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A Plug-and-Play Optimization Module that Improves the Geometry of Generated 3D Assets

Xiaoyan Cong, Jiayi Shen, Rui Zhou, Yixin Wan

December 16, 2024

Outline

- Background
- Problem Statement
- Motivation
- Framework
- Experiments
- Discussion

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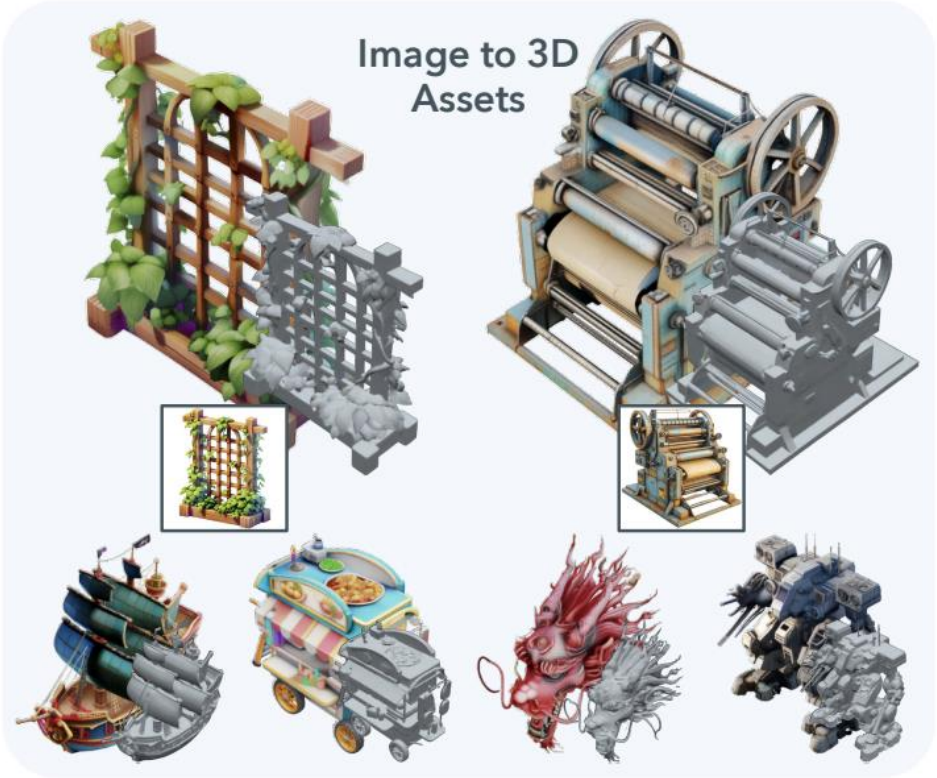
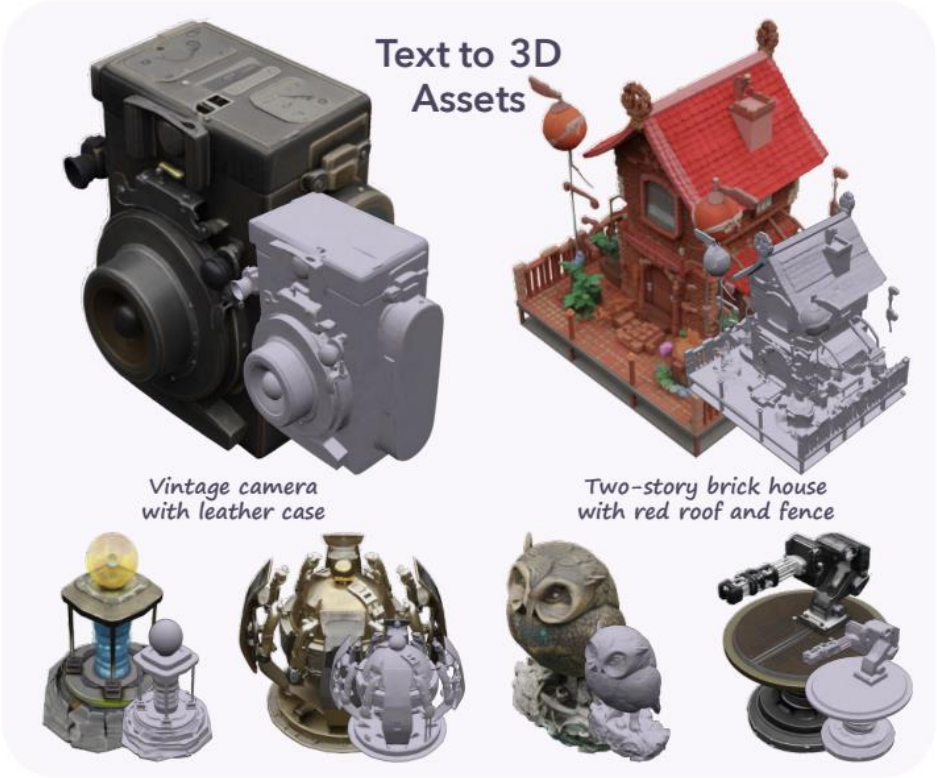
Background

