



Component Biologically Inspired Features with Moving Segmentation for Age Estimation

Yi-Tseng Cheng, Gee-Sern (Jison) Hsu

National Taiwan University of Science and Technology

Choon Ching Ng, Moi Hoon Yap

Manchester Metropolitan University, UK

Outline

- Issues
 - Many different boundaries for age segmentation
 - Limitations of BIF (Biologically Inspired Feature)
- Proposed Solution
 - Moving segmentation and hierarchical classification
 - Component BIF (CBIF)
- Performance on benchmark databases

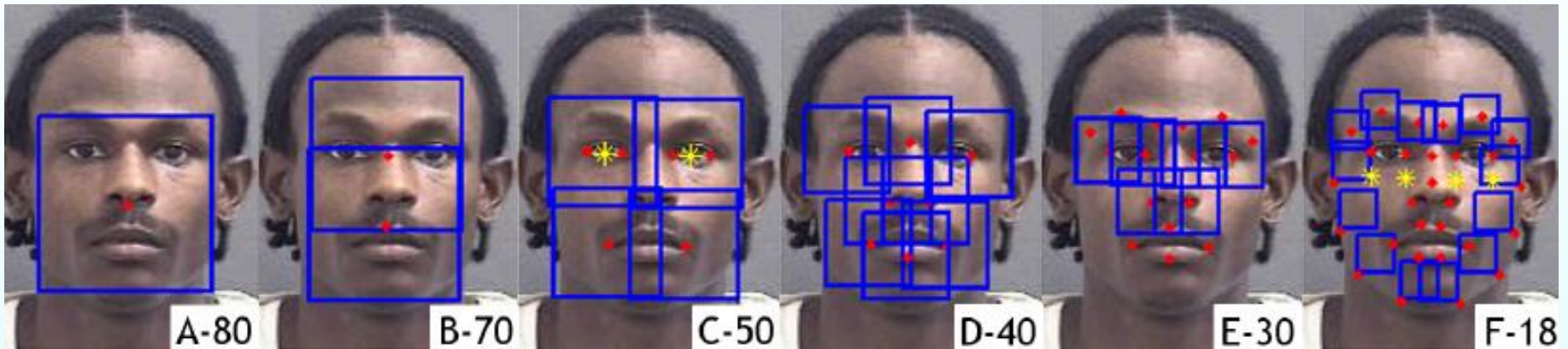
Issues

- 2 Groups: ages split into Young and Adult groups with 20 as the boundary age in [5, Neurocomputing, 2013].
- 3 Groups: boundaries at 10 and 20 in [12, SMC 04], 19 and 60 in [11, ICCV 09], and 15 and 30 in [4, ICASSP 12].
- 4 Groups: boundaries at 1, 16, 50 years in [13, ICB 09], and 29, 49, 69 in [14, CVPR 12].
- Groups with the same age gap: [2, CVPR 09], [15, ISCIS 08].

Solution

- Moving segmentation: exhaustive search for boundary ages good for segmentation across various age gaps.
- Component BIF: an improved version of the BIF, defined on facial components with more parameters allowed to vary, leading to a superset of BIF.
- Hierarchical classification.

