Modeling the Evolution Dynamics to Enhance Micro-Expression Recognition

Yuhong HE, Guangyu WANG, Wenchao LIU, Lin MA, Haifeng LI

Frontiers of Computer Science, DOI: 10.1007/s11704-025-40976-3

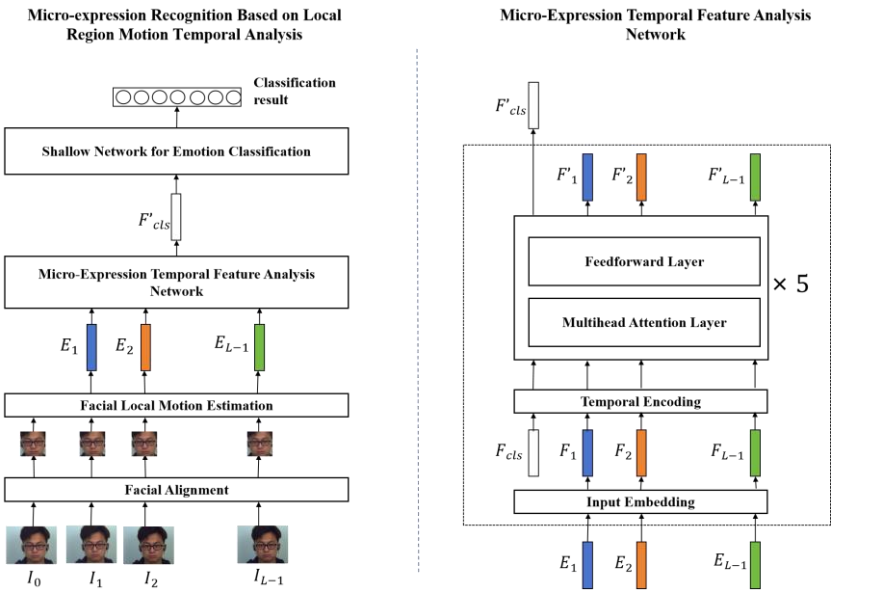
Problems & Ideas

- Problems of existing Micro-expression(ME) recognition methods:
  - Onset-apex methods struggle with apex localization and miss asynchronous Action Unit (AU) peaks.
  - Fixed-frame approaches discard critical temporal dynamics due to variable ME durations.
- Proposed solution:

  A full-sequence transformer network integrating adaptive spatiotemporal attention to:

  (1) Track asynchronous AU activations by weighting localized facial movements,

  (2) Model long-range temporal dependencies for holistic ME dynamics.



Overall Framework of the Method. Left: ME recognition based on local region motion temporal analysis; Right: ME temporal feature analysis network.

Main Contributions

- Contributions:
  - A novel temporal feature analysis network, utilizing the complete image sequence to model the dynamic evolution of micro-expressions, effectively handling the long-range temporal dependencies;
  - Notably, in DFME, the largest available micro-expression dataset, our method achieves the highest performance in 7-class classification task;
  - We earn the first place in the 4th Chinese Conference on Affective Computing (CCAC 2024) competition, with an approximate 5% improvement over the second-place entry.

Result of "test_A" of DFME dataset

	UF1	UAR	ACC
FeatRef (baseline) [2]	0.3410	0.3686	50.84%
jessica (rank 3) [10]	0.3462	0.3610	46.20%
Xiao el. (rank 2) [10]	0.4067	0.4074	46.41%
Our method (rank 1) [10]	0.4123	0.4210	48.73%

Result of "test_B" of DFME dataset

	UF1	UAR	ACC
FeatRef (baseline) [2]	0.2875	0.3228	36.45%
Zhang el.(rank 3) [10]	0.3356	0.3549	37.79%
Xiao el.(rank 2) [10]	0.3534	0.3661	38.13%
Our method (rank 1) [10]	0.4016	0.4008	41.47%

Comparison with other methods on CAS(ME)^3 dataset

	Classes	UF1	UAR	AVG
FeatRef [2]	3	0.2875	0.3228	0.3052
HTnet [3]	3	0.5767	0.5415	0.5591
μ-Bert [7]	3	0.5604	0.6125	0.5865
HSTA [8]	3	0.5930	0.6180	0.6055
HDRCL [9]	3	**0.6423**	0.6065	0.6244
Our method	3	0.6182	**0.6643**	**0.6413**
Baseline [6]	7	0.1759	0.1801	0.1780
Baseline(+D) [6]	7	0.1773	0.1829	0.1801
μ-Bert [7]	7	0.3264	0.3254	0.3259
Our method	7	**0.4166**	**0.4172**	**0.4169**

Micro-expression recognition results in two datasets. Left: 7-class classification task in"test_A" and "test_B" of DFME; Right: 7-class and 3-class classification task on CAS(ME)^3.