Introduction to Computer Vision

Michael J. Black

Oct 2009

PCA and applications

©Michael J. Black

Talk

Wed, October 14, 200912-1pm, 182 George St, Rm 110SIFT Flow: Dense Scene Alignment and Its Applications

Ce Liu

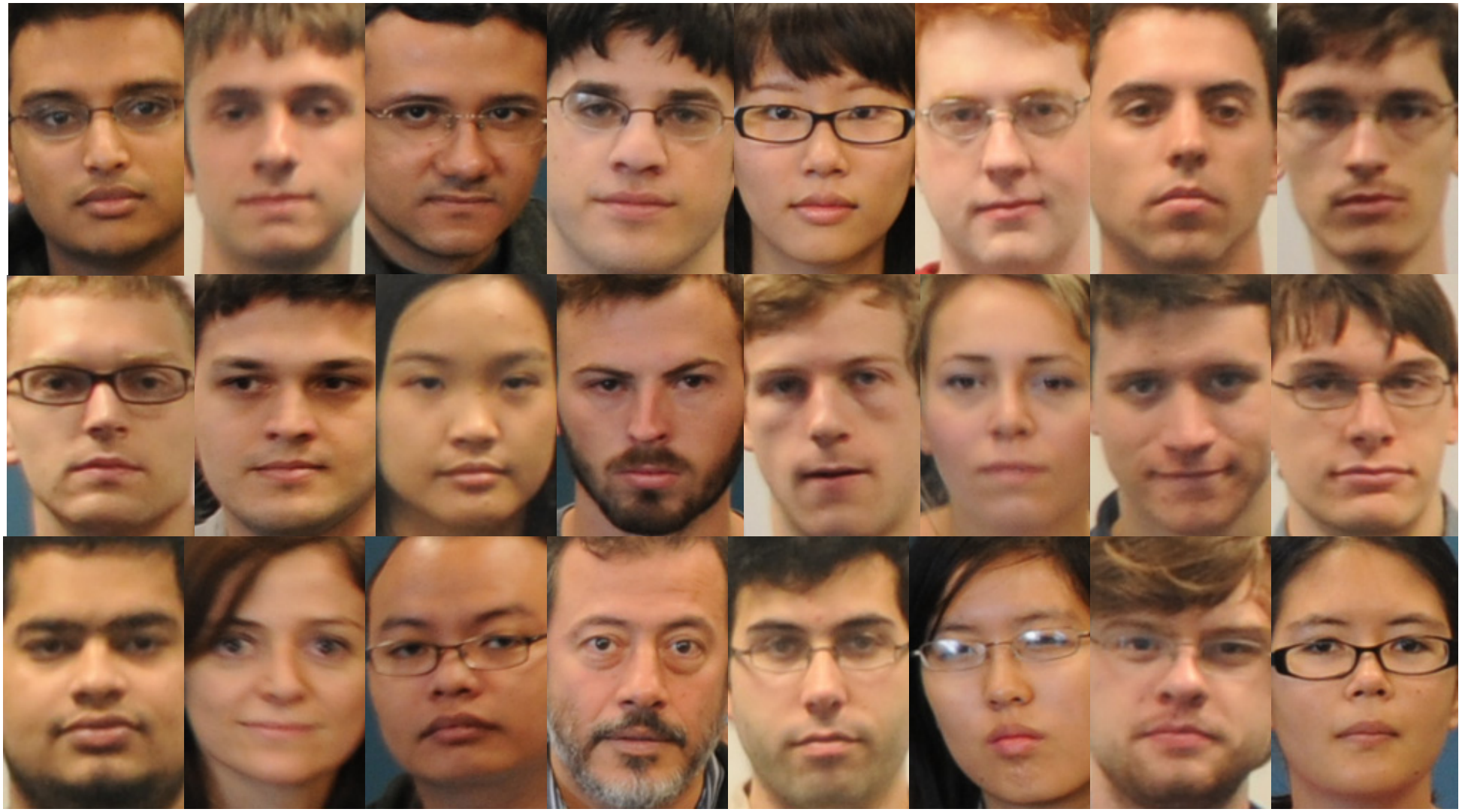
In this talk I will introduce dense scene alignment and how it can be applied to a number of computer vision problems varying from satellite image registration to object recognition and scene parsing. …

