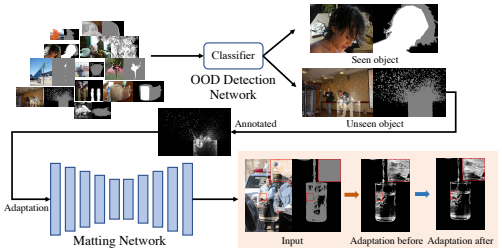
OSM: An Open Set Matting Framework with OOD Detection and Few-Shot Learning

Yuhongze Zhou[1], Issam Hadj Laradji[2], Liguang Zhou[3], Derek Nowrouzezahrai[1]
[1]McGill University & [2]ServiceNow Research & [3]The Chinese University of Hong Kong (Shenzhen)

Open Set Matting Framework (OSM)

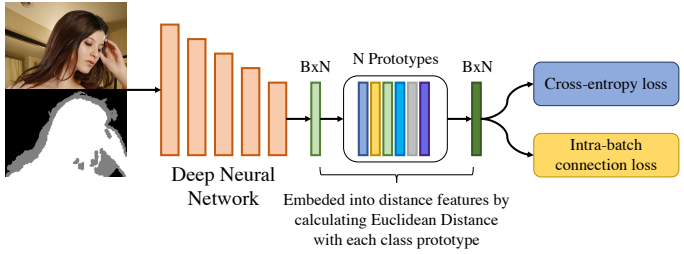


The overview of our OSM. The out-of-distribution (OOD) detection network detects unseen samples whose appearance within unknown region of trimap is unseen during training. After annotation of a few unseen samples, we conduct few-shot adaptation.

Our contributions:

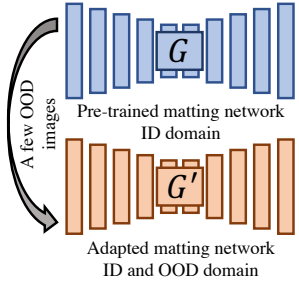
- The first open set matting (OSM) framework to tackle matting task from an open set perspective.
- Our OOD detection network achieves the new state-of-the-art performance on SIMD dataset compared to other OOD detection methods.
- We validate that our few-shot learning matting module can not only prevent catastrophic forgetting but also avoid over-fitting.

OOD Detection Network (OOD-DN)

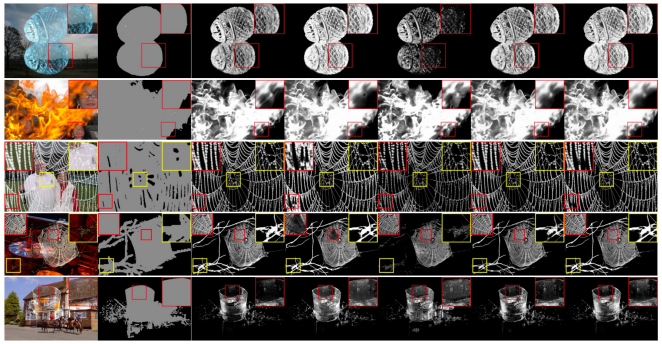


Our OOD-DN leverages prototype learning with intra-batch connection to be unseen-aware and generate informative logit features whose maximum is regarded as negative anomalous score.

Incremental Few-Shot Learning Matting Module (IFL-MM)



After training the matting network on ID data, we extend it to OOD data with a few samples but without catastrophic forgetting by RemodelBN, lr ExpDecay, and EWC based Reg.



Visual comparison of matting results on 5 OOD classes of SIMD dataset. From the 1st row to the 5th row, glass_ice, fire, water_drop, spider_web, and water_spray. From left to right, image, trimap, GT, Pre-trained model, Finetune, IFL-MM (Ours), and OSM (Ours).

Experimental Results

Methods	AUROC(IN)↑	AUPR(IN)↑	FPR95(IN)↓	AUROC(OUT)↑	AUPR(OUT)↑	FPR95(OUT)↓	DetectionError↓
MSP [18]	0.673	0.879	0.882	0.673	0.360	0.621	0.332
MaxLogit [19]	0.623	0.855	0.959	0.623	0.290	0.740	0.363
EnergyScore [30]	0.605	0.847	0.995	0.605	0.278	0.751	0.363
1-D Subspaces [58]	0.734	0.896	0.795	0.734	0.501	0.722	0.322
MMSP [3]	0.660	0.864	0.941	0.660	0.328	0.837	0.360
EDS [3]	0.630	0.810	0.959	0.630	0.319	1.000	0.367
OOD-DN (Ours)	**0.819**	**0.940**	**0.791**	**0.819**	**0.541**	**0.413**	**0.230**

OOD detection results on SIMD dataset.

λ	PL	$\mathcal{L}_{CE}$	$\mathcal{L}_{MC}$	MSP	MaxLogit	AUROC(IN)↑	AUPR(IN)↑	FPR95(IN)↓	AUROC(OUT)↑	AUPR(OUT)↑	FPR95(OUT)↓	DetectionError↓
	✓	✓			✓	0.315	0.663	0.996	0.315	0.183	0.964	0.485
	✓	✓		✓		0.664	0.857	0.841	0.664	0.353	0.722	0.349
		✓	✓	✓		0.589	0.807	0.945	0.589	0.293	0.919	0.406
		✓	✓		✓	0.717	0.891	0.850	0.717	0.414	0.703	0.328
λ = 0.1	✓	✓	✓	✓		0.493	0.738	0.955	0.493	0.247	0.979	0.464
	✓	✓	✓		✓	**0.819**	**0.940**	**0.791**	**0.819**	**0.541**	**0.413**	**0.230**
		✓	✓	✓		0.763	0.917	0.923	0.763	0.431	0.576	0.283
		✓	✓		✓	0.752	0.917	0.950	0.752	0.390	0.558	0.279
λ = 1.0	✓	✓	✓	✓		0.547	0.791	0.914	0.547	0.308	0.891	0.445
	✓	✓	✓		✓	0.743	0.876	0.655	0.743	0.573	0.848	0.287

Ablation study results of our OOD detection network on SIMD dataset. PL refers to prototype learning.

Methods	SAD(IN)↓	SAD(OUT)↓
Pre-trained	33.71	79.47
Finetune	154.07±17.45	147.46±9.86
IFL-MM (Ours)	**44.87±5.13**	**68.08±3.56**
OSM (Ours)	**37.22±2.54**	**70.78±3.84**

Matting results on SIMD dataset.

Reg	ExpDecay	RemodelBN	SAD(IN)↓	SAD(OUT)↓
✓	✓		**43.89**	69.64
✓		✓	47.65	69.25
	✓	✓	153.54	149.15
✓	✓	✓	44.87	**68.08**

Ablation study results of our IFL-MM