- The automatic creation of 3D digital content finds applications in many scenarios, such as virtual reality, filming, gaming, and aided industrial design.





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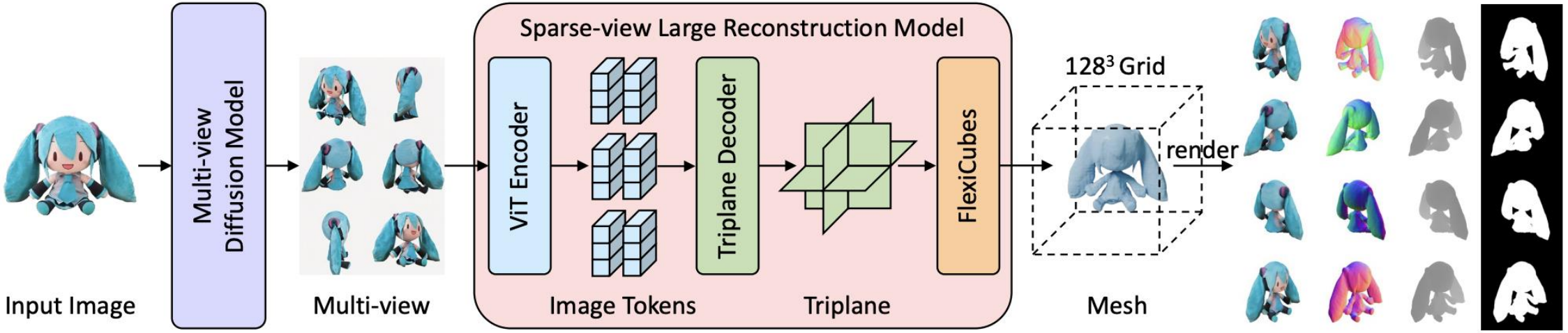
- The automatic creation of 3D digital content finds applications in many scenarios, such as virtual reality, filming, gaming, and aided industrial design.
- In this work, we focus on generating high-quality 3D assets from a single image.



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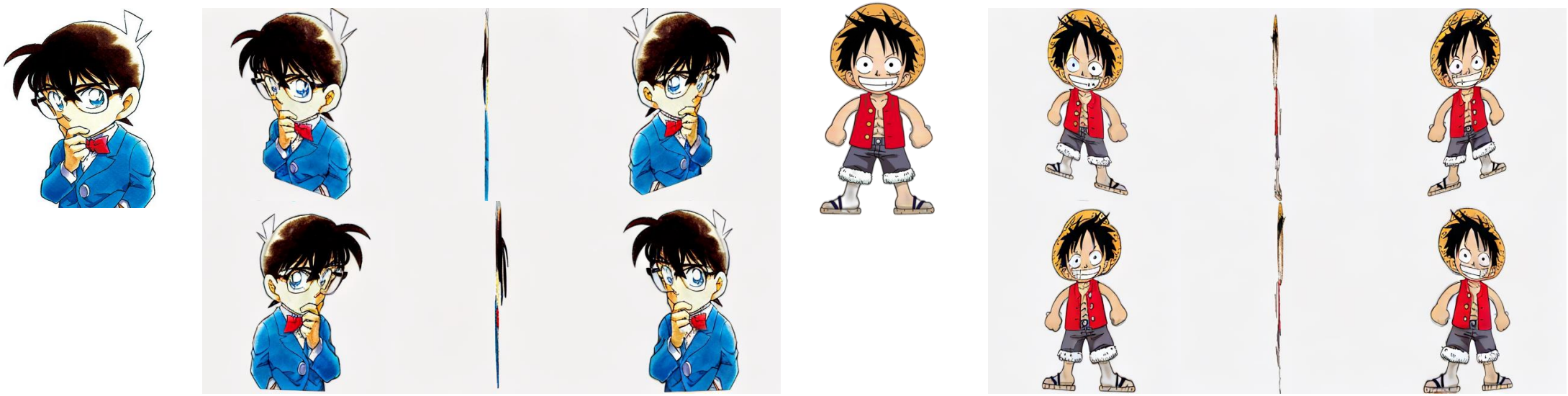
Problem Statement

- When applied to out-of-distribution data such as **flat-shaped images**, all the feed-forward image-to-3D models significantly degenerate and produce 3D assets with abnormal thin structure.



