Place Recognition under Occlusion and Changing Appearance via Disentangled Representations

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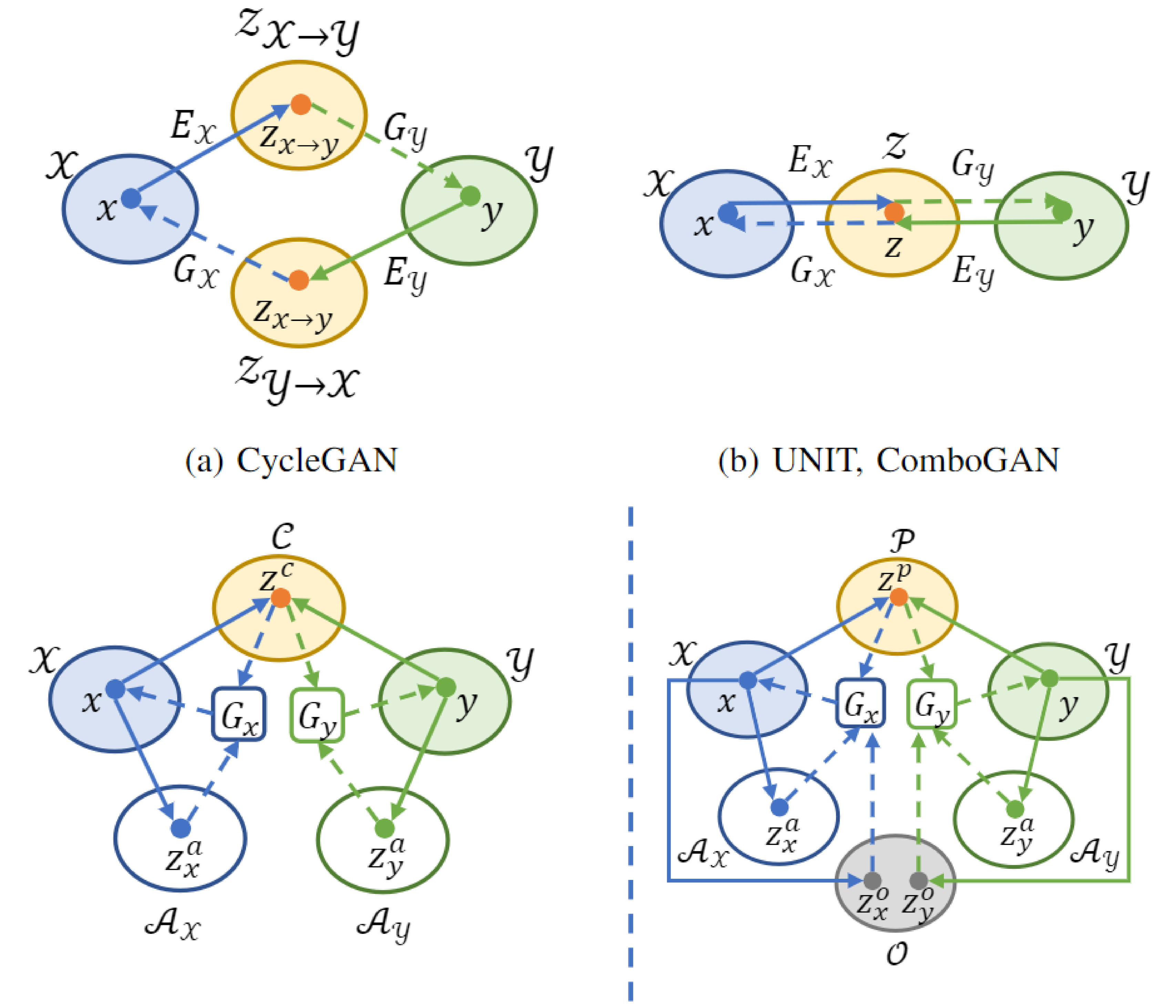
Motivation



