



**3D Face**  
Biometric Research



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# Multibiometrics for Face Recognition

3D Face Project – End User  
Meeting

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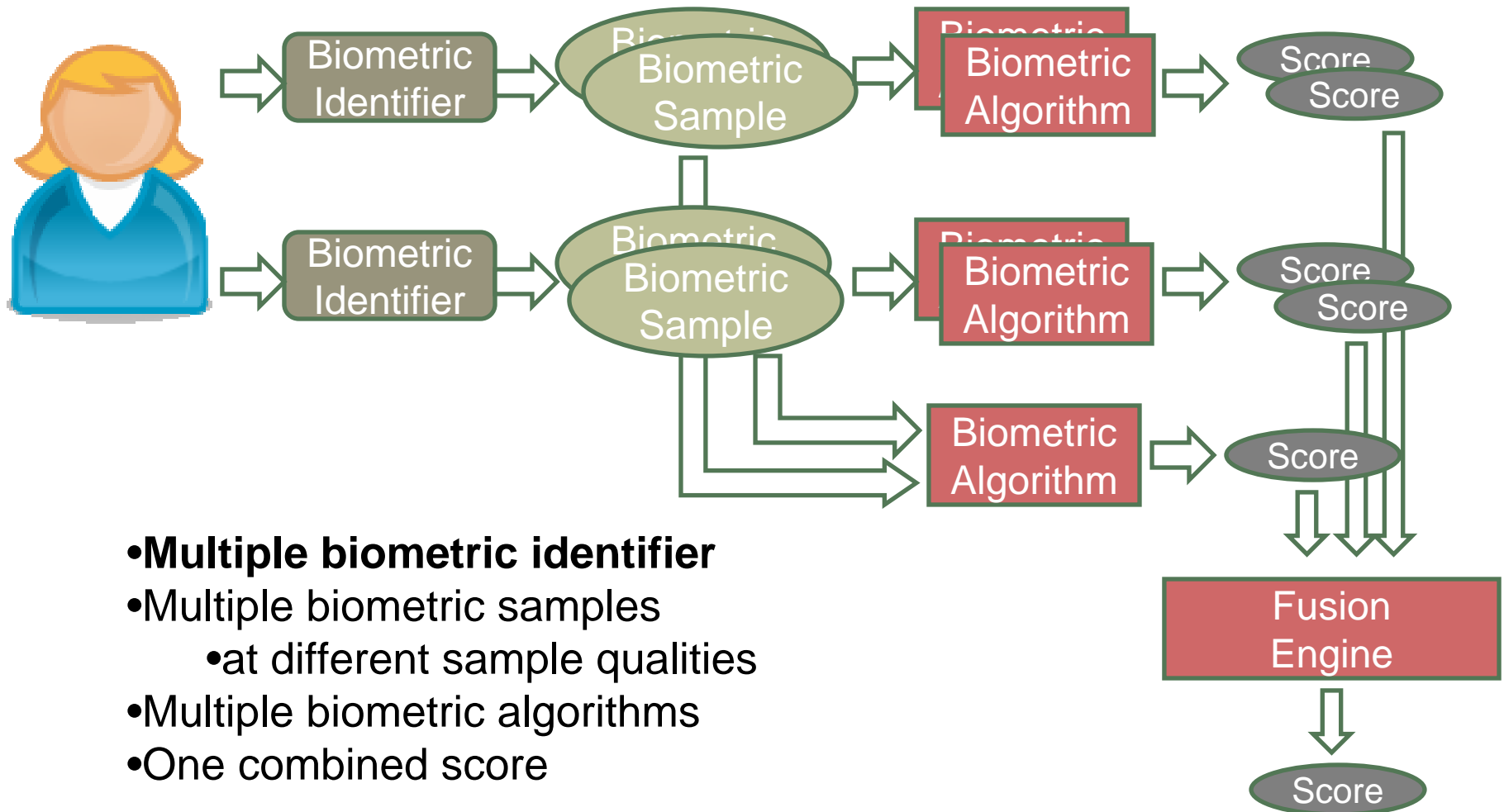
# Agenda

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- Multibiometrics in general
- Multibiometrics related to the face
- Biometric Face Identifiers
- Capturing Biometric Face Identifiers
- Fusion related to the face
- Conclusions



