Cut out and Replay: A Simple yet Versatile Strategy for Multi-Label Online Continual Learning

Background

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多标签在线持续学习（MOCL）

Task at timestamp 1 : Traning set X^1

person
sun glass
~~dog~~
~~bike~~
~~car~~

Task at timestamp 2: Traning set X^2

~~person~~
dog
bike
~~car~~

.....

Task at timestamp t: Traning set X^t

~~person~~
~~bike~~
traffic
light
car

θ^1 θ^2 ..... θ^t

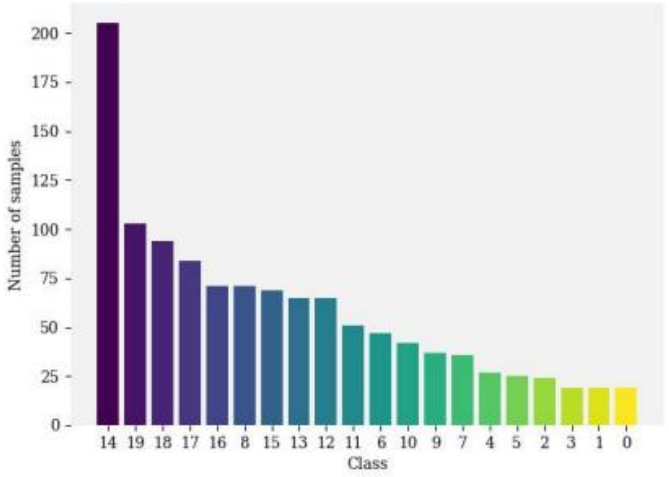
Memory Buffer

person ~~bike~~
~~car~~ ~~dog~~

~~person~~ ~~bike~~
traffic light

...

Class distribution in memory buffer



Given labels

~~Missing past labels~~

~~Missing future labels~~

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预训练模型的零样本定位能力评估

$$G = (V, E, W)$$

$$\downarrow$$

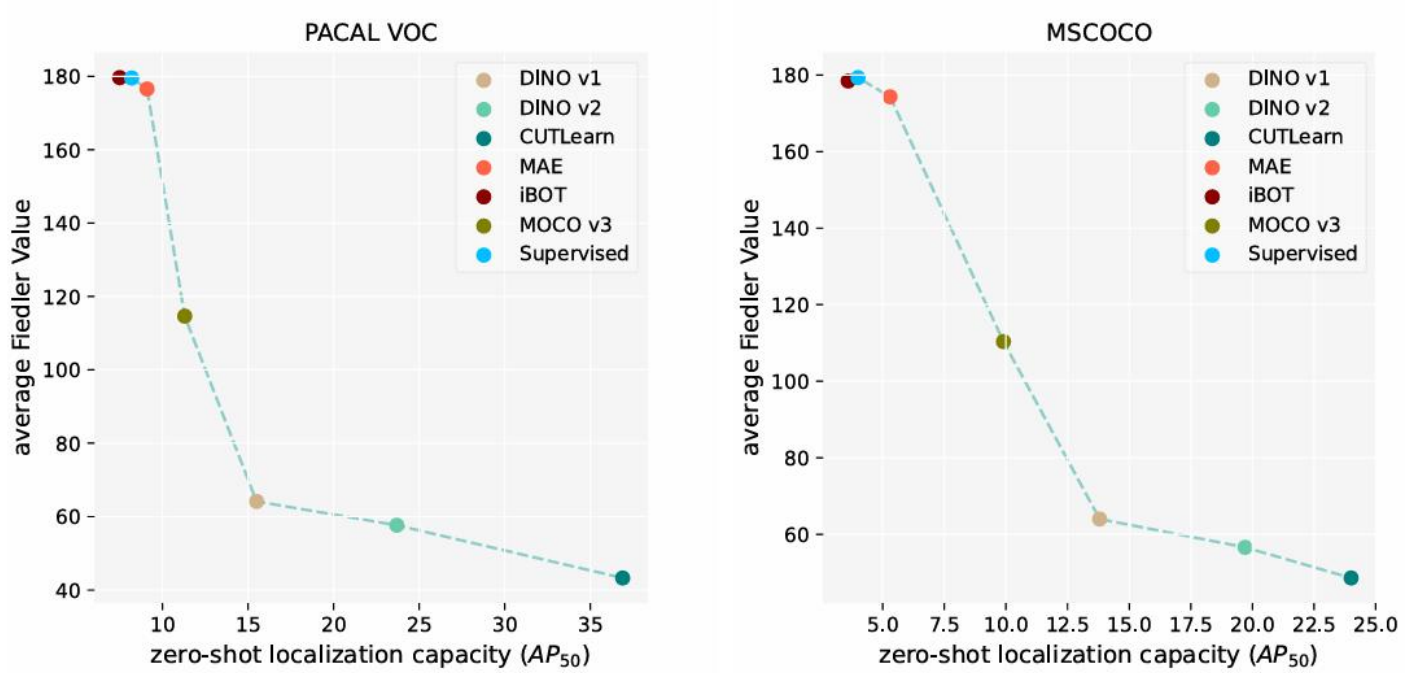
$$A_{ij} = exp(-\frac{||\theta(x_i) - \theta(x_j)||^2}{2\sigma^2})$$

