Short-Time and Long-Time Aging Analysis in Human Faces

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Outline

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- Introduction
- Short-time analysis
  - Quantitative measure of face differences
  - Experimental evaluation
- Long-time analysis
  - Current status of long-time analysis
  - Delhi face aging database
  - Experimental evaluation
- Summary

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Aging analysis in human faces

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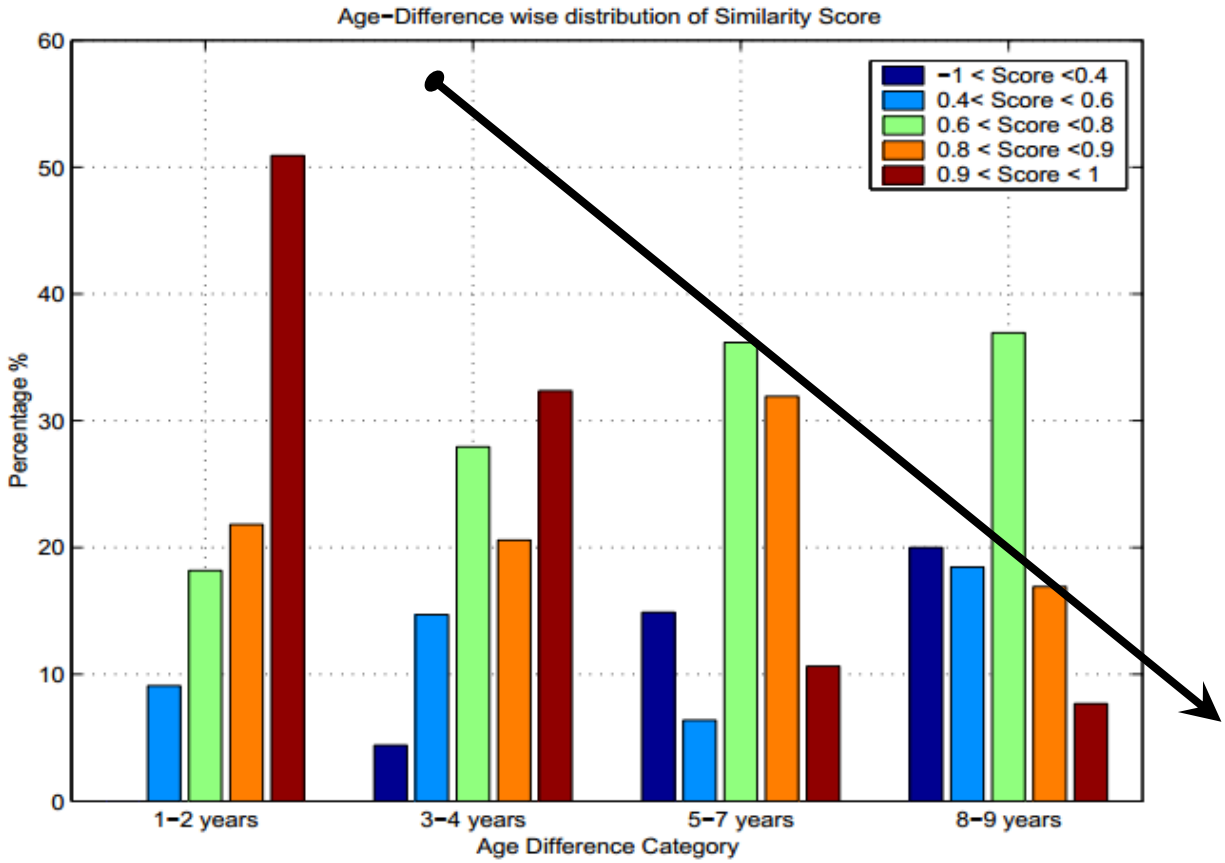
- Aging effect in faces

Similarity scores decreased as age difference increases



N. Ramanathan and R. Chellappa, ”Face verification across age progression”, IEEE TIP, 2006.

Aging analysis in human faces

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- Aging effect in faces

N. Ramanathan, R. Chellappa, and S. Biswas, "Age Progression in Human Faces: A Survey", J. of Visual Languages and Computing, 2009.