# Multibiometrics





# Why Multibiometrics?

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- Compared to single biometrics identifier
  - Higher Accuracy → More secure
  - More robust
  - Higher fraud resistance
- Disadvantages
  - More complex biometric capturing processes
  - More complex devices and algorithms → Higher operational costs



# Multi-Modal Biometrics

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Example for worse performance (John Daugman, 1999):

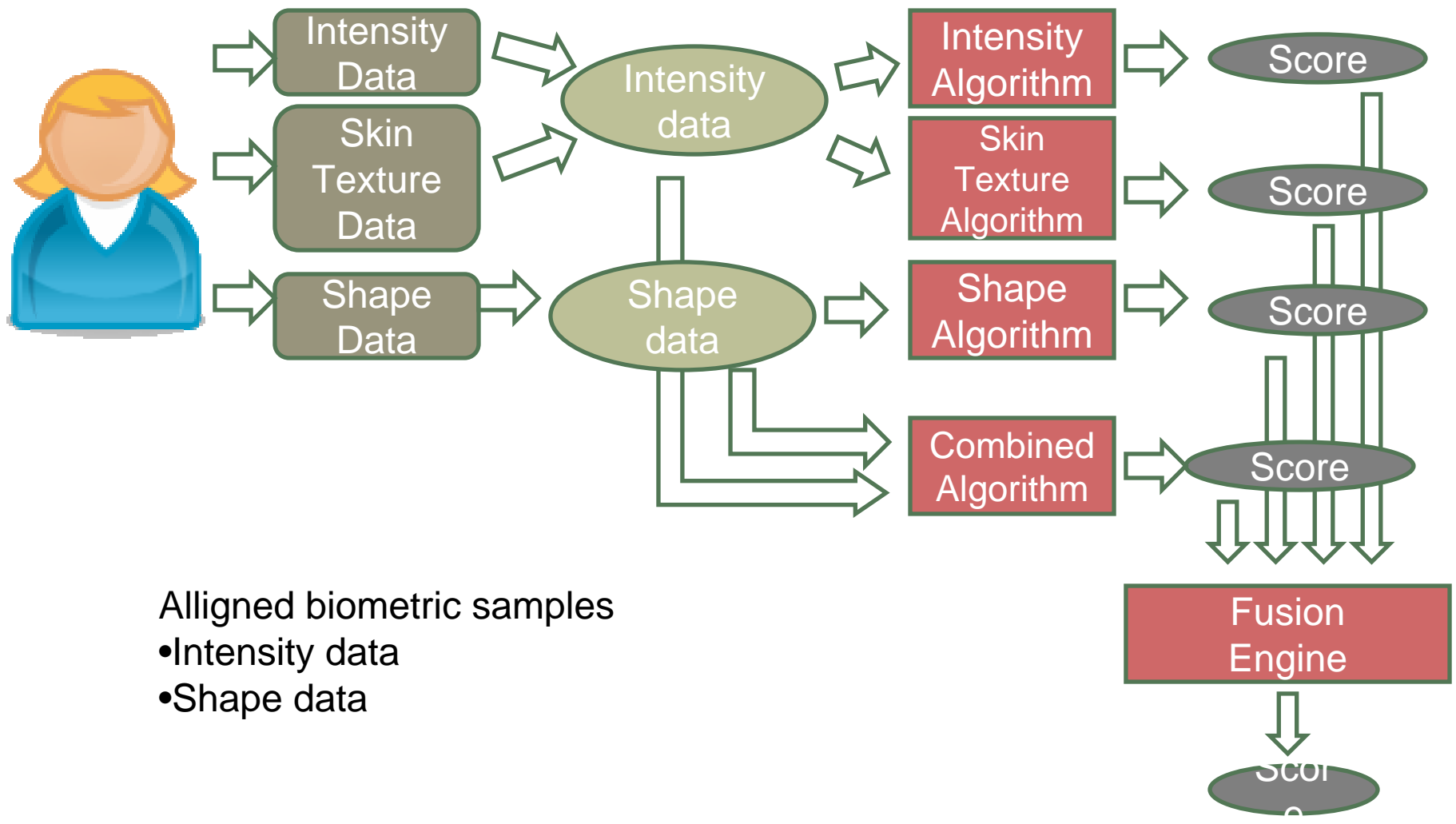
- Biometric system A: EER = 1%
- Biometric system B: EER = 0.1%

