Capabilities of automatic and manual face morphing

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Introduction

- Biometric face detection
  - Wide spread practise
  - Used in automated border controls (ABC)
    - Standard identification process selected by the ICAO
  - Compare the biometric photo in the eMRTD with a photo taken presently
  - Alteration on the photo in the passport is possible
    - Beautification
    - Morphing
- Capability of morphing to subjects into one photo
  - Ability to create a morph that is recognized to both persons
    - Ranges on this

Database and selection of test subjects

- FaceDB
  - 136 images
  - ICAO compliant datasets
- Automatic morphing
  - All data sets were morphed
  - 45 morphs selected
- Manual morphing
  - Visually high similarity
  - 10 datasets selected
  - 5 morphs generated

Morphing of Faces

- Iterated conversion from one subject to another

Subject 1

Morph 5

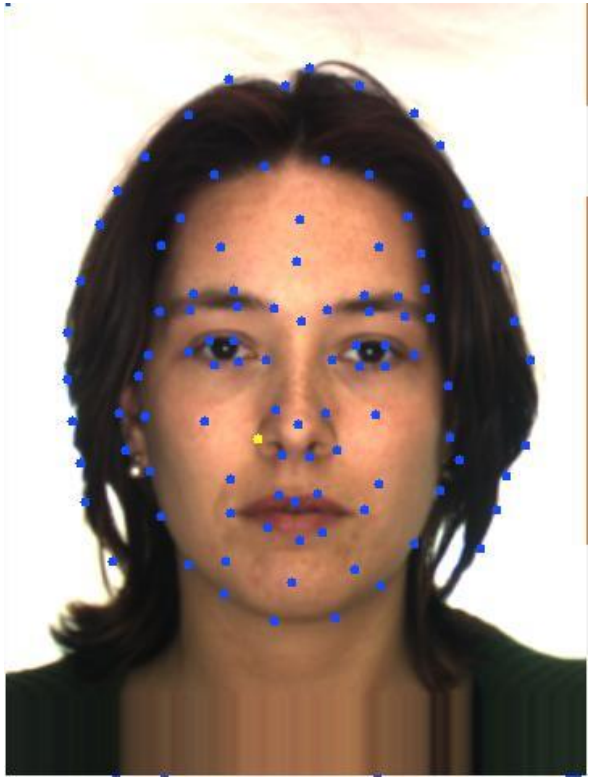
Morph 15

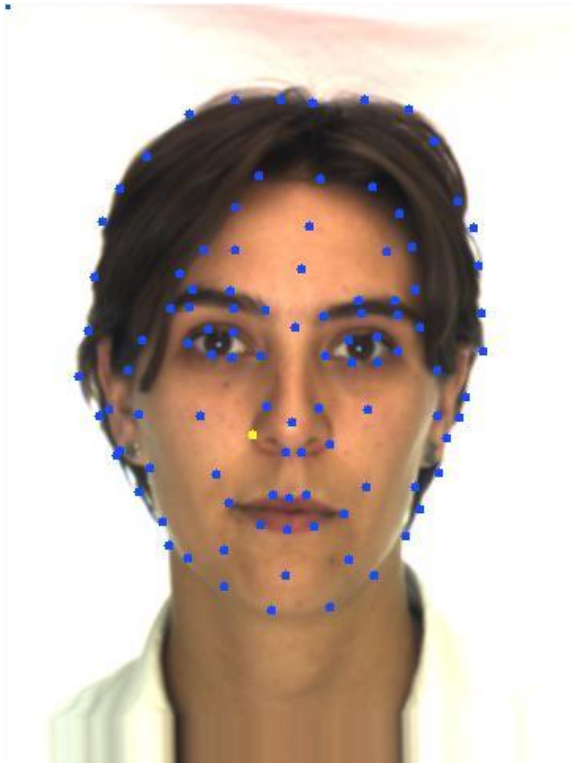
Morph 25

Subject 2

Manual morphing

- Software: GIMP GAP
- Placing landmarks
  - 100 - 125
  - Characterizing points
  - Shifting points to fit in both faces
- Morphing photo one to photo two
  - 30 stages as output