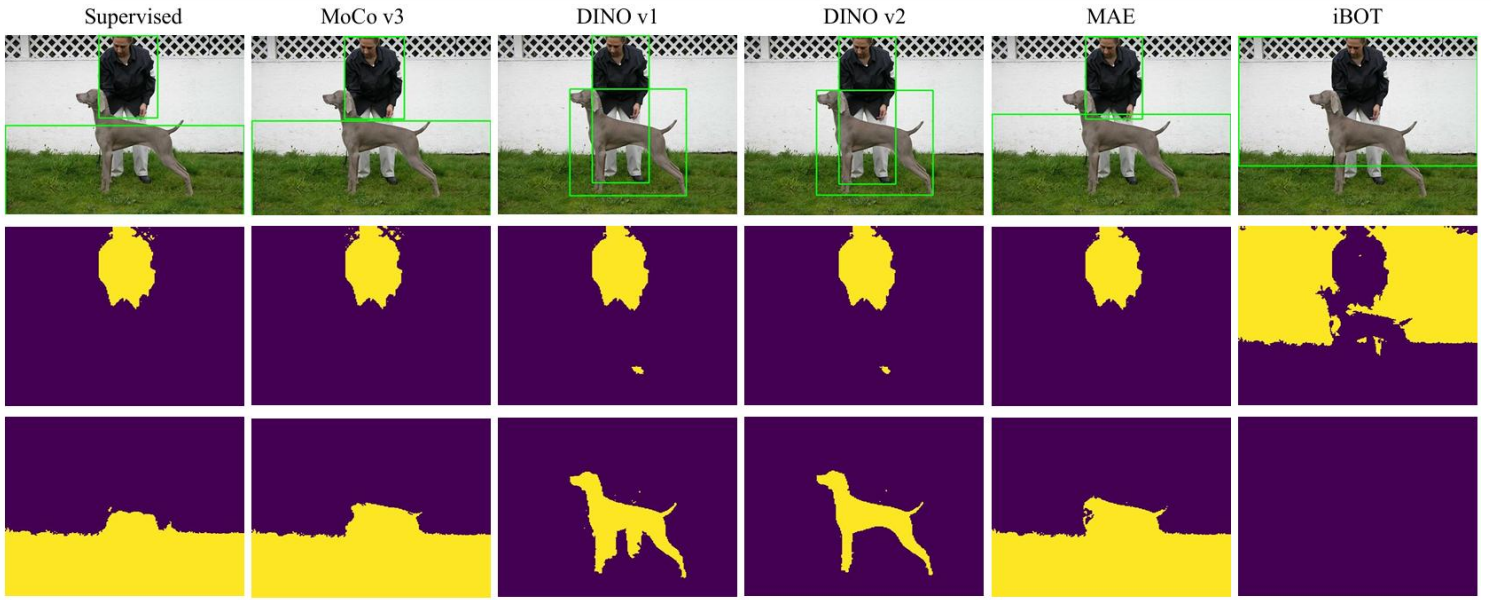
$$\downarrow$$

$$L = D - A$$

$$\downarrow$$

$$\lambda_2$$





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裁剪重放策略

$$p = f(x) \longrightarrow L_{asl} = \frac{1}{|\mathcal{C}_k|}\sum_{c=1}^{|\mathcal{C}_k|}\begin{cases}(1-p_c)^{\gamma^+}\log(p_c), & y_c = 1\\ p_c^{\gamma^-}\log(1-p_c), & y_c = 0\end{cases}$$