Formative years: shape variation
Later stages: texture variation

H. Ling, S. Soatto, N. Ramanathan, and D. Jacobs, "A Study of Face Recognition as People Age", ICCV 2007.

Performance degradation is observed
when matching age separated faces

Aging analysis in human faces

- To design a robust face recognition algorithm, both quantitative evaluation of appearance changes and regular update of facial template are required.

- Long-time vs short-time

Aging analysis in human faces

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- To design a robust face recognition algorithm, there is a great demand for both quantitative evaluation of appearance changes and regular update of facial template

- Long-time vs short-time

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Quantitative measure of face differences

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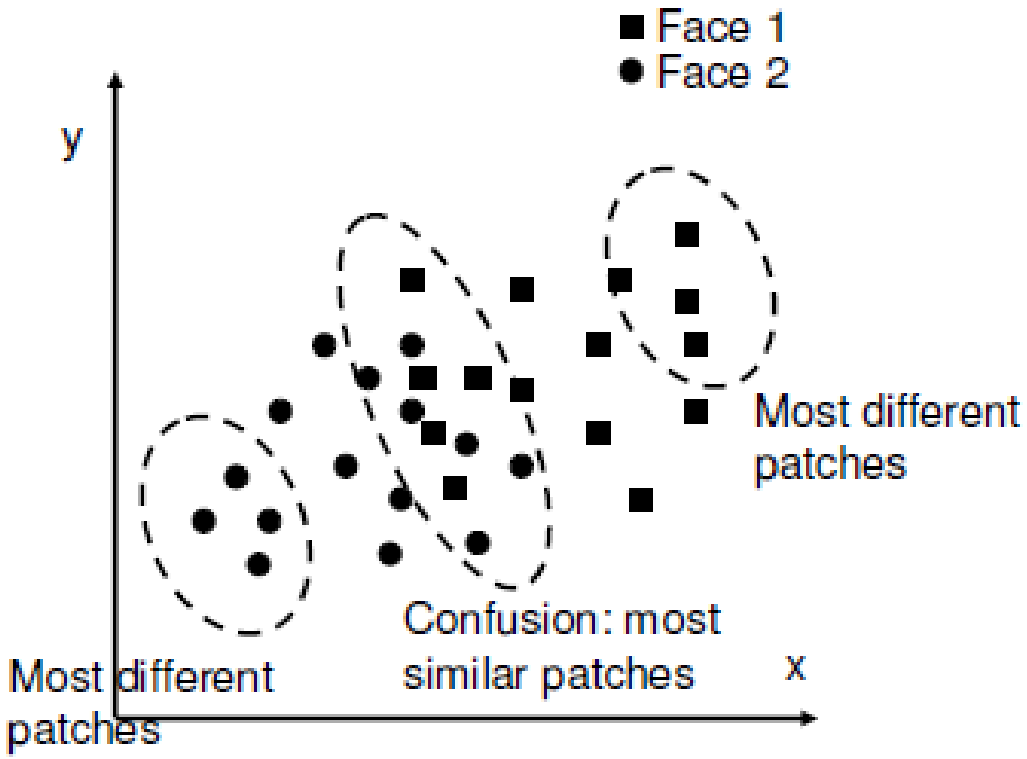
- Time evolution between faces
- Differences computation between faces