Goals

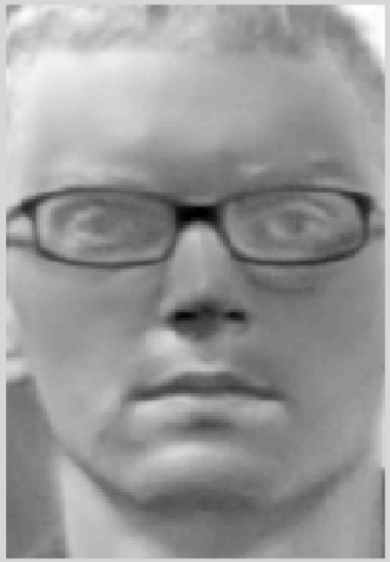
- Wed: Conclude PCA. Applications of PCA. Start probability and classification.

- Fri: probability and classification

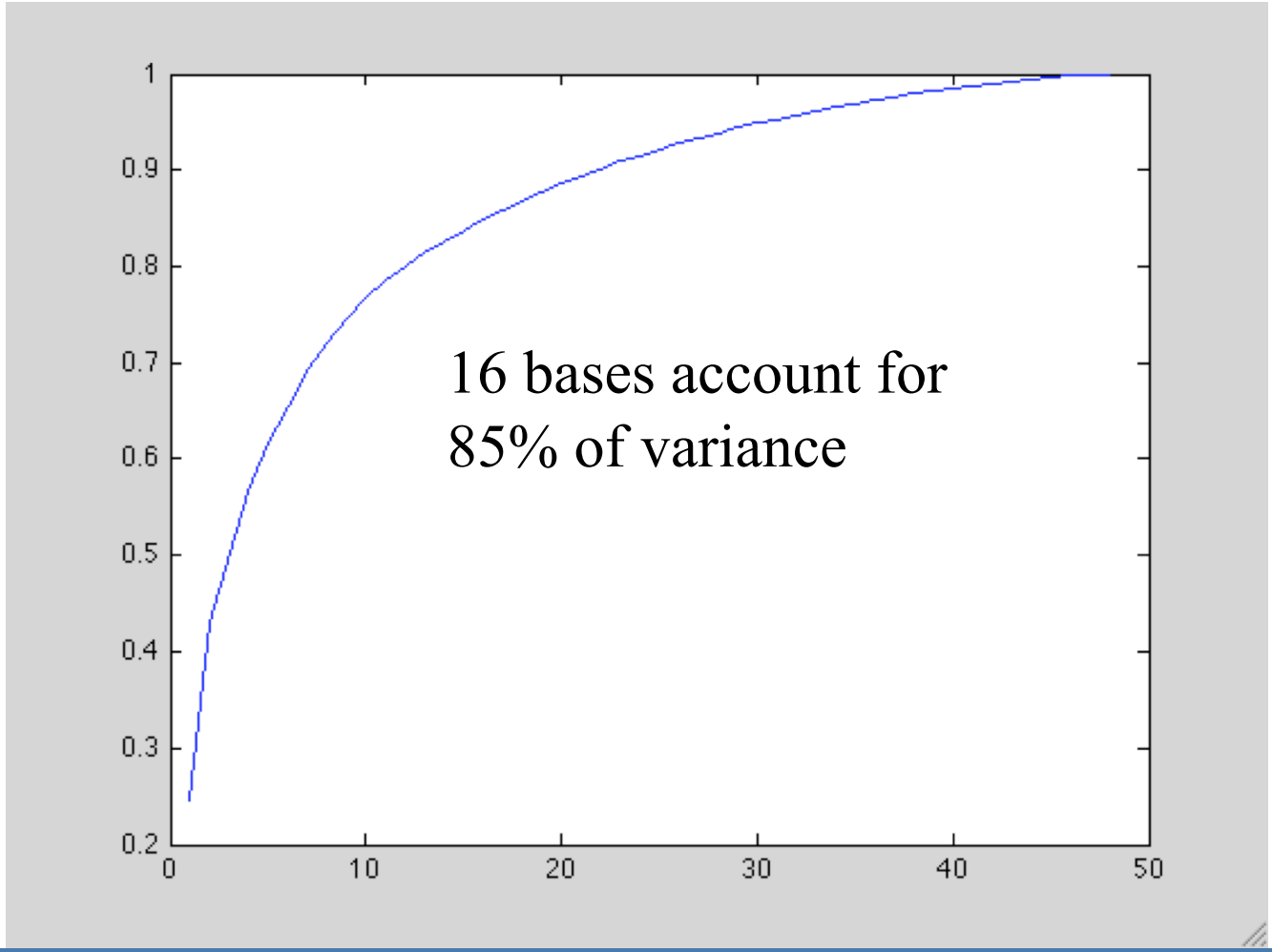
