

## Appendix

### A. Details in Image-wise and pixel-wise AUROCs

Image-wise and pixel-wise AUROCs of each class in MVTec-AD, which have not been listed in detail in Section 4.2, are reported in Table 1. N-pad achieves state-of-the-art performance in pixel-wise AUROC for all classes except for carpet, grid and screw.

Method Class/Model	Normalizing Flow Based			Pre-trained Feature Based			
	FastFlow	PEFM	CFLOW-AD	SPADE	PaDiM	PatchCore	<i>N-pad</i>
Bottle	<b>100/98.10</b>	<b>100/98.11</b>	<b>100/98.14</b>	- /98.4	-/98.3	<b>100/98.6</b>	<b>100/98.91</b>
Cable	97.58/96.98	98.95/96.58	97.41/96.70	-/97.2	-/96.7	99.4/98.5	<b>99.54/98.88</b>
Capsule	98.52/98.84	91.90/97.94	97.69/98.64	-/99.0	-/98.5	97.8/98.9	<b>99.40/98.96</b>
Carpet	99.15/98.95	100/99.00	99.04/98.99	-/97.5	-/99.1	98.7/ <b>99.1</b>	<b>99.27/99.03</b>
Grid	<b>99.68/99.24</b>	96.57/98.48	96.24/96.76	-/93.7	-/97.3	97.9/98.7	98.67/98.13
Hazelnut	97.96/97.62	99.89/98.78	<b>100/98.35</b>	-/99.1	-/98.2	<b>100/98.7</b>	<b>100/99.03</b>
Leather	<b>100/99.41</b>	<b>100/99.24</b>	<b>100/99.36</b>	-/97.6	-/99.2	<b>100/99.3</b>	<b>100/99.43</b>
Metalnut	99.51/98.36	99.85/96.89	98.92/98.32	-/98.1	-/97.2	<b>100/98.4</b>	<b>100/99.19</b>
Pill	<b>98.22/97.64</b>	97.51/96.67	96.92/98.70	-/96.5	-/95.7	96.0/97.6	98.00/ <b>99.04</b>
Screw	86.34/98.48	96.43/98.93	83.95/97.74	-/98.9	-/98.5	97.0/ <b>99.4</b>	<b>97.40/98.80</b>
Tile	<b>100/96.45</b>	99.49/95.19	<b>100/97.30</b>	-/87.4	-/94.1	98.9/95.9	<b>100/97.62</b>
Toothbrush	89.16/97.87	96.38/98.28	92.78/98.27	-/97.9	-/98.8	99.7/98.7	<b>100/99.00</b>
Transistor	98.58/97.07	97.83/96.58	97.38/93.15	-/94.1	-/98.5	<b>100/96.4</b>	99.58/ <b>98.55</b>
Wood	<b>99.56/96.23</b>	99.19/95.27	99.30/94.80	-/88.5	-/94.9	99.0/95.1	<b>99.56/97.49</b>
Zipper	98.55/99.04	98.03/98.29	99.03/98.38	-/96.5	-/98.5	<b>99.5/98.9</b>	99.34/ <b>99.16</b>
Average	97.52/98.03	98.13/97.61	97.24/97.57	-/96.0	-/97.5	99.0/98.1	<b>99.37/98.75</b>

Table 1. Image-wise and pixel-wise AUROC comparison of various models on MVTec-AD dataset

### B. Details in PRO-score

PRO-scores of each class in the MVTec-AD, which have not been listed in detail in Section 4.2, are reported in Table 2. Here, N-pad reports the best performance in terms of PRO score for 11 out of 15 classes of MVTec-AD. Specifically, previous models report higher scores only for carpet, grid, screw, and zipper. Thus, we may suggest that the proposed model has been developed with superior performance.