Quantitative measure of face differences

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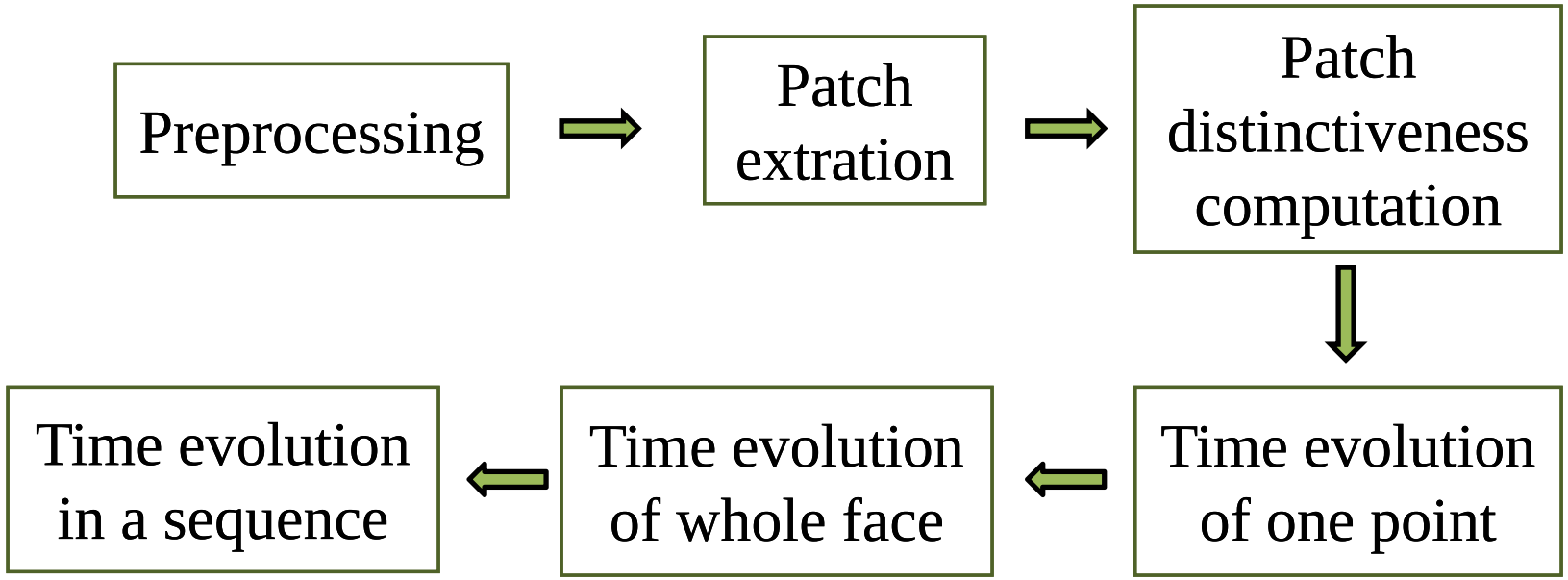
- How to compute the time evolution within a time span?



Quantitative measure of face differences

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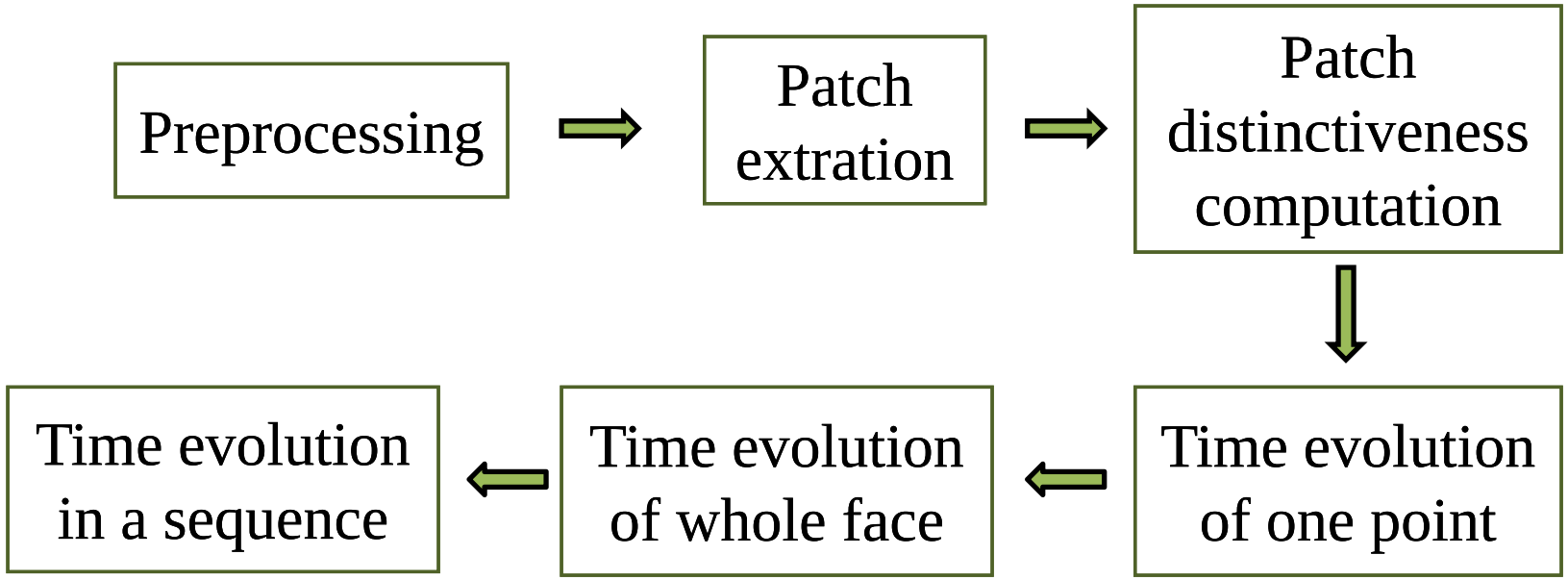
- How to compute the time evolution within a time span?