©Michael J. Black



©Michael J. Black



Cumulative variance



©Michael J. Black

$A =$

©Michael J. Black

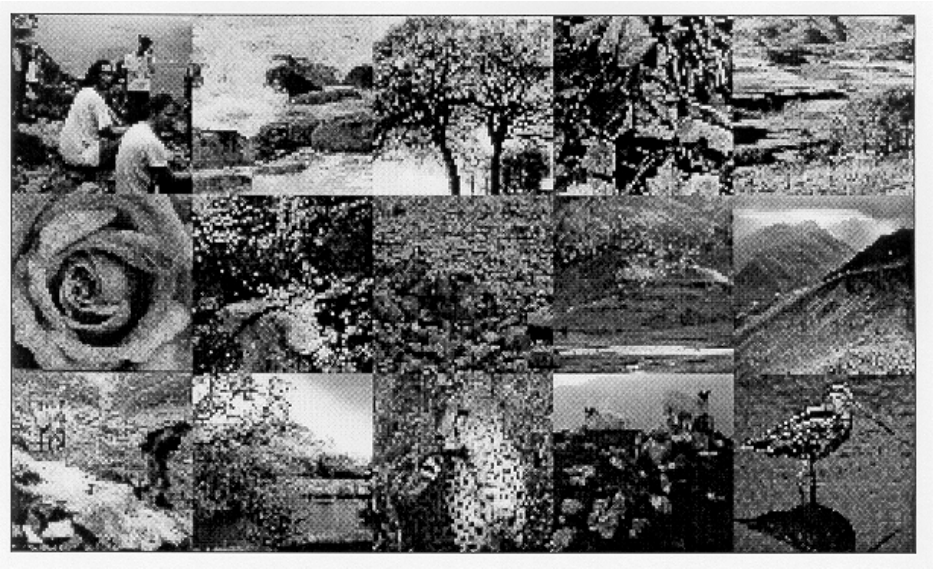
SVD

$U =$

[U S V]=svd(A,0);

