

华中科技大学

Huazhong University of Science and Technology

RoBiS: Robust Binary Segmentation for High-Resolution Industrial

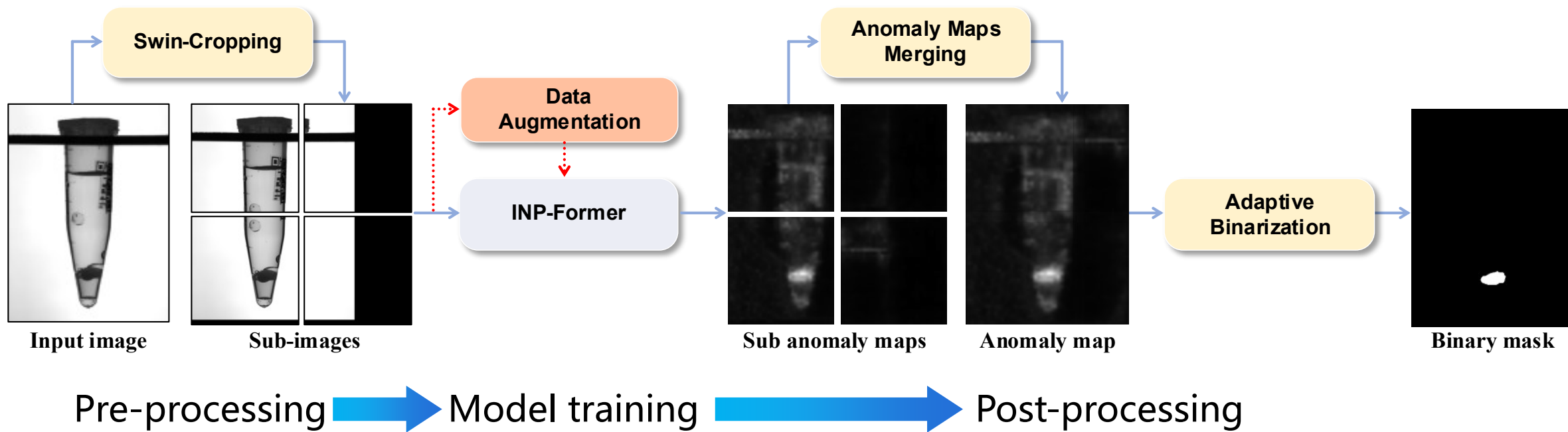
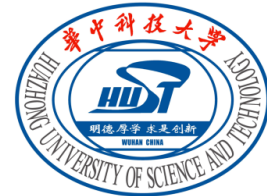
(VAND3.0 challenge Track 1 second place)

