

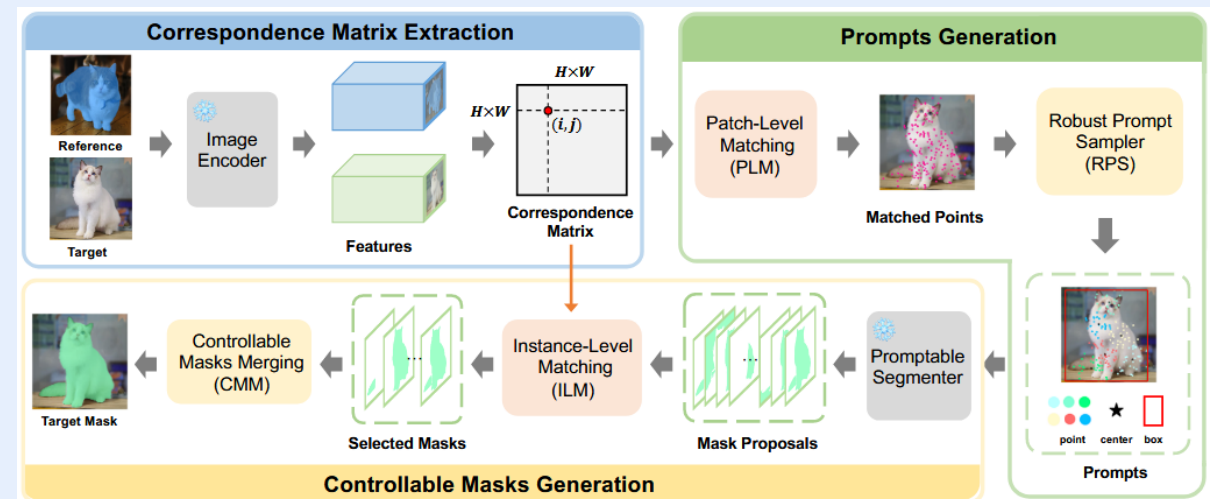
Bridge the Points: Graph-based Few-shot Segment Anything Semantically

