Breaking Bad: A Dataset for Geometric Fracture and Reassembly

Silvia Sellán* @sellan_s

Yun-Chun Chen* @ycchen918

Ziyi Wu* @Dazitu_616

Animesh Garg @animesh_garg

Alec Jacobson @_AlecJacobson

University of Toronto · Vector Institute · NVIDIA · Adobe

breaking-bad-dataset.github.io

Fracture Reassembly

Input: A set of fractures

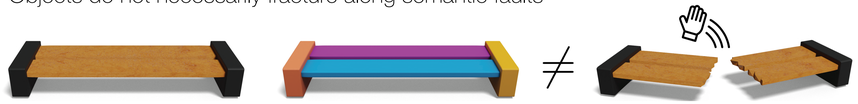
Goal: Compose the fractures back into its original shape

A set of fractures

Assembly

Semantic vs. Geometric

Objects do not necessarily fracture along semantic faults



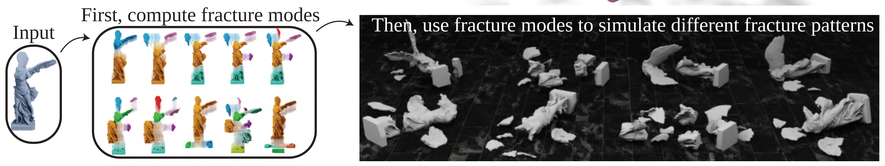
Shape ≠ Semantic ≠ Geometric

Fracture Simulation

Simulator: *Breaking Good* by Sellán et al. [1]

- Geometrically natural fractures
- Various fracture patterns for an object
- Fast runtime (milliseconds)

Our data processing pipeline



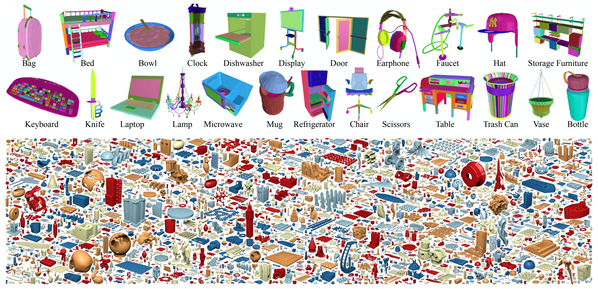
Breaking Bad Dataset

Base shapes:

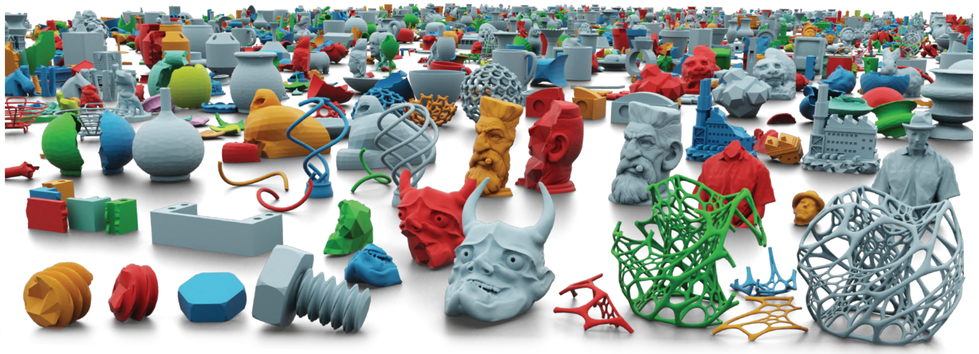
- Source: PartNet [2] and Thingi10K [3]
- 10,221 objects in total

Each base shape:

- 20 fracture modes
- 80 random impacts
- 100 unique fracture patterns in total



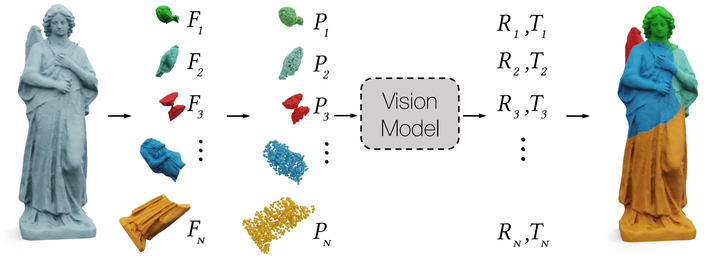
Breaking Bad contains over 1 million physically realistic fractured objects



Breaking Bad contains various objects, which be used for archaeology, vision and robotics applications

Experiments

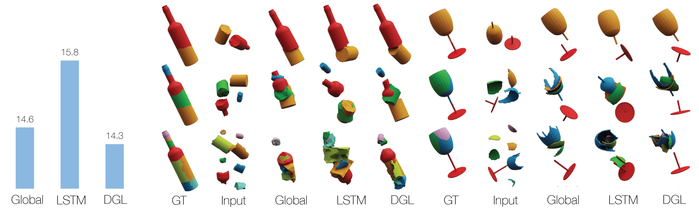
Pipeline of state-of-the-art learning-based shape assembly algorithms



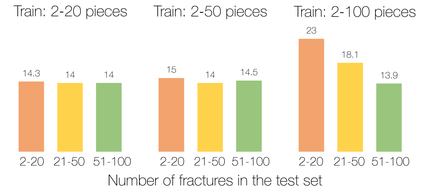
Object · Fractures · Point clouds · Predicted poses · Assembly

Evaluation on fracture reassembly

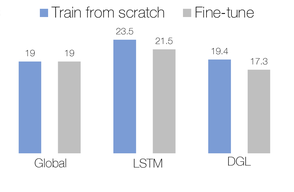
- Metric: Chamfer distance (x10^{-3})
- Baselines: Global, LSTM, DGL [4]



Train / test on different numbers of fractures



Effect of model fine-tuning



References

[1] Sellán et al. Breaking Good: Fracture Modes for Realtime Destruction. ACM ToG, 2022.

[2] Mo et al. PartNet: A Large-scale Benchmark for Fine-grained and Hierarchical Part-level 3D Object Understanding. In *CVPR*, 2019.

[3] Zhou et al. Thingi10K: A Dataset of 10,000 3D-Printing Models. *Technical Report*, 2015.

[4] Huang et al. Generative 3D Part Assembly via Dynamic Graph Learning. In *NeurIPS*, 2020.