Triangle-Net: Towards Robustness in Point Cloud Learning

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1. Pseudo-code for Feature Extraction

The pseudo-code for extracting object feature vector $\mathcal{A}(\mathbf{x_1}, ..., \mathbf{x_n})$ as well as the point level feature $\mathcal{A}(\mathbf{x}_i)$ using feature function $\mathcal{D}_C$ is presented in Algorithm 1. In our implementation, lines 4-8 extracts $\mathcal{F}/n$ features for each point and then calculates $\mathcal{A}(\mathbf{x}_i)$ by the dimension-wise max aggregation function. The object feature $\mathcal{A}(\mathbf{x_1}, ..., \mathbf{x_n})$ is then aggregated with $\mathcal{A}(\mathbf{x}_i)$ that being stored in buffer $\mathrm{B_X}$ by another dimension-wise max function, as shown in lines 8-10.

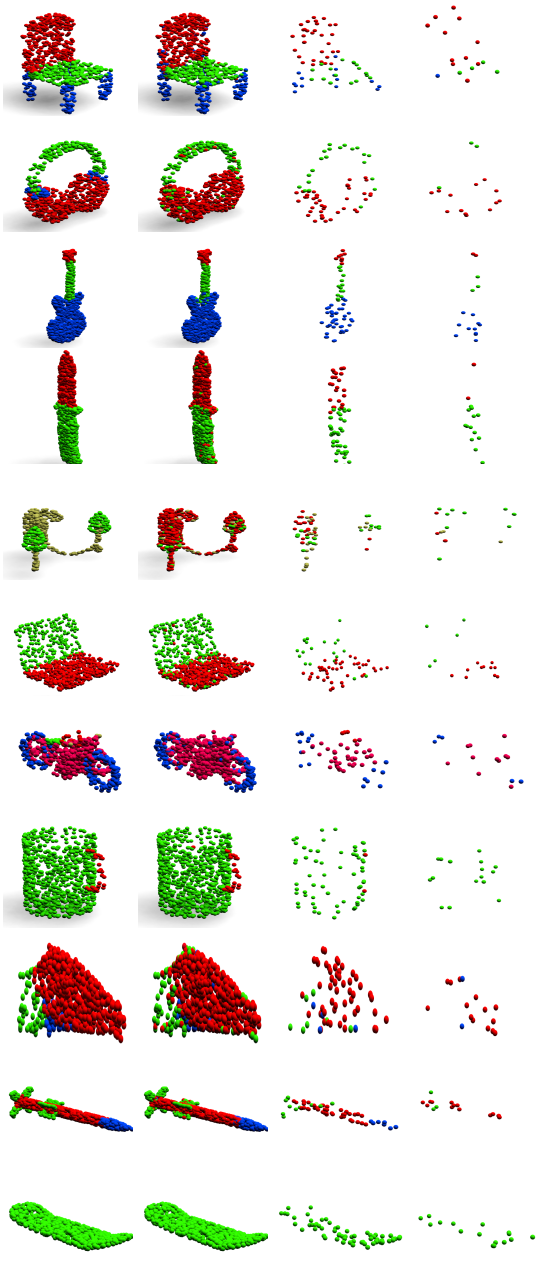
Algorithm 1: Latent Feature Extraction

Input : A point cloud $\mathrm{X} = \{\mathbf{x}_1, \ldots, \mathbf{x}_n\}$,
Number of features $\mathcal{F}$
Result: Point-wise feature set $[\mathcal{A}(\mathbf{x}_1), ..., \mathcal{A}(\mathbf{x}_n)]$,
Object global feature $\mathcal{A}(\mathbf{x}_1, ..., \mathbf{x}_n)$

1 $\mathrm{B_X} = \Phi$
2 **for** *each point* $\mathbf{x}_i \in \mathrm{X}$ **do**
3 $\quad \mathrm{B}_{x_i} = \Phi$
4 $\quad$ **for** $m = 1$ *to* $\mathcal{F}/n$ **do**
5 $\quad\quad$ select 2 points $\mathbf{x}_j$, $\mathbf{x}_k$ from X randomly
6 $\quad\quad \mathrm{B}_{x_i} \leftarrow \mathrm{B}_{x_i} \cup H_\Theta(\mathcal{D}_C(\mathbf{x}_i, \mathbf{x}_j, \mathbf{x}_k))$
7 $\quad$ **end**
8 $\quad \mathcal{A}(\mathbf{x}_i) =$ dimension-wise $max(\mathrm{B}_{x_i})$
9 $\quad \mathrm{B_X} \leftarrow \mathrm{B_X} \cup \mathcal{A}(\mathbf{x}_i)$
10 **end**
11 $\mathcal{A}(\mathbf{x_1}, ..., \mathbf{x_n}) =$ dimension-wise $max(\mathrm{B_X})$

2. Additional Part Segmentation Objects

Due to the page limit of the main paper, additional point cloud segmentation results are presented in this section. We show one randomly selected instance for each category in the ShapeNet Part dataset.



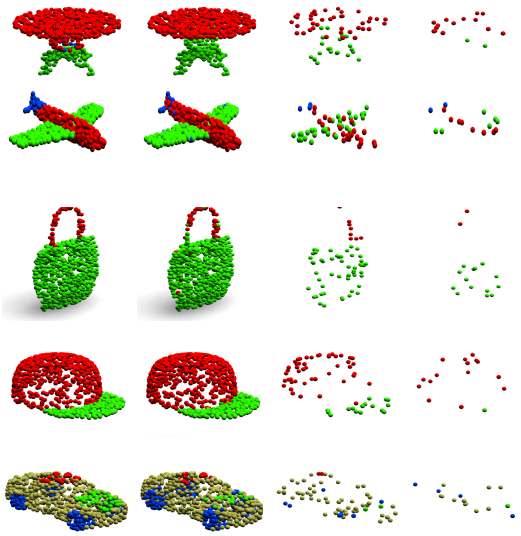


Figure 1. Ground truth and segmentation result of instances from ShapeNet Part dataset. The left-most column demonstrates the ground truth object, and then followed by segmentation result on different point densities (1024, 64 and 16 points per object).