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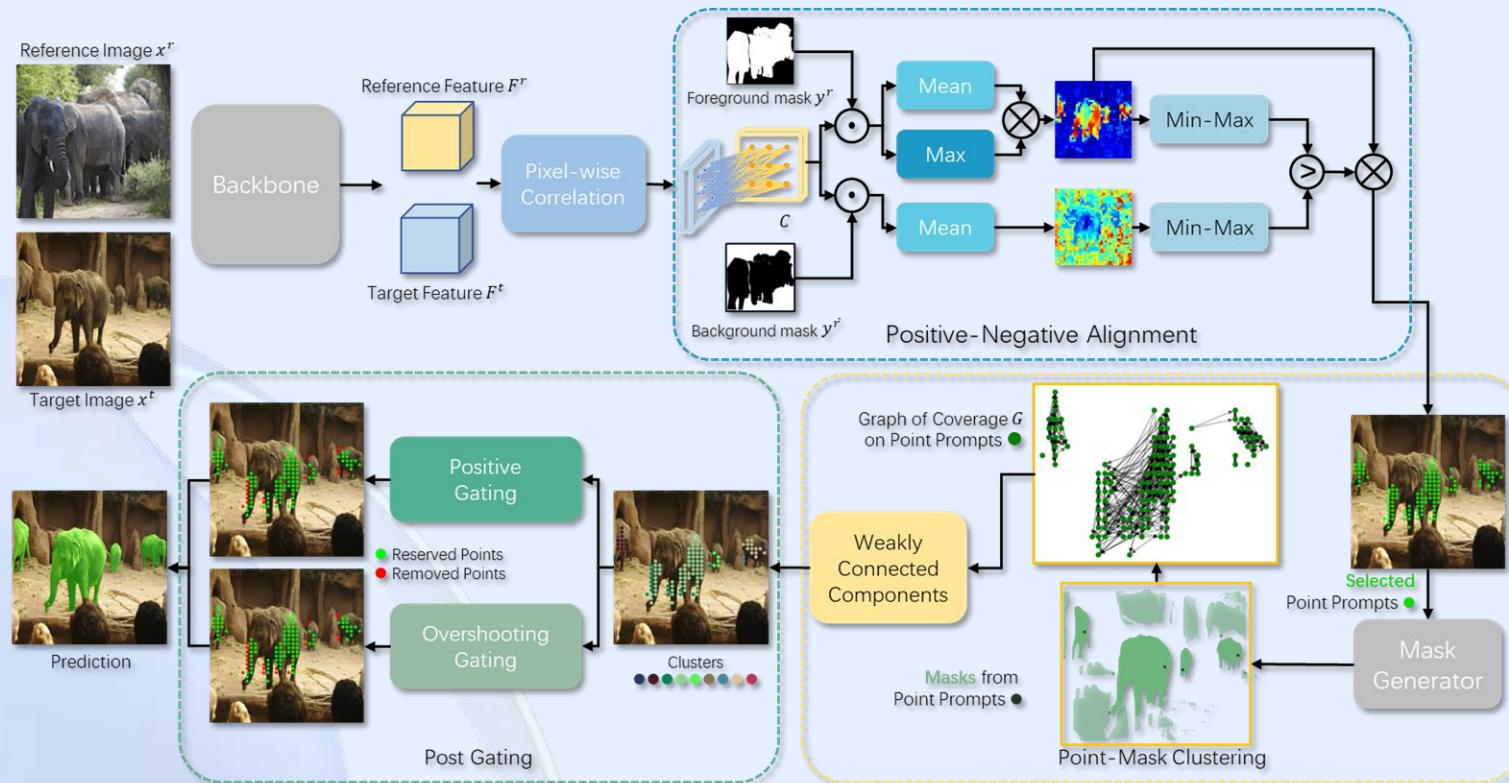
Motivation

- Segment Anything Model (SAM) relies on point/box/mask prompts
 - Cannot apply for automatic semantic segmentation
- Previous methods (Matcher, PerSAM) introduce Few-shot Semantic Segmentation (**FSS**) for *SAM-based automatic semantic segmentation*.
 - Lots of external hyperparameters
 - Low efficiency
 - Iterative mask generation



Our Contribution

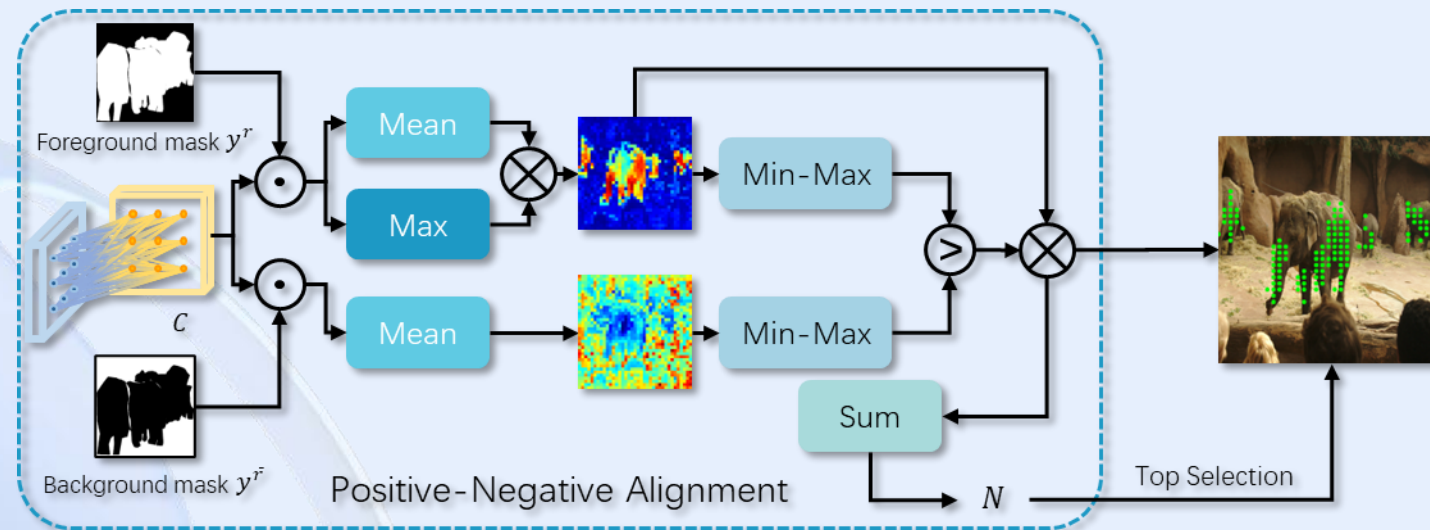
- ✓ Training-Free
- ✓ External-Hyperparameter-Free
- ✓ No iterative mask generation
- ✓ Fast inference within 2s per image*
- ✓ New state-of-the-art performance
- ✓ Effective in various domains