Model/Class	Bottle	Cable	Capsu.	Carpet	Grid	Hazel.	Leat.	Metal.	Pill	Screw	Tile	Tooth.	Trans.	Wood	Zip.	Average
FastFlow	91.9	89.6	92.7	96.3	<b>97.4</b>	94.5	<b>99.1</b>	93.4	92.4	92.6	89.1	83.6	91.7	93.0	96.7	93.0
CFLOW	93.2	92.6	93.9	95.3	89.5	95.3	98.5	90.2	94.4	91.7	86.8	85.7	84.7	90.4	93.1	91.7
PEFM	95.4	93.7	93.4	96.3	94.8	95.5	98.3	93.1	95.2	94.7	81.5	89.0	79.9	90.3	95.1	92.4
SPADE	95.5	90.9	93.7	94.7	86.7	95.4	97.2	94.4	94.6	<b>96.0</b>	75.6	93.5	87.4	87.4	92.6	91.7
PaDiM	94.8	88.8	93.5	96.2	94.6	92.6	97.8	85.6	92.7	94.4	86.0	93.1	84.5	91.1	95.9	92.1
PatchCore	96.1	92.6	95.5	<b>96.6</b>	95.9	93.9	98.9	91.3	94.1	97.9	87.4	91.4	83.5	89.6	<b>97.1</b>	93.5
<i>N-pad</i>	<b>96.3</b>	<b>97.2</b>	<b>95.7</b>	95.6	94.2	<b>95.6</b>	97.2	<b>95.1</b>	<b>97.1</b>	94.9	<b>89.8</b>	<b>93.7</b>	<b>94.5</b>	<b>93.4</b>	<b>97.1</b>	<b>95.1</b>

Table 2. PRO-score comparison of various models on MVTec-AD dataset

### C. Visual result

We present pixel-wise anomaly maps of several anomalous images for all classes in MVTec-AD that were computed by PaDiM, PatchCore and *N-pad* in Figs. 1 to 3. Herein, pixel-wise anomaly maps were visualized by normalizing the anomaly scores from 20% to 80% to eliminate relatively nominal pixels and emphasize the anomalous regions. The results are as follows:

