Supplementary Material for
Towards Scalable 3D Anomaly Detection and Localization: A Benchmark via 3D Anomaly Synthesis and A Self-Supervised Learning Network

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In this supplementary material, we provide more details that could not be included in the main manuscript due to the lack of space. The contents are summarized below:

- S1. More Anomaly-ShapeNet anomaly samples.
- S2.Visualization samples of Real3D-AD for anomaly detection and localization.
- S3. Complete experiment results of IMRNet on anomaly detection and segmentation.
- S4. Ablation Study of iteration number and patch size.
- S5. Limitations and future works.

S1. Anomaly-ShapeNet Samples

In this section, we present more anomalous examples of our proposed Anomaly-ShapeNet dataset. Figure S1 and S2 display the meshes and point clouds legends of six different anomaly types.

S2. Visualization samples of Real3D-AD for anomaly detection and localization.

Within the main text, we showcase a subset of the visualization results for anomaly detection and localization performed by the IMRNet algorithm on Anomaly-ShapeNet. Due to space constraints, the visualizations of IMRNet's detection results on Real-3D are presented in Figure S3. In this figure, the detection and localization performance of our IMRNet algorithm is evidently superior to that of the CPMF and RegAD algorithms.

S3. Complete experiment results of IMRNet on anomaly detection and segmentation

To provide a comprehensive benchmark for our Anomaly-ShapeNet dataset, we tested different metrics on the Anomaly-ShapeNet dataset using mainstream 3D algorithms. The experimental results are presented in Table S1 and Table S2

S4. Ablation study of iteration number and patch size.

In the main text, we present the experimental results demonstrating the correlation between the effectiveness of IMRNet's anomaly detection and the masking rate. As a supplement, we provide the relationship curves between anomaly detection performance, mask size, and iteration number in Figure S4 to aid in understanding the relation of experimental parameters and the detection effect. Figure S4 demonstrate the best iteration time and patch size are 3 and 64. Theoretically, larger iteration time and patch size may induce normal point drift and increase the positive false rate, while smaller ones may be not enough to cover all anomaly regions.

S5. Limitations and future works.

Our proposed Anomaly-ShapeNet dataset, while encompassing a broad distribution of samples, still lacks sufficient scale. Future work will need to focus on expanding the number of samples within the dataset. Moreover, Pure point cloud coordinate-based 3D anomaly detection does not fully conform to real-world 3D anomaly detection scenarios. Subsequent efforts should involve the integration of RGB values into our anomaly detection model.

