3D Facial Matching by Spiral Convolutional Metric Learning and a Biometric Fusion-Net of Demographic Properties

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Problem Statement
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SEX
AGE
BMI
GB
Problem Statement: Step 1

Geometric Metric Learner (GML)
Problem Statement: Step 1

Geometric Metric Learner (GML)
Problem Statement: Step 2
Data
2,145 individuals

SEX
68% female, 32% male

AGE
[5 - 80]
$\bar{x} = 27, \bar{\bar{x}} = 21$

BMI
[11.87 - 62.11]
$\bar{x} = 25.03, \bar{\bar{x}} = 23.74$

First SUGIBS axes

[1] J. Li et al. - Robust genome-wide ancestry inference for heterogeneous datasets: illustrated using the 1,000 genome project with 3D facial images
Step 1: Metric Learning – Triplet loss

$$\text{TripletLoss} = \max(\|f(A) - f(P)\|_2^2 - \|f(A) - f(N)\|_2^2 + \alpha, 0)$$
Step 1: Metric Learning – Triplet loss

\[ \text{TripletLoss} = \max\left(\|f(A) - f(P)\|_2^2 - \|f(A) - f(N)\|_2^2 + \alpha, 0\right) \]
Step 1: Spiral convolutions

[2] Vincent Dumoulin, Francesco Visin - A guide to convolution arithmetic for deep learning
Step 1: Mesh sampling
Step 1: Geometric Metric Learner
Step 1: Geometric Metric Learner
Step 2: Fusion-Net
Step 2: Fusion-Net
Step 2: Fusion-Net

- SEX
- AGE
- BMI
- GB

Diagram showing layers FC1, FC2, FC3 with dimensions 48x1, 12x1, 7x1, followed by 2x1 output layers.
Step 2: Fusion-Net

The diagram shows a neural network with layers labeled FC1, FC2, and FC3. Inputs include SEX, AGE, BMI, and GB. The network processes these inputs and outputs a decision, indicated by the checkmark and cross symbols on the right.
Results

---: Principal component analysis + support vector machines + Naïve Bayes score fuser
—: Geometric Metric Learner + Fusion-Net
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