* Evaluated on a single NVIDIA RTX2080Ti

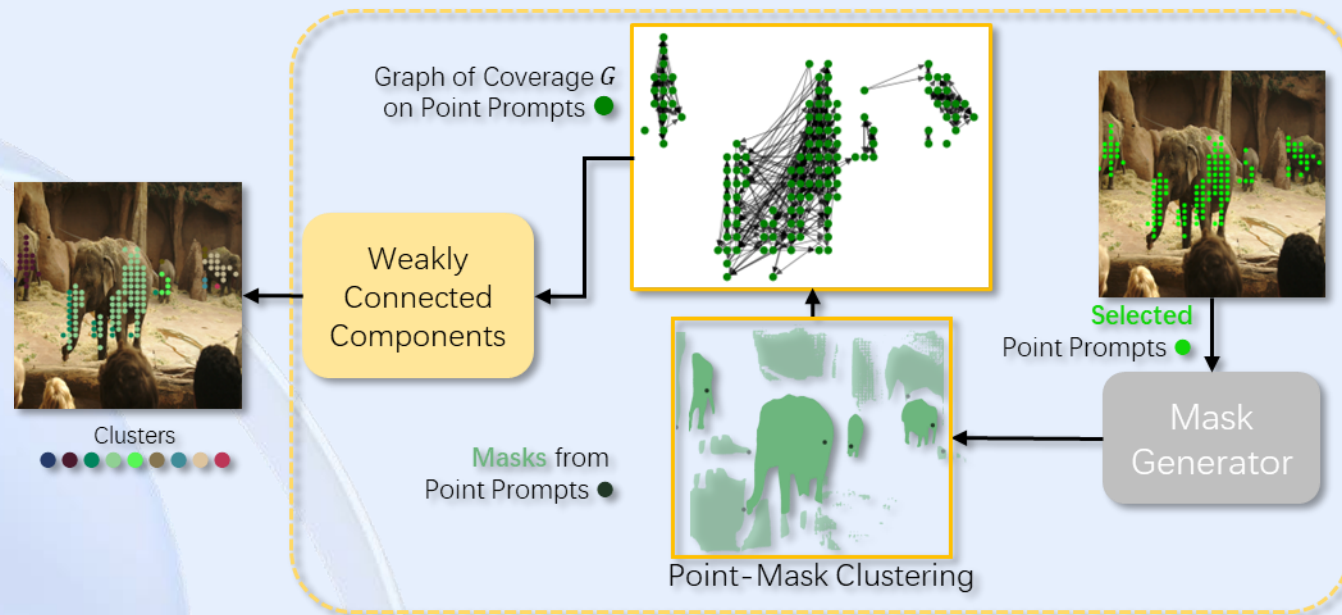
Positive-Negative Alignment

- **C**: Pixel-wise correlation ($hw \times hw$) between reference and target features.
- **Min-Max**: Highlight the similarity values of foreground/background.
- **Mean/Max**: Get mean/max value on the dimension corresponding to reference



