Anomaly Detection in 3D Point Clouds using Deep Geometric Descriptors Supplementary Material

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1. Additional Information on Ablation Experiments

For reference, we report numerical values of the results of our ablation studies corresponding to the line and bar charts in our main manuscript.

Lower Integration Limits. In our work, quantitative results are reported as AU-PRO, i.e., PRO values integrated over false-positive rates (FPR). In the majority of our experiments, we limit the FPR by an upper integration limit of 0.3. In order to enable a comparison at lower integration limits, we list the performance of our method at four different integration limits $\{0.01, 0.05, 0.10, 0.20\}$ in Table 1. The first four rows show the performance of our model with a descriptor dimension of $d = 64$. The bottom four rows show the corresponding performance of our model with feature dimension $d = 128$. These values are also depicted in the line plot shown in Figure 5 of our main manuscript.

Varying Key Model Hyperparameters. We performed an ablation study with respect to the key hyperparameters of our proposed approach. In particular, we analyzed the dependency of the anomaly detection performance on the number of input points, the feature dimension of the geometric descriptors, and the number of nearest neighbors used for local feature aggregation. In Table 2, we provide the numerical values for this ablation study. The values correspond to the line plots in Figure 6 of our main manuscript.

Modifying the Training Strategy. We also experimented with different training strategies applied to our proposed approach. We tested the effects of a randomly initialized teacher network, adding absolute point coordinates to the model, and incorporating rotation invariance to the anomaly detection training. We then examined different pretraining datasets and pretrained feature extractors. The numerical values for these experiments are listed in Table 3. These values correspond to the bar plots in Figure 7 of our main manuscript.

2. Additional Qualitative Results

Figure 1 shows additional qualitative results of our method for each dataset category of the MVTec 3D-AD dataset for which our method reliably localizes anomalies.

	integration limit	bagel	cable gland	carrot	cookie	dowel	foam	peach	potato	rope	tire	mean
$d = 64$	0.01	0.361	0.019	0.690	0.461	0.147	0.232	0.433	0.762	0.558	0.008	0.367
	0.05	0.718	0.095	0.909	0.699	0.481	0.428	0.735	0.934	0.841	0.083	0.592
	0.10	0.832	0.177	0.954	0.791	0.662	0.505	0.837	0.966	0.910	0.187	0.682
	0.20	0.910	0.322	0.977	0.869	0.815	0.578	0.909	0.983	0.952	0.364	0.768
$d = 128$	0.01	0.438	0.023	0.710	0.500	0.239	0.278	0.511	0.791	0.630	0.015	0.414
	0.05	0.776	0.114	0.917	0.741	0.581	0.456	0.773	0.933	0.876	0.113	0.628
	0.10	0.867	0.200	0.957	0.824	0.738	0.521	0.858	0.964	0.932	0.223	0.709
	0.20	0.927	0.352	0.979	0.891	0.858	0.584	0.920	0.982	0.965	0.399	0.786

Table 1: Performance of our method on the MVTec 3D-AD dataset for various integration limits.

Performance Metric	Number of Points				Feature Dimension					Nearest Neighbors			
	16	32	64	128	16	32	64	128	256	8	16	32	64
Localization (AU-PRO)	0.759	0.803	0.818	0.821	0.740	0.785	0.818	0.833	0.833	0.755	0.804	0.818	0.821
Inference Time (s)	0.014	0.026	0.049	0.080	0.017	0.028	0.049	0.093	0.189	0.020	0.030	0.049	0.080
Training Mem. (GB)	2.29	3.33	5.89	7.87	2.06	3.54	5.89	10.98	21.13	2.43	3.98	5.89	10.86
Inference Mem. (GB)	1.71	2.15	2.71	3.47	1.75	2.24	2.71	5.14	8.81	1.79	2.28	2.71	4.76

Table 2: Ablation study on various hyperparameters of our proposed method.