Authors: Xurui Li, Zhongsheng Jiang, Tingxuan Ai, Yu Zhou

Speaker: Xurui Li

Email: xrli_plus@hust.edu.cn

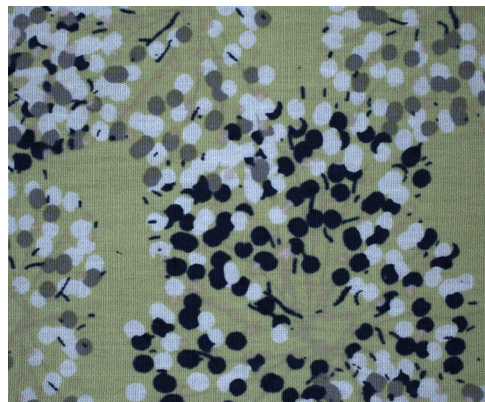
Pipeline



Dataset pre-processing

Challenge

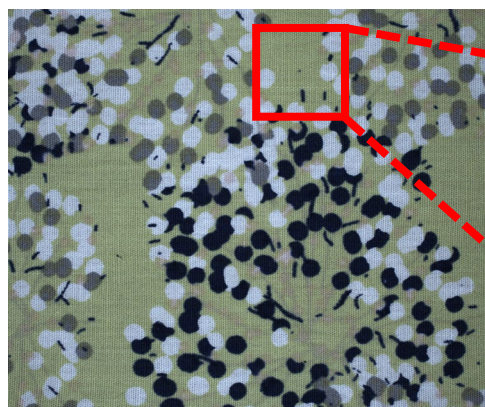
All images are high-resolution



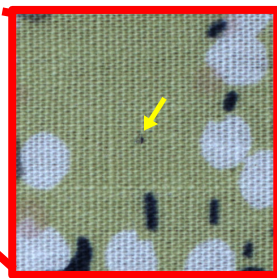
2448×2048



Some defects are subtle

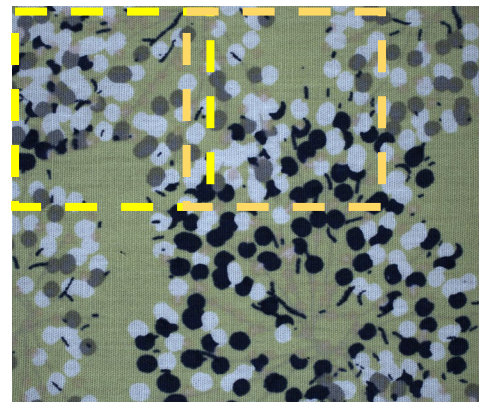


5px

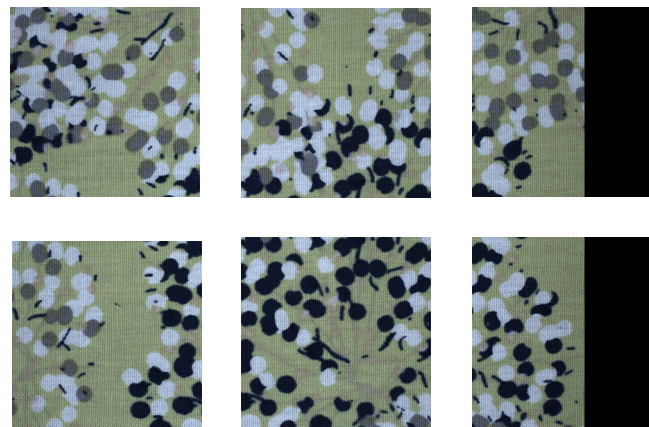


Solution

Swin-cropping operation



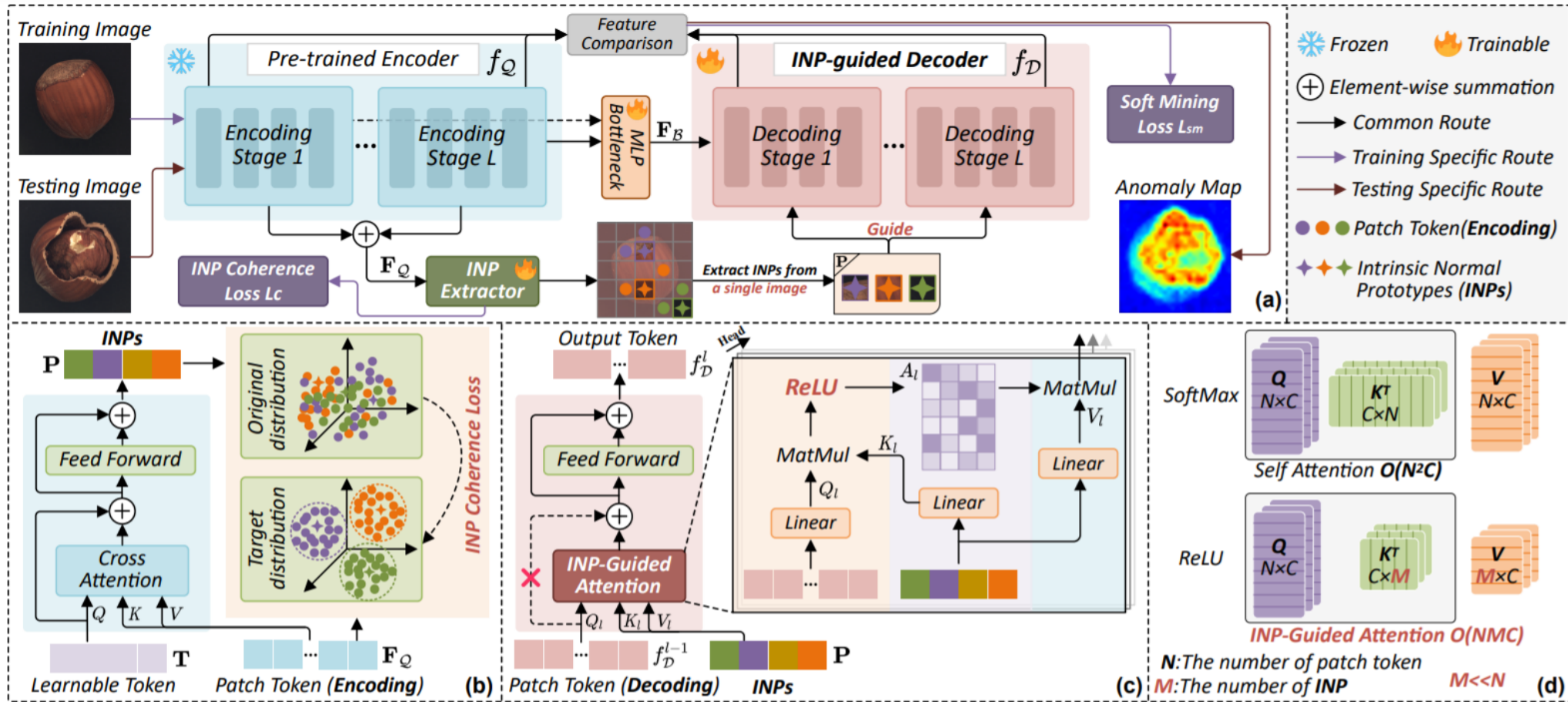
Window size
1024×1024
Overlap 10%



Sub-images

Model design

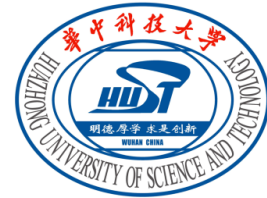
Baseline: INP-Former^[1] (CVPR 2025)



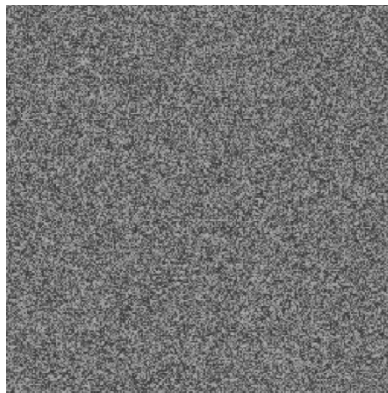
The SOTA multi-class method to handle differences between sub-images

Model design

Data augmentation of lighting condition and noise



(1) Inject gaussian noise



mean=0, std=15

(2) Simulate illumination variations

$$\hat{I}_i = \text{clamp}(\bar{I}_i * 2^\lambda)$$

Clamp(\cdot) : constrain pixel values to [0, 255]

$\lambda \sim \mathcal{U}(-0.2, 0.2)$ controls exposure levels

$\lambda > 0$: overexposure $\lambda < 0$: underexposure

Results post-processing

Adaptive binarization :

mean + 3std

Segment regions
with high scores



MEBin^[2]