Have A and B operate at their EERs; conduct 100,000 verification attempts with impostors, 100,000 with authentic; then:

- A alone: 2000 errors; B alone: 200 errors
- “AND” rule: 1099 FR’s, 1 FA  1100 errors
- “OR” rule: 1099 FA’s, 1 FR  1100 errors



# Multibiometrics using the face



Aligned biometric samples

- Intensity data
- Shape data



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# Sample FRGC images

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Controlled



Uncontrolled





# Sample frontal Yale images

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Varying lighting conditions



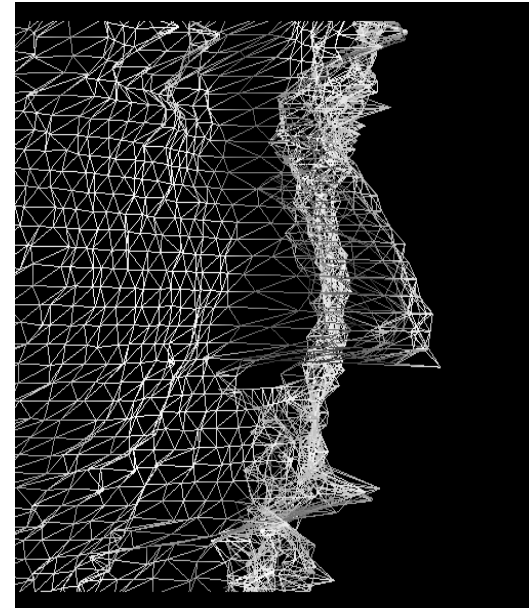


# Example: shape data

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Monocular, fixed view  
sensors produce  
occlusions

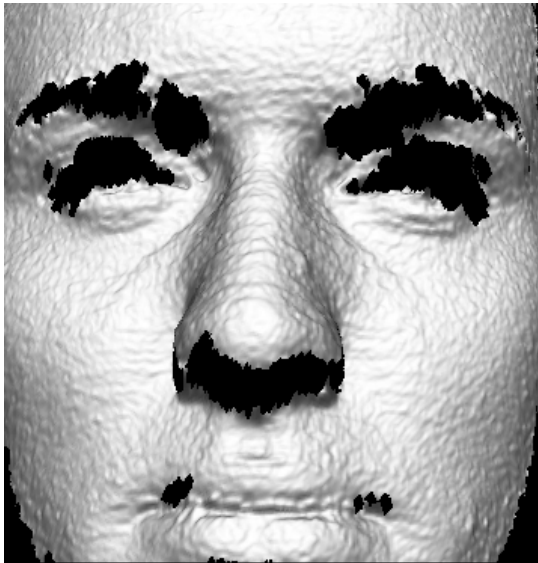


vertex data is  
subject to noise

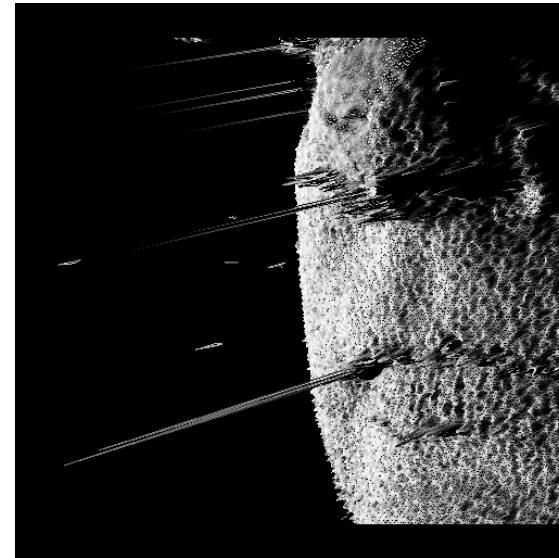


# Example: shape data

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Gap Filling /  
plane surface patches