Point-Mask Clustering

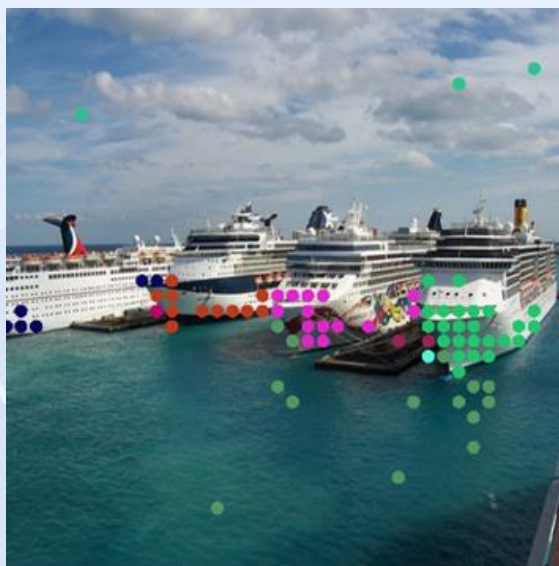
- Each point P_l corresponds to a **unique mask** \hat{y}_l from SAM.
- Selected Points from **fine-grained** features need to **align** to masks from **coarse-grained** features.
- PMC module constructs **directed graph G** according to the **coverage of masks over other points**.
- Each **weakly connected component** become a cluster.



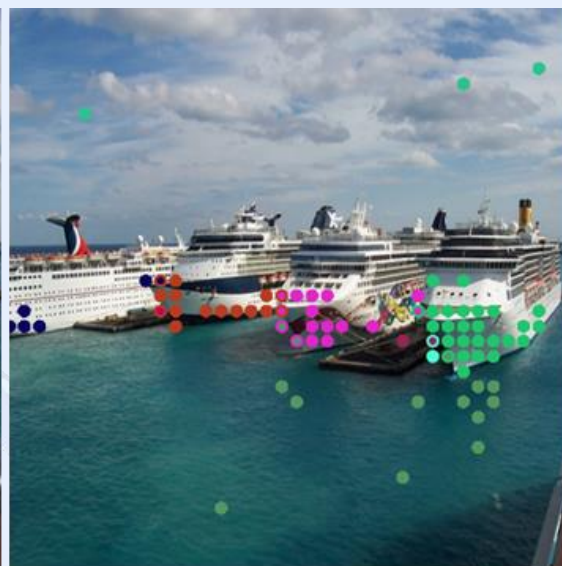
Post Gating

➤ **Positive Gating:** Compare number of positive and negative pixels according to positive and negative similarity maps.

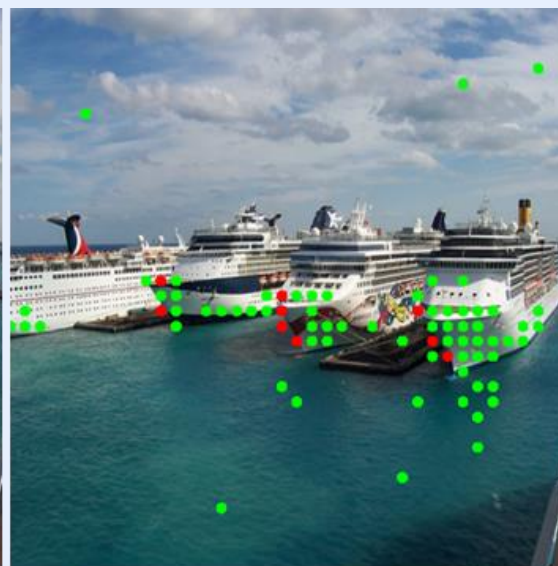
➤ **Overshooting Gating:** Retain points having highest similarity on regions of its corresponding mask (with distance factor).