Segment regions with stable
connected-component



Ours

False negatives ↓

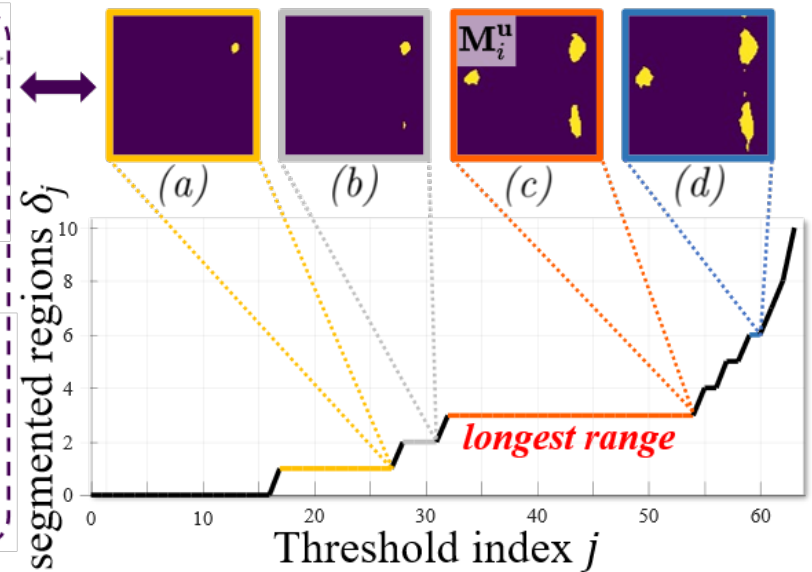
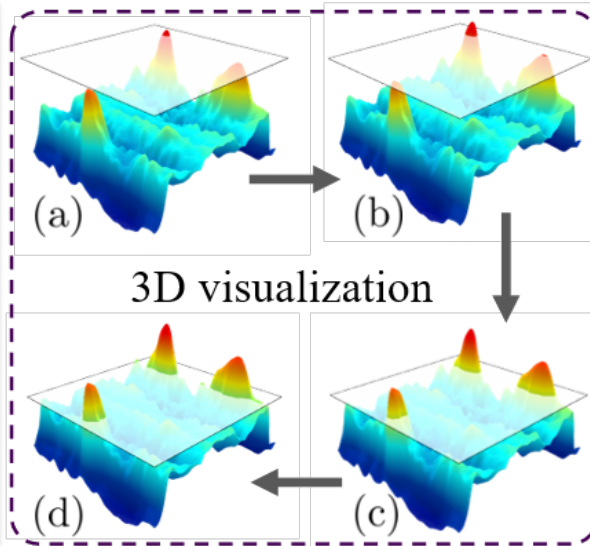
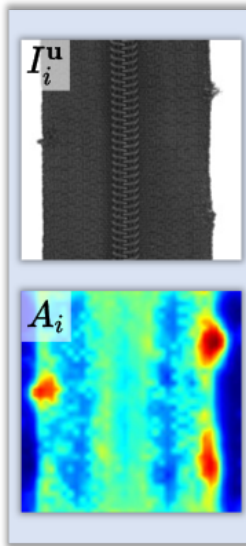
MEBin^[2]