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Motivation

- We attribute this failure mode to the **data distribution misalignment** between flat-shaped images and those that image-to-3D models use for training.

- Although all the images are represented as 2D, many of them implicitly contain 3D information such as **shadows**, **certain viewpoints**, and **reasonable depth or normal structures**, especially those images rendered from a 3D world.

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Motivation

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- We curate a new dataset ***Flat2D*** from online publicly available resources, which all the existing image-to-3D models fail for.

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Motivation

- We attribute this failure mode to the **data distribution misalignment** between flat-shaped images and those that image-to-3D models use for training.
- We curate a new dataset ***Flat2D*** from online publicly available resources, which all the existing image-to-3D models fail for.
- **Contribution:**
  - we introduce a plug-and-play optimization module to modify the flat-shaped inputs to align them with the distribution of training data used in pre-trained image-to-3D models.
  - We curate a new dataset Flat2D to evaluate this general failure mode.
  - Experimental results demonstrate that our optimization module can significantly enhance the geometry quality of generated 3D assets and exhibits superior generalizable capacities and promising practical applicability.

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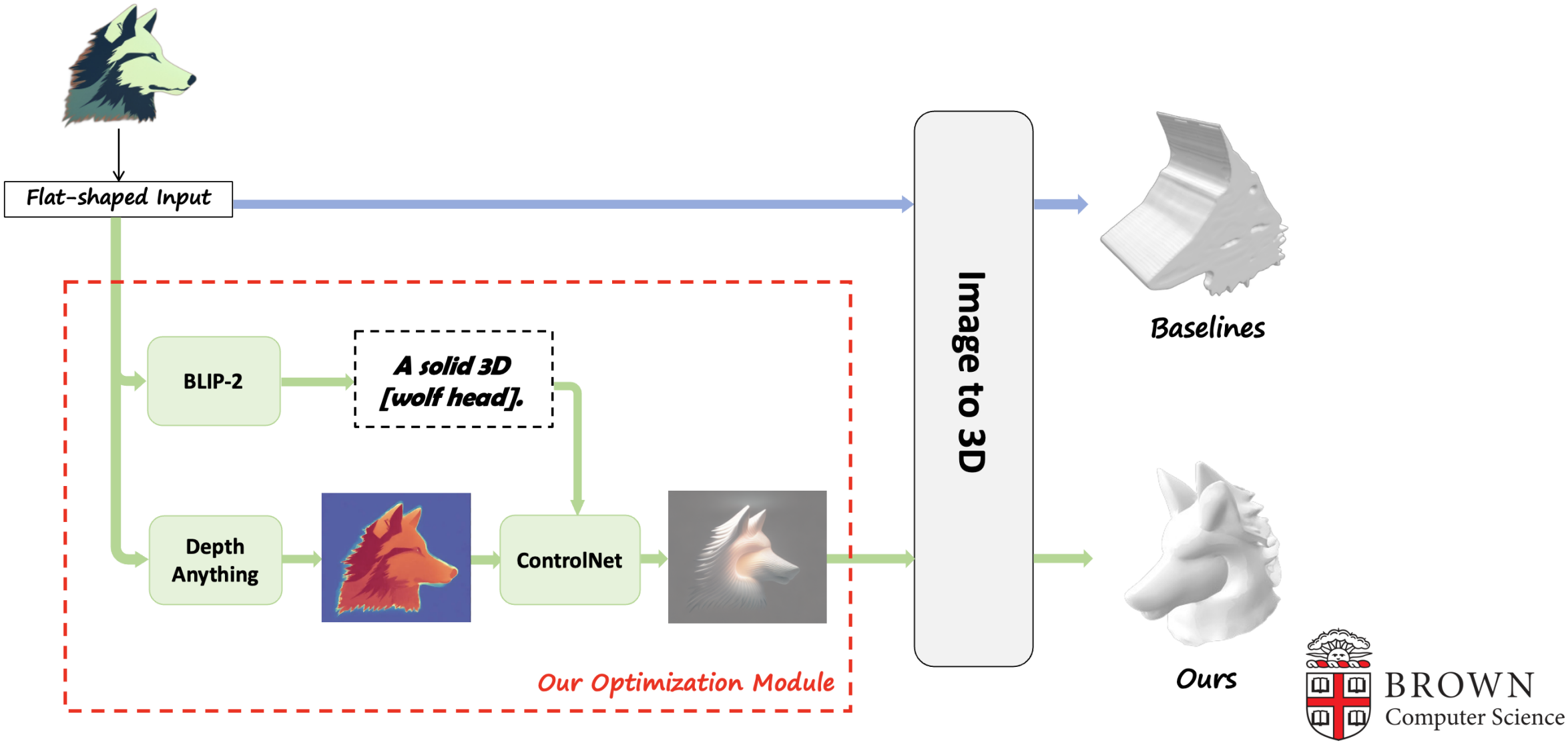
Framework