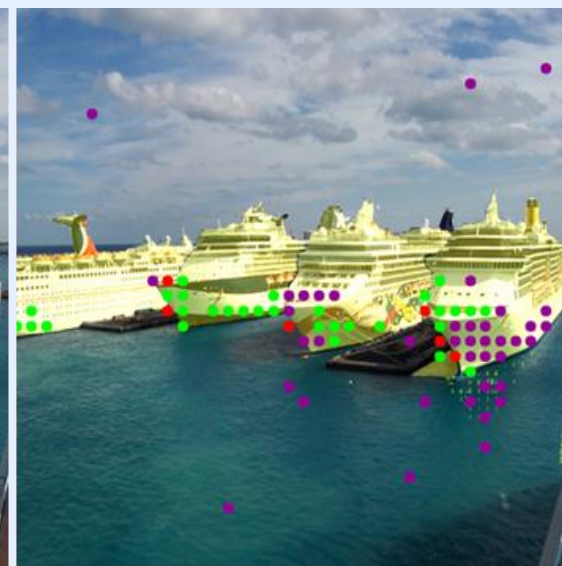
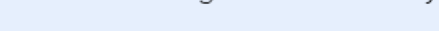
Point Prompt Clusters from Weakly Connected Components



Points Indicated by their Most Similar Clusters (Outer Ring)



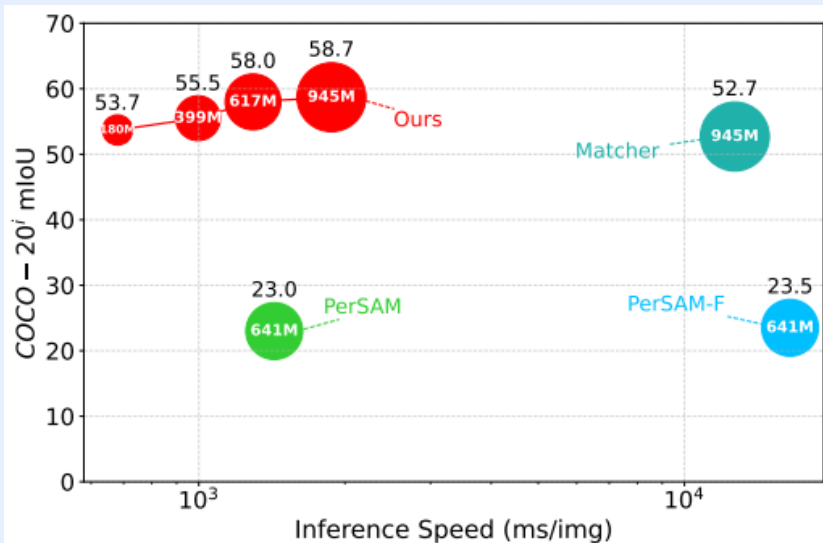
● Points Satisfying Self-Consistency
● Points Failing Self-Consistency



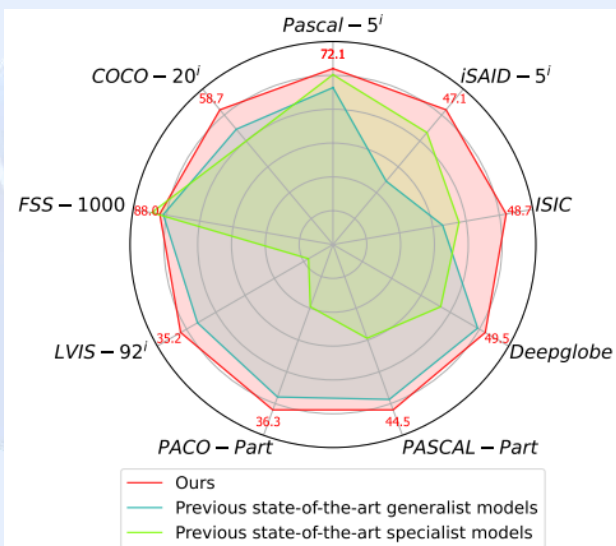
● Both Self-Consistency and Positive Gating
● Either Self-Consistency or Positive Gating
● Neither Self-Consistency nor Positive Gating