Component Biologically Inspired Features

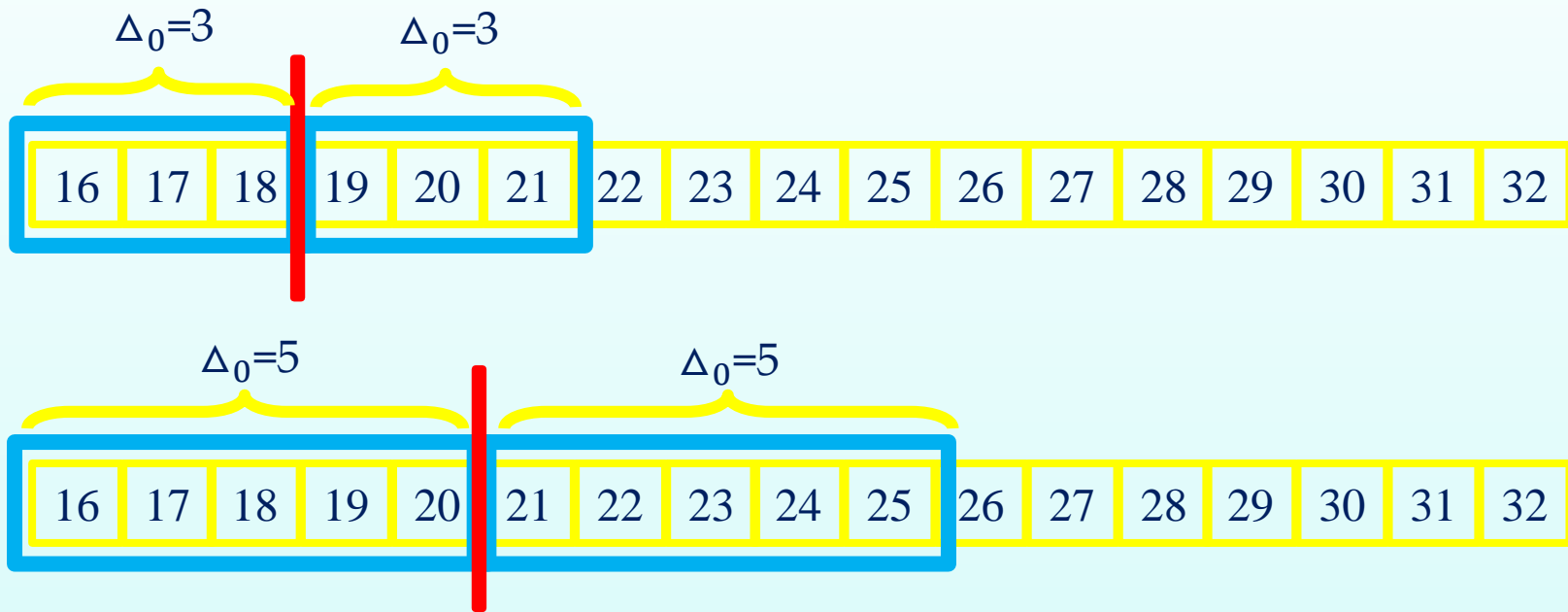


- Components defined by landmarks (RTSM, ICCV 15);
- Independent and catenated features;
- Number of layers, orientations, scales, spatial frequencies can be different for each component.

Differences between CBIF and BIF

- **BIF:** $G(x, y; \omega_i) = \exp\left(-\frac{(X^2 + \gamma_i^2 Y^2)}{2\sigma_i^2}\right) \cos\left(\frac{2\pi}{\lambda_i} X\right)$
- **CBIF:** $G(x, y; \omega_{i,j,k}) = \exp\left(-\frac{(X^2 + \gamma_{i,j}^2 Y^2)}{2\sigma_{i,j}^2}\right) \cos\left(\frac{2\pi}{\lambda_{i,j}} X\right)$
 - We can define J_i Gabor filters for Layer- i , in terms of layer parameter $\omega_{i,j,k} = [s_{i,j}, \gamma_{i,j}, \theta_{i,k}, \sigma_{i,j}, \lambda_{i,j}]$.
 - $X = x \cos \theta_{i,k} + y \sin \theta_{i,k}$, $Y = x \sin \theta_{i,k} + y \cos \theta_{i,k}$
 - More independent parameters in each layer!!

Moving Segmentation



Weighted average of miscl. rates at each age over multiple age gaps Δ_i 's. The weight is normalized to $\sqrt{1/\Delta_i}$