MCut算法

$$\{(h_1^j, w_1^j, h_2^j, w_2^j)\}_{j=1}^N$$

$$\downarrow$$

$$\{x_{obj}^j\}_{j=1}^N$$

$$\downarrow$$

$$p_{obj}^j = f(x_{obj}^j)$$

$$\downarrow$$

$$p_{obj,(1)}^j > \tau \wedge p_{obj,(2)}^j < 0.5$$

重平衡蓄水池采样策略

$$1 - m/m_{max}$$

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模型定位与分割能力的巩固

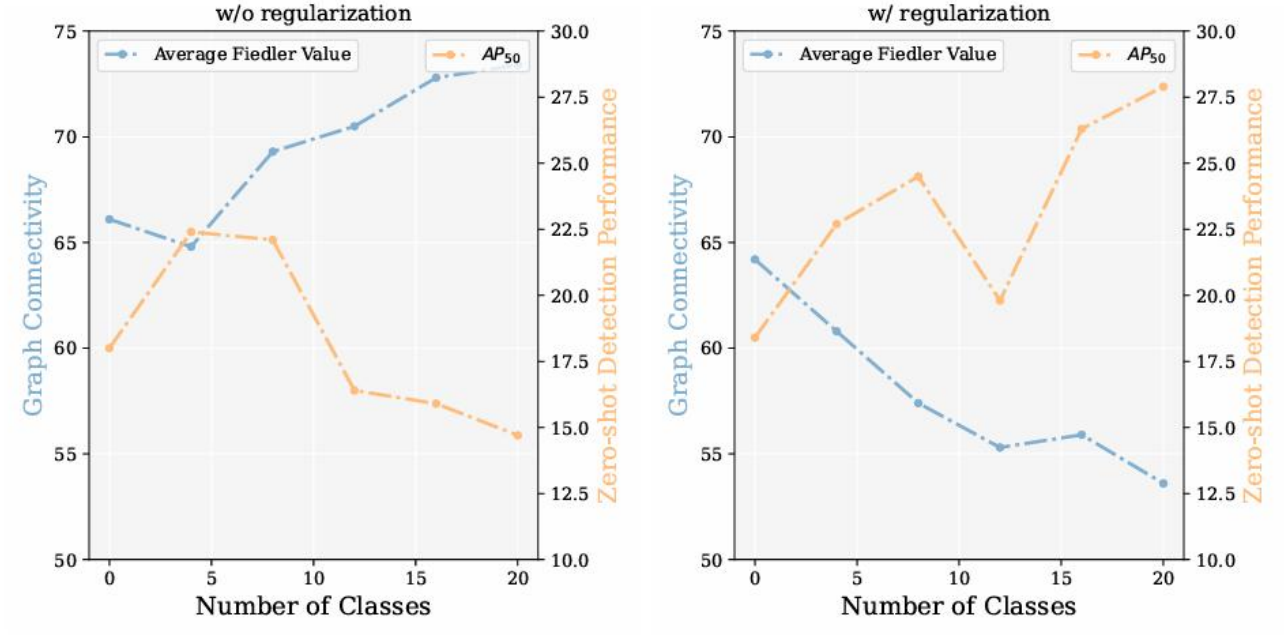

Figure 5. Visualization of model's zero-shot localization capability on PASCAL VOC dataset during MOCL training.

$$L = L_{asy}(f, x, y) + R(A)$$

$$R(A) = ||A||_*$$

Experiment

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Table 1. Comparison results on PASCAL VOC dataset with memory size being $1000 \times 224 \times 224 \times 3$.

Method	Source Task	Average Performance			Last Performance		
		Avg mAP	Avg CF1	Avg OF1	mAP	CF1	OF1
RS	OCL	75.05±1.28	60.32±1.35	61.29±0.74	59.71±1.75	39.88±1.04	46.09±1.24
GSS		76.01±1.24	60.84±0.82	62.37±1.14	58.64±1.29	40.10±0.82	45.13±0.90
iCarl		72.67±3.14	56.24±2.31	58.46±1.78	50.77±2.18	36.51±1.70	41.02±1.91
NsCE		75.24±1.41	64.42±1.05	65.30±0.97	56.87±1.14	40.78±1.22	42.39±1.50
KRT*	MLCIL	59.45±1.17	46.49±0.88	57.12±1.38	38.90±0.77	33.47±1.14	36.82±0.95
APPLE		76.24±1.25	67.01±2.12	66.74±1.23	58.27±0.82	43.77±1.03	50.21±0.98
PRS	MOCL	75.87±0.82	58.15±1.46	61.62±1.69	54.67±0.64	42.15±1.15	43.87±0.86
OCDM		76.14±1.14	52.84±0.79	65.08±1.11	45.35±1.12	36.41±0.25	40.45±1.01
AGCN		75.06±1.01	62.37±0.89	61.87±2.04	57.21±0.74	42.06±1.47	44.79±1.91
AGCN++		74.14±0.78	65.04±1.24	63.55±1.45	55.34±0.87	40.06±0.75	44.21±1.14
CUTER w/ R_l		**82.07±0.53**	**72.19±0.70**	**75.27±0.57**	**67.89±1.28**	**51.35±0.98**	**59.98±1.17**

