Neural Shape Mating: Self-Supervised Object Assembly with Adversarial Shape Priors

Yun-Chun Chen¹,²
Haoda Li¹,²
Dylan Turpin¹,²
Alec Jacobson¹,⁴
Animesh Garg¹,²,³

¹University of Toronto
²Vector Institute
³NVIDIA
⁴Adobe Research, Toronto
neural-shape-mating.github.io

Geometric Shape Mating
- Input: Two shapes
- Goal: Develop an algorithm that learns to assemble the two shapes

Fractured Shapes

Semantic vs. Geometric

Challenges in Geometric Shape Mating
- Shape fragments do not have well-defined semantic meanings
- No target shapes available
- Shape assembly relies purely on geometric reasoning
- No large-scale datasets available

Problem Formulation: Part Pose Prediction

RegISTRATION vs. Assembly

- Self-supervised data collection
- Objects from 11 categories
- 5 different types of cuts
- Each object, generate shell and solid test cases
- Random initial poses for object parts

Geometric Shape Mating Dataset

- Solid Shape Mating
- Shell Shape Mating

ICP (point-to-point) [1]
Sparse ICP (point-to-point) [2]
Sparse ICP (point-to-plane) [2]
DCP [3]
GNN Assembly [4]

Method: Neural Shape Mating

Part Pose Prediction

- Encoder
- Transformer
- Regressor

Adversarial Shape Prior

Input

Ground Truth
ICP
Sparse ICP
GNN Assembly
NSM

Visual Comparisons of Pairwise 3D Geometric Shape Mating

References