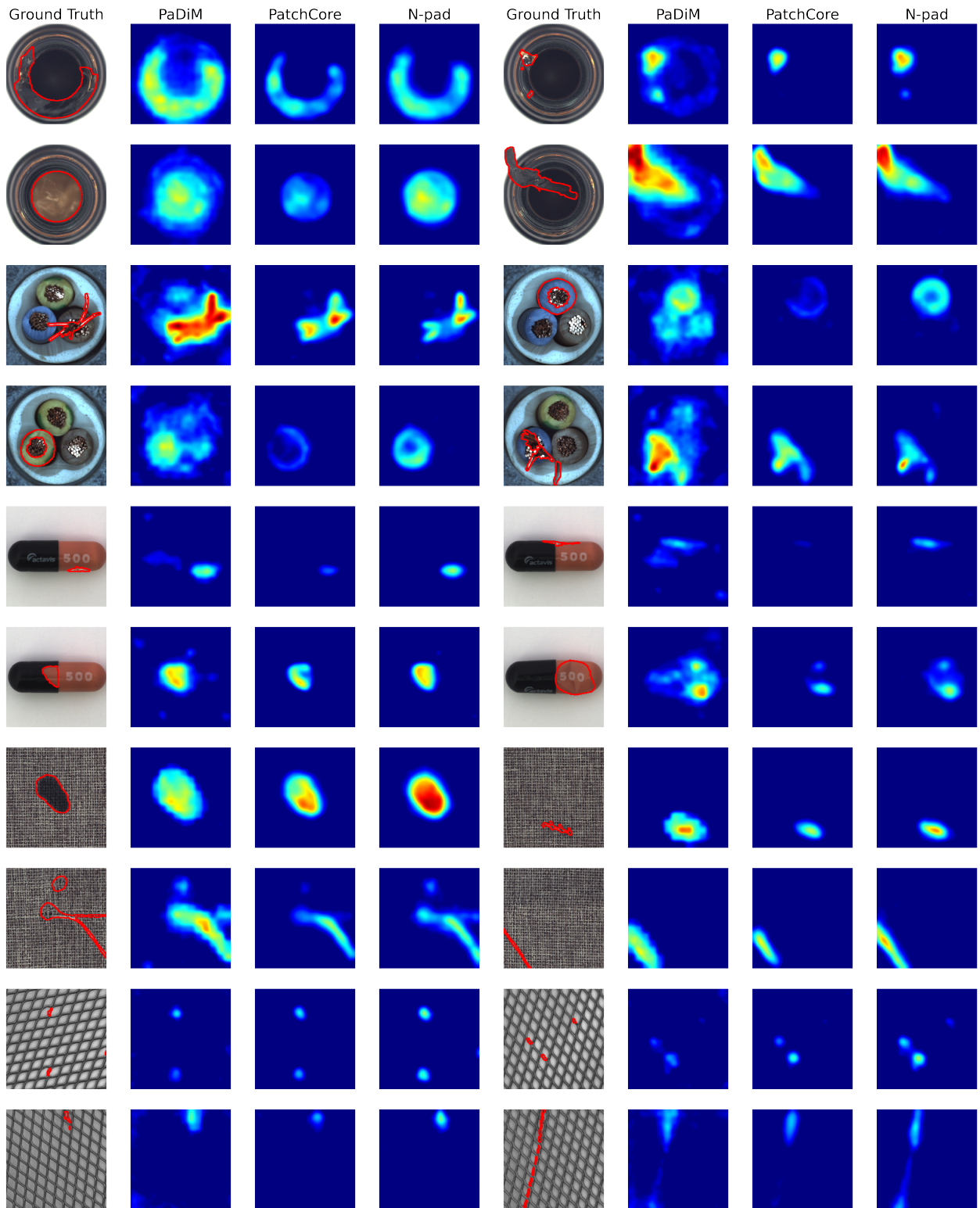


Figure 1. Visualization anomalies from top to bottom: bottle, cable, capsule, carpet, and grid.

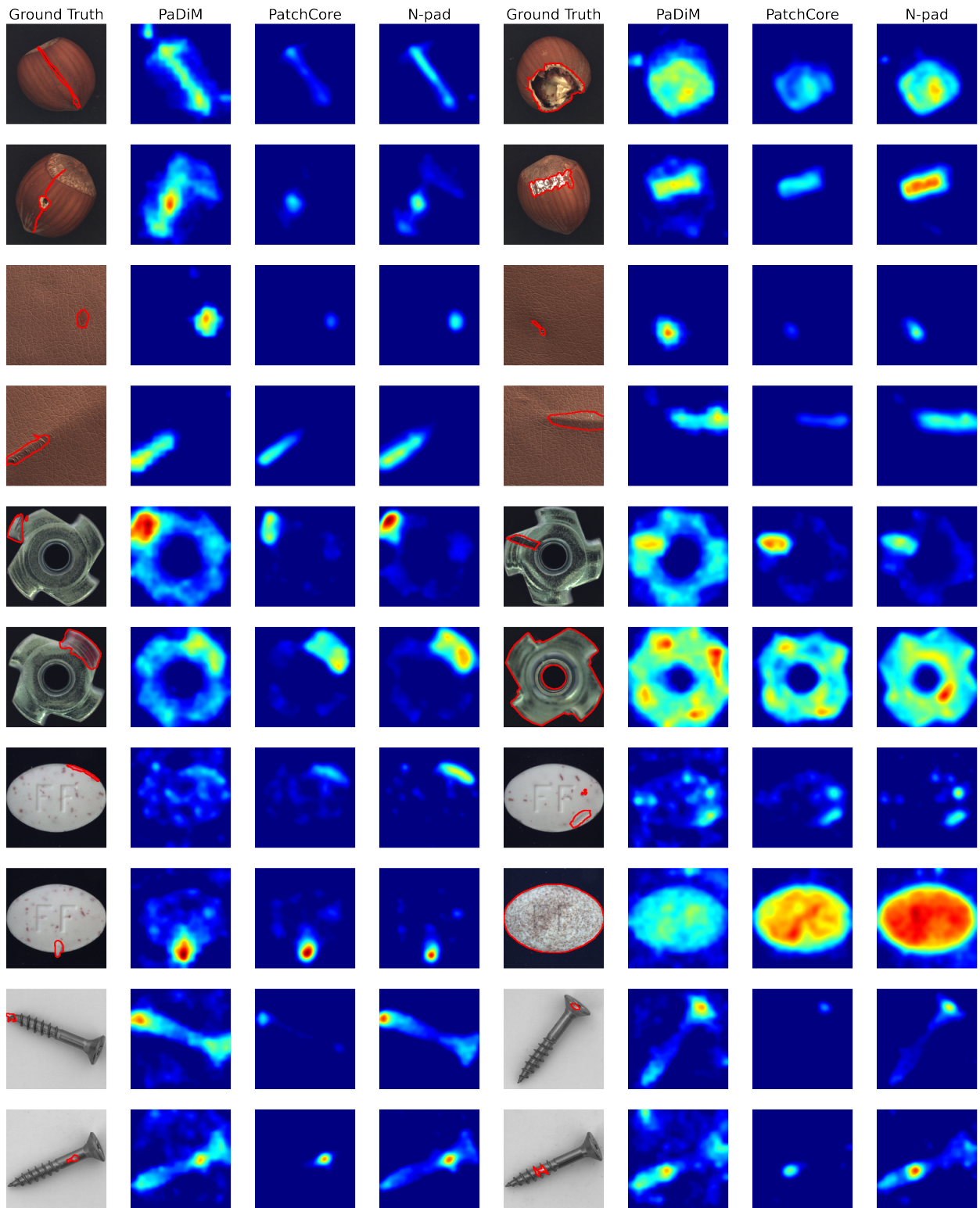


Figure 2. Visualization anomalies from top to bottom: hazelnut, leather, metalnut, pill, and screw.

