Learning Meta Face Recognition in Unseen Domains
-Supplementary Material-

A. Theoretical Analysis for MFR

Our meta-objective of MFR is summarized as:

$$\arg\min_{\theta} \gamma\mathcal{L}_S(\theta) + (1-\gamma)\mathcal{L}_T(\theta - \alpha\mathcal{L}'_S(\theta)). \quad (1)$$

MFR The first order Taylor expansion has the following form:

$$f(x) = f(x_0) + f'(x_0) \times (x - x_0), \quad (2)$$

where x_0 is a value close to x. Let $x = \theta - \alpha\mathcal{L}'_S(\theta)$ and $x_0 = \theta$, the second term of Eqn. 1 becomes:

$$\mathcal{L}_T(\theta - \alpha\mathcal{L}'_S(\theta)) = \mathcal{L}_T(\theta) + \mathcal{L}'_T(\theta) \cdot (-\alpha\mathcal{L}'_S(\theta)). \quad (3)$$

Then the meta objective Eqn. 1 becomes:

$$\arg\min_{\theta} \gamma\mathcal{L}_S(\theta) + (1-\gamma)\mathcal{L}_T(\theta) - \alpha(1-\gamma)(\mathcal{L}'_S(\theta)\mathcal{L}'_T(\theta)). \quad (4)$$

It indicates that the model is optimized to: (i) minimize the loss on both meta-train and meta-test domains. (ii) maximize the dot product of $\mathcal{L}'_S(\theta)$ and $\mathcal{L}'_T(\theta)$. The former is obvious as we want to learn discriminative representations on both domains. For the latter, if we regard $\mathcal{L}'_S(\theta)\mathcal{L}'_T(\theta)$ as the similarity between two gradient vectors, it can be understood as we want to encourage two gradients on both domains towards a similar direction. Thus this objective can be understood as: *optimize the model parameters, such that after updating on the meta-train domains, the model also performs well on the meta-test domain*. In contrast, the conventional objective $\arg\min_\theta \mathcal{L}_S(\theta) + \mathcal{L}_T(\theta)$ has no such constraint.

B. Feature Visualization

In Fig. 1, we show t-SNE projections of face representations from testing sets in four racial domains. We compare *Base* and *MFR* options in the GFR-V protocol. The visualization shows that our method MFR pushes the representations from different domains close to the center and makes them more "domain-invariant" than *Base*.

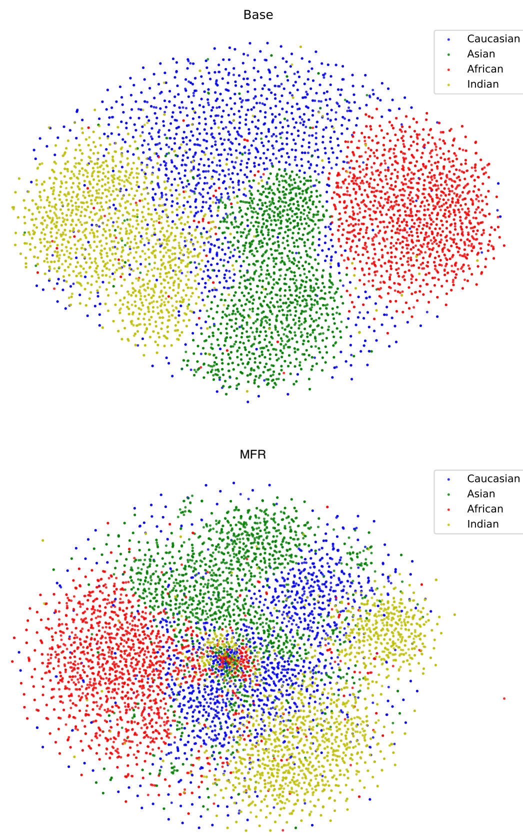

Figure 1: Feature visualization of four racial domains by t-SNE. *Base* and our *MFR* in GFR-V are compared.

Method	Base	Base-Agg	MLDG	MFR (Ours)
CPLFW	89.3	89.49	88.58	**90.67**
CALFW	95.19	95.27	94.88	**96.67**
CFP-FP	93.68	93.84	92.98	**95.3**

Table 1: Comparative results on CPLFW, CALFW and CFP-FP.

C. Additional Experiments

We perform additional experiments on CALFW, CPLFW and CFP-FP in Table 1, and all of them show the improvements of our proposed MFGR.