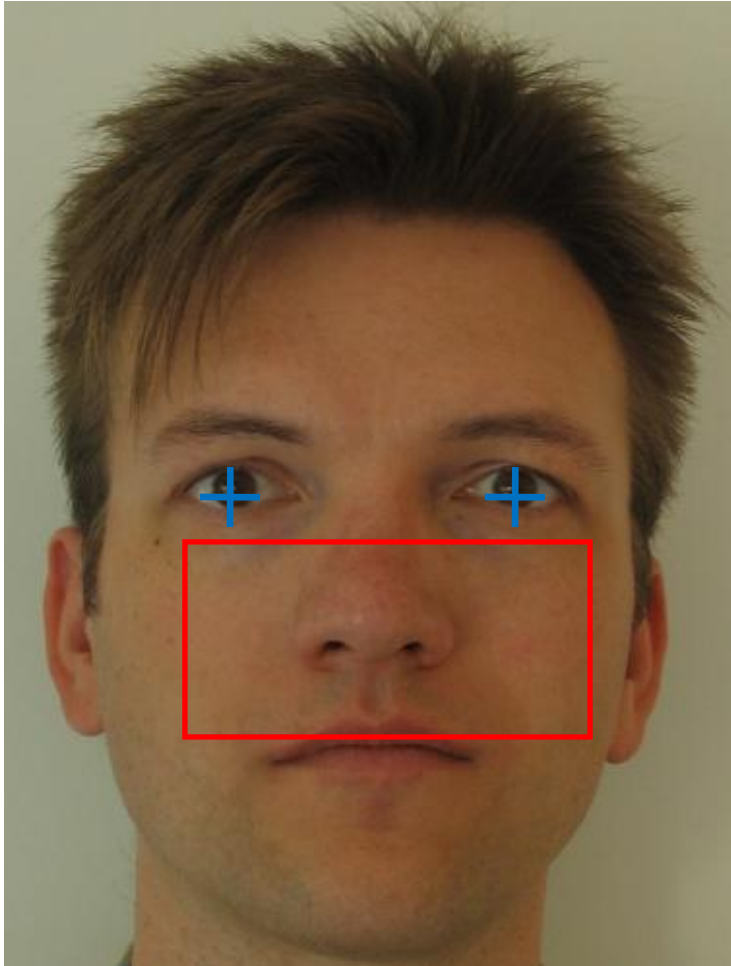


some vertices  
have large deviations



# Example: skin texture

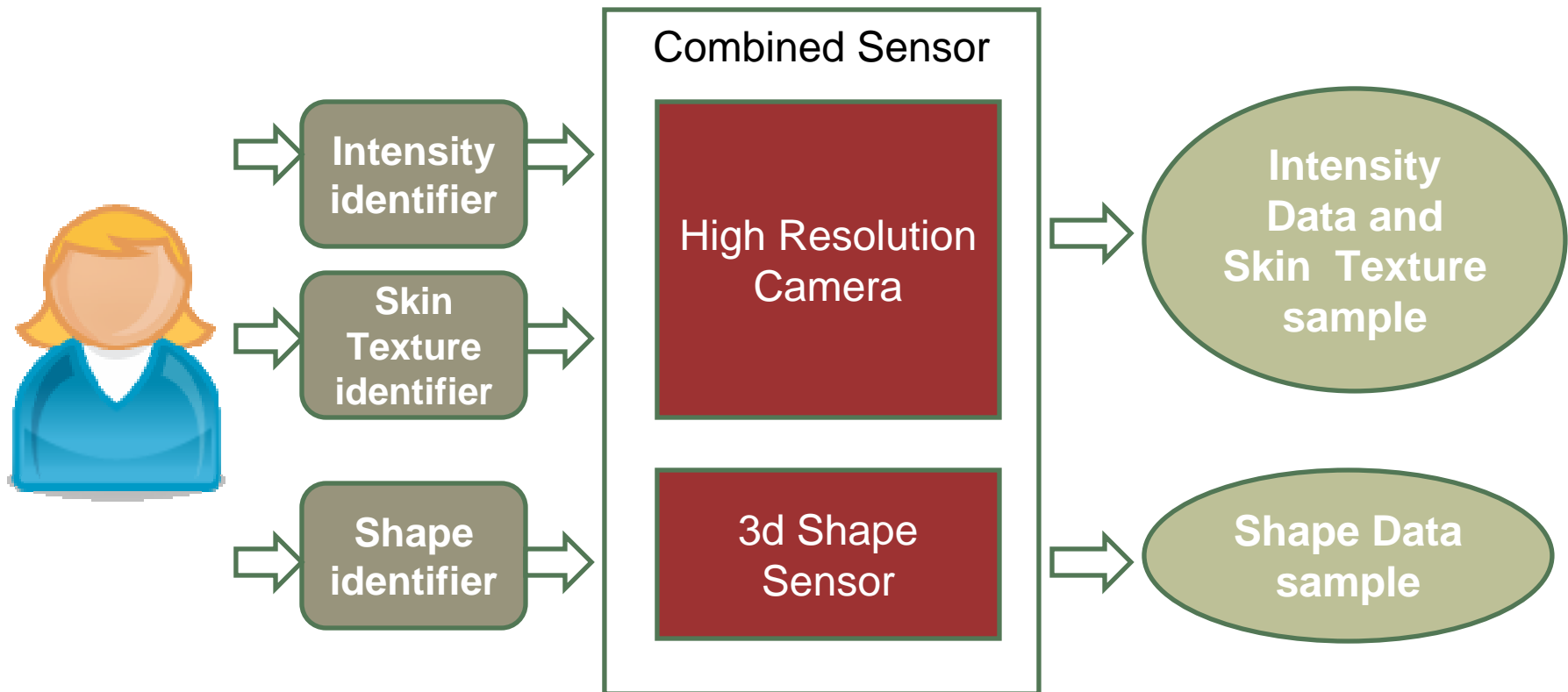
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Skin texture analysis indicates the degree to which two surfaces are the same if the blocks match in an orderly fashion