Anomaly detection

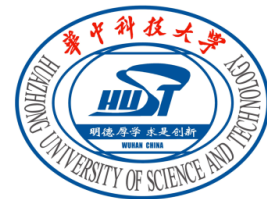
Setting threshold
search range ①

Binarization using
all thresholds ②

Finding main
anomaly regions ③

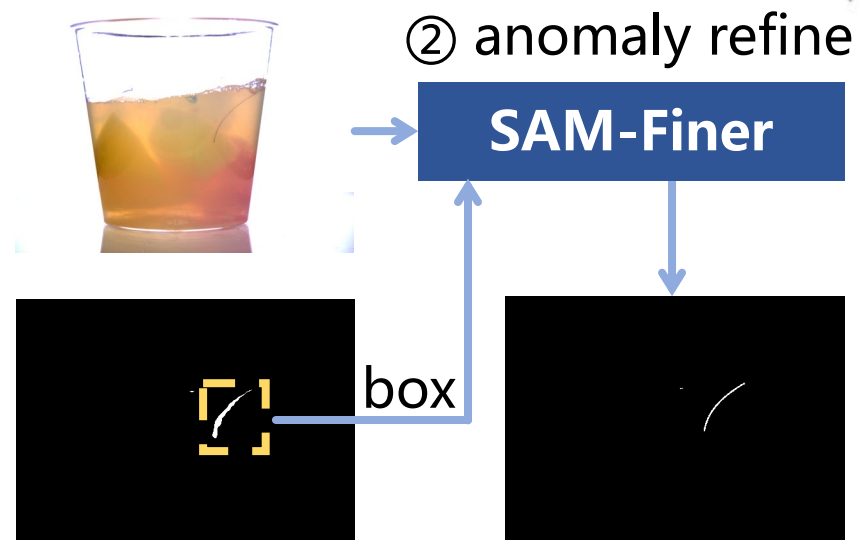
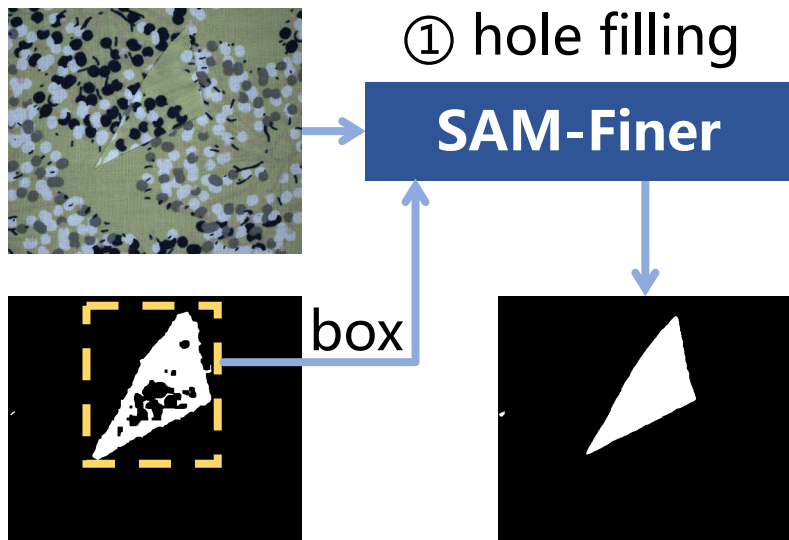
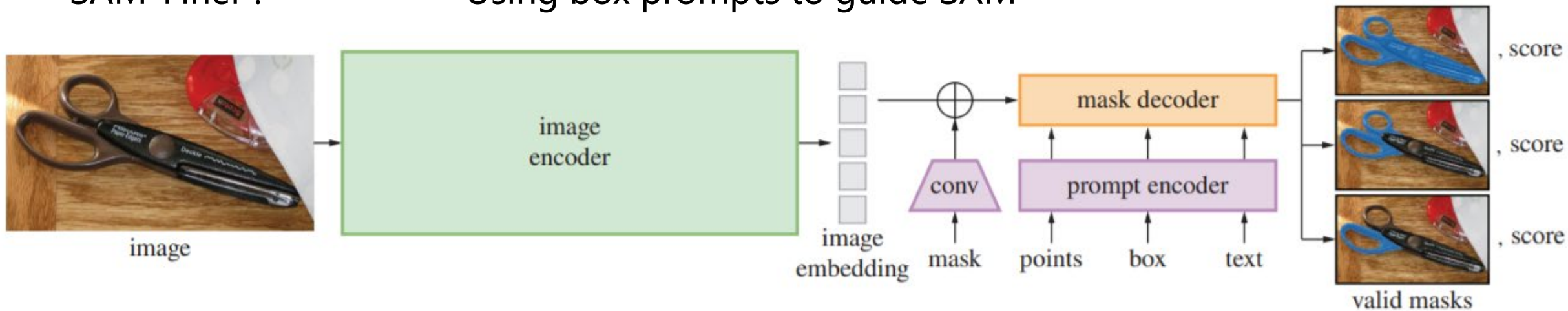


Results post-processing



SAM-Finer :

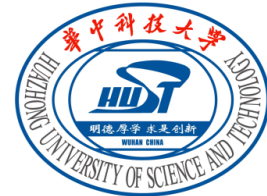
Using box prompts to guide SAM^[3]



[3] Alexander Kirillov, Eric Mintun, Nikhila Ravi, Hanzi Mao, Chloe Rolland, Laura Gustafson, Tete Xiao, Spencer Whitehead, Alexander C Berg, Wan-Yen Lo, et al.

