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

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neural-shape-mating.github.io

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

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

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
- Align two scans of the same object
- Align the interfaces of the two shapes to form an object

Experimental Results
Evaluation metric: root mean squared error (RMSE)
- $R$: rotation, $T$: translation

Results of Unseen Categories

Method
Solid Shape Mating
Shell Shape Mating

<table>
<thead>
<tr>
<th>Method</th>
<th>RMSE ($\times 10^{-3}$)</th>
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</thead>
<tbody>
<tr>
<td>ICP (point-to-point)</td>
<td>95.14</td>
<td>90.41</td>
<td>92.01</td>
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<tr>
<td>ICP (point-to-plane)</td>
<td>82.15</td>
<td>81.83</td>
<td>68.19</td>
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<tr>
<td>Sparse ICP (point-to-point)</td>
<td>69.93</td>
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<td>62.98</td>
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<td>Sparse ICP (point-to-plane)</td>
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<td>59.33</td>
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<td>GNN Assembly [4]</td>
<td>32.98</td>
<td>40.77</td>
<td>33.18</td>
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Results of Unseen Cut Types

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References