What does the global evolution of face appearance?

Experimental evaluation

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- Face dataset
  - Sequences of faces from publicly available videos.
  - Three sequences: S1 (4 years), S2 (3 years), S3 (1 year)

S1 S2 S3

Experimental evaluation

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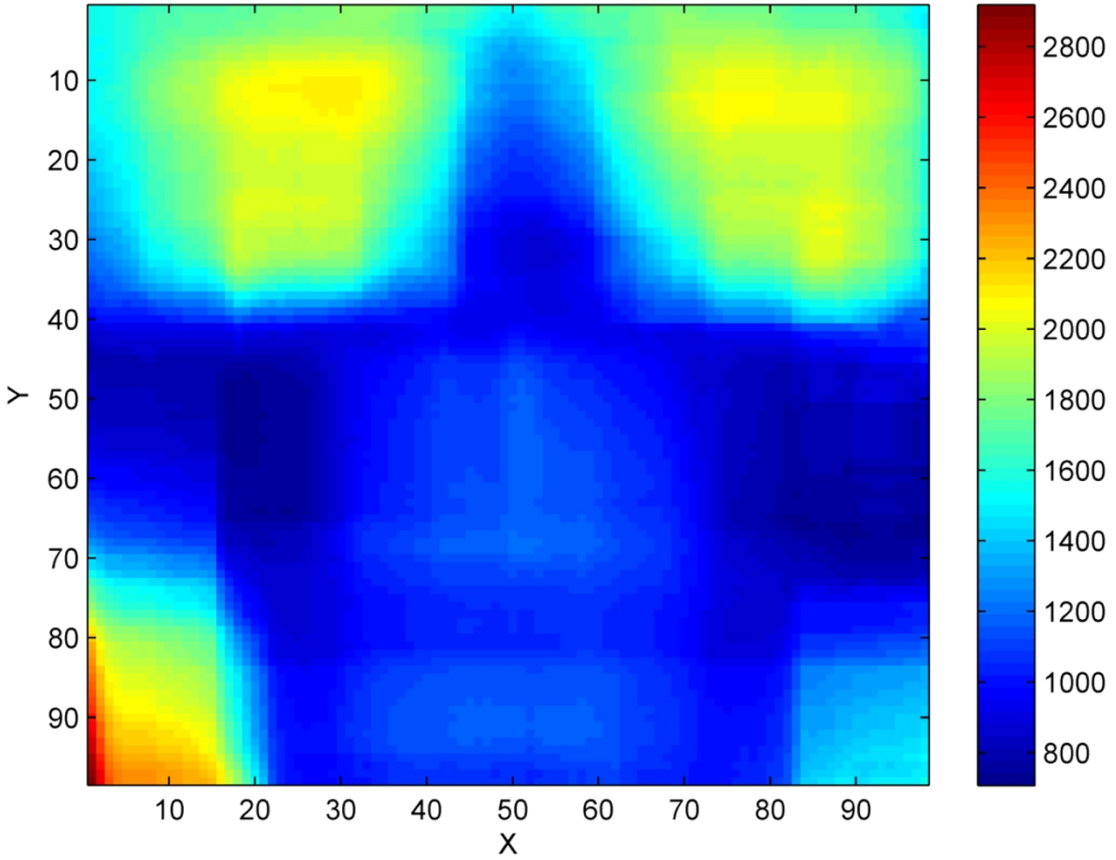
- Q1: global evolution of face appearance