Automatic morphing

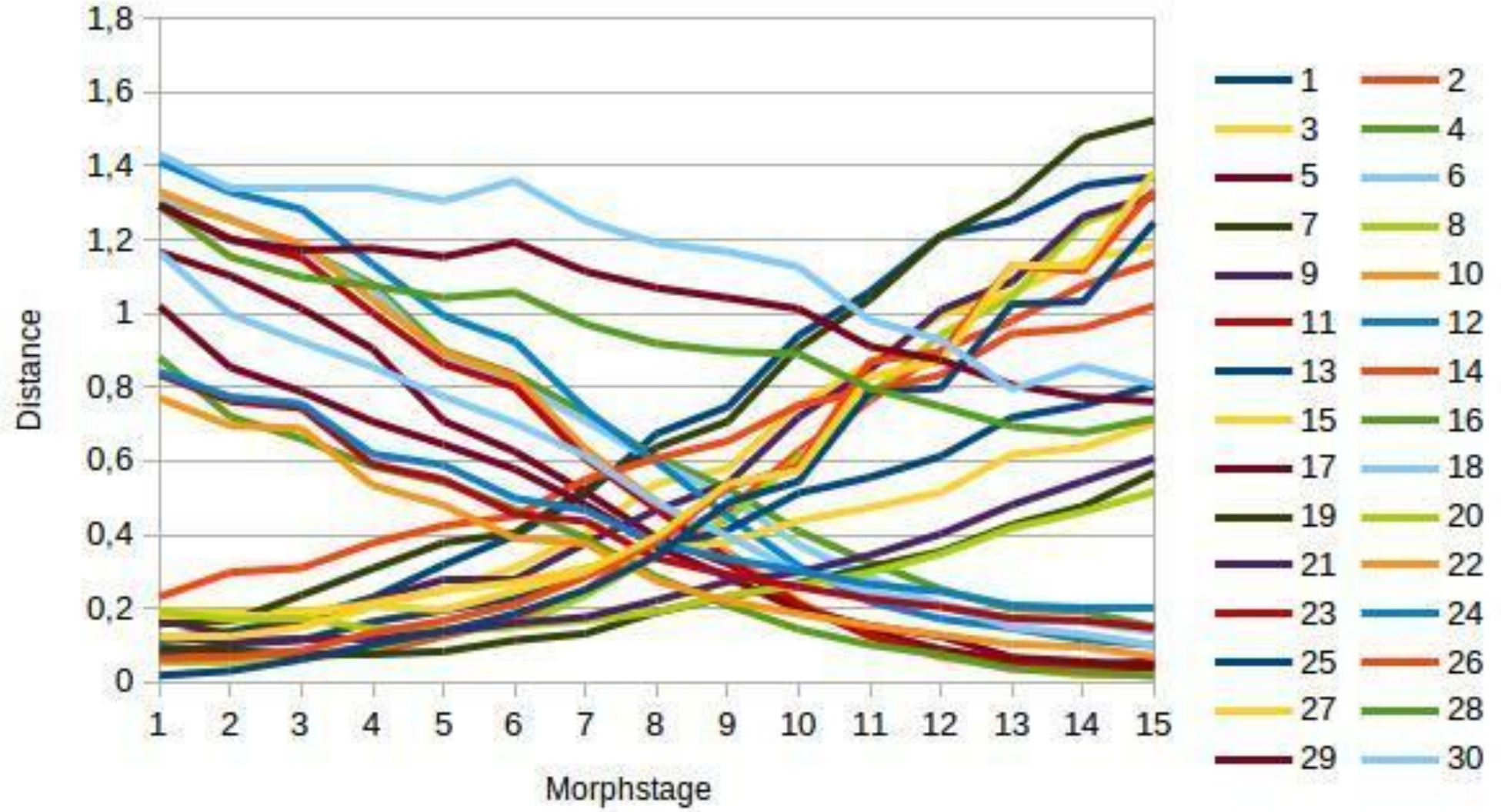
- FantaMorph 5
- Sequencial morphing
- 15 Images per morph
- Automatic recognition of landmarks
- Subsets of morphs
  - 5 morphs
  - 39 morphs

