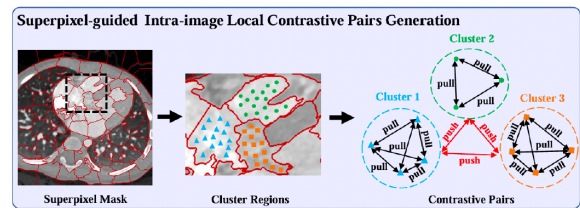


MILabTIP, JBHI

MILab1SuperCL: ()2MACL: 1"SuperCL: Superpixel Guided Contrastive Learning for Medical Image Segmentation Pre-Training"IEEE Transactions on Image Processing2"Multi-level Asymmetric Contrastive Learning for Medical Image Segmentation Pre-training"IEEE Journal of Biomedical and Health Informatics

SuperCL:

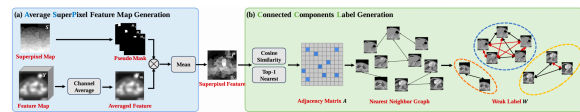
1.
- SLIC 1 Intra-image Local Contrastive Pairs, ILCP



1.
2.
- Inter-image Global Contrastive Pairs, IGCP

1ASP

2CCLASP 2

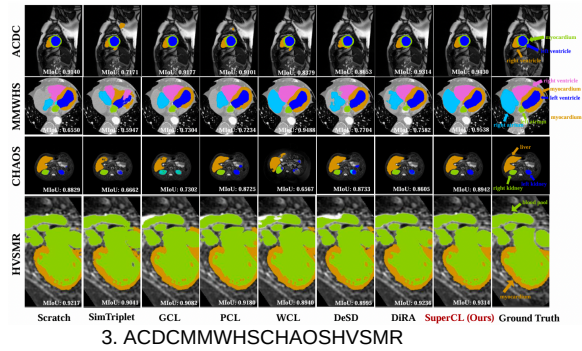


SuperCL 10%SuperCLDice 3.98%Jaccard 4.90%25% SuperCL 2.89% Dice MMWHS 90%Dice

Labelset	Methods	ACDC (100 patients)				MMWHS (20 patients)				HVSIMR (10 patients)				CHACS (20 patients)			
		DSC (%)	IC (%)	HD95 (mm)	ASD (mm)	DSC (%)	IC (%)	HD95 (mm)	ASD (mm)	DSC (%)	IC (%)	HD95 (mm)	ASD (mm)	DSC (%)	IC (%)	HD95 (mm)	ASD (mm)
10 %	Scratch	79.99	61.39	8.58	3.82	83.06	48.89	9.31	3.39	72.81	50.02	38.34	10.18	51.76	37.51	23.08	9.90
	SimCLR [3]	78.60	65.47	8.11	3.36	61.70	46.59	9.67	3.53	75.78	62.34	25.16	6.22	53.22	38.11	22.28	9.04
	MoCo [16]	81.34	69.13	8.12	3.20	57.54	42.62	11.37	4.15	76.20	62.79	27.45	8.33	53.14	38.49	21.45	9.53
	BYOL [12]	77.55	64.17	9.05	3.96	63.75	49.54	9.34	3.61	73.57	59.87	29.79	8.51	50.45	35.66	24.20	10.32
	SwAV [2]	82.11	70.20	6.35	2.46	64.27	49.96	10.31	3.98	76.28	62.91	24.09	6.42	49.87	35.04	19.75	8.86
	SimSiam [7]	71.96	57.01	11.05	4.98	61.37	46.51	10.61	3.89	75.10	61.47	29.73	8.72	41.21	28.87	21.55	10.20
	SimTriplet [30]	71.07	56.07	11.31	5.20	62.52	47.81	10.98	4.10	72.66	58.48	30.72	8.65	32.88	23.14	27.81	12.90
	GCL [3]	84.86	74.07	7.07	2.85	71.41	58.58	7.22	2.55	75.70	62.22	28.15	7.68	58.78	44.00	15.28	6.36
	PCL [51]	84.91	74.16	6.54	2.65	65.98	53.32	9.07	3.16	76.12	63.82	24.50	6.43	63.61	48.23	16.15	8.79
	WCL [55]	75.46	61.52	11.05	4.69	60.82	45.66	9.82	3.92	75.05	61.42	26.09	6.35	56.87	41.39	20.83	9.31