Training Strategy	AU-PRO	Pretraining Dataset	AU-PRO	Feature Extractor	AU-PRO
Random Weights	0.278	ITODD	0.820	FCGF	0.719
Absolute Coordinates	0.505	3DMatch	0.819	PPF-FoldNet	0.682
Rotation Invariance	0.650	KITTI	0.735	-	-

Table 3: Performance of our method in relation to changes to the training strategy. The numbers represent the AU-PRO values with an upper integration limit of 0.3.

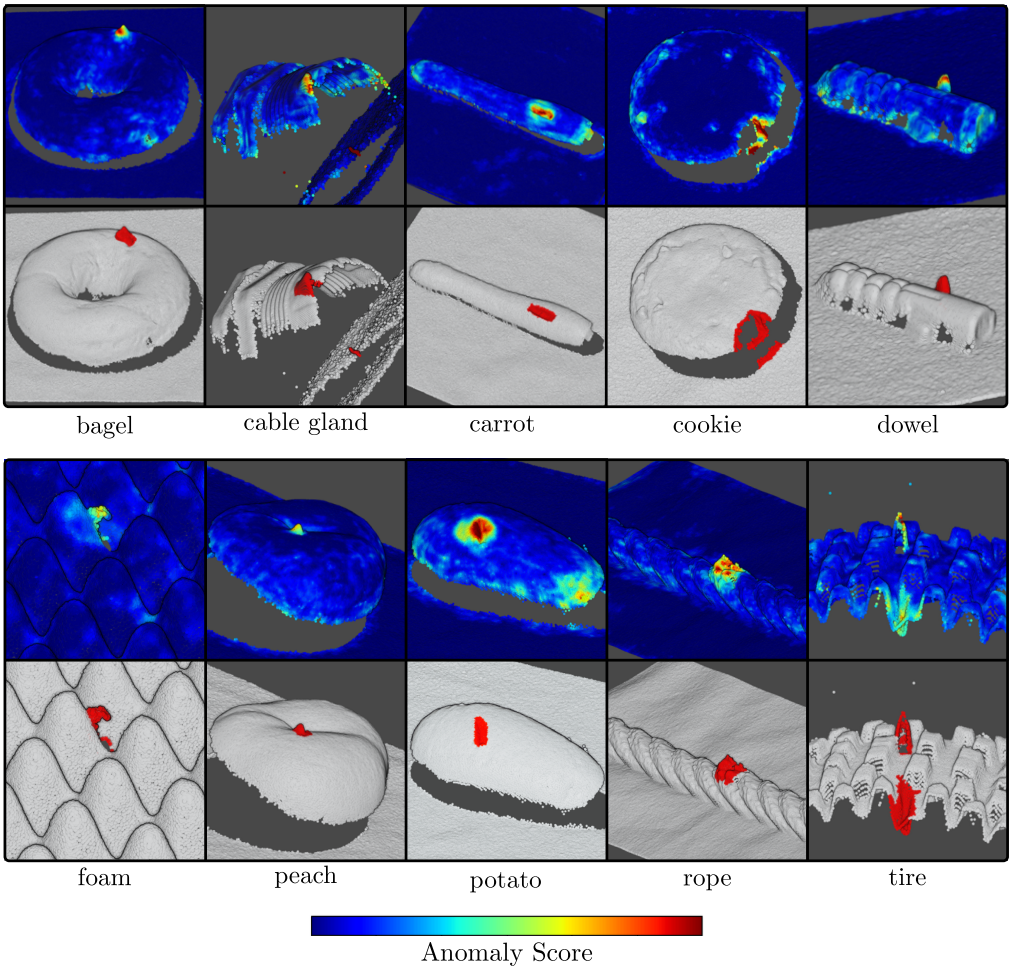

Figure 1: Additional qualitative results of our method on the MVTec 3D-AD dataset. Top row: Anomaly scores for each 3D point predicted by our algorithm. Bottom row: Ground truth annotations of anomalous points in red.