Segment anything. In IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR), pages 4015–4026, 2023. 3

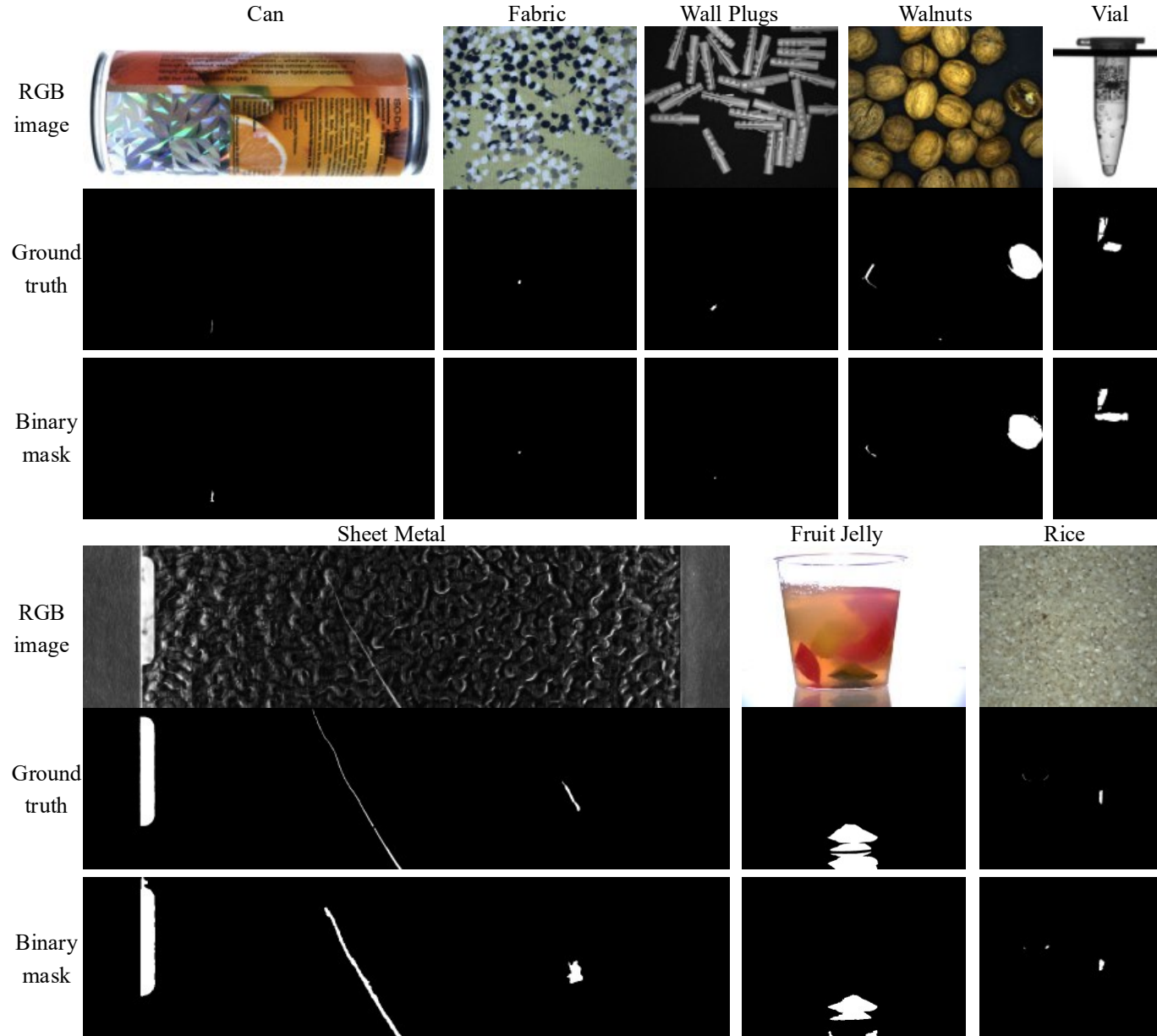
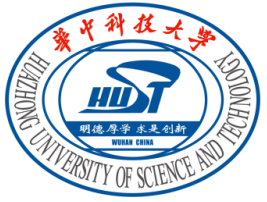
Quantitative results