	DsSD [49]	76.02	62.27	10.25	4.15	57.03	42.30	10.89	4.36	74.57	61.16	24.00	6.40	61.93	46.68	18.91	8.39
	DIRA [14]	83.14	71.61	6.73	2.60	57.73	42.95	10.92	3.76	74.87	61.35	27.91	8.01	44.30	31.24	24.63	11.93
	SuperCL (Ours)	86.06	75.79	4.68	1.80	74.56	62.05	6.50	2.22	78.35	65.46	23.23	6.61	69.05	54.09	15.43	6.32
25 %	Scratch	88.99	80.34	3.09	1.24	85.14	74.87	4.96	1.45	81.26	69.23	20.63	5.85	66.11	52.74	12.32	4.59
	SimCLR [3]	88.55	79.71	4.33	1.47	86.14	76.03	4.59	1.36	80.53	68.50	23.42	6.75	66.15	52.21	11.76	4.75
	MoCo [16]	88.38	79.39	5.01	1.55	82.89	71.46	5.40	1.69	81.26	69.18	20.41	5.64	65.33	50.93	15.12	6.40
	BYOL [12]	89.27	80.78	4.62	1.64	87.63	78.43	3.87	1.20	81.33	69.30	19.95	5.80	62.49	48.31	14.13	5.71
	SwAV [2]	88.99	80.34	4.90	1.78	87.71	78.61	3.78	1.22	81.30	69.18	17.24	4.62	68.12	54.01	12.71	5.15
	SimSiam [7]	88.24	79.18	4.85	1.71	82.71	71.19	5.25	1.78	79.70	67.30	22.83	6.31	51.82	39.11	14.82	6.86
	SimTriplet [30]	87.99	78.80	5.78	2.00	82.43	70.82	5.24	1.73	80.51	68.24	24.34	7.17	63.55	49.30	13.23	5.98
	GCL [3]	88.55	79.67	4.22	1.34	88.01	79.04	4.02	1.17	82.41	70.80	22.08	6.59	76.88	63.48	9.11	3.70
	PCL [51]	88.97	80.33	4.17	1.43	86.65	76.90	4.23	1.28	83.13	71.70	20.28	5.17	78.88	66.08	8.87	3.32
	WCL [55]	87.25	77.68	5.33	1.63	84.42	73.66	4.82	1.58	81.65	69.75	19.33	5.55	63.87	49.46	11.59	4.70
	DsSD [49]	87.14	77.47	6.11	2.19	84.46	73.66	5.15	1.70	81.44	69.44	21.19	5.57	67.96	54.28	11.70	4.90
	DIRA [14]	88.92	80.22	4.24	1.48	86.66	77.08	4.46	1.43	81.56	69.67	20.85	5.69	64.00	49.87	13.47	5.69
	SuperCL (Ours)	89.68	81.44	3.34	1.17	90.26	82.52	3.36	0.98	83.48	72.18	18.35	4.50	80.02	67.30	7.49	3.03
100 %	Scratch	92.07	85.38	3.06	1.07	92.27	85.79	2.71	0.76	84.95	74.33	14.83	3.56	88.63	79.84	4.38	1.62

¹ 指标旁向上箭头表示数值越大性能越好，向下箭头表示数值越小性能越好。DSC 和 IC 是百分数 (%), 粗体表示最优结果，下划线表示次优结果。

1. SuperCL



MILabMILab“+X”——

MACL:

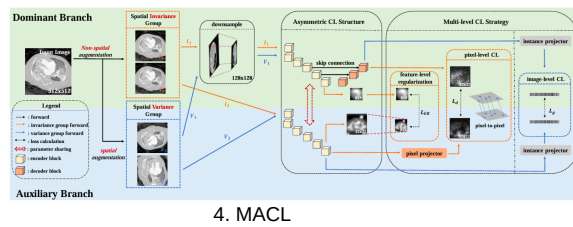
Siamese

1

2

3

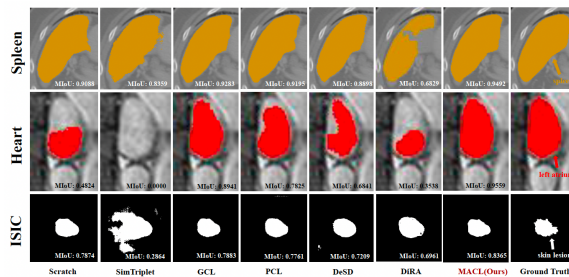
MACL (Multi-level Asymmetric Contrastive Learning)1(2) MACL-



