

Table 2: Average results of 5 runs on synthetic images with resolution 64×64 . “real(*)” and “syn(*)” denote the results are trained on small real and synthetic dataset. “emb-Conv” and “emb-ResNet” denotes we generate the embedding by ConvNet and ResNet18 respectively. “umap-10” means we reduce the dimension of flattened image to 10 by UMAP. “bound” is the short of boundary in the contrastive learning loss.

	ConvNet			ResNet18		
	ACC	F1Score	AUC	ACC	F1Score	AUC
real (all)	91.44±0.20	88.36±0.24	99.23±0.05	91.25±0.71	87.95±0.97	99.00±0.24
syn (all)	79.87±0.86	73.59±0.90	96.74±0.22	86.18±0.46	80.80±0.80	98.15±0.12
Cluster by random selection						
real	77.04±1.27	69.32±1.84	95.84±0.54	78.92±1.47	71.97±2.23	96.80±0.54
syn	61.52±0.60	54.29±0.65	89.31±0.94	72.82±2.13	64.74±3.10	94.33±1.03
Cluster by Kmeans, num_cluster=100, num_sample=1						
real (emb-Conv)	76.93±0.57	70.73±0.92	96.46±0.29	78.70±1.20	72.78±1.93	96.78±0.48
real (umap-10+bound)	79.13±0.90	72.31±1.33	95.70±0.63	71.84±4.47	58.41±6.50	94.49±1.15
syn (emb-Conv)	59.71±1.02	52.75±1.02	90.04±0.35	72.51±1.77	64.88±1.74	95.15±0.90
syn (emb-ResNet)	61.08±1.54	53.96±1.33	89.51±0.78	72.77±1.83	64.54±1.78	94.42±0.85
syn (umap-10+bound)	66.92±1.24	59.35±0.36	90.60±0.49	56.03±1.95	37.55±3.47	89.04±1.48
Cluster by Kmeans, num_cluster=50, num_sample=2						
real (emb-Conv)	76.31±1.12	69.22±1.58	96.04±0.30	75.81±1.40	69.97±1.95	95.87±0.65
real (umap-10)	77.80±1.14	70.76±2.04	96.10±0.88	81.38±1.11	75.93±1.13	97.43±0.10
real (umap-128)	78.03±0.90	70.89±1.43	96.32±0.32	80.08±1.02	73.84±0.63	96.84±0.24
real (umap-10+bound)	78.64±1.35	71.95±1.95	95.09±1.24	70.83±4.09	57.49±6.47	92.87±1.36s
syn (emb-Conv)	60.83±1.18	53.88±1.17	90.50±0.46	71.52±1.42	63.98±1.12	95.03±0.56
syn (emb-ResNet)	58.94±2.68	51.93±2.30	89.24±1.08	71.15±2.77	63.03±1.12	94.50±0.47
syn (umap-10)	60.89±1.11	54.07±1.32	89.50±0.90	74.74±1.02	68.04±2.20	95.75±0.70
syn (umap-128)	63.06±1.29	55.79±1.29	89.65±1.11	74.68±1.17	66.81±1.80	94.79±0.78
syn (umap-10+bound)	67.04±1.83	57.23±2.03	89.94±0.87	58.02±5.88	43.72±4.34	88.93±2.04
Cluster by Kmeans, num_cluster=25, num_sample=4						
real (emb-Conv)	75.93±0.72	68.46±0.71	96.00±0.21	77.13±2.07	70.85±3.01	96.04±0.70
real (umap-10)	79.03±1.58	72.67±2.45	96.61±0.80	80.57±2.66	75.06±3.50	97.08±0.73
real (umap-10+bound)	79.02±1.12	72.27±1.79	95.69±0.57	72.57±6.04	58.01±7.45	94.28±1.58
syn (emb-Conv)	59.97±1.14	53.42±0.91	89.91±0.84	71.24±2.35	63.66±2.11	94.60±0.92
syn (emb-ResNet)	59.37±1.54	52.74±1.75	89.37±0.99	69.62±3.94	61.53±3.77	94.36±1.00
syn (umap-10)	61.27±2.13	54.87±2.14	90.19±0.89	75.49±1.97	68.38±1.95	95.89±0.83
syn (umap-128)	62.25±1.26	55.31±1.03	90.75±0.66	74.04±1.59	66.48±0.67	95.56±0.36
syn (umap-10+bound)	68.04±1.40	59.04±1.52	90.87±0.48	56.24±7.04	42.16±6.09	87.31±4.22
Cluster by Infomap						
real (emb-Conv+info-001)	75.75±0.35	67.45±0.51	96.13±0.30	78.53±1.38	72.17±2.12	96.75±0.66
real (emb-Conv+info-004)	75.87±0.17	67.50±0.16	95.82±0.09	78.50±0.62	71.77±0.21	96.47±0.57
real (emb-ResNet+info-004)	75.62±0.70	67.44±0.68	95.87±0.25	78.66±1.98	72.45±2.19	96.76±0.39
real (umap+info)	74.63±1.55	66.88±1.98	95.46±0.43	73.40±1.46	66.23±1.68	95.33±0.19
real (umap+info+bound)	72.17±1.56	68.49±0.93	93.02±0.71	68.61±4.90	60.13±6.27	92.06±2.10
real (emb-Conv+info+bound)	77.34±0.42	69.45±0.51	94.98±0.23	68.13±3.75	53.35±6.26	91.40±1.37
syn (emb-Conv+info-001)	66.04±1.36	59.33±1.15	91.09±0.37	73.54±0.48	67.14±0.67	94.19±0.78
syn (emb-Conv+info-004)	64.74±1.12	58.64±1.11	91.67±0.17	77.48±1.52	70.80±1.03	96.84±0.33
syn (emb-ResNet+info-004)	64.67±1.14	58.74±1.35	91.79±0.40	77.01±1.15	69.95±0.67	96.69±0.28
syn (umap+info)	59.70±1.41	53.83±1.22	88.83±0.49	70.69±0.97	62.83±0.90	94.16±0.39
syn (umap+info+bound)	61.79±1.12	54.45±2.05	88.34±0.96	61.33±0.34	44.72±0.80	89.96±0.55
syn (emb-Conv+info+bound)	69.79±1.28	63.01±1.10	91.15±0.35	73.97±3.71	65.75±4.44	92.47±0.89