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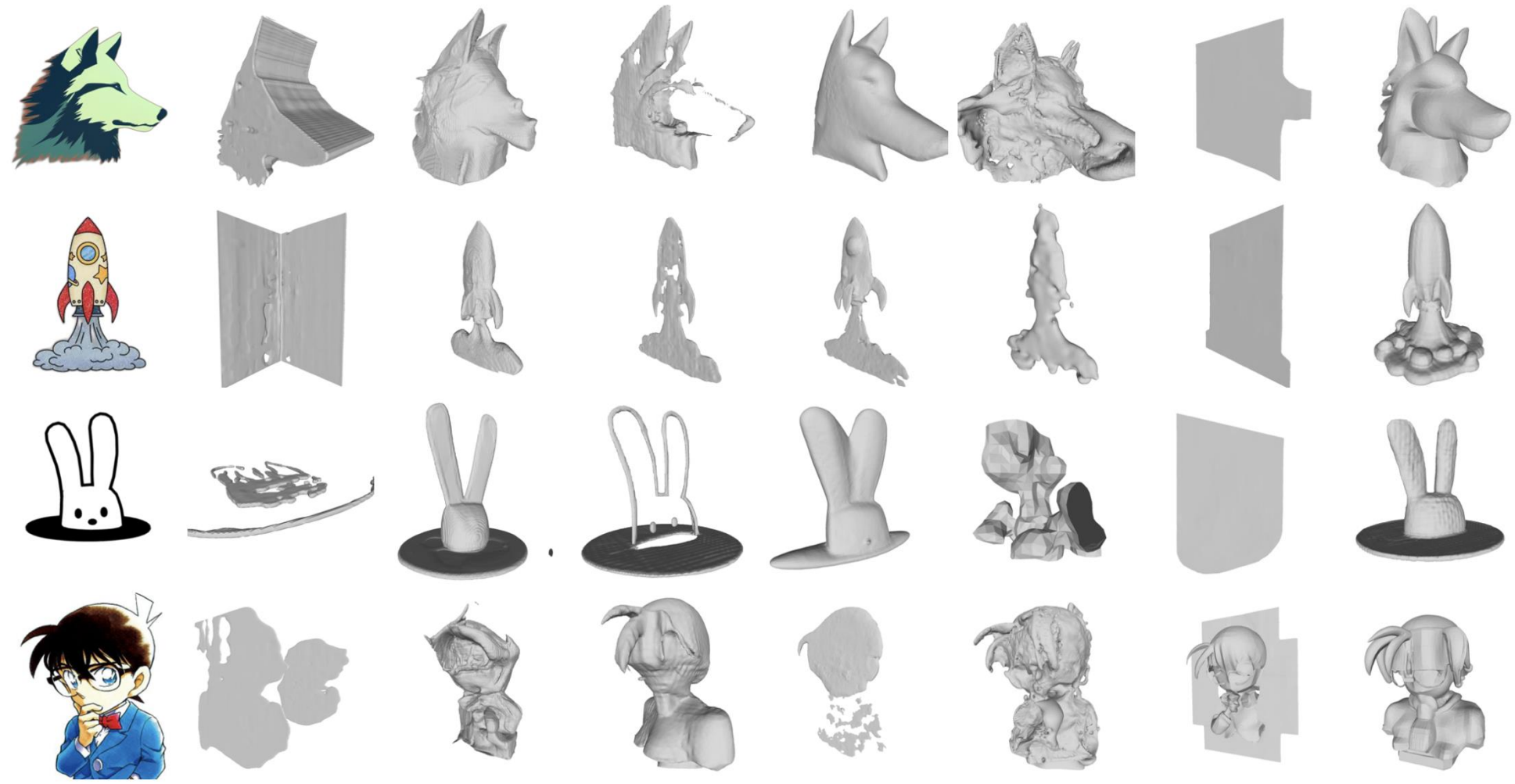
Experiments