©Michael J. Black

Generic Image Ensembles



Fleet & Szeliski

©Michael J. Black

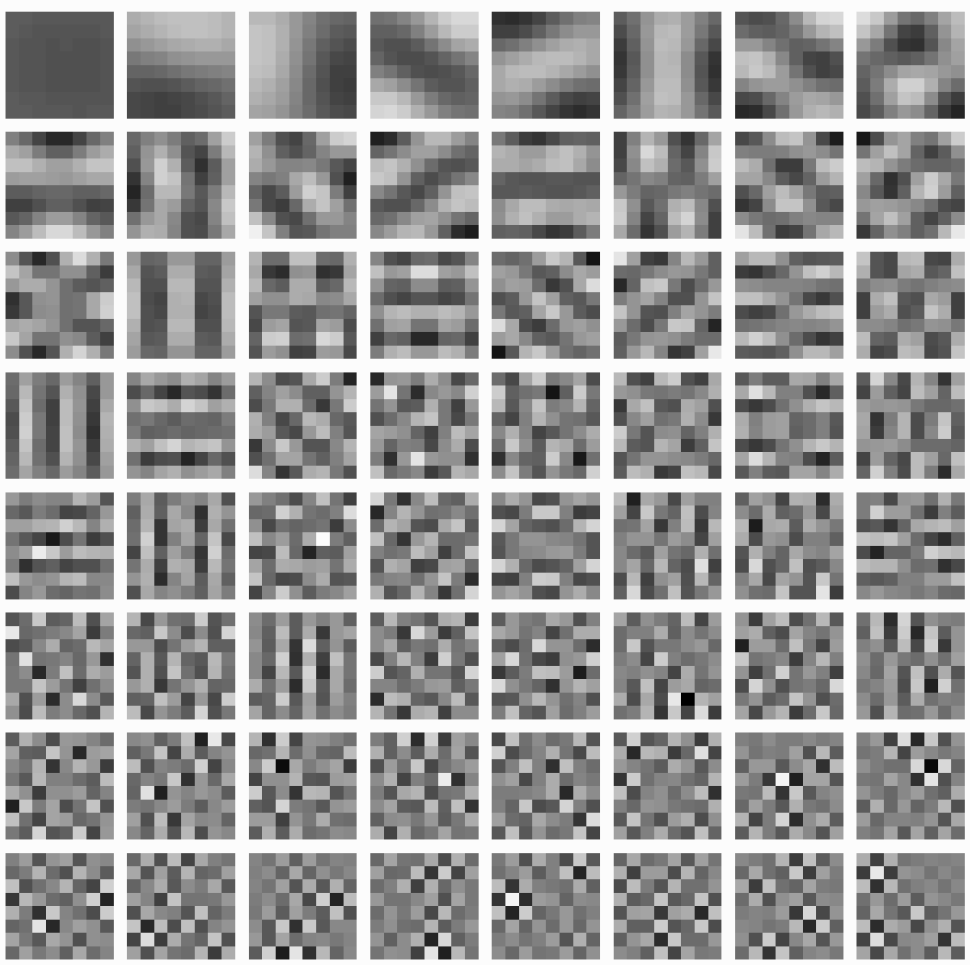
Generic Image Ensembles

Is there a low dimensional model describing natural images?

Fleet & Szeliski

©Michael J. Black

Natural Images



What do these bases look like?