# Simultaneous Capture

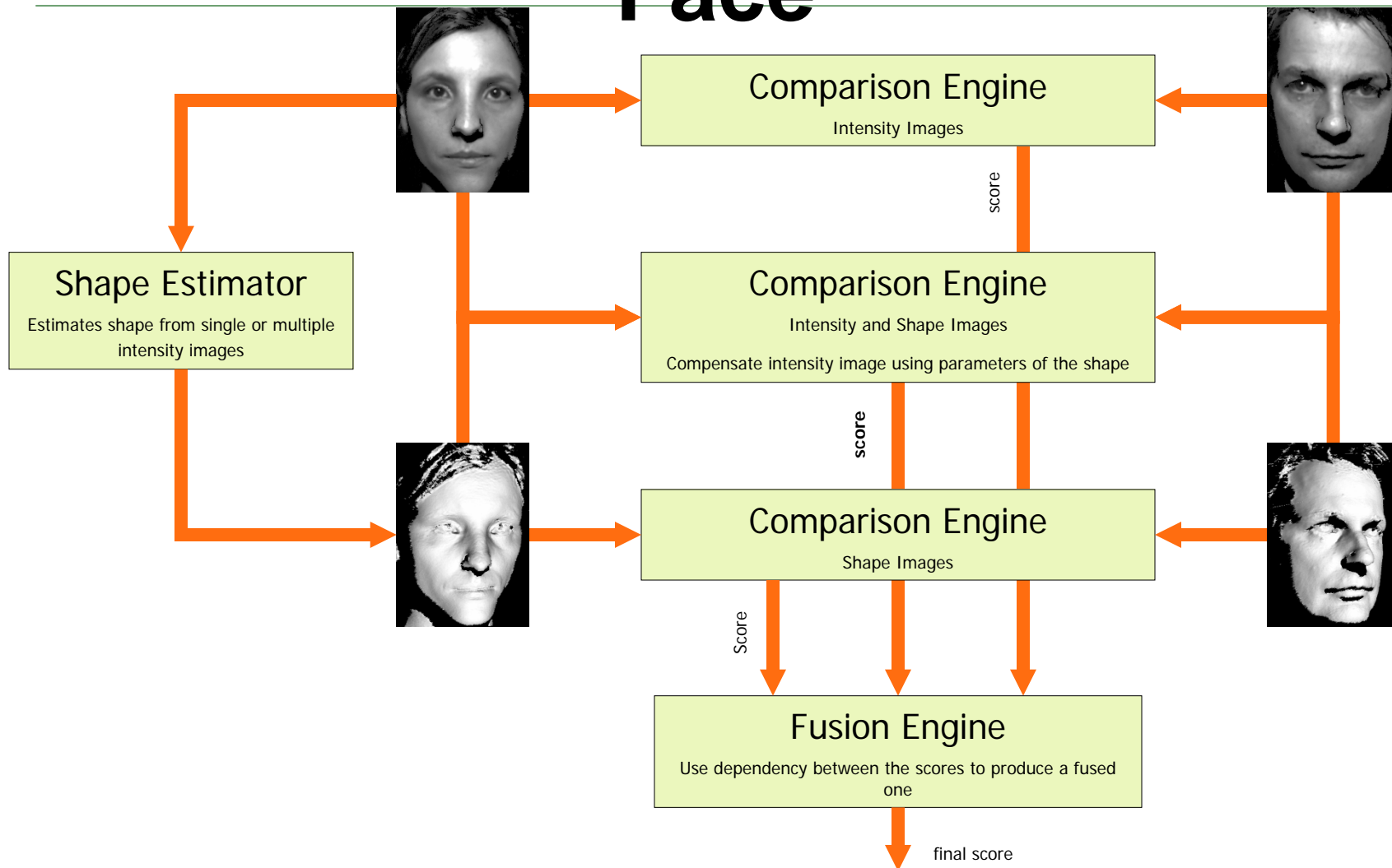


Real Person with  
Facial characteristics

Digital representation  
of biometric samples

