# A   Appendix

## A.1   Label Annotation Augmentation

As aforementioned in Sec 3.2, the proposed approach strengthens the annotations by replacing the exact size of an instance object with an uncertain size. Furthermore, the markup encoding module can identify instances and be aware of the uncertainty. We ablate their usage as shown in Table A.1. As expected, both information augments methods are helpful. Table A.2 shows the performance of size augment with different scale factors $B_\eta$. An appropriate scale factor allows the label encoding module to better perceive the uncertainty without losing the original annotated information.

Table A.1: Ablation study results of label information augmentation strategies.

| Size Aug. | Fake Instance | mAP@0.25 | mAP@0.5 |
|:---:|:---:|:---:|:---:|
|  |  | 64.5 | 42.4 |
| ✓ |  | 64.9 | 42.9 |
|  | ✓ | 64.8 | 42.7 |
| ✓ | ✓ | **65.1** | **43.0** |

Table A.2: Results of label information using different scale factors.

| Scale Factor | mAP@0.25 | mAP@0.5 |
|:---:|:---:|:---:|
| 0 (Baseline) | 64.5 | 42.4 |
| 0.1 | **65.1** | **43.0** |
| 0.2 | 64.8 | 42.7 |
| 0.3 | 64.7 | 42.7 |

## A.2   Per-Category Detection Results

Our method can supplement the missing target object information in the features extracted from the original point clouds. Especially for small objects, our method has a more obvious effect. Tables A.3 and A.4 show the specific results for each category on the ScanNet. Fig. A.1 shows the improvement of LG3D on VoteNet in terms of mAP@0.25 on ScanNetV2. From these results, we can see that the original method is less effective in detecting small objects. For example, in the picture and garbage bin categories, the original VoteNet has only 7.8% AP@0.25 and 37.2% AP@0.25, but after adding our module for such objects, the metrics are up to 16.1% AP@0.25 and 52.3% AP@0.25. This is mainly due to the complementary of our module for small object representation.

Table A.3: Per-category AP@0.25 scores on the ScanNetV2 dataset.

| Method | cab | bed | chair | sofa | tabl | door | wind | bkshf | pic | cntr | desk | curt | fridg | showr | toil | sink | bath | ofurn | mAP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GSDN | 41.6 | 82.5 | 92.1 | 87.0 | 61.1 | 42.4 | 40.7 | 51.5 | 10.2 | 64.2 | 71.1 | 54.9 | 40.0 | 70.5 | 100 | 75.5 | 93.2 | 53.1 | 62.8 |
| H3DNet | 49.4 | 88.6 | 91.8 | 90.2 | 64.9 | 61.0 | 51.9 | 54.9 | 18.6 | 62.0 | 75.9 | 57.3 | 57.2 | 75.3 | 97.9 | 67.4 | 92.5 | 53.6 | 67.2 |
| VoteNet | 36.3 | 87.9 | 88.7 | 89.6 | 58.8 | 47.3 | 38.1 | 44.6 | 7.8 | 56.1 | 71.7 | 47.2 | 45.4 | 57.1 | 94.9 | 54.7 | 92.1 | 37.2 | 58.7 |
| VoteNet+Ours | 49.8 | 88.1 | 91.5 | 86.2 | 64.3 | 55.2 | 42.6 | 48.6 | 16.1 | 57.4 | 71.4 | 58.5 | 55.7 | 72.3 | 96.7 | 73.8 | 92.0 | 52.3 | 65.1 |
| GroupFree3D | 52.1 | 92.9 | 93.6 | 88.0 | 70.0 | 60.7 | 53.7 | 62.4 | 16.1 | 58.5 | 80.9 | 67.9 | 47.0 | 76.3 | 99.6 | 72.0 | 95.3 | 56.4 | 69.1 |
| GroupFree3D+Ours | **56.9** | **93.1** | **94.5** | **89.4** | 69.4 | **63.1** | **55.6** | **63.6** | **21.4** | 64.2 | **82.2** | **71.5** | 49.2 | **81.4** | 99.4 | **79.2** | **95.8** | **61.3** | **70.9** |

Table A.4: Per-category AP@0.5 scores on the ScanNetV2 dataset.

| Method | cab | bed | chair | sofa | tabl | door | wind | bkshf | pic | cntr | desk | curt | fridg | showr | toil | sink | bath | ofurn | mAP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GSDN | 13.2 | 74.9 | 75.8 | 60.3 | 39.5 | 8.5 | 11.6 | 27.6 | 1.5 | 3.2 | 37.5 | 14.1 | 25.9 | 1.4 | 87.0 | 36.5 | 76.9 | 30.5 | 34.8 |
| H3DNet | 20.5 | 79.7 | 80.1 | 79.6 | 56.2 | 29.0 | 21.3 | 45.5 | 4.2 | 33.5 | 50.6 | 37.3 | 41.4 | 37.0 | 89.1 | 35.1 | 90.2 | 35.4 | 48.1 |
| VoteNet | 8.1 | 76.1 | 67.2 | 68.8 | 42.4 | 15.3 | 6.4 | 28.0 | 1.3 | 9.5 | 37.5 | 11.6 | 27.8 | 10.0 | 86.5 | 16.8 | 78.9 | 11.7 | 33.5 |
| VoteNet+Ours | 14.9 | 83.4 | 71.8 | 69.1 | 46.3 | 22.8 | 15.5 | 44.5 | 5.1 | 29.9 | 41.5 | 25.6 | 39.3 | 28.0 | 90.2 | 37.3 | 86.5 | 22.5 | 43.0 |
| GroupFree3D | 26.0 | 81.3 | 82.9 | 70.7 | 62.2 | 41.7 | 26.5 | 55.8 | 7.8 | 34.7 | 67.2 | 43.9 | 44.3 | 44.1 | 92.8 | 37.4 | 89.7 | 40.6 | 52.8 |
| GroupFree3D+Ours | **27.7** | **81.5** | **83.1** | 68.2 | 61.4 | **42.6** | **27.3** | 55.3 | 7.5 | **37.9** | **66.9** | **48.7** | 43.0 | **46.0** | **99.8** | **42.3** | **90.4** | **44.7** | **54.1** |
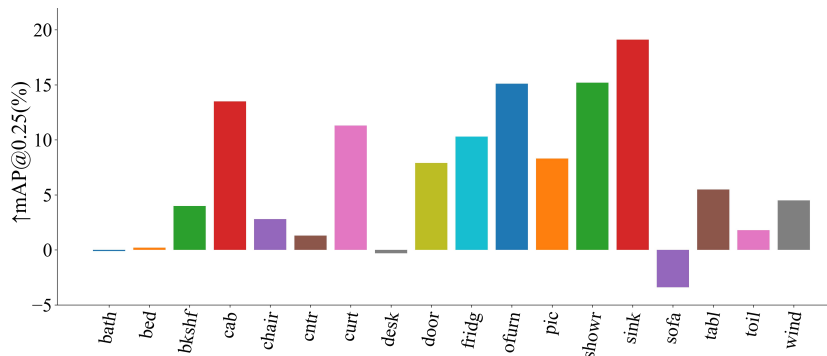


Fig. A.1: The mAP@0.25 score improvement by LG3D applied to VoteNet of each category on the ScanNetV2 dataset.