  → More than 4000 images created

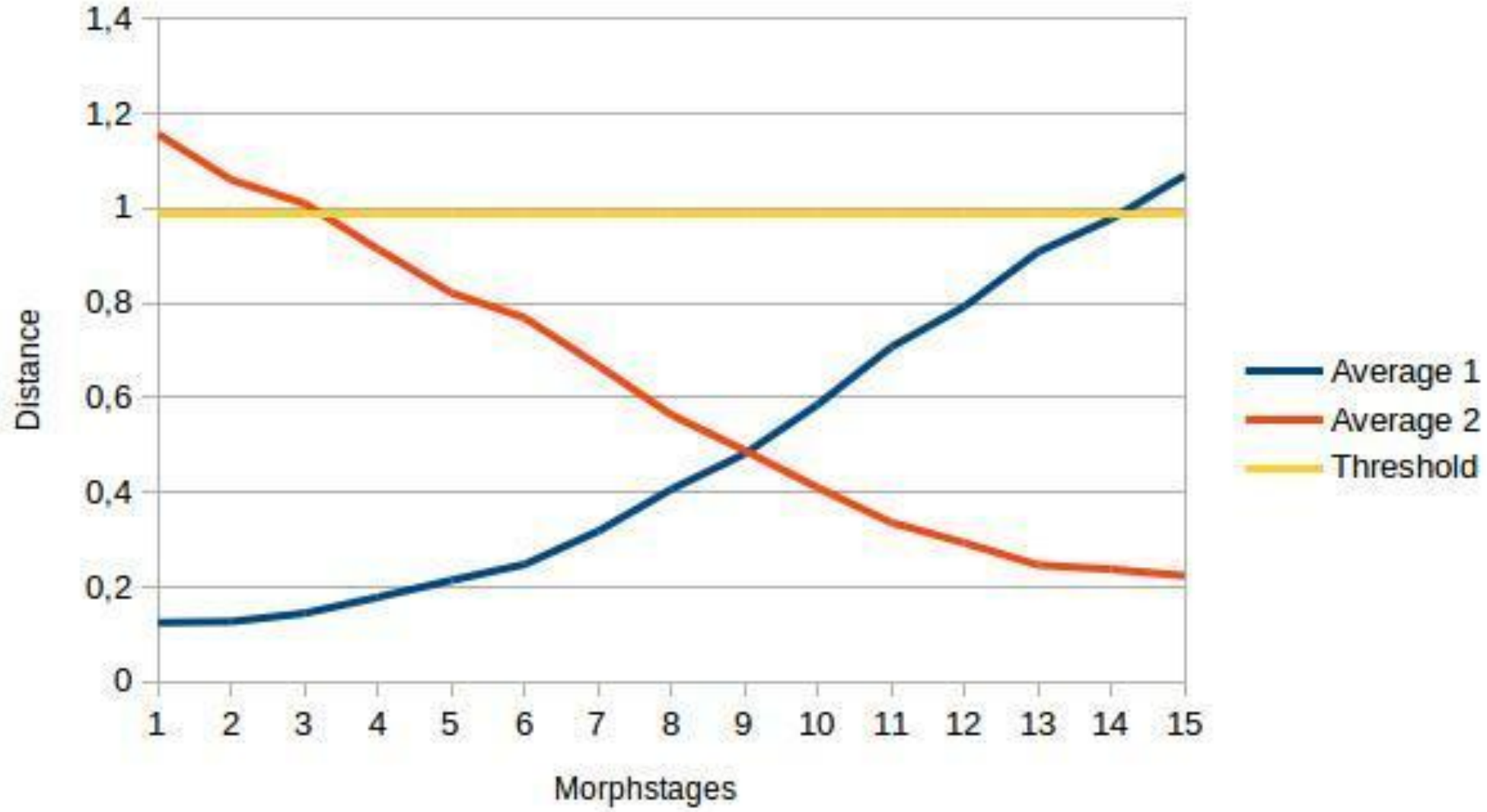
Face detection

- OpenFace
- Released in 2015
- Euclidean distance
  - Automatic (2 subsets)
  - Manual
- Average distance for every picture (step) and for both subjects
- Compared to standard OpenFace threshold 0.9999
- Treated as blackbox in our work

