

Local Relationship Learning with Person-specific Shape Regularization for **Facial Action Unit Detection**

LONG BEACH **CALIFORNIA**

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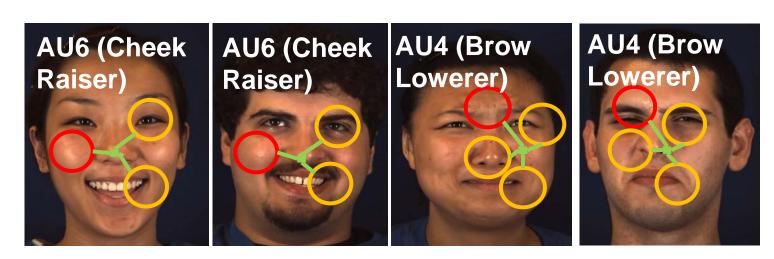
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> What is facial action unit?

Facial action units refer to a set of facial muscle movements coded by their appearance on the face, which can be used for coding nearly any anatomically possible facial expression.

- > Taking into account the relationship AU6 (Cheek of multiple related face regions can provide better robustness than using individual single local regions separately.
- The influence of person-specific shape information can be reduced by regularization based on facial shape during feature learning.

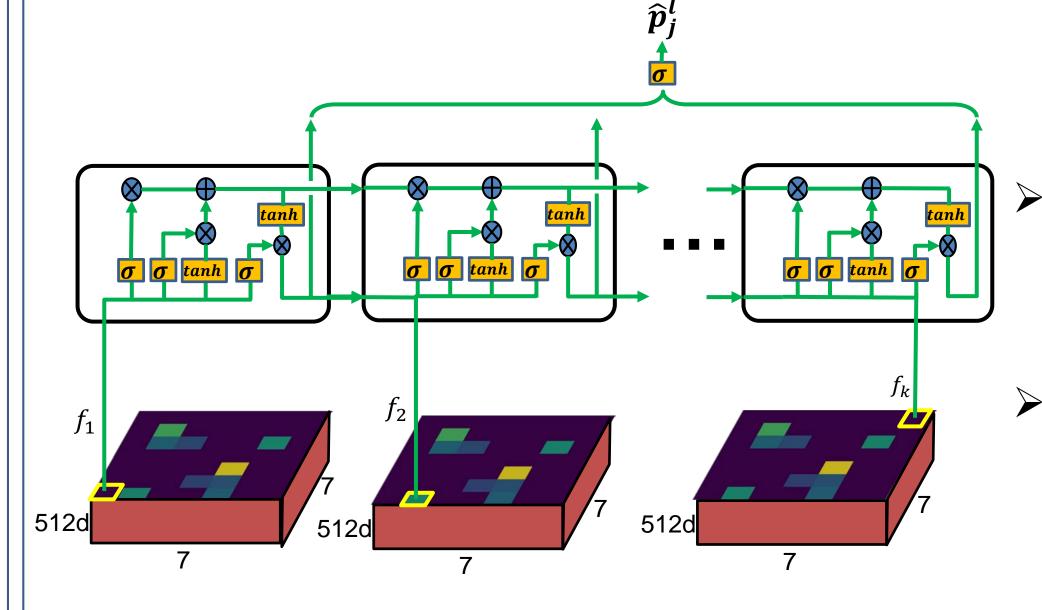






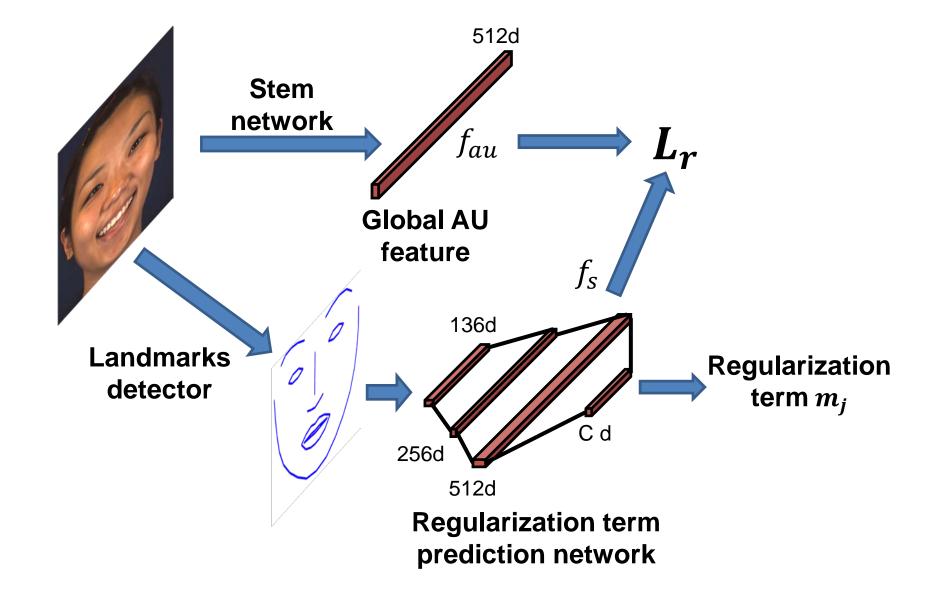
Detailed Structure

> L-Net for Local Relationship Learning



- The output feature maps from the Stem-Net are used as the local features.
- > LSTM is used for relationship learning.