The brighter the pixel, the faster the temporal evolution of the corresponding face point.

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Current status of long-time analysis

- Well studied in human anatomy and visual perception
- Three active topics in aging analysis
  - Age estimation

    Y.H. Kwon and N. da Vitoria Lobo, “Age classification from facial images”, Computer Vision and Image Understanding, 1999.

    N. Ramanathan and R. Chellappa, ”Face verification across age progression”, IEEE TIP, 2006.
  - Computational models for age progression

    N. Ramanathan and R. Chellappa, “Modeling age progression in young faces”, CVPR 2006.

    N. Ramanathan and R. Chellappa, “Modeling shape and textural variations in aging adult faces”, FG 2008.
  - Face recognition across age progression

    H. Ling, S. Soatto, N. Ramanathan, and D. Jacobs, “A study of face recognition as people age”, CVPR 2007

Delhi face aging database

- Traditional face aging databases
  - FG-NET and MORPH
  - Acquired under very controlled conditions
- Delhi face aging database
  - Face images of celebrities collected in real-life scenarios
  - Real-life variations: makeup, pose, illumination, expression and resolution
  - Over 2,600 images from 49 female and 53 male Indian celebrities
  - Age span: between 4 and 88 years

Delhi face aging database

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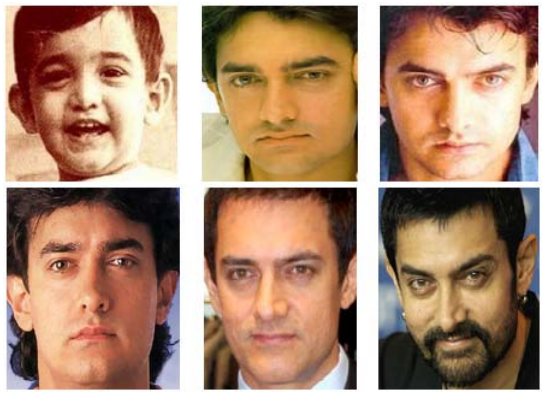
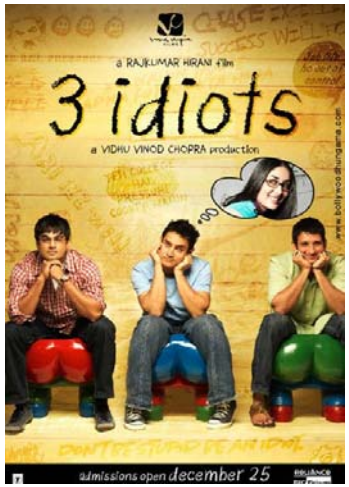
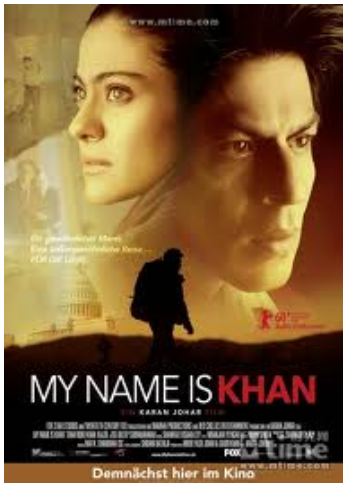