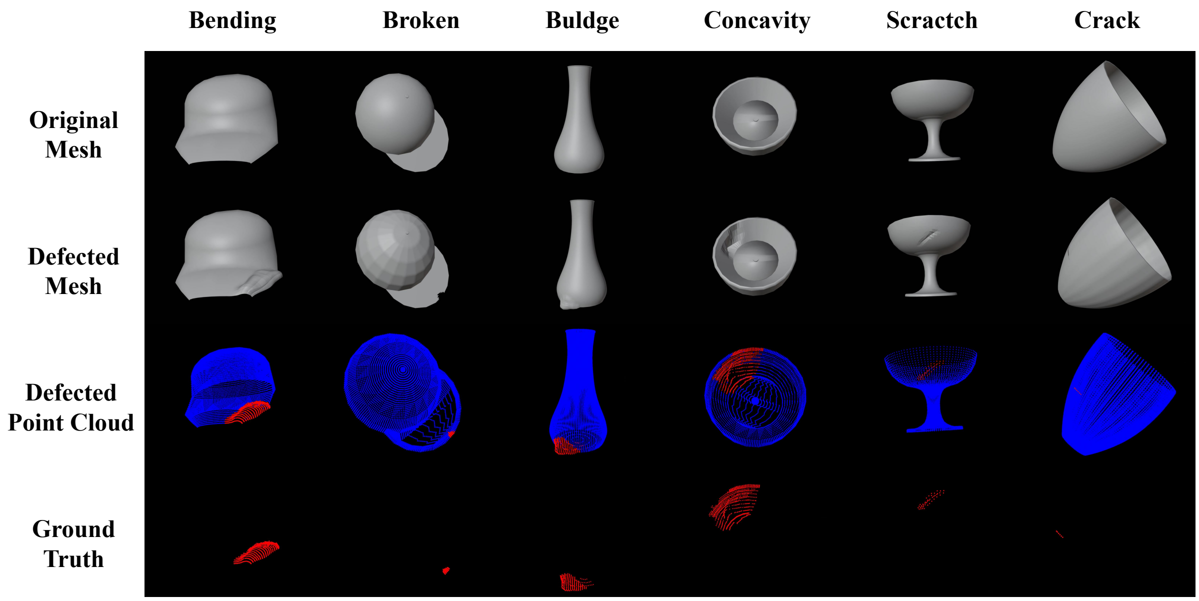


Figure S1. **Examples of the proposed Anomaly-ShapeNet**

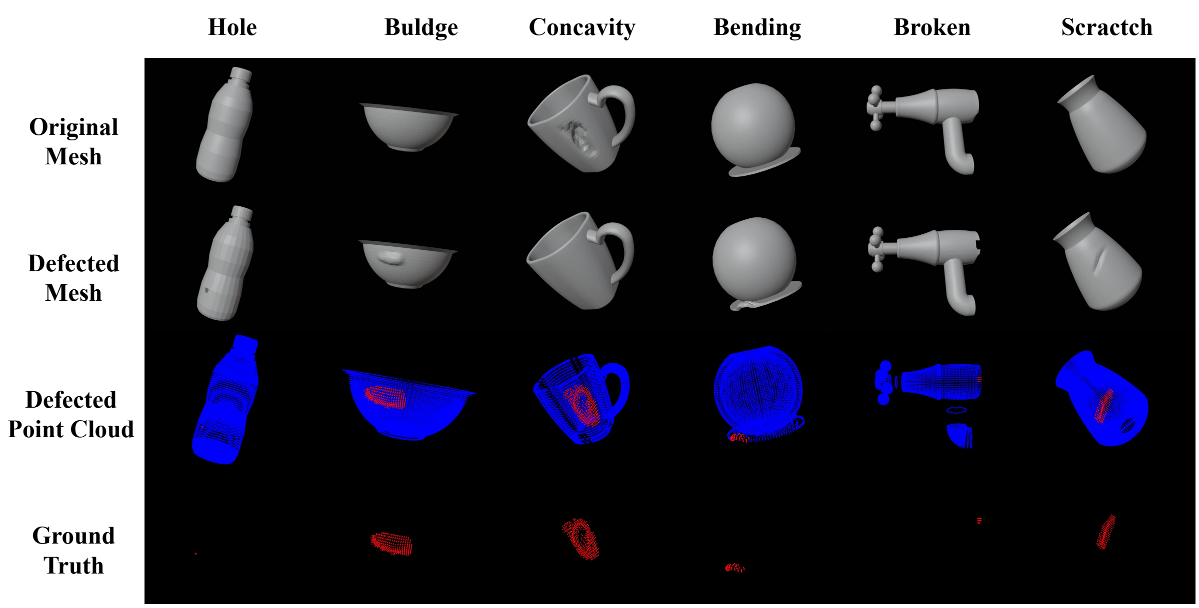


Figure S2. **Examples of the proposed Anomaly-ShapeNet.**

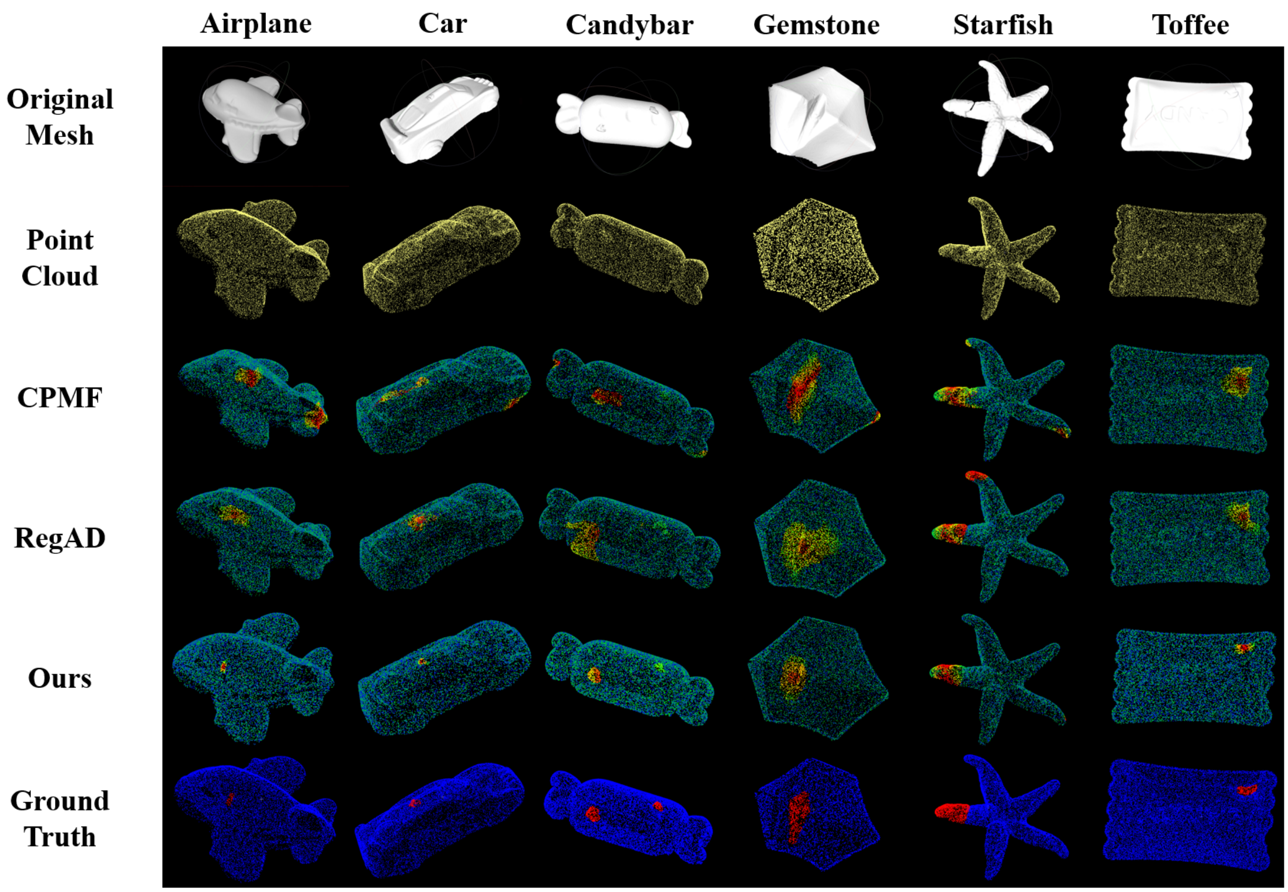
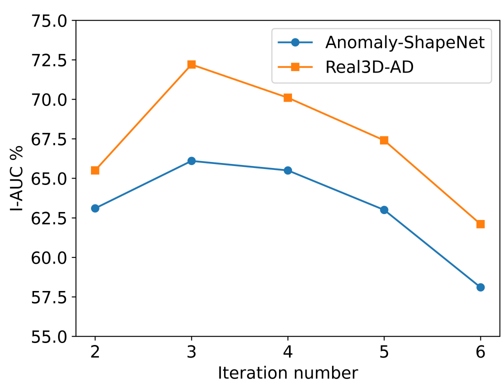
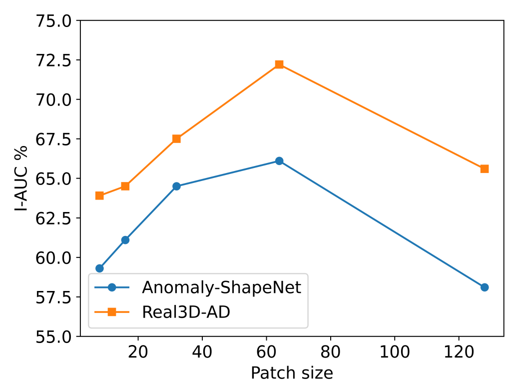


Figure S3. **Qualitative results visualization of anomaly localization performance on Real3D-AD.**



(a) Iteration number influence.



(b) Patch size influence.

Figure S4. Ablation study of iteration number and patch size.