Results

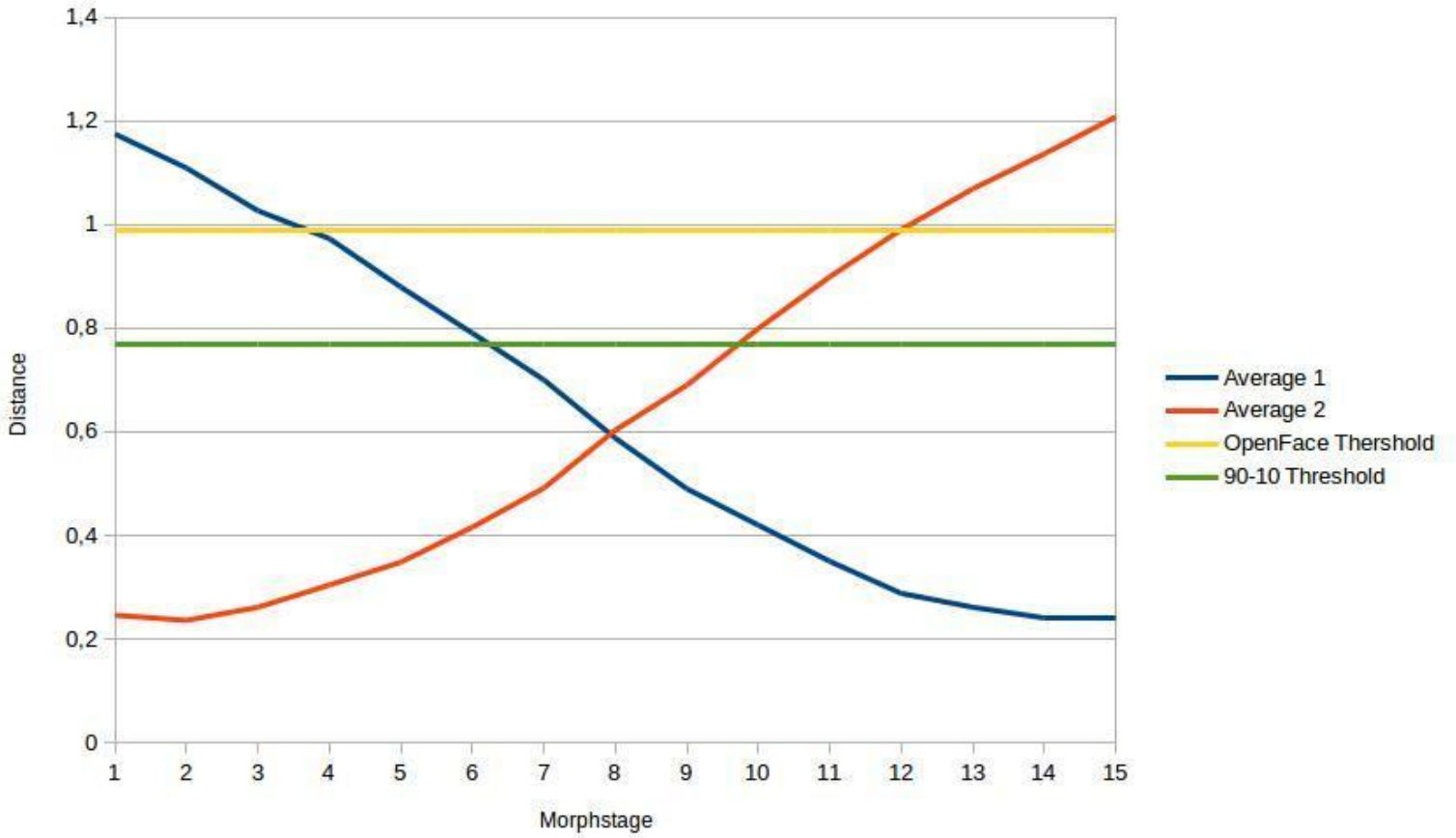

1,8
1,6
1,4
1,2
1
0,8
0,6
0,4
0,2
0
Distance
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Morphstage
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30

Results


1,4
1,2
1
0,8
0,6
0,4
0,2
0
Distance
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Morphstages
Average 1
Average 2
Threshold