MACL : (1)10% MACL 4 ACDC PCL1.72% DSC225% MACL MMWHS GCL 1.89% DSC 2.88% JC Spleen GCL 1.45% DSC3.42%JC

Labeled	Method	Spleen (41 patients)				ISC (2594 images)				Heart (20 patients)				Hippocampus (260 patients)			
		DSC (%)	JC (%)	(%) HD95	ASD	DSC (%)	JC (%)	(%) HD95	ASD	DSC (%)	JC (%)	(%) HD95	ASD	DSC (%)	JC (%)	(%) HD95	ASD
10 %	Scratch	66.63	49.95	12.58	5.78	37.21	77.32	23.47	9.72	73.30	57.85	5.21	1.82	78.27	64.30	1.36	0.51
	SimCLR [5]	60.38	43.24	12.42	4.67	85.85	75.21	23.81	10.32	73.42	58.00	4.32	1.40	75.91	61.78	1.48	0.54
	MoCo [16]	56.49	39.36	21.32	9.35	85.61	74.84	24.56	9.95	68.32	51.88	6.71	2.48	78.27	64.30	1.27	0.46
	BYOL [12]	61.38	44.28	14.56	6.32	87.00	77.00	24.20	10.28	70.34	58.00	6.17	2.16	77.24	62.92	1.39	0.49
	SwAV [21]	61.87	44.79	13.61	6.53	85.85	75.20	24.19	10.45	72.31	56.63	5.95	2.27	76.00	61.29	1.47	0.52
	SimSum [7]	67.88	51.37	12.89	3.65	83.02	70.97	30.04	13.70	58.56	41.41	10.71	5.15	73.45	58.05	1.39	0.49
	SimTriplet [30]	63.56	46.59	16.95	7.54	83.01	70.96	29.27	13.03	57.76	40.61	8.85	3.94	74.80	59.74	1.31	0.46
	GCL [31]	73.40	57.07	11.79	4.99	85.53	74.72	24.37	10.44	76.88	62.44	5.21	1.73	78.14	64.13	1.32	0.46
	PCL [51]	71.22	55.30	11.10	4.97	86.64	76.43	24.41	10.50	78.47	64.57	5.95	2.14	78.13	64.11	1.29	0.47
	DeSD [49]	64.24	47.31	7.18	2.83	83.56	71.76	25.66	11.50	77.55	63.33	5.80	2.28	74.48	59.34	1.64	0.62
25 %	DIRA [14]	66.23	49.51	20.06	8.93	87.02	77.02	22.91	9.28	70.19	54.07	4.26	1.36	77.15	62.80	1.36	0.50
	MACL (Ours)	80.93	67.97	6.93	2.92	87.45	77.70	21.53	8.91	79.37	65.79	5.40	1.99	78.33	64.38	1.31	0.46
	Scratch	74.99	59.98	9.14	4.33	88.44	79.28	16.32	6.41	78.35	64.41	4.57	1.33	83.48	71.65	1.08	0.35
	SimCLR [5]	81.75	69.13	7.05	3.06	87.82	78.28	17.79	7.18	80.07	66.76	3.48	0.98	83.35	71.46	1.05	0.36
	MoCo [16]	75.98	61.26	8.55	4.09	87.53	77.83	17.87	7.01	75.35	60.45	5.60	2.11	83.94	72.33	0.98	0.33
	BYOL [12]	75.15	60.19	6.34	2.39	88.50	79.38	16.78	6.54	80.70	67.65	4.36	1.16	83.38	71.50	1.04	0.35
	SwAV [21]	80.40	67.23	5.52	2.34	87.90	78.41	17.65	6.77	81.94	69.40	3.98	1.22	83.05	71.02	1.06	0.35
	SimSum [7]	78.70	64.88	8.87	4.56	87.29	77.45	19.31	7.52	71.65	55.83	3.24	1.17	80.60	67.51	1.11	0.37
	SimTriplet [30]	78.81	65.04	8.84	3.96	86.52	76.24	19.50	7.68	76.42	61.83	3.11	1.72	82.01	69.31	1.06	0.35
	GCL [31]	84.37	72.97	6.25	2.52	88.52	79.41	17.55	7.06	82.30	69.92	3.76	0.96	83.63	71.87	1.07	0.37
100 %	PCL [51]	83.55	71.74	7.03	2.96	88.26	78.99	18.04	7.27	82.69	70.49	3.78	0.93	83.98	72.40	0.96	0.33
	DeSD [49]	81.02	68.10	6.59	3.28	87.34	77.52	20.29	8.41	81.50	68.77	4.45	1.43	81.81	69.22	1.08	0.37
	DIRA [14]	80.80	67.78	7.95	4.17	88.38	79.18	18.96	6.63	79.91	66.54	4.87	1.35	83.60	71.83	1.00	0.33
	MACL (Ours)	85.82	75.16	4.85	1.91	88.96	80.12	17.61	6.79	82.93	70.84	3.85	1.24	84.13	72.61	0.99	0.32
	Scratch	89.92	81.69	4.59	2.12	90.11	82.01	15.71	6.17	91.52	84.36	2.45	0.61	87.00	77.00	0.81	0.27
	SimTriplet																
	GCL																
	PCL																
	DeSD																
	DIRA																
	MACL (Ours)																
	Ground Truth																

2. MACL



MILabMILabBio-MIBLab"+X"——