8X8 image patches

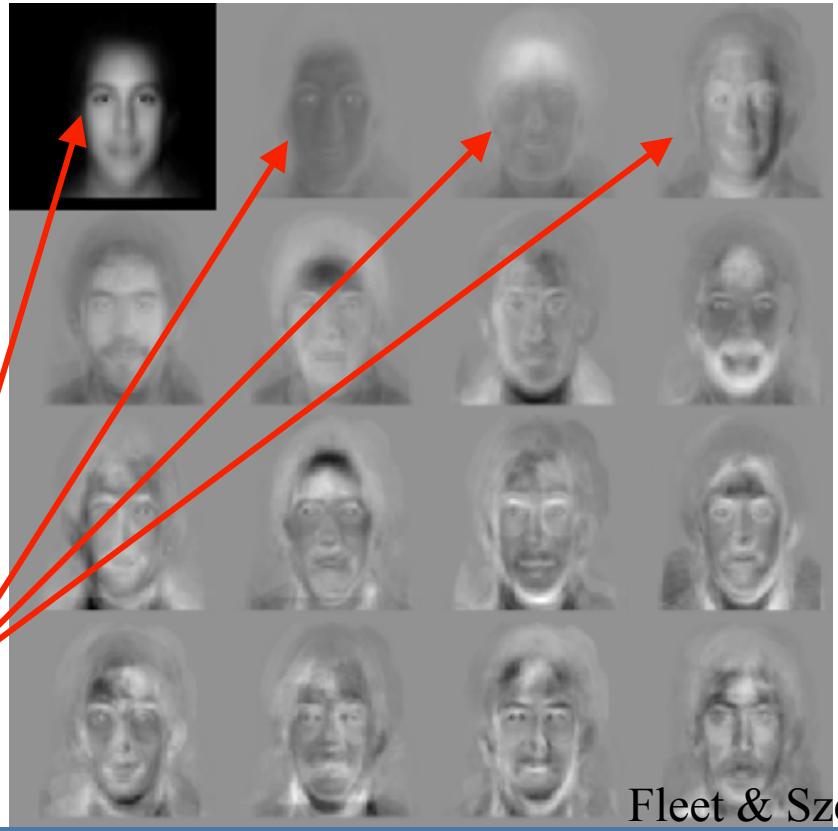
Fleet & Szeliski

©Michael J. Black

EigenFaces

First popular use of PCA for object recognition was for the detection and recognition of faces *[Turk and Pentland, 1991]*

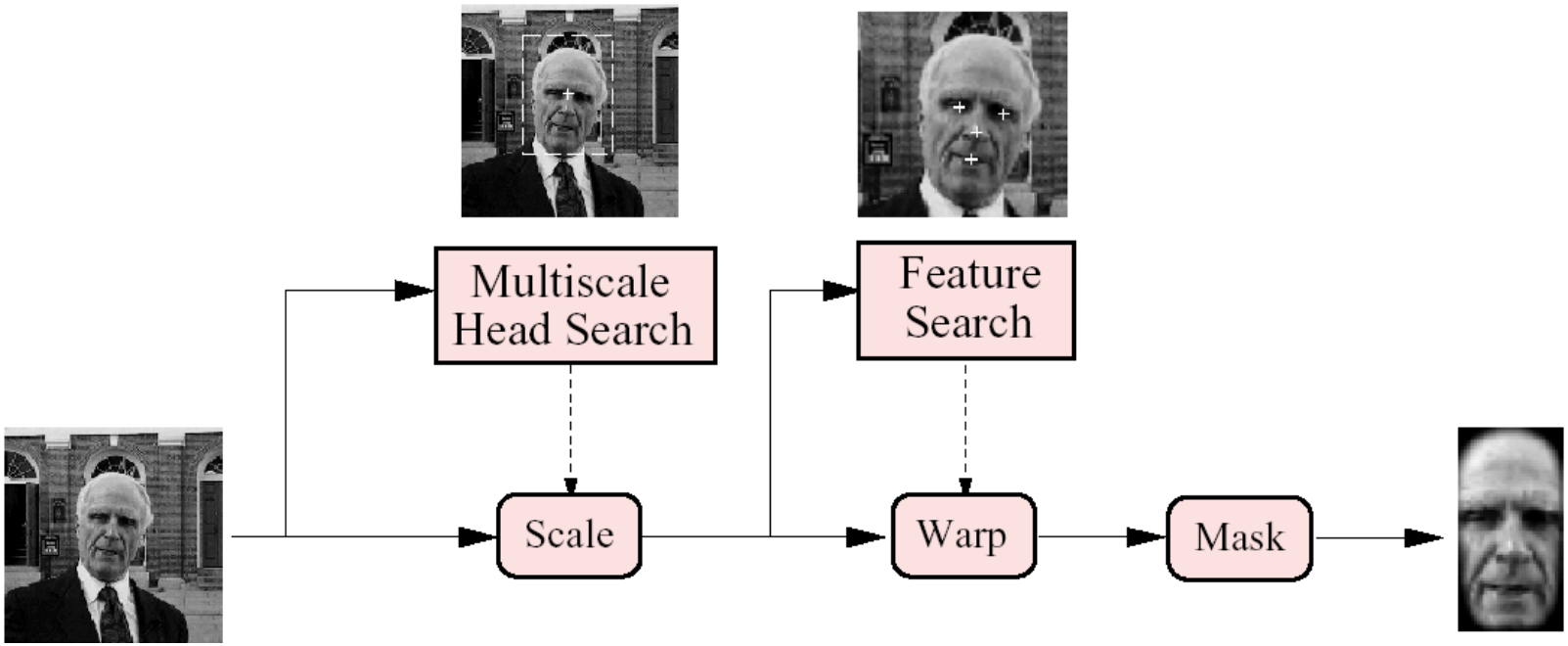
- Collect a face ensemble
- Normalize for contrast, scale, & orientation.
- Remove backgrounds
- Apply PCA & choose the first N eigen-images that account for most of the variance of the data.