Table 2. Comparison results on MSCOCO dataset with memory size being $1000 \times 224 \times 224 \times 3$.

Method	Source Task	Average Performance			Last Performance		
		Avg mAP	Avg CF1	Avg OF1	mAP	CF1	OF1
RS	OCL	48.12±1.78	32.21±1.04	37.36±0.92	18.97±2.01	6.44±1.56	12.84±1.05
GSS		49.41±0.84	32.85±0.70	38.26±0.55	25.67±1.34	11.82±0.96	17.40±1.18
iCarl		47.51±1.30	33.09±0.86	37.51±1.09	19.24±1.37	7.62±1.38	12.51±0.89
NsCE		51.24±0.95	37.10±1.10	44.73±0.96	26.19±1.24	17.07±1.04	22.30±0.94
KRT*	MLCIL	44.34±0.95	39.06±1.08	43.51±1.17	36.51±0.87	27.41±0.92	30.16±1.15
APPLE		48.67±1.28	42.34±0.85	46.86±1.31	38.47±0.94	30.12±1.08	33.51±0.67
PRS	MOCL	51.79±1.08	33.64±1.32	38.06±0.94	27.95±1.98	15.33±2.47	18.22±1.29
OCDM		55.45±0.87	46.78±1.02	50.59±0.92	40.56±0.80	28.45±0.71	31.29±0.52
AGCN		56.45±0.92	48.03±1.35	51.27±0.91	37.48±0.73	27.82±0.96	32.38±1.29
AGCN++		54.31±0.82	47.69±0.47	52.27±0.85	36.45±0.74	29.64±0.83	33.05±0.71
CUTER w/ R_l		**60.14±0.60**	**51.53±0.61**	**54.92±0.62**	**47.82±0.60**	**35.94±0.71**	**39.18±0.65**

评估指标

- 平均精度均值（mAP）
- 单类别 F1 值（CF1）
- 整体 F1 值（OF1）

Experiment

Table 4. Comparison results on NUSWIDE dataset with memory size being $1000 \times 224 \times 224 \times 3$.

Method	Avg mAP	Avg CF1	Last mAP
RS	43.90±1.08	36.79±0.76	26.78±0.59
GSS	44.28±0.76	37.01±1.14	28.22±0.90
iCarl	43.50±0.83	35.74±0.95	27.60±0.85
NsCE	45.72±0.52	34.95±0.75	27.14±0.60
KRT*	47.30±1.07	39.70±1.24	31.25±1.19
APPLE	47.53±0.76	40.89±0.97	32.40±1.34
PRS	42.74±0.84	35.01±0.92	22.78±0.72
AGCN	49.16±0.97	38.41±1.05	33.49±0.88
AGCN++	49.03±1.35	40.17±1.28	32.09±1.41
OCDM	40.05±0.42	33.66±0.87	29.41±0.65
CUTER w/ R_l	**51.14±0.72**	**42.92±1.03**	**37.57±1.46**

Table 5. Cut and Replay (CutRep) works as a plug-in component for several MOCL methods (Averaged mAP reported).

Method	VOC	MSCOCO	NUSWIDE
Cut.Rep	77.92±0.78	53.40±0.82	46.30±1.02
Cut.Rep w/ PRS	**81.35±1.02**	58.72±0.94	50.69±0.45
Cut.Rep w/ OCDM	81.09±0.67	57.90±0.73	**51.21±1.38**
CUTER	79.45±0.92	59.23±0.72	50.51±0.64
CUTER w/ KRT	79.37±1.25	57.09±1.32	50.56±0.95
CUTER w/ AGCN	76.95±1.14	**59.31±0.94**	48.95±0.89

Thanks