Face2Exp: Combating Data Biases for Facial Expression Recognition
Dan Zeng, Zhiyuan Lin, Xiao Yan, Yuting Liu, Fei Wang, Bo Tang


Introduction

Face2Exp utilizes large unlabeled FR datasets to enhance FER

Challenges

➢ Class imbalance in FER data (a: 1st data bias)
➢ Distribution mismatch between FR and FER data (b: 2nd data bias)

➢ The image gap between FR and FER data is large

Motivation

➢ A base network learns prior expression knowledge from class balanced FR data (to solve (a))
➢ The circuit feedback mechanism improves the base network with the cognitive differences from the adaptation network (to solve (b))

Contributions

➢ A general framework to utilize large unlabeled FR data for other face-related tasks (e.g., gender/race classification, age estimation) that lack high quality data
➢ Extract de-biased knowledge from auxiliary FR data
➢ Obtain comparable results to the state-of-the-art FER methods with 10% labeled FER data

Method: Meta-Face2Exp

Loss functions:

\[ L_u = CE(y_{FR}, A(x_{FR}; \theta_u)) \]
\[ L_s = CE(y_{FER}, B(x_{FER}; \theta_s)) \]
\[ L_f = f \cdot CE(y_{FER}, B(x_{FR}; \theta_b)) \]

De-biased Mechanism:

\[ f = \frac{\partial L_s}{\partial \theta_s} \cdot \left( \frac{\partial L_u}{\partial \theta_u} + \frac{\partial L_f}{\partial \theta_f} \right) \]

➢ 1st term: the gradients of the new adaptation network on debiased FER data
➢ 2nd term: the gradients of the old adaptation network on biased FR data

Evaluation on class imbalance

➢ De-biased behavior

- Meta-Face2Exp yields more balanced accuracy, despite it is trained with unbalanced FER data. (RAF-DB dataset)

- Higher mean accuracy with small labeled data (e.g., 5%)
- Significantly lower the std accuracy.

➢ Effect of unbalanced FR data
- Meta-Face2Exp is general across different FR datasets (i.e., training our model with Webface260M: VGGFace2 yields similar accuracy.)

Experiments

Table: Comparison of meta-Face2Exp and SL model on different FR datasets.

<table>
<thead>
<tr>
<th>Models</th>
<th>SL model</th>
<th>Meta-Face2Exp</th>
<th>Models</th>
<th>SL</th>
<th>Meta-Face2Exp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data size</td>
<td>100%</td>
<td>1%</td>
<td>5%</td>
<td>10%</td>
<td>100%</td>
</tr>
<tr>
<td>Mean Acc</td>
<td>58.37</td>
<td>53.54</td>
<td>61.66</td>
<td>64.23</td>
<td>84.16</td>
</tr>
<tr>
<td>Std Acc</td>
<td>21.53</td>
<td>14.41</td>
<td>10.69</td>
<td>10.07</td>
<td>15.48</td>
</tr>
</tbody>
</table>

- Higher mean accuracy with small labeled data (e.g., 5% AffectNet).
- Significantly lower the std accuracy.

Conclusion

➢ Combat two data biases: class imbalance and distribution mismatch
➢ Two networks constantly complement each other to extract de-biased knowledge through the circuit feedback paradigm
➢ Meta-Face2Exp effectively produces low std and high mean accuracy

Homepage
Wechat