Method	cap0	cap3	helmet3	cup0	bowl4	vase3	headset1	eraser0	vase8	cap4	vase2	vase4	helmet0	bucket1
BTF(Raw)	0.524	0.687	0.700	0.632	0.563	0.602	0.475	0.637	0.550	0.469	0.403	0.613	0.504	0.686
BTF(FPFH)	0.730	0.658	0.724	0.790	0.679	0.699	0.591	0.719	0.662	0.524	0.646	0.710	0.575	0.633
M3DM	0.531	0.605	0.655	0.715	0.624	0.658	0.585	0.710	0.551	0.718	0.737	0.655	0.599	0.699
Patchcore(FPFH)	0.472	0.653	0.737	0.655	0.720	0.430	0.464	0.810	0.575	0.595	0.721	0.505	0.548	0.571
Patchcore(PointMAE)	0.544	0.488	0.615	0.510	0.501	0.465	0.423	0.378	0.364	0.725	0.742	0.523	0.580	0.574
CPMF	0.601	0.551	0.520	0.497	0.683	0.582	0.458	0.689	0.529	0.553	0.582	0.514	0.555	0.601
RegAD	0.632	0.718	0.620	0.685	0.800	0.511	0.626	0.755	0.811	0.815	0.405	0.755	0.600	0.752
Ours	0.715	0.706	0.663	0.643	0.576	0.401	0.476	0.548	0.635	0.753	0.614	0.524	0.598	0.774

Method	bottle3	vase0	bottle0	tap1	bowl0	bucket0	vase5	vase1	vase9	ashtray0	bottle1	tap0	phone	cup1
BTF(Raw)	0.720	0.618	0.551	0.564	0.524	0.617	0.585	0.549	0.564	0.512	0.491	0.527	0.583	0.561
BTF(FPFH)	0.622	0.642	0.641	0.596	0.710	0.401	0.429	0.619	0.568	0.624	0.549	0.568	0.675	0.619
M3DM	0.532	0.608	0.663	0.712	0.658	0.698	0.642	0.602	0.663	0.577	0.637	0.654	0.358	0.556
Patchcore(FPFH)	0.512	0.655	0.654	0.768	0.524	0.459	0.447	0.453	0.663	0.597	0.687	0.733	0.488	0.596
Patchcore(PointMAE)	0.653	0.677	0.553	0.541	0.527	0.586	0.572	0.551	0.423	0.495	0.606	0.858	0.886	0.856
CPMF	0.435	0.458	0.521	0.657	0.745	0.486	0.651	0.486	0.545	0.615	0.571	0.458	0.545	0.509
RegAD	0.525	0.548	0.886	0.741	0.775	0.619	0.624	0.602	0.694	0.698	0.696	0.589	0.599	0.698
Ours	0.641	0.535	0.556	0.699	0.781	0.585	0.682	0.685	0.691	0.671	0.702	0.681	0.742	0.688

Method	vase7	helmet2	cap5	shelf0	bowl5	bowl3	helmet1	bowl1	headset0	bag0	bowl2	jar	**Mean**
BTF(Raw)	0.578	0.605	0.373	0.464	0.517	0.685	0.449	0.464	0.578	0.430	0.426	0.423	0.550
BTF(FPFH)	0.540	0.643	0.586	0.619	0.699	0.590	0.749	0.768	0.620	0.746	0.518	0.427	0.628
M3DM	0.517	0.623	0.655	0.554	0.489	0.657	0.427	0.663	0.581	0.637	0.694	0.541	0.616
Patchcore(FPFH)	0.693	0.455	0.795	0.613	0.358	0.327	0.489	0.531	0.583	0.574	0.625	0.478	0.580
Patchcore(PointMAE)	0.651	0.651	0.545	0.543	0.562	0.581	0.562	0.524	0.575	0.674	0.515	0.487	0.577
CPMF	0.504	0.515	0.551	0.783	0.684	0.641	0.542	0.488	0.699	0.655	0.635	0.611	0.573
RegAD	0.881	0.825	0.467	0.688	0.691	0.654	0.624	0.615	0.580	0.715	0.593	0.599	0.668
Ours	0.593	0.644	0.742	0.605	0.715	0.599	0.604	0.705	0.705	0.668	0.684	0.765	0.650

Table S1. **P-AUROC score for anomaly detection of 40 categories of our Anomaly-ShapeNet dataset**