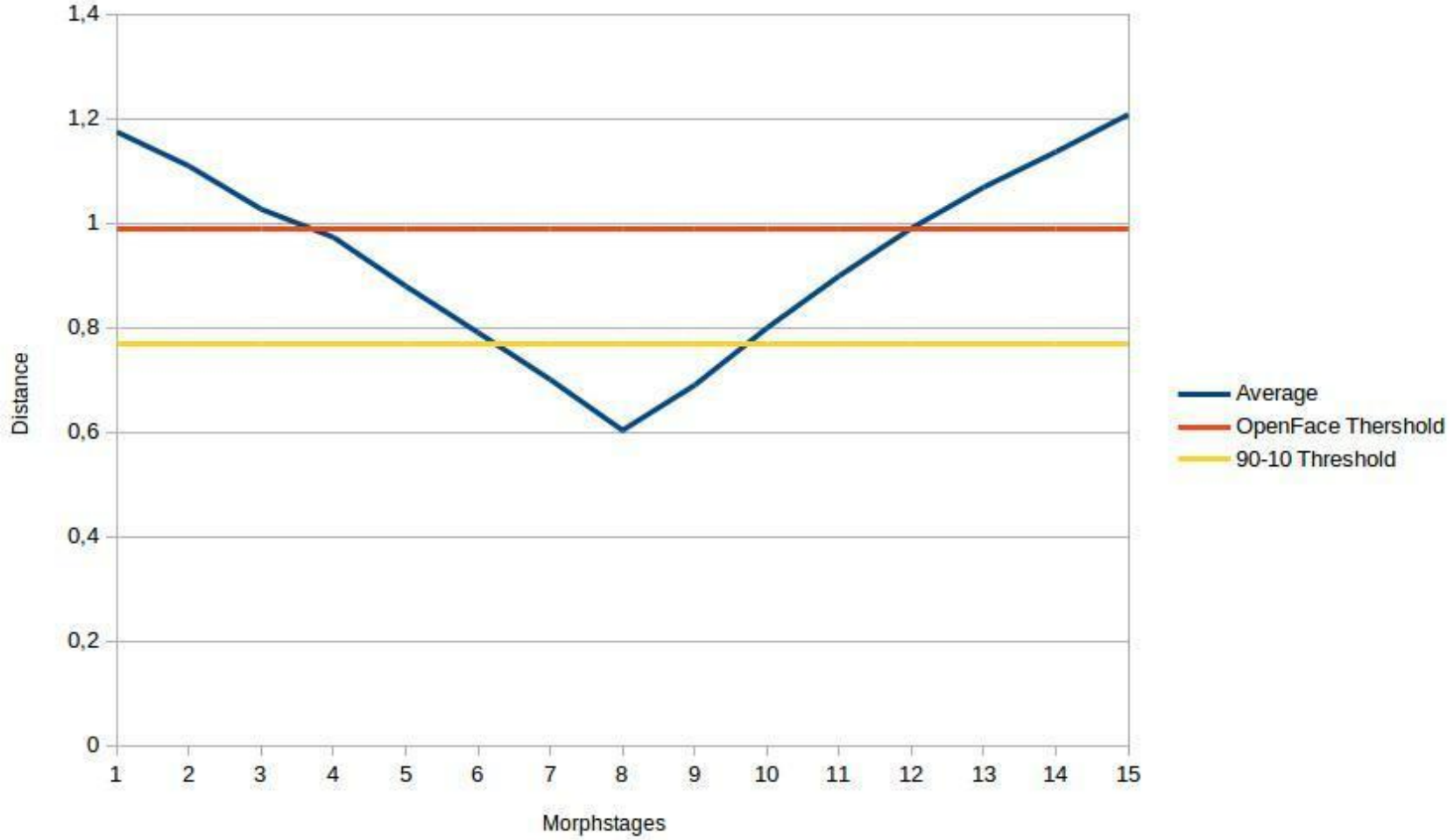
Automatic morphing results

- Subset with 39 morphs
- Crossing by (7.93, 0.6)
- Best distance in picture 8
  - Distance 0.6
  - Distance 0.59
  - 50% of person 1 and 50% of person 2



