openLDN

Notation: feature extractor network f_θ

$$f_\theta : X \to Z$$

image — embed dim $\mathbb{R}^d$

classifier projector: f_ϕ

$$f_\phi : Z \to \mathbb{R}^{C_L + C_N}$$

probability score: $\hat{y} = \text{Softmax}(f_\phi \circ f_\theta(x))$

Objective to discover Novel classes.

$$\mathcal{L}_{NOV} = \mathcal{L}_{pair} + \mathcal{L}_{CE} + \mathcal{L}_{reg}$$

$$\mathcal{L}_{pair} = \sum_{i \neq j} \left(\underbrace{\text{sim}(\hat{y}_{i:}, \hat{y}_{j:})}_{f_\phi} - \overbrace{f_R(z_{i:}, z_{j:})}^{f_R} \right)^2$$

Pairwise Similarity loss: Novelty

Pairwise Similarity function

$$f_\Omega : Z \times Z \rightarrow [0, 1]$$

Bi-level optimization procedure:

① $$(\theta^*, \phi^*) = (\theta, \phi) - \alpha_{(\theta,\phi)} \nabla_{(\theta,\phi)} \mathcal{L}_{tar}(\theta, \phi, \Omega)$$

level ① classifier & feature extractor Networks.

Supervised cross-entropy: $$\mathcal{L}_{ce}^{l} = -\sum_i \sum_k y_{i,k} \log \hat{y}_{i,k}$$

utilize updated parameter.

② $$\Omega^* = \Omega - \alpha_\Omega \nabla_\Omega \mathcal{L}_{CE}^{l}(\theta^*, \phi^*)$$

level ②

Swapped prediction !!

Learning with labeled & pseudo-labeled data ?

weak aug.

$$S_{PL} = \left\{ \left(x_i^s, \mathbb{1}_{\max}(\hat{y}_i^w) \right) \middle| \max\left(\hat{y}_{i,:}^w\right) > \tau \right\}$$

strong augmentation

New ground truth $S = S_{PL} \cup S_L$

Retrain using these.

$$\mathcal{L}_{ce} = -\sum_{i \in S_B} \sum_{k=1}^{C_u} \tilde{y}_{i,k} \log \hat{y}_{i,k}$$

Entropy regularization

$$\mathcal{L}_{reg} = -\sum_{k=1}^{C_u} y_k \log \hat{y}_k$$ // enforce single decision.

Close world setting with iterative Pseudo-Labeling