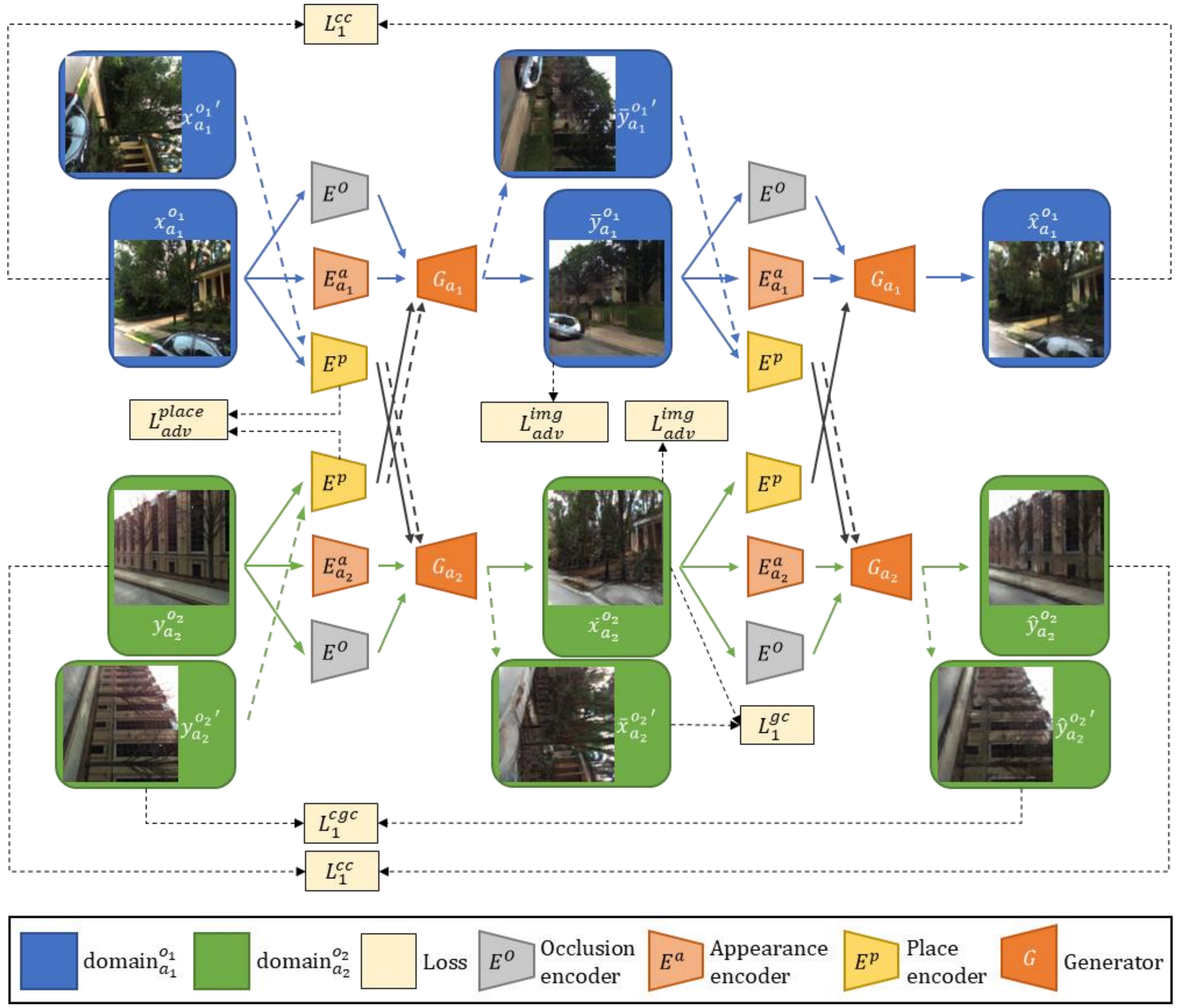
(a) CycleGAN (b) UNIT, ComboGAN

(c) MUNIT, DRIT (d) PROCA

PROCA, an unsupervised method to decompose the image representation into three codes:

- a domain-invariant **place code** used as a descriptor to retrieve images
- a domain-specific **appearance code** that captures appearance properties
- a domain-invariant **occlusion code** that encodes occlusion content.