Method	cap0	cap3	helmet3	cup0	bowl4	vase3	headset1	eraser0	vase8	cap4	vase2	vase4	helmet0	bucket1
BTF(Raw)	0.659	0.612	0.526	0.601	0.601	0.717	0.515	0.425	0.416	0.515	0.413	0.428	0.559	0.620
BTF(FPFH)	0.618	0.579	0.564	0.585	0.632	0.652	0.523	0.719	0.624	0.545	0.569	0.587	0.568	0.648
M3DM	0.564	0.652	0.458	0.570	0.571	0.551	0.623	0.625	0.463	0.477	0.615	0.526	0.528	0.507
Patchcore(FPFH)	0.585	0.457	0.494	0.604	0.575	0.481	0.601	0.584	0.515	0.655	0.801	0.777	0.525	0.565
Patchcore(PointMAE)	0.561	0.583	0.611	0.642	0.601	0.455	0.423	0.801	0.655	0.721	0.711	0.586	0.633	0.642
CPMF	0.601	0.541	0.645	0.647	0.683	0.588	0.619	0.544	0.673	0.645	0.632	0.655	0.333	0.501
RegAD	0.693	0.711	0.468	0.531	0.624	0.651	0.617	0.424	0.629	0.623	0.641	0.505	0.600	0.714
Ours	0.711	0.702	0.575	0.455	0.630	0.708	0.656	0.599	0.639	0.658	0.655	0.528	0.697	0.732

Method	bottle3	vase0	bottle0	tap1	bowl0	bucket0	vase5	vase1	vase9	ashtray0	bottle1	tap0	phone	cup1
BTF(Raw)	0.543	0.562	0.466	0.594	0.588	0.652	0.615	0.441	0.482	0.578	0.573	0.535	0.613	0.701
BTF(FPFH)	0.602	0.641	0.644	0.575	0.576	0.483	0.472	0.655	0.638	0.651	0.625	0.610	0.662	0.651
M3DM	0.451	0.788	0.763	0.638	0.525	0.609	0.633	0.652	0.651	0.632	0.674	0.722	0.464	0.752
Patchcore(FPFH)	0.579	0.645	0.615	0.684	0.548	0.604	0.515	0.623	0.660	0.445	0.677	0.712	0.332	0.586
Patchcore(PointMAE)	0.651	0.548	0.545	0.542	0.562	0.541	0.585	0.572	0.634	0.679	0.645	0.712	0.652	0.710
CPMF	0.505	0.632	0.588	0.697	0.775	0.662	0.518	0.645	0.618	0.453	0.592	0.639	0.655	0.609
RegAD	0.474	0.615	0.632	0.599	0.494	0.632	0.588	0.468	0.574	0.588	0.695	0.676	0.614	0.638
Ours	0.648	0.573	0.558	0.796	0.481	0.578	0.654	0.725	0.462	0.612	0.702	0.401	0.552	0.627

Method	vase7	helmet2	cap5	shelf0	bowl5	bowl3	helmet1	bowl1	headset0	bag0	bowl2	jar	**Mean**
BTF(Raw)	0.547	0.615	0.653	0.624	0.615	0.654	0.388	0.464	0.379	0.458	0.576	0.428	0.549
BTF(FPFH)	0.592	0.588	0.593	0.611	0.699	0.499	0.721	0.648	0.531	0.551	0.515	0.479	0.598
M3DM	0.648	0.636	0.642	0.665	0.601	0.635	0.627	0.515	0.632	0.642	0.630	0.555	0.603
Patchcore(FPFH)	0.621	0.475	0.725	0.504	0.541	0.620	0.630	0.545	0.701	0.608	0.611	0.499	0.588
Patchcore(PointMAE)	0.652	0.496	0.542	0.543	0.585	0.556	0.571	0.611	0.515	0.601	0.456	0.463	0.595
CPMF	0.432	0.477	0.697	0.681	0.685	0.418	0.501	0.621	0.602	0.655	0.601	0.618	0.597
RegAD	0.455	0.618	0.77	0.675	0.555	0.441	0.381	0.515	0.538	0.608	0.495	0.601	0.584
Ours	0.601	0.602	0.502	0.625	0.652	0.614	0.615	0.504	0.701	0.665	0.681	0.760	0.621

Table S2. **I-AP score for anomaly detection of 40 categories of our Anomaly-ShapeNet dataset**