Note: Semantic-Aware Domain Generalized Segmentation

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1 Introduction

The authors argue that existing method standardizing data to a unified distribution is not discriminated enough to get clear segmentation boundaries.
This paper proposed a new frameworks consists of 2 major parts: Semantic-Aware Normalization (SAN) and Semantic-Aware Whitening (SAW). SAN focuses on category-level center alignment between features from different image styles, while SAW enforces distributed alignment for the already center-aligned features.
Contributions:
1, The proposed methods SAN and SAW are plug-and-play.
2, This approach set the new SOTA and even perform at par with approaches using target domains.

2 Method

IN and IW are detailed in the paper.

2.1 Semantic-Aware Normalization (SAN)

Using category branches to approximate F_{obj}.

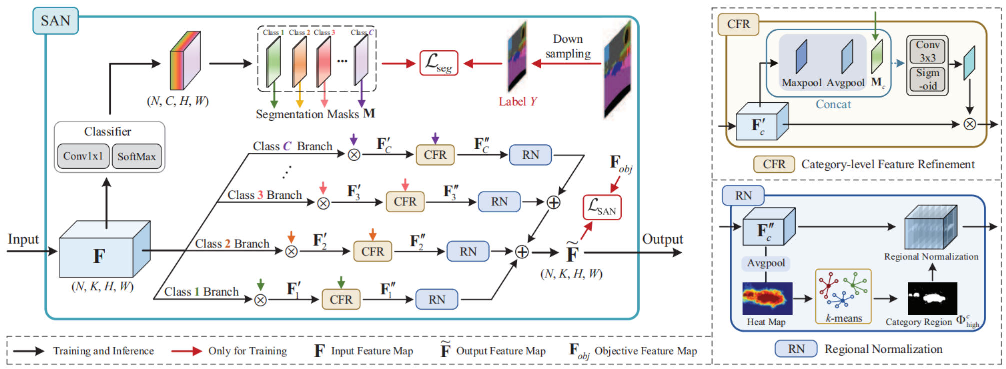

Figure 2. The detailed architecture of our Semantic Aware Normalization (SAN) module. SAN adapts a multi-branch normalization strategy, aiming to transform the feature map $\mathbf{F}$ into the category-level normalized features $\widetilde{\mathbf{F}}$, that are semantic-aware center aligned.

The overall framework is described above and some details are shown below:
1, Category Region Φ^c_{high} is generated of top-t clusters of k-means method on the spatial map.
2, $\gamma^c,\mathbf{and}\beta^c$ are learnable parameters.

$$\widetilde{\mathbf{F}} = \sum_{c=1}^{C} \mathrm{RN}(\mathbf{F}''_c, \Phi^c_{\text{high}}) \cdot \gamma^c + \beta^c,$$

3, Sigm refers to Sigmod function.
4, In order to ensure the processed feature map $\tilde{F}$ are categorylevel-center-aligned as F_{obj}, Loss is applied:
5, F_{obj} is generated because Training are labeled.

2.2 Semantic-Aware Whitening (SAW)

Conventional IW is too strong resulted resulting in loss of crucial domain-invariant information.

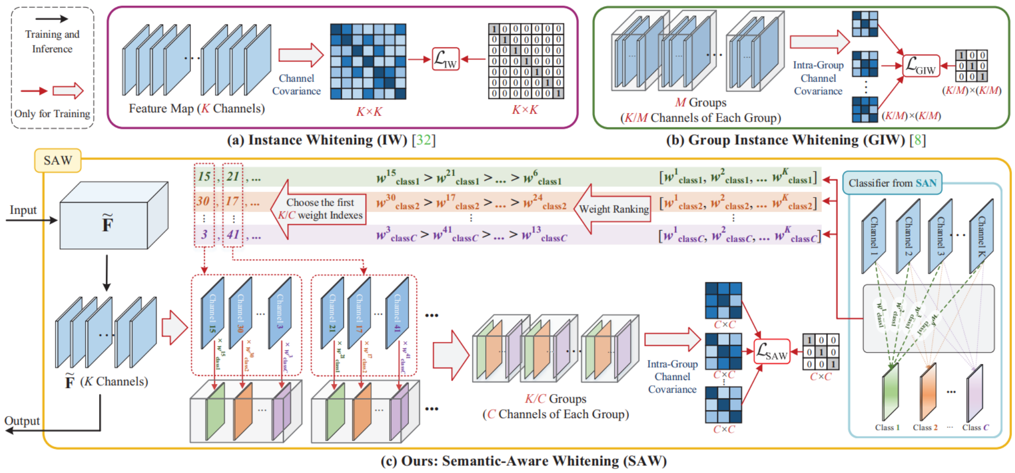

Figure 3. Illustration of feature whitening in IW [32], GIW [8] and the proposed SAW. **(a)** IW de-correlates all channels from each other. **(b)** GIW only de-correlates the channels in the same group. **(c)** SAW allocates channels related to different categories in each group.

Details:
1, The classifier is from the SAN
2, The loss:

$$\mathcal{L}_{\text{SAW}} = \frac{1}{N}\sum_{n=1}^{N}\sum_{m=1}^{\frac{K}{C}} ||\Psi(\bar{\mathbf{G}}_n^m) - \mathbf{I}||_1.$$

3, The Φ function :

$$\Psi(\mathbf{F}_n) = \begin{bmatrix} \text{Cov}(\mathbf{F}_{n,1}, \mathbf{F}_{n,1}) & \cdots & \text{Cov}(\mathbf{F}_{n,1}, \mathbf{F}_{n,K}) \\ \vdots & \ddots & \vdots \\ \text{Cov}(\mathbf{F}_{n,K}, \mathbf{F}_{n,1}) & \cdots & \text{Cov}(\mathbf{F}_{n,K}, \mathbf{F}_{n,K}) \end{bmatrix},$$

3 Summary

This paper proposed 2 new modules : SAN and SAW. SAN performs category-level center alignment. SAW distributed alignment to achieve both domain-invariant and discriminative features.

References