Our Method

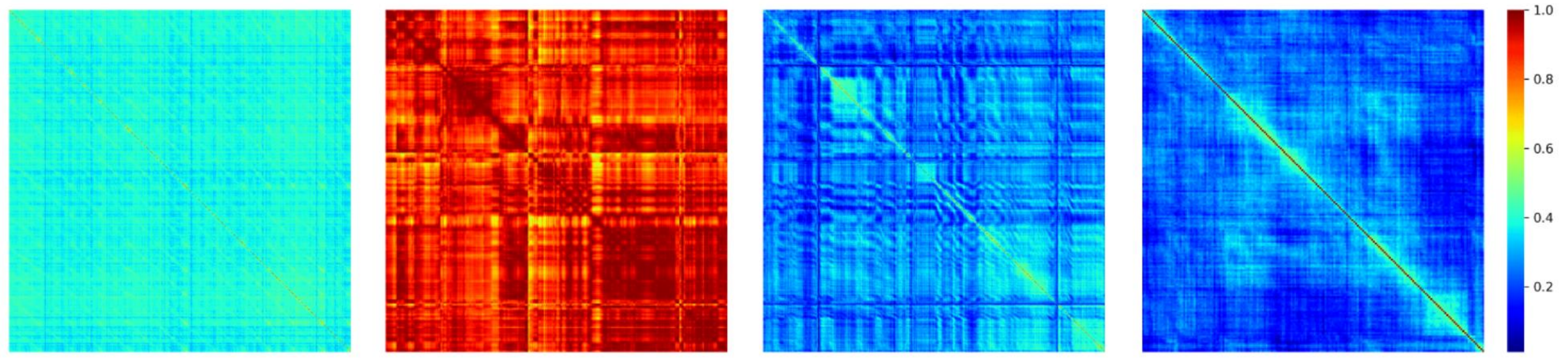


We train the PROCA with **adversarial objectives** to ensure disentangled representations and the **cross-cycle consistency objective** to learn the mapping between domains with unpaired data. We further disentangle the place and occlusion codes with the **geometry consistency** and **cross-cycle geometry consistency objectives**.

Results

Query image Retrieved image Query image Retrieved image

Methods	Overcast(%) 0.25m / 0.5m / 5m 2° / 5° / 10°	Sunny(%) 0.25m / 0.5m / 5m 2° / 5° / 10°	Low Sun(%) 0.25m / 0.5m / 5m 2° / 5° / 10°	Cloudy(%) 0.25m / 0.5m / 5m 2° / 5° / 10°	Snow(%) 0.25m / 0.5m / 5m 2° / 5° / 10°
FAB-MAP [28]	0.9 / 2.7 / 17.0	1.0 / 2.5 / 15.2	2.0 / 4.6 / 20.8	1.8 / 4.1 / 20.1	2.2 / 4.8 / 22.4
NetVLAD [19]	10.9 / 27.0 / 82.7	10.5 / 25.9 / 79.2	10.1 / 25.7 / 77.7	13.0 / 30.5 / 82.9	10.2 / 25.3 / 75.5
DenseVLAD [18]	15.1 / 35.2 / 85.2	13.2 / 31.3 / 81.4	15.1 / 36.9 / 86.0	18.4 / 41.8 / 89.0	17.4 / 41.3 / 87.2
DIFL-FCL [23]	15.9 / 36.9 / 83.1	14.1 / 32.7 / 78.7	13.9 / 34.1 / 79.2	16.4 / 37.6 / 84.8	13.6 / 33.4 / 70.1
DISAM [24]	18.0 / 39.6 / 85.3	15.2 / 33.9 / 80.9	15.8 / 37.3 / 82.3	18.6 / 40.5 / 87.6	15.7 / 37.3 / 76.3
PROCA-O	12.9 / 31.5 / 83.1	11.4 / 27.1 / 79.5	11.7 / 29.6 / 81.2	15.5 / 32.9 / 83.4	10.8 / 27.2 / 76.5
PROCA-A	18.4 / 40.5 / 87.6	16.7 / 35.9 / 81.5	17.3 / 40.6 / 84.6	19.7 / 42.4 / 88.3	18.1 / 43.8 / 87.8
PROCA	19.5 / 43.9 / 88.4	17.2 / 38.9 / 82.9	17.6 / 42.1 / 87.7	20.0 / 44.4 / 90.4	18.3 / 44.3 / 89.6



(a) All (b) Appearance (c) Occlusion (d) Place

https://www.youtube.com/watch?v=W_tol4aHIQk xingyu@stu.xjtu.edu.cn