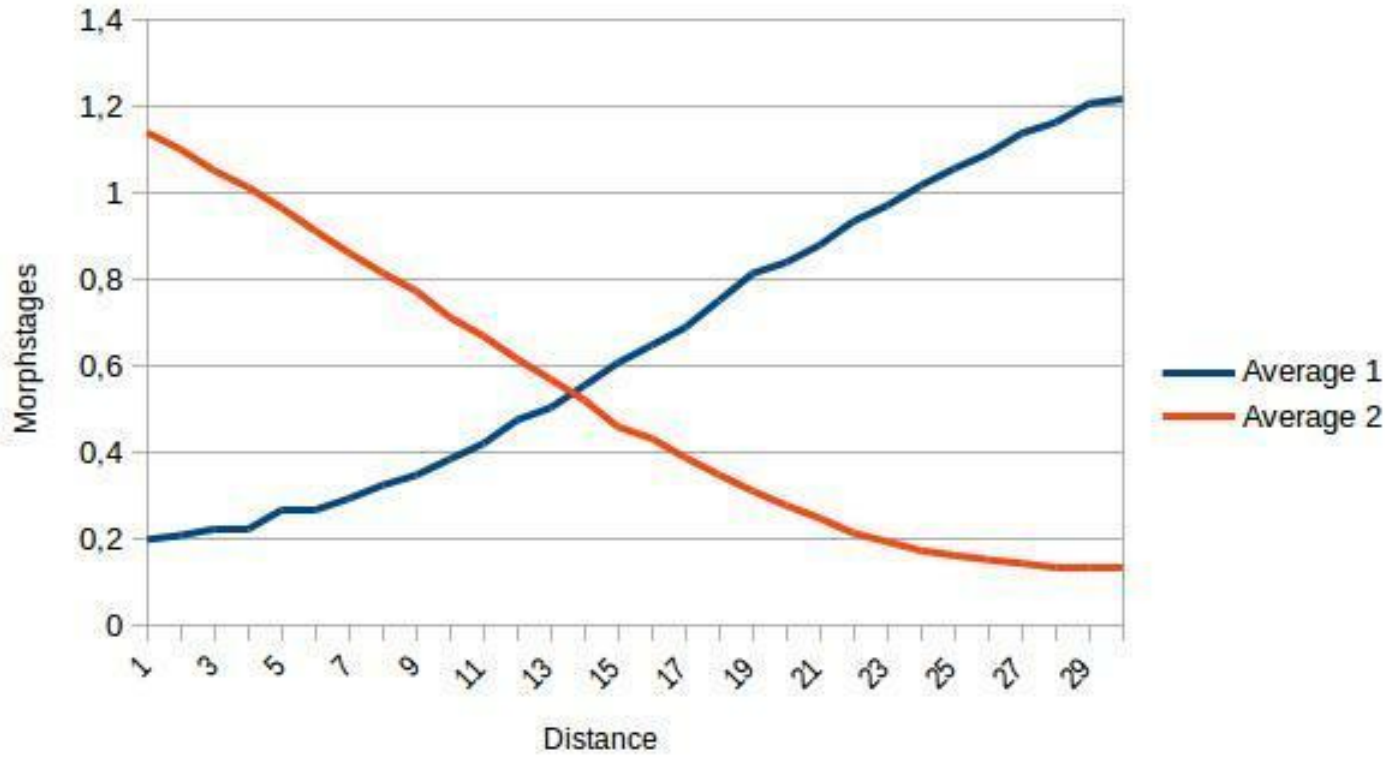
Automatic morphing results

- Threshold
  - 10% false acceptance
  - 90% chance to non-match a morphed image
- 0.76891524