Fleet & Szeliski

©Michael J. Black

Face Recognition

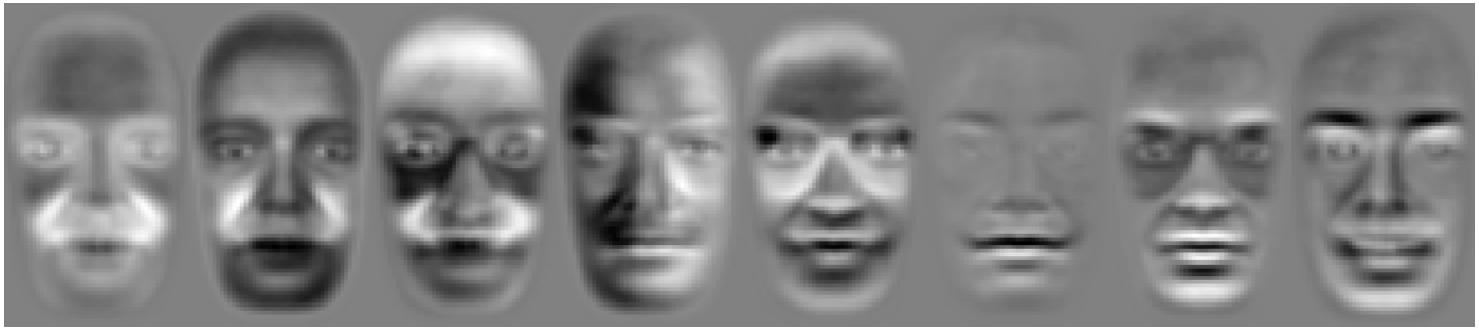


[Moghaddam, Jebara & Pentland, 2000]

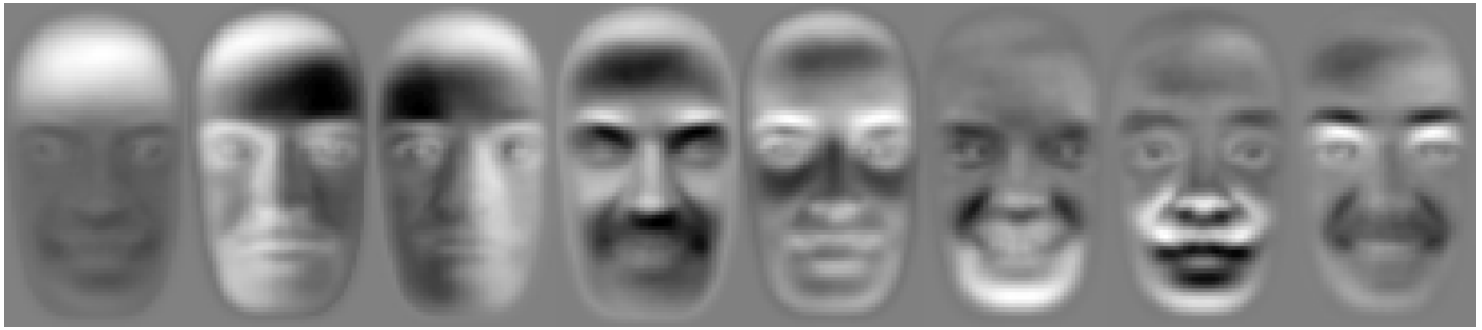
Fleet & Szeliksi

©Michael J. Black

Intra- & Extra-Personal Subspaces



Intra-personal subspace (variations in expression)



Extra-personal subspace (variation between people)

Fleet & Szeliski

©Michael J. Black

Antonio Torralba & Aude Oliva (2002)
http://web.mit.edu/torralba/www/gallery/gallery1.html

Antonio Torralba & Aude Oliva (2002)
http://web.mit.edu/torralba/www/gallery/gallery2.html

©Michael J. Black

Average fashion model

Average of 60 shape-aligned fashion model faces

http://perception.st-and.ac.uk//Prototyping/prototyping.htm

©Michael J. Black

Attractiveness

92% of the time people choose the average face as more attractive.