> P-Net for Person-specific Shape Regularization

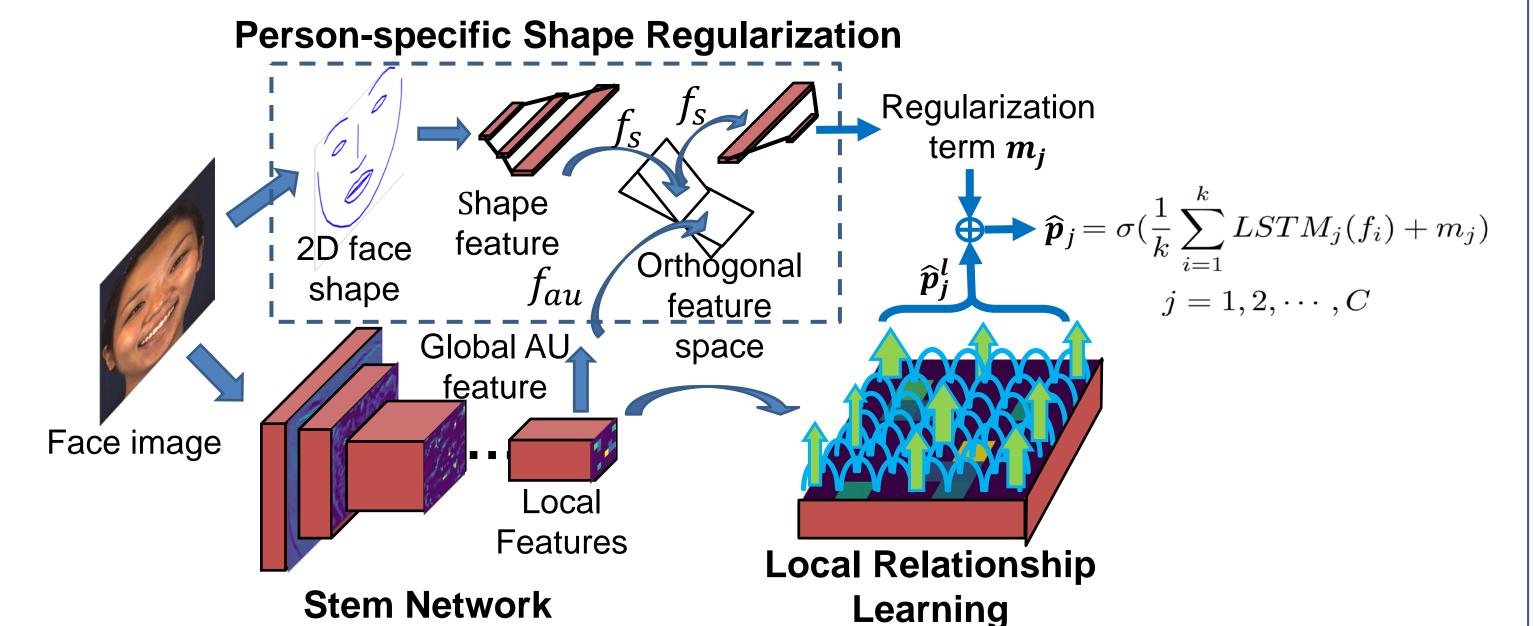


- > Facial landmark features are used for regularization prediction.
- landmark > The features projected to an AUindependent feature space by using loss function:

$$L_r = |f_{au} \bullet f_s|$$

Overview

LP-Net for AU detection consists of a stem network, a local relationship learning module to model the related facial regions and a personspecific shape regularization module to reduce the shape bias.



> Loss functions

> Loss function for AU prediction: weighted binary cross-entropy.

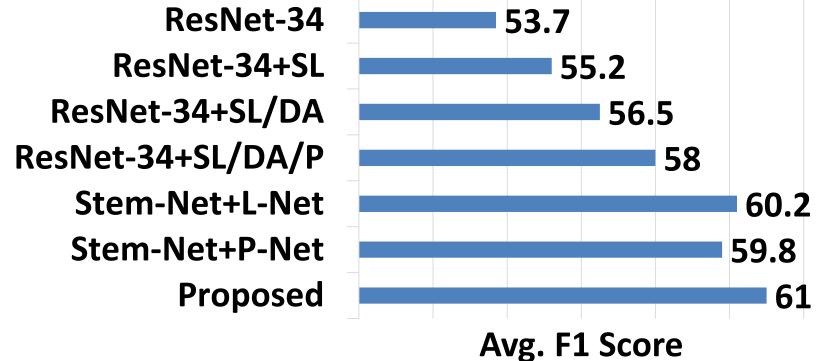