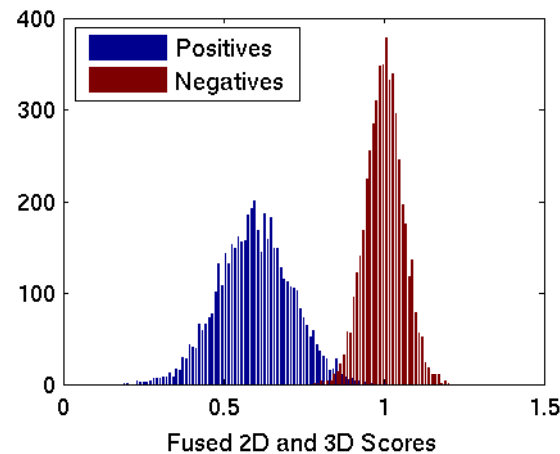
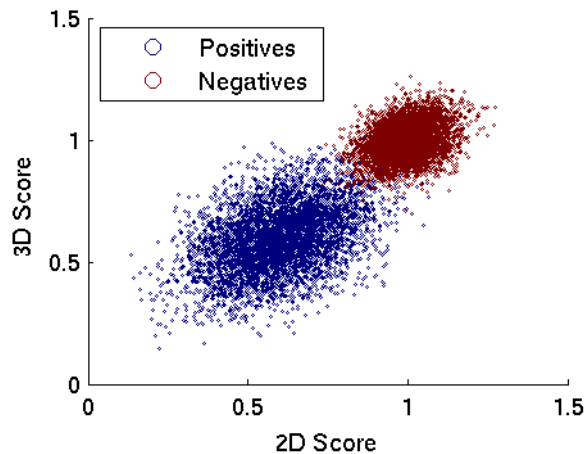
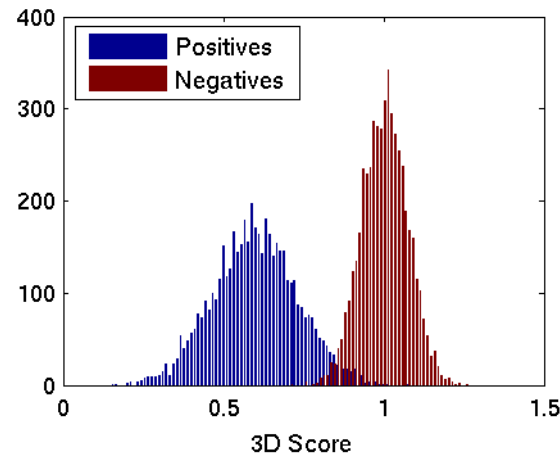
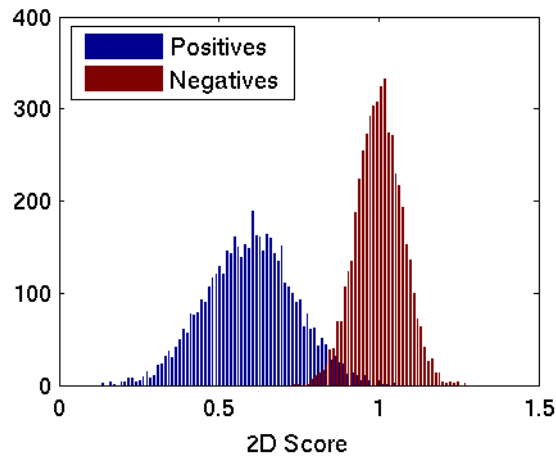