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Experiments

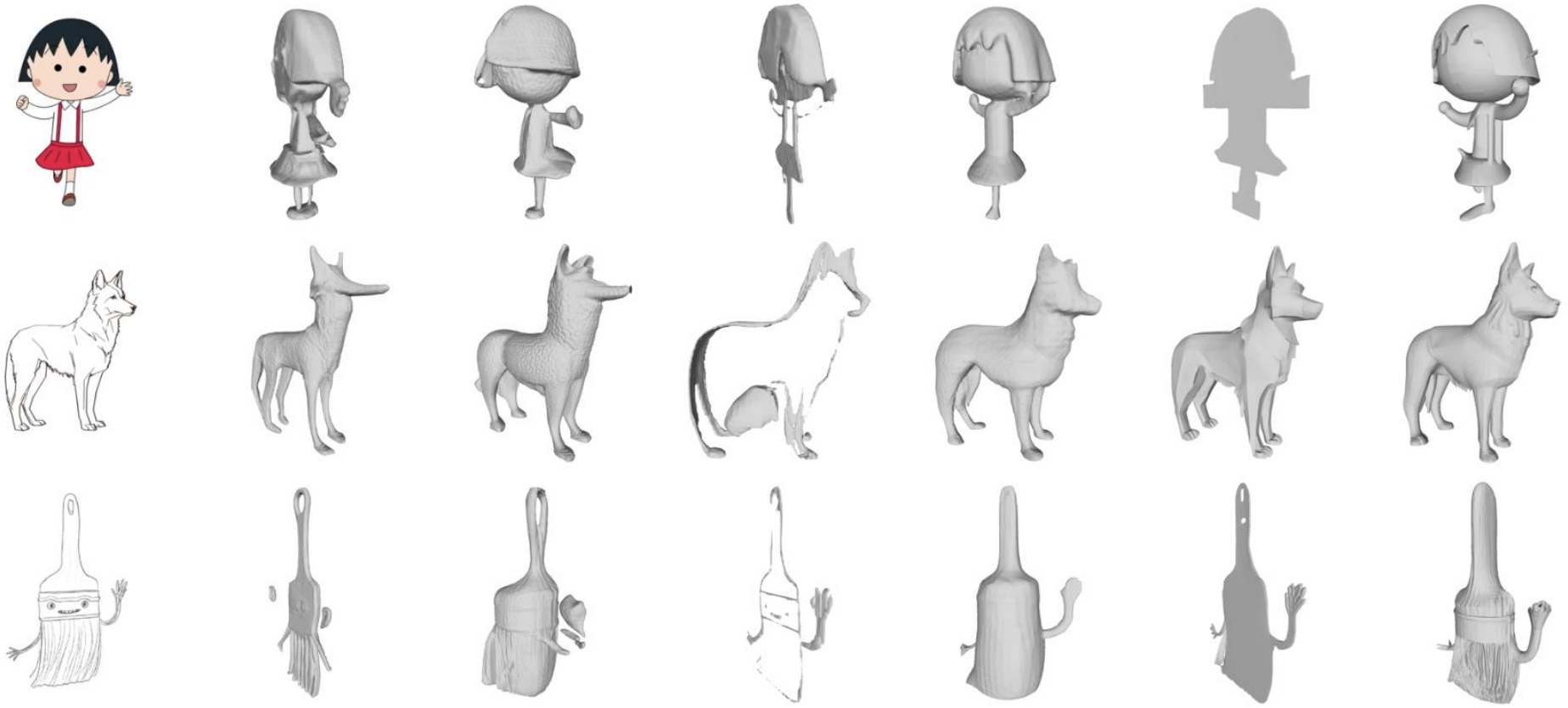

Image Prompts | LN3Diff [18] | LN3Diff + Ours | InstantMesh [52] | InstantMesh + Ours | Trellis [51] | Trellis + Ours

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Discussion

- How to map texture?
  - SDS: practical, robust, but time-consuming
  - Feed-forward:
- How to extend to other user-friendly input modalities?
  - E.g. Sketch / Edge images…

Thank you!

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