Object	PatchCore [20]	RD [7]	RD++ [21]	EfficientAD [1]	MSFlow [29]	SimpleNet [16]	DSR [27]	RoBiS (Ours)
Can	0.3 / 0.1	0.1 / 0.1	0.1 / 0.1	0.8 / 0.1	5.0 / 0.1	0.6 / 0.1	0.4 / 0.1	<u>1.86</u> / 0.84
Fabric	11.5 / 9.8	2.6 / 2.2	2.9 / 2.3	7.6 / 1.0	<u>22.0</u> / 4.1	21.6 / <u>10.2</u>	7.9 / 5.0	87.46 / 73.37
Fruit Jelly	8.7 / 8.2	22.5 / 22.7	26.9 / 26.7	20.8 / 18.2	<u>47.6</u> / <u>38.1</u>	25.1 / 23.0	17.9 / 17.2	53.63 / 52.62
Rice	3.8 / <u>4.2</u>	7.0 / 3.9	9.5 / 2.9	15.0 / 0.5	<u>19.1</u> / 1.8	11.6 / 1.0	1.5 / 1.4	63.86 / 63.23
Sheet Metal	1.8 / 1.1	<u>41.3</u> / <u>39.2</u>	40.9 / 37.7	9.3 / 3.8	13.0 / 7.6	14.6 / 2.8	13.9 / 14.4	70.98 / 70.92
Vial	2.3 / 2.2	28.0 / <u>28.3</u>	28.2 / 22.8	30.5 / 26.5	23.3 / 6.2	<u>31.9</u> / 17.5	28.2 / 27.9	48.73 / 48.83
Wall Plugs	0.0 / 0.0	1.9 / 0.8	1.3 / <u>0.9</u>	<u>4.4</u> / 0.3	0.1 / 0.2	1.0 / 0.3	0.4 / 0.4	14.38 / 3.40
Walnuts	1.2 / 1.3	41.2 / 36.7	44.1 / <u>40.5</u>	34.6 / 13.3	<u>44.5</u> / 14.3	35.2 / 14.3	17.0 / 9.6	67.13 / 58.94
Mean	3.7 / 3.4	18.1 / <u>16.7</u>	19.2 / <u>16.7</u>	15.4 / 8.0	<u>21.8</u> / 9.0	17.7 / 8.7	10.9 / 9.5	51.00 / 46.52

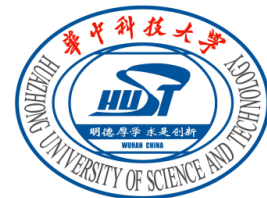
Our method significantly outperforms the existing methods on $Test_{priv}$ / $Test_{priv,mixed}$

Qualitative results



Accurately locate defects of different sizes and shapes

Participants



We are from **SLOW team** of Huazhong University of Science and Technology



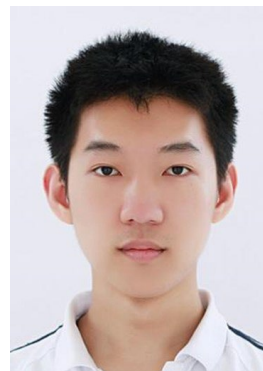
Xurui Li (李煦蕊)

xrli_plus@hust.edu.cn



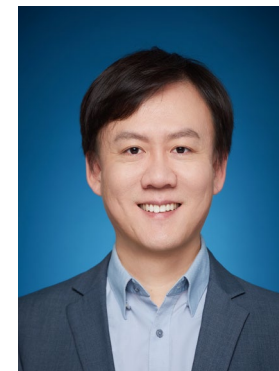
Zhongsheng Jiang (蒋中盛)

zsjiang@hust.edu.cn



Tingxuan Ai (艾廷轩)

tingxuanai@hust.edu.cn

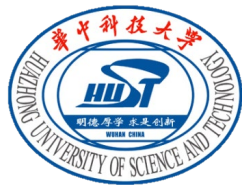


Yu Zhou (周瑜)

yuzhou@hust.edu.cn

We sincerely acknowledge Wuhan Jingce Electronic Group Co., Ltd. for their support of our studies in industrial anomaly detection.





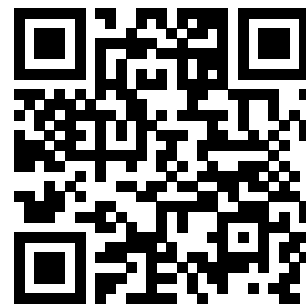
华中科技大学

Huazhong University of Science and Technology

Paper



Code



<https://github.com/xrli-U/RoBiS>

Thank you !