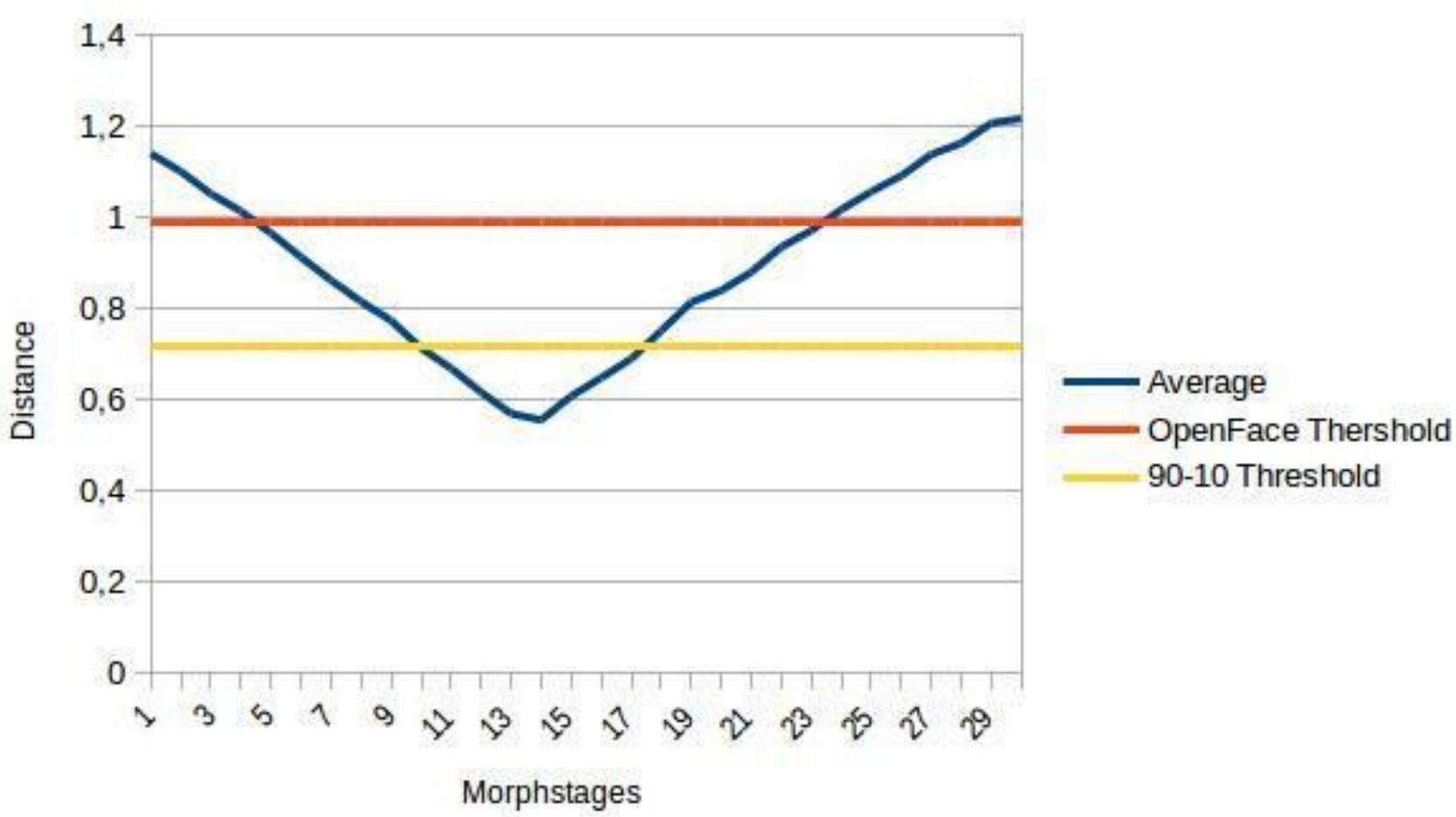
Manual morphing results

- Subset with 8 morphs
- Best distance in picture 14
  - Distance 0.56
  - Distance 0.57
  - 46.6% of person 1 and 53.4% of person 2



Manual morphing results

- Threshold
  - 10% false acceptance
  - 90% chance to non-match a morphed image
- 0.7172467154



Conclusion

- Attack OpenFace with a morphed photo works
  - With default threshold many morphstages are accepted
  - New suggestion of a threshold (0.71)
- Manual morphing is not better than automatic morphing
  - Lower standard deviation

Further topics

- Pre compare photos to determine photos with high similarity
  - Get better morphs
- Evaluation of more subjects and morphs
  - Especially manual morphs
- Morph 3 or more subjects together
- Evaluate if morphs can be revealed by manual inspection

Thanks for your attention

References can be found in the belonging term paper.