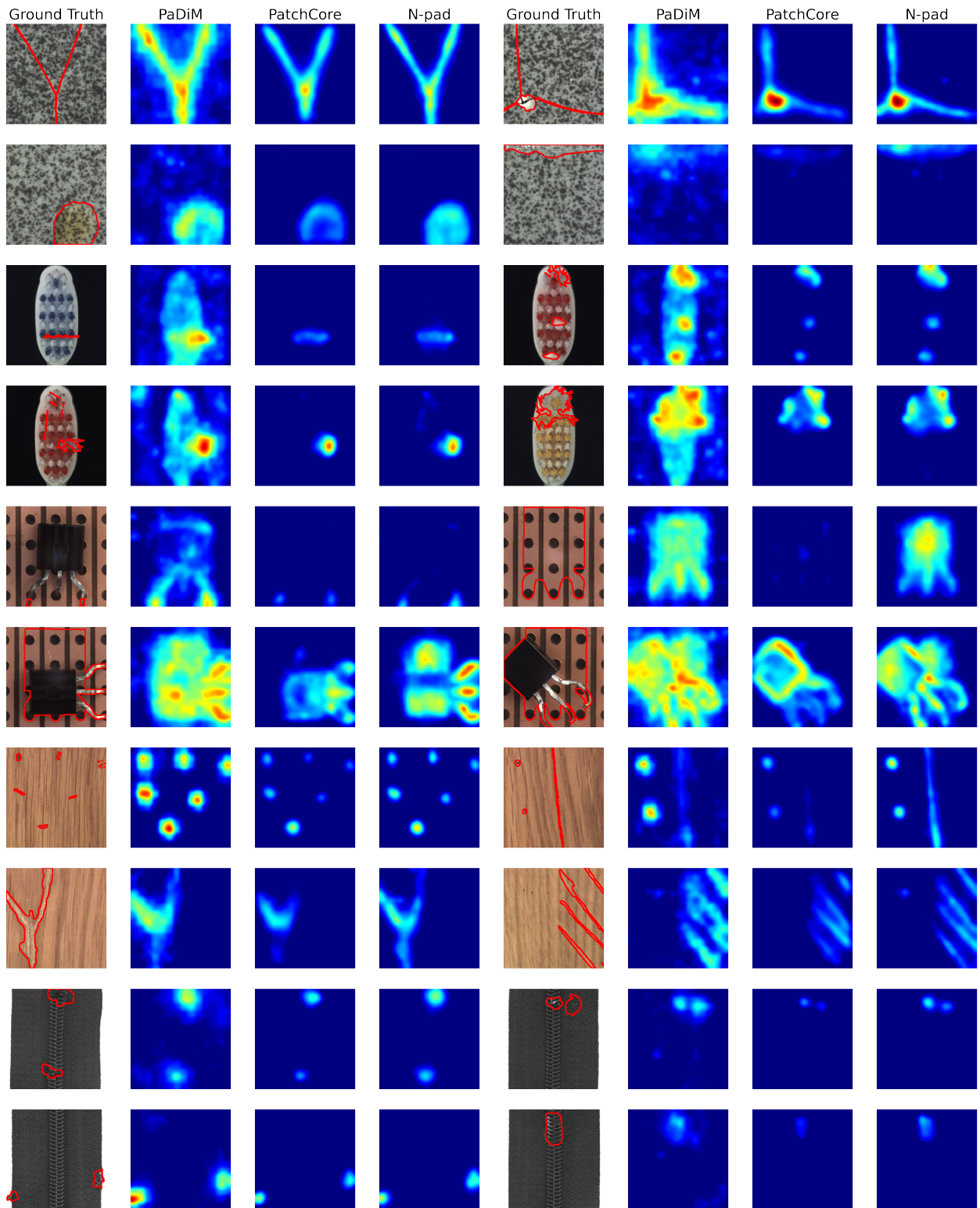


Figure 3. Visualization anomalies from top to bottom: tile, toothbrush, transistor, wood and zipper.