Amir Khan



Kajol Devgan

Delhi face aging database

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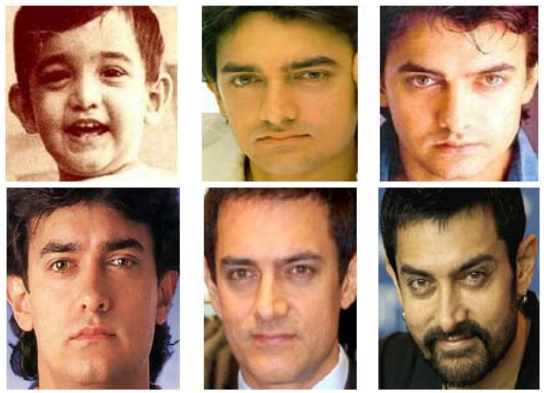

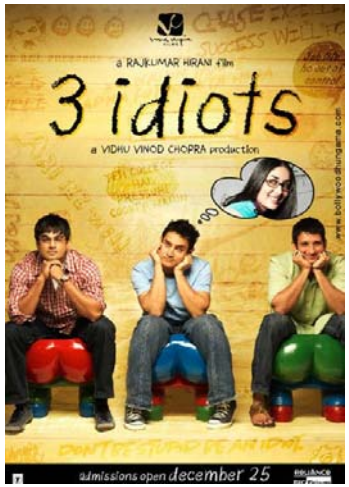

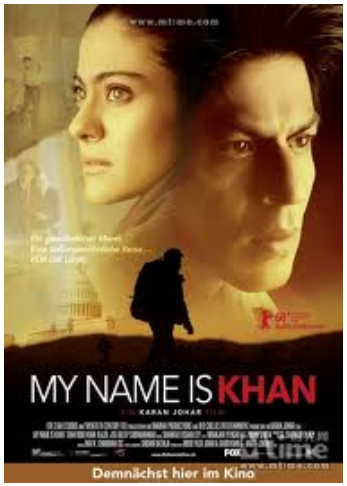

Delhi face aging database

- Ground truth
  - Hair color, eye color, beard, mustache, eyebrows, glasses
  - Surroundings
  - Pose
  - Full body or face image
  - Gender, age and ethnicity
  - Smiling or not

Delhi face aging database

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How about the performance of current face algorithms on this real-life database?

Will the aging behavior different for subjects of different age groups and gender classes?

Experimental evaluation

- Q1 : performance of current face algorithms
  - Facial features and matching algorithms: local binary patterns (LBP) and its variants, principal component analysis (PCA) of intensity, sparse representation of both intensity and LBP
  - Score fusion of different regions: binocular, left periocular, right periocular and mouth regions
  - Performance measures: cumulative match characteristic (CMC), rank-1 accuracy and receiver operating characteristic (ROC)