$$L_{au} = -\frac{1}{C} \sum_{j=1}^{C} w_c [p_j \log \hat{p_j} + (1 - p_j) \log(1 - \hat{p_j})]$$

Overall loss function

$$L_{all} = L_{au} + \lambda L_r$$

> Databases No. Subj. No. Vids. No. AU No. Imgs. Protocol three-fold ~140,000 BP4D 324 ~130,000 27 **DISFA** Fine-tune > Results **JAA-Net Proposed** Performance on BP4D database 23.8 **LSVM JAA-Net** Proposed Performance on DISFA database > Ablation Study on BP4D Database

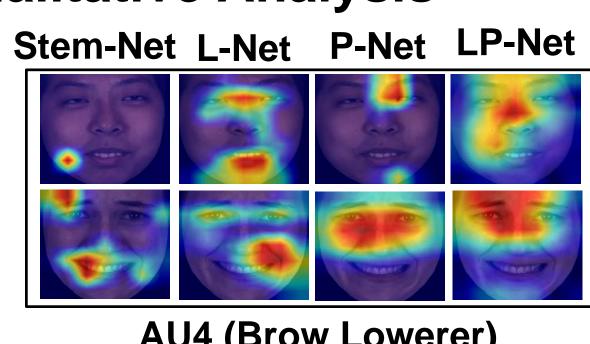
ResNet-34 SL: Selective Learning balancing



DA: Data Augmentation P: Pre-training on VGGFace2

Stem-Net: ResNet-34 + SL/DA/P

> Qualitative Analysis



Stem-Net L-Net P-Net LP-Net

AU23 (Lip Tightener) AU4 (Brow Lowerer)