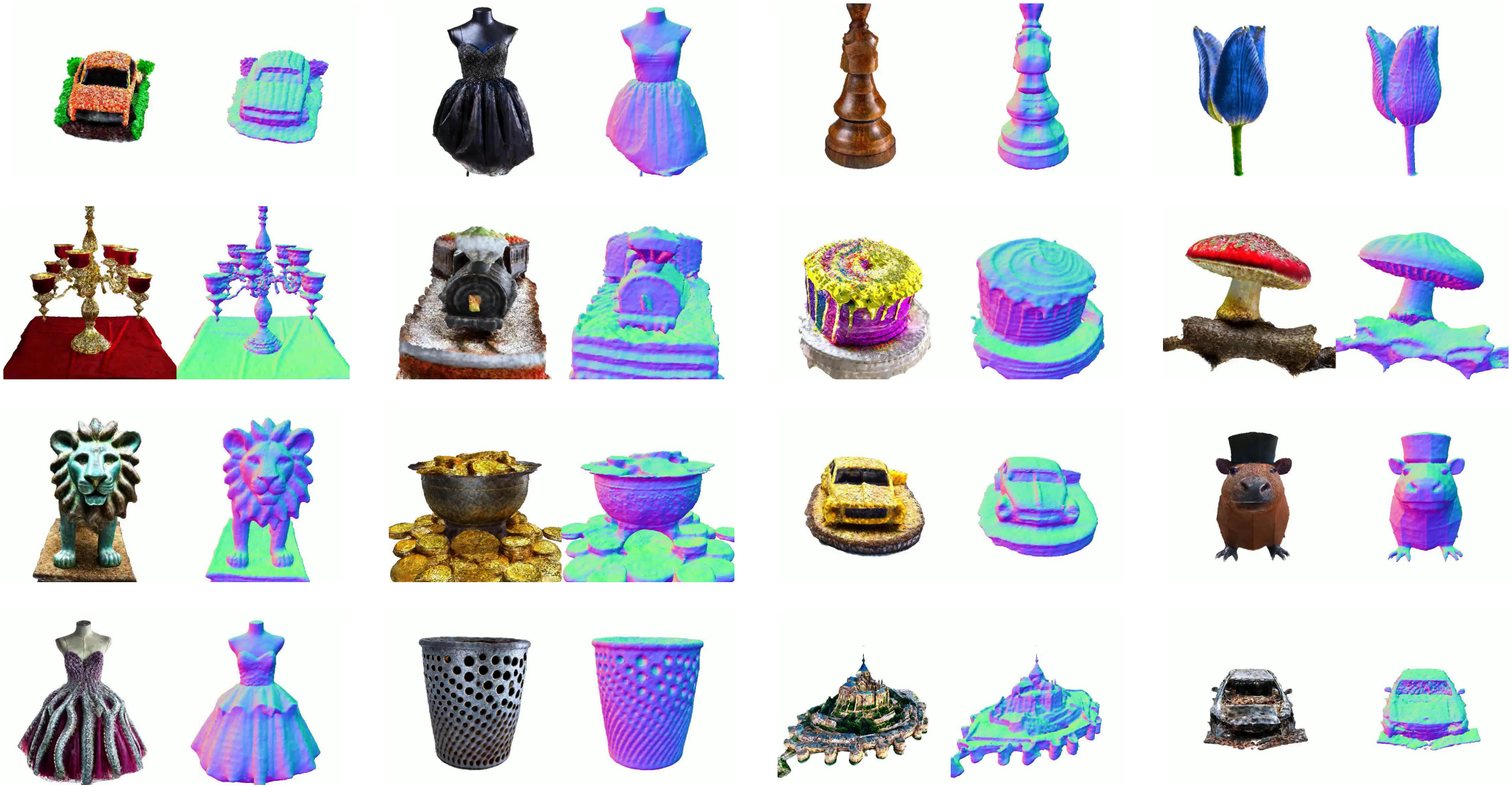


Results with rich diffusion priors



Results with rich diffusion priors

Results with rich diffusion priors



THANKS FOR WATCHING

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