Experimental evaluation

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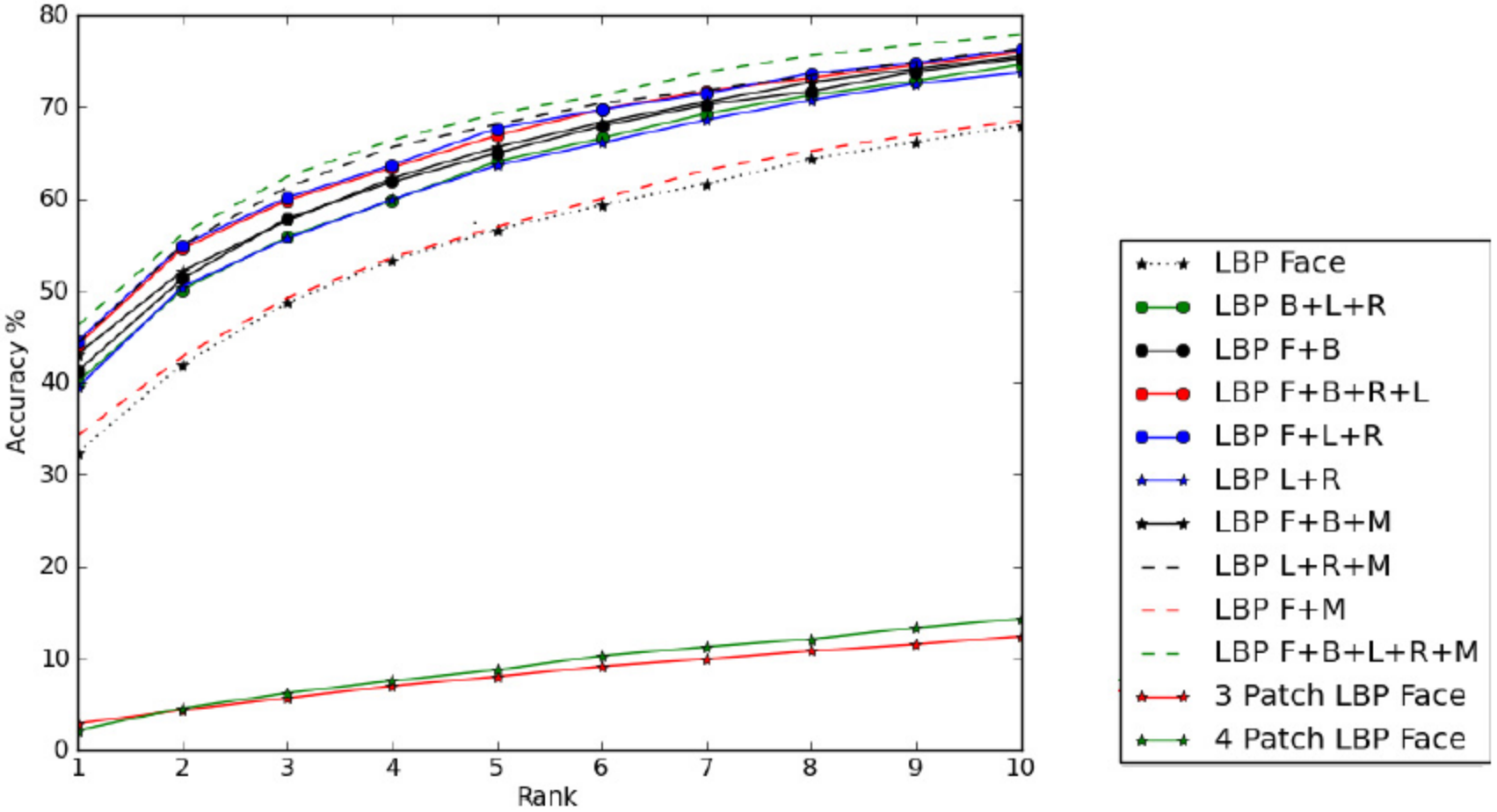

CMC curves obtained from the matching scores of using LBP and its variants.