Moving Segmentation

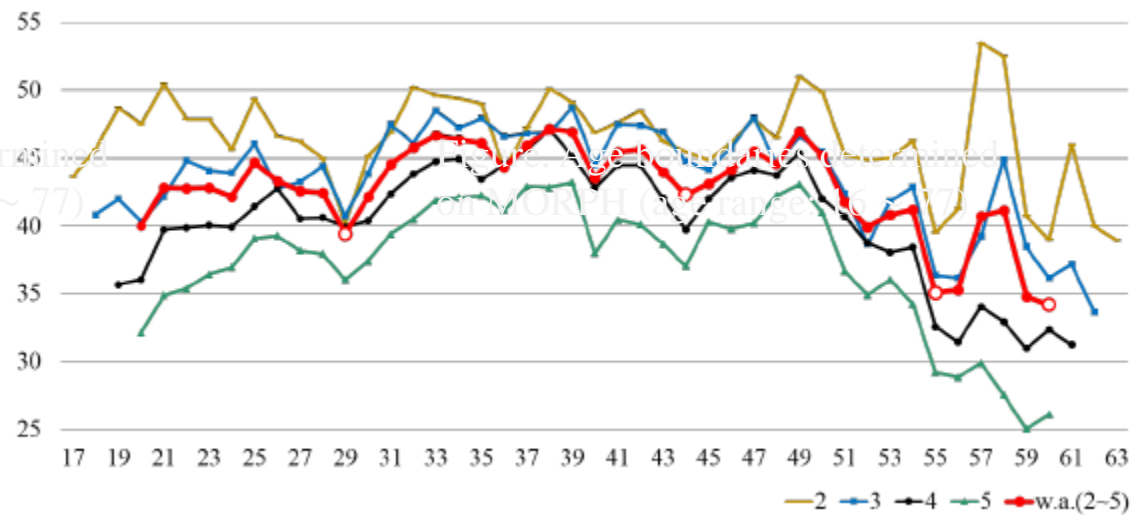
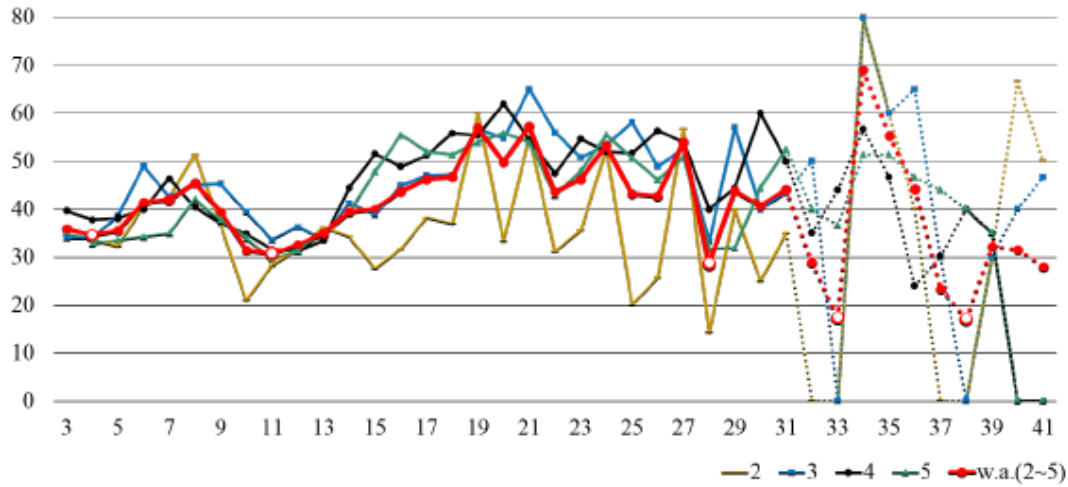
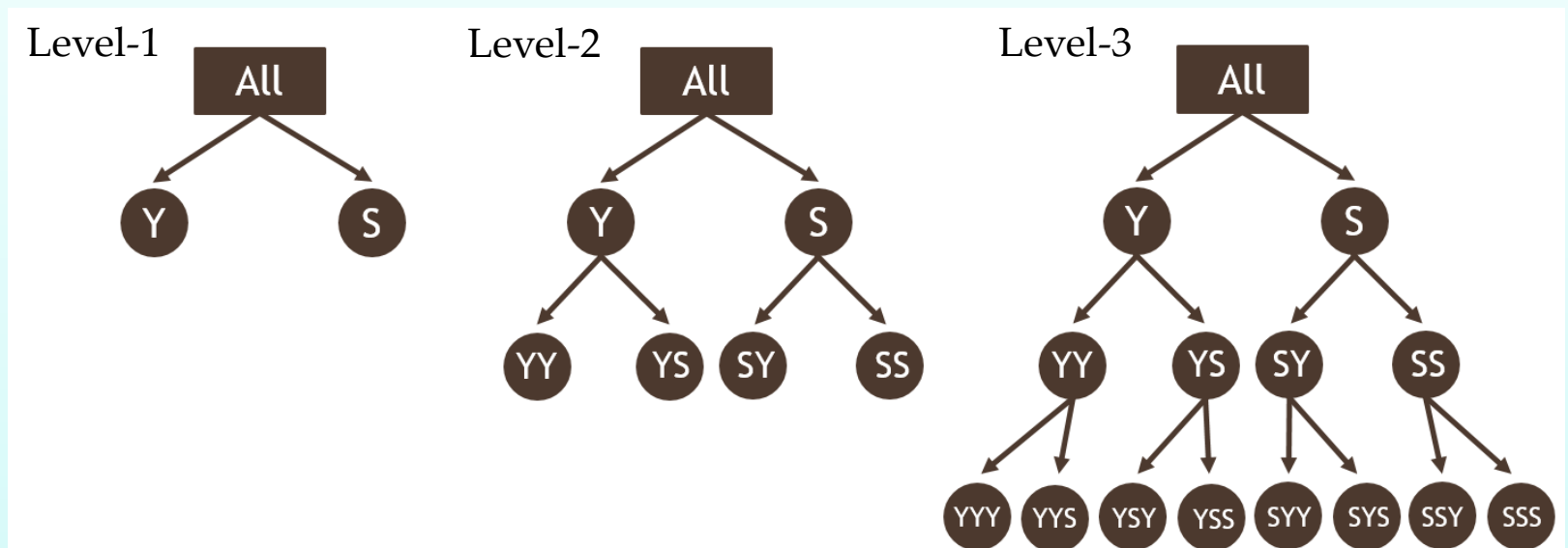


Figure. Age boundaries determined on FG-NET (age range: 16~77) and ORF-H (age range: 16~77).

Hierarchical Classification

- Given boundary ages, a hierarchical configuration is needed to determine the structure for classification



Comparison with BIF

GT (CBIF, BIF)



43 (38, 19)



25 (21, 49)



24 (26, 49)



19 (24, 48)



48 (50, 18)



52 (51, 29)



23 (28, 48)

Evaluation

- Evaluation on FG-NET and MORPH

| Publication | FG-NET | MORPH |
|---------------------------|--------|-------|
| Guo et al.(2009) | 4.8 | N/A |
| Luu et al.(2011) | 4.1 | N/A |
| Chang et al.(2011) | 4.5 | 6.1 |
| Kohli et al.(2013) | 3.9 | N/A |
| Hu Han et al.(2013) | 4.6 | 4.2 |
| Hu Han et al.(2015) | 3.8 | 3.6 |
| Proposed (truncated CBIF) | 3.62 | 3.41 |
| Proposed (CBIF+CNN) | N/A | 2.78 |