# Fusion Architecture for Face





# Promising Results

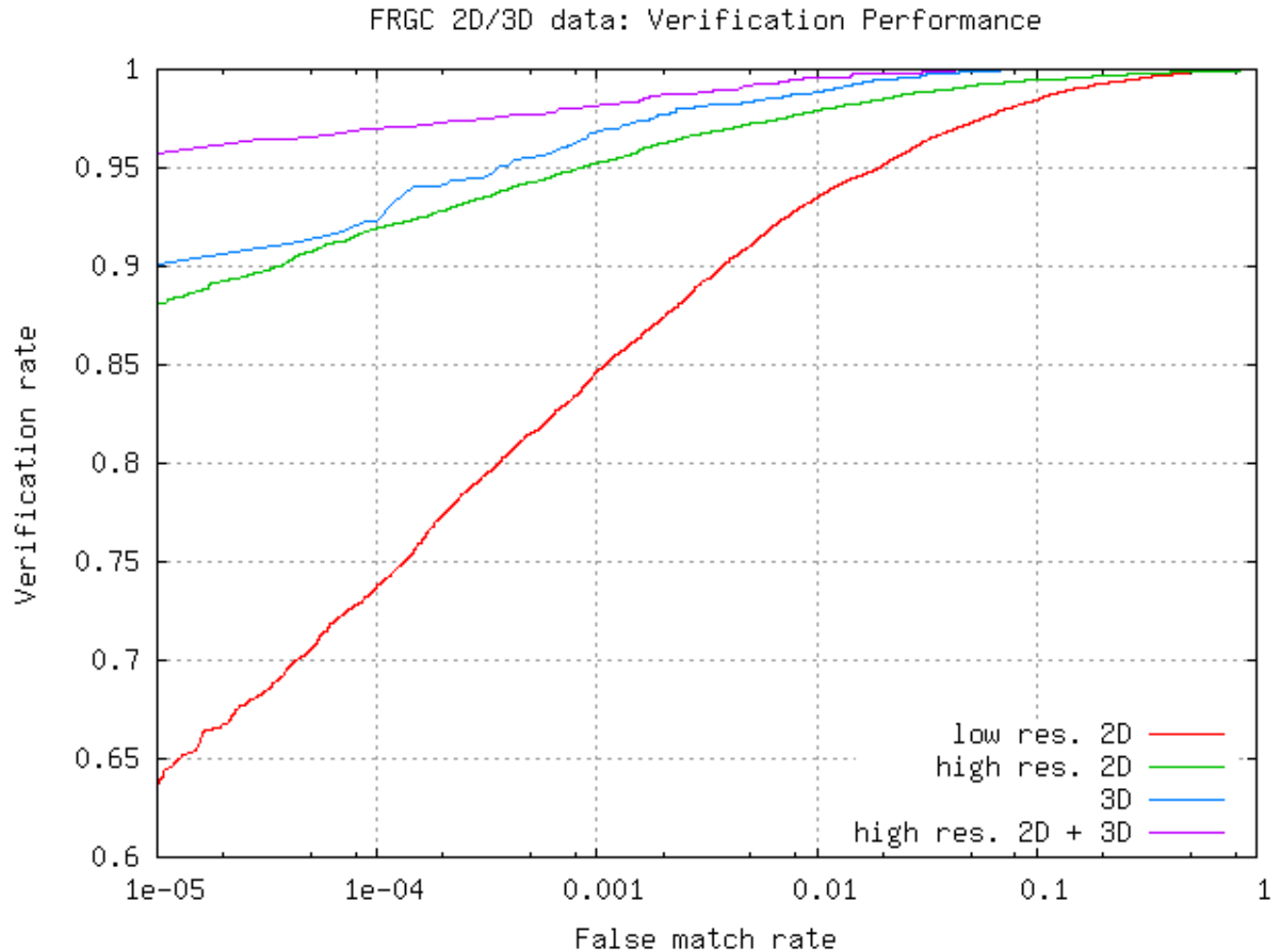


## Equal Error Rates

- Using Intensity Images („2d“): 3.14%
- Using Shape Data („3d“): 2.54%
- Using both (2d+3d): 1.01%



# Promising Results (2)





# Conclusions

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- Multi (modal) biometrics help to improve accuracy compared to single biometrics
- Face is an object that allows the simultaneous capturing of multi-biometrics identifiers
- Multi-biometrics systems are more difficult to outsmart