Experimental evaluation

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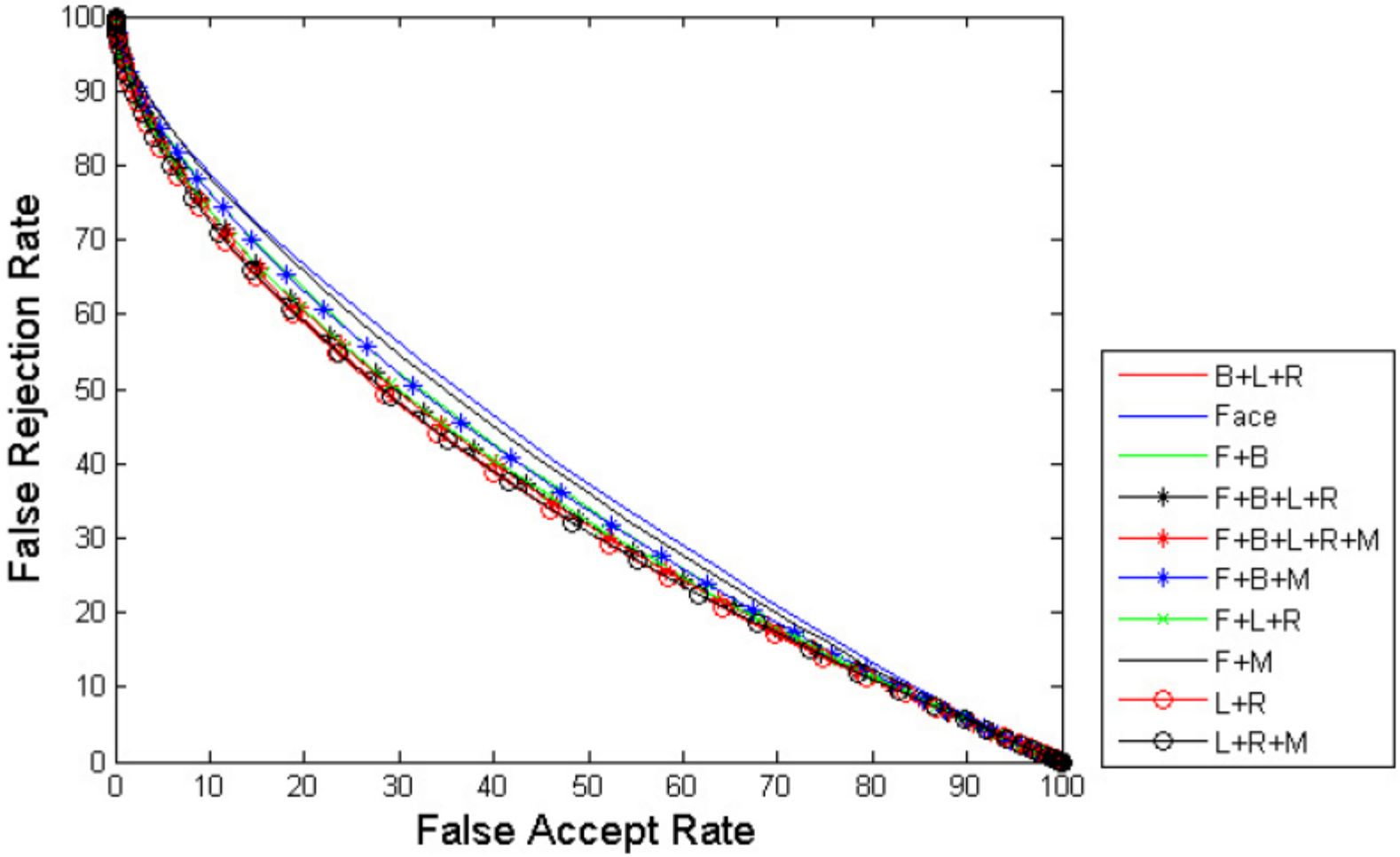

ROC curves obtained from the matching scores of using LBP and its variants.

Experimental evaluation

- Q2: behavior in facial aging for subjects of different age groups and gender classes

  Numbers of correctly classified probes, according to the gender.

Male				
	0-18	19-35	36-55	Above 55
0-18	0	0	1 (0.038%)	0
19-35	0	99 (3.78%)	38 (1.45%)	9 (0.34%)
36-55	0	18 (0.72%)	161 (6.14%)	8 (0.30%)
Above 55	0	7 (0.26%)	20 (0.76%)	39 (1.48%)
Female				
	0-18	19-35	36-55	Above 55
0-18	0	0	0	0
19-35	0	203 (7.75%)	28 (1.07%)	11 (0.42%)
36-55	0	16 (0.61%)	93 (3.55%)	12 (0.45%)
Above 55	0	8 (0.30%)	11 (0.42%)	65 (2.48%)

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Summary

- A computation model to account for and predict transient changes due to aging
  - Some specific areas are best candidates for transient changes.
  - Flexible template capable of tolerating transient changes in face appearance due to short-time aging

- A novel face aging database for long-time aging analysis in unconstrained scenarios
  - Need for better algorithms to cope with real-life variations
  - Different behavior in facial aging for subjects belonging to different gender and age classes

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- Special thanks to:

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Thanks