Table 3: Average results of 5 runs on synthetic images with resolution 256×256 .

	ConvNet			ResNet18		
	ACC	F1Score	AUC	ACC	F1Score	AUC
real(all)	92.52	-	-	90.78	-	-
Cluster by random selection						
real	79.01±0.96	71.11±1.16	95.91±0.50	83.22±0.79	75.84±1.17	97.50±0.22
syn	58.29±2.58	50.95±2.29	89.97±0.97	71.82±3.21	63.88±3.14	94.99±0.86
Cluster by Kmeans, num_cluster=100, num_sample=1						
real (emb-Conv)	79.18±0.74	72.03±1.16	96.04±0.49	84.57±1.22	79.45±1.87	97.92±0.35
real (umap-10)	79.51±0.86	72.11±1.41	96.49±0.53	83.55±1.81	76.60±2.64	97.27±0.44
real (umap-10+bound)	79.00±0.85	71.78±1.45	95.12±0.64	85.97±1.10	79.05±1.40	97.30±0.64
syn (emb-Conv)	56.30±1.81	49.52±2.04	88.45±0.78	72.00±3.10	63.61±2.59	94.92±0.55
syn (umap-10)	59.59±0.45	52.29±0.38	90.09±0.35	74.12±1.11	66.76±1.54	95.89±0.48
syn (umap-10+bound)	57.26±2.40	50.94±2.33	85.85±1.51	75.30±2.49	68.06±3.14	93.52±1.78
Cluster by Kmeans, num_cluster=50, num_sample=2						
real (emb-Conv)	79.99±0.93	72.63±1.10	96.26±0.38	82.23±1.09	75.68±1.77	97.39±0.14
real (umap-10)	80.98±0.84	74.01±1.38	97.01±0.39	84.78±0.71	77.74±1.25	97.59±0.25
real (umap-10+bound)	80.19±0.59	73.17±1.06	95.49±0.37	86.48±1.28	80.25±2.38	97.65±0.55
syn (emb-Conv)	59.35±1.81	52.12±1.87	89.75±1.17	75.48±1.25	66.81±0.94	94.44±0.84
syn (umap-10)	59.16±3.14	51.69±2.75	89.81±1.01	74.04±2.05	66.23±1.77	95.54±0.52
syn (umap-10+bound)	57.12±0.83	50.99±0.86	86.09±0.31	73.65±5.47	66.16±6.33	93.83±1.39
Cluster by Infomap						
real (umap+info)	70.62±1.70	65.82±2.10	94.85±0.47	70.90±2.51	67.07±3.16	94.70±0.91
real (umap+info+bound)	71.29±0.74	65.22±0.84	91.25±0.33	74.10±1.43	68.19±2.15	92.43±0.46
real (emb-Conv+info-004)	78.78±0.71	70.88±0.91	96.39±0.47	83.87±0.93	77.40±1.32	97.74±0.16
real (emb-Res+info-004)	81.17±0.53	73.81±0.64	96.73±0.24	83.69±0.87	76.28±1.60	97.25±0.23
real (emb-Conv+info+bound)	79.15±0.74	71.63±0.83	96.61±0.32	83.90±0.50	77.47±0.77	97.77±0.11
syn (umap+info)	53.69±1.31	46.55±1.27	87.62±0.70	65.63±4.72	57.43±4.44	92.45±1.30
syn (umap+info+bound)	50.83±2.03	43.89±2.42	82.68±1.29	70.12±3.04	62.62±2.79	92.05±1.00
syn (emb-Conv+info-004)	56.93±1.56	49.97±1.31	89.29±0.81	74.19±2.15	66.81±2.47	96.39 ±0.34
syn (emb-Res+info-004)	65.45 ±1.40	57.47±1.40	91.45 ±0.43	75.79±1.83	66.89±2.05	95.18±0.58
syn (emb-Conv+info+bound)	64.40±1.48	57.84 ±1.27	88.94±0.66	77.79 ±1.18	72.53 ±1.53	94.59±0.37

Table 4: Comparison of different node selection metrics on synthetic images with resolution 64×64 .

selection metrics	ConvNet			ResNet18		
	ACC	F1Score	AUC	ACC	F1Score	AUC
modular centrality	64.74 ±1.12	58.64 ±1.11	91.67±0.17	77.48 ±1.52	70.80 ±1.03	96.84 ±0.33
enter flow	64.01±0.40	57.73±0.55	91.58±0.39	76.48±1.42	70.08±1.65	96.49±0.26
exit flow	64.40±0.50	58.35±0.61	91.74 ±0.29	75.35±2.05	68.25±2.18	96.48±0.52