

ClusterFace: Joint Clustering and Classification for Set-Based Face Recognition

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Problem Statement

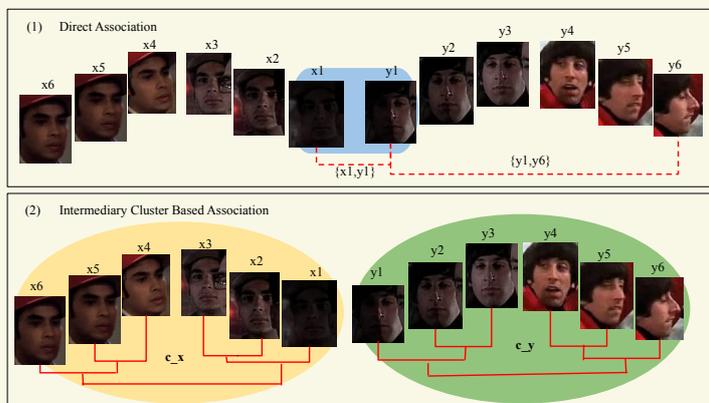
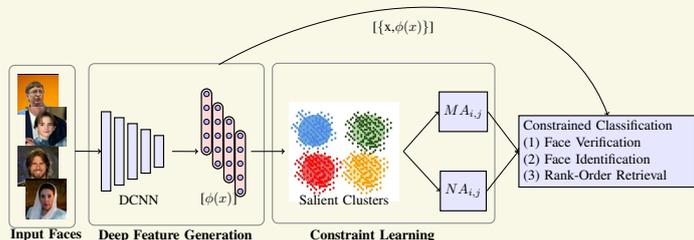


Figure: x_1, \dots, x_6 are faces of individual x and y_1, \dots, y_6 are of individual y . c_x denotes cluster x and c_y denotes cluster y . Dashed lines show direct associations, solid lines show ClusterFace associations. **Top:** Direct associations incorrectly conclude that x_1 and y_1 (faces of different individuals under similar illumination conditions) are more similar than y_1 and y_6 (faces of same individual under different settings). **Bottom:** ClusterFace associations begin by merging the closest faces. Gradual and incremental associations correctly group the samples of same individual in to a single cluster.

When unconstrained faces are mapped into deep features, variations such as illumination, pose, occlusion, etc., can create inconsistencies in the resultant feature space. Hence, deriving conclusions based on direct associations could lead to degraded performance. This rises the requirement for a basic feature space analysis prior to face recognition. This paper devises a joint clustering and classification scheme which learns deep face associations in an easy-to-hard way.

Framework overview



Clustering based constraint formulation

- ▶ Hierarchical clustering preserves high reliability in early iterations .
- ▶ A reliable clustering result provides insights on the distribution of the feature space.
- ▶ MA: Must Associate constraints based on the clustering result.
- ▶ NA: neighbourhood associate constraints based on clustering and MA results.

Performance Evaluation

System	YTC Accuracy (%)
SANP	65.60
MMDML	78.5
DRM-PWV	72.55
Fast FR	72.1
GJRNP	81.3
Direct Associations	90.71
ClusterFace Associations	91.06

IJB-A verification (TAR)			
System	FAR=0.001	FAR=0.01	FAR=0.1
Triplet Emb	81.3	91	96.4
FastSearch	51.0	72.9	89.3
Joint Bayesian	-	83.8	96.7
PAM	65.2	82.6	-
NAN	88.1	94.1	97.8
Template	83.6	93.9	97.9
DR GAN	53.9	77.4	-
Direct Associations	84.95	93.76	98.13
ClusterFace Associations	86.60	94.23	98.30

IJB-A closed-set face recognition			
System	Rank-1	Rank-5	Rank-10
Triplet Emb	93.2	-	97.7
FastSearch	82.2	93.1	-
Joint Bayesian	90.3	96.5	97.7
PAM	84	92.5	94.6
NAN	95.8	98.0	98.6
Template	92.8	97.7	98.6
DR GAN	85.5	94.7	-
Direct Associations	94.23	97.05	97.71
ClusterFace Associations	94.28	97.05	97.72

Discussion

- ▶ ClusterFace based associations outperform direct associations in all experiments.
- ▶ ClusterFace is effective on face recognition based tasks such as face verification, identification and rank-order retrieval.
- ▶ ClusterFace achieves highly competitive results compared to state-of-the-art.

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