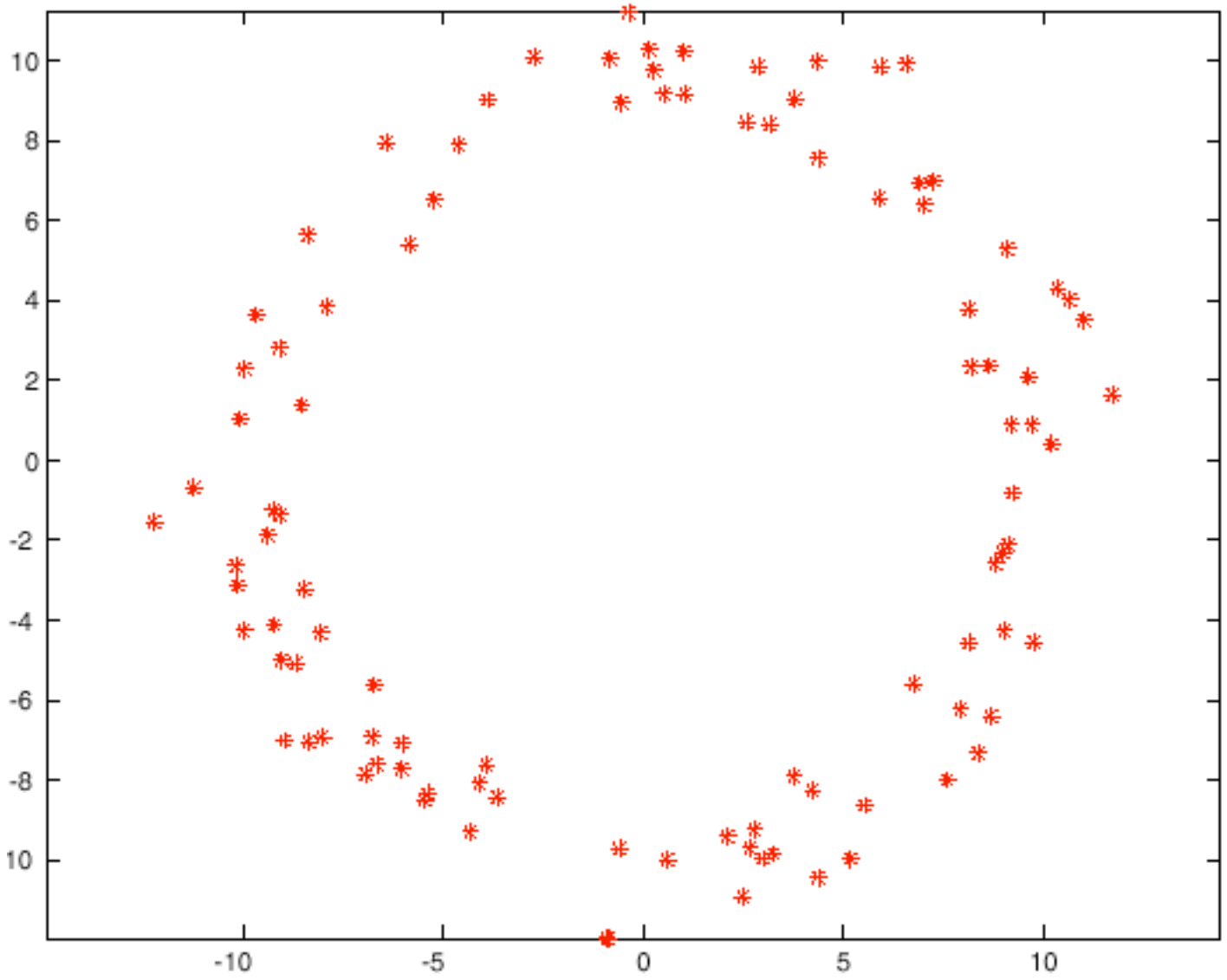
http://www.faceresearch.org/feedback/average_sym

©Michael J. Black