Experiments



Methods	Pascal-5 ⁱ		COCO-20 ⁱ		FSS-1000		LVIS-92 ⁱ	
	1-shot	5-shot	1-shot	5-shot	1-shot	5-shot	1-shot	5-shot
<i>specialist model</i>								
HSNet [14] _[CVPR21]	66.2	70.4	41.2	49.5	86.5	88.5	17.4	22.9
VAT [50] _[ECCV22]	67.9	72.0	41.3	47.9	90.3	90.8	18.5	22.7
HDMNet [44] _[CVPR23]	69.4	71.8	50.0	56.0	-	-	-	-
AMFormer [45] _[NeurIPS23]	70.7	73.6	51.0	57.3	-	-	-	-
<i>generalist model</i>								
PerSAM [12] _[ICLR24]	43.1	-	23.0	-	71.2	-	11.5	-
PerSAM-F [12] _[ICLR24]	48.5	-	23.5	-	75.6	-	12.3	-
Matcher [13] _[ICLR24]	68.1	74.0	52.7	60.7	87.0	89.6	33.0	40.0
VRP-SAM [49] _[CVPR24]	71.9	-	53.9	-	-	-	-	-
Ours	72.1	82.6	58.7	66.8	88.0	88.9	35.2	44.2



Methods	One-shot Part Seg.		Cross Domain FSS					
	PASCAL-Part 1-shot	PACO-Part 1-shot	Deepglobe 1-shot	Deepglobe 5-shot	ISIC 1-shot	ISIC 5-shot	iSAID-5 ⁱ 1-shot	iSAID-5 ⁱ 5-shot
<i>specialist model</i>								
HSNet [14] _[CVPR21]	32.4	22.6	29.7	35.1	31.2	35.1	34.1	40.4
DRA [51] _[CVPR24]	-	-	41.3	50.1	40.8	48.9	-	-
FRINet [52] _[TGRS23]	-	-	-	-	-	-	42.6	44.5
<i>generalist model</i>								
PerSAM [12] _[ICLR24]	32.5	22.5	31.4	-	23.9	-	19.2	-
PerSAM-F [12] _[ICLR24]	32.9	22.7	35.0	-	23.6	-	20.3	-
Matcher [13] _[ICLR24]	42.9	34.7	48.1	50.9	38.6	35.0	33.3	34.3
Ours	44.5	36.3	49.5	57.7	48.7	55.2	47.1	52.4

Ablation Studies

Table 3: Ablation study of Point Selection.

S_{mean}^+	S_{max}^+	S_{mean}^-	Top N	mIoU
✓		✓	✓	53.1
	✓	✓	✓	54.1
✓	✓	✓	✓	56.4
✓	✓		✓	51.5
✓	✓	✓	✓	58.7

Table 4: Ablation study of PMC and Post-Gating.

PG		OG		COCO-20 ⁱ	LVIS-92 ⁱ
Strong	Weak	Strong	Weak		
				44.0	24.2
	✓			57.1	34.3
✓				57.1	33.9
	✓	✓		56.7	35.2
	✓		✓	58.7	35.2
k-means++				57.5	34.0

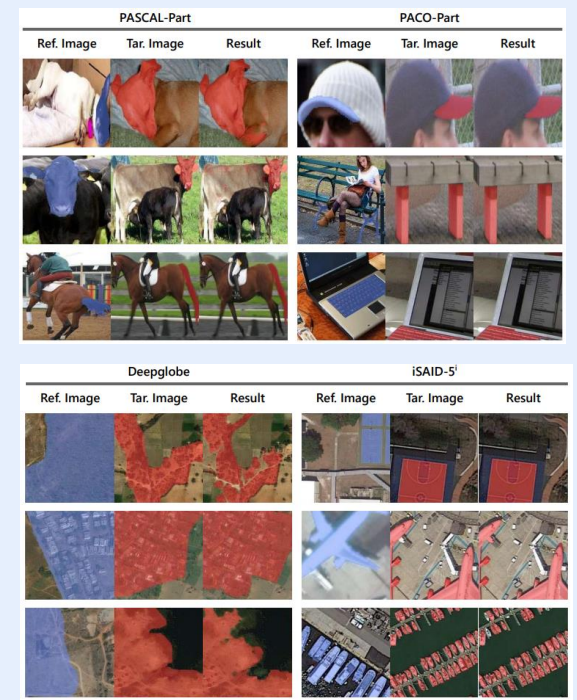
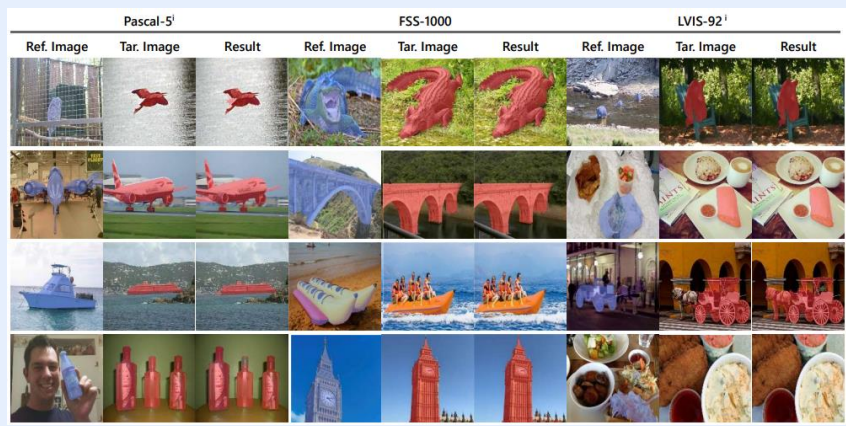
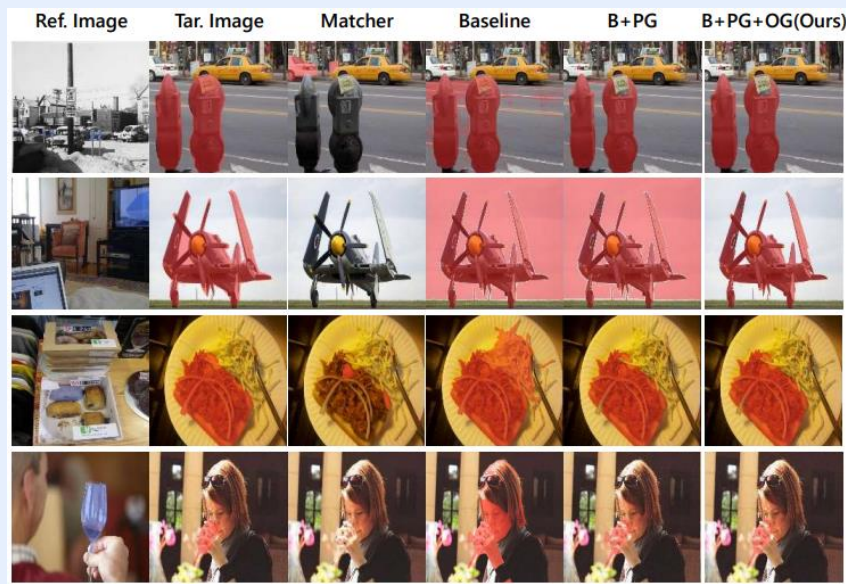
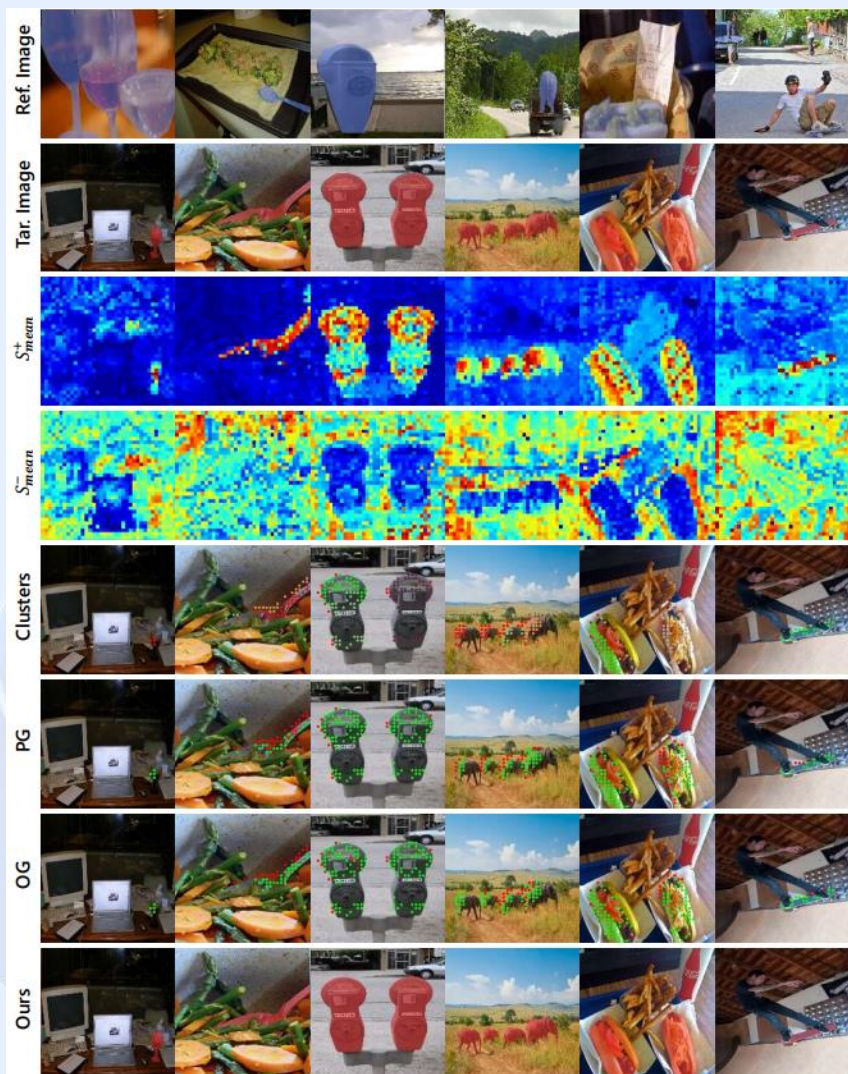
Table 5: Ablation study of positive gating on each cluster. M.G. represents the Mask Growth algorithm.

Strategies	M.G.	COCO-20 ⁱ	PASCAL-Part
Sum		55.3	39.1
	✓	58.6	44.3
Num		57.1	42.2
	✓	58.7	44.5

Table 6: Ablation on the strategies of Self-Consistency measurement.

Strategies	mIoU	Δ
None	57.1	0.0
Point Sim.	56.7	-0.4
MAP Sim.	57.7	+0.6
Mean Sim. W/o dist	49.1	-8.0
Mean Sim. (Ours)	58.7	+1.6

Visualization



The background is a light blue gradient with abstract, flowing, and layered blue shapes. On the left, there are curved, overlapping bands that resemble a stack of pages or a ribbon. On the right, there are larger, more solid-looking curved shapes that also appear to be layered or overlapping. The overall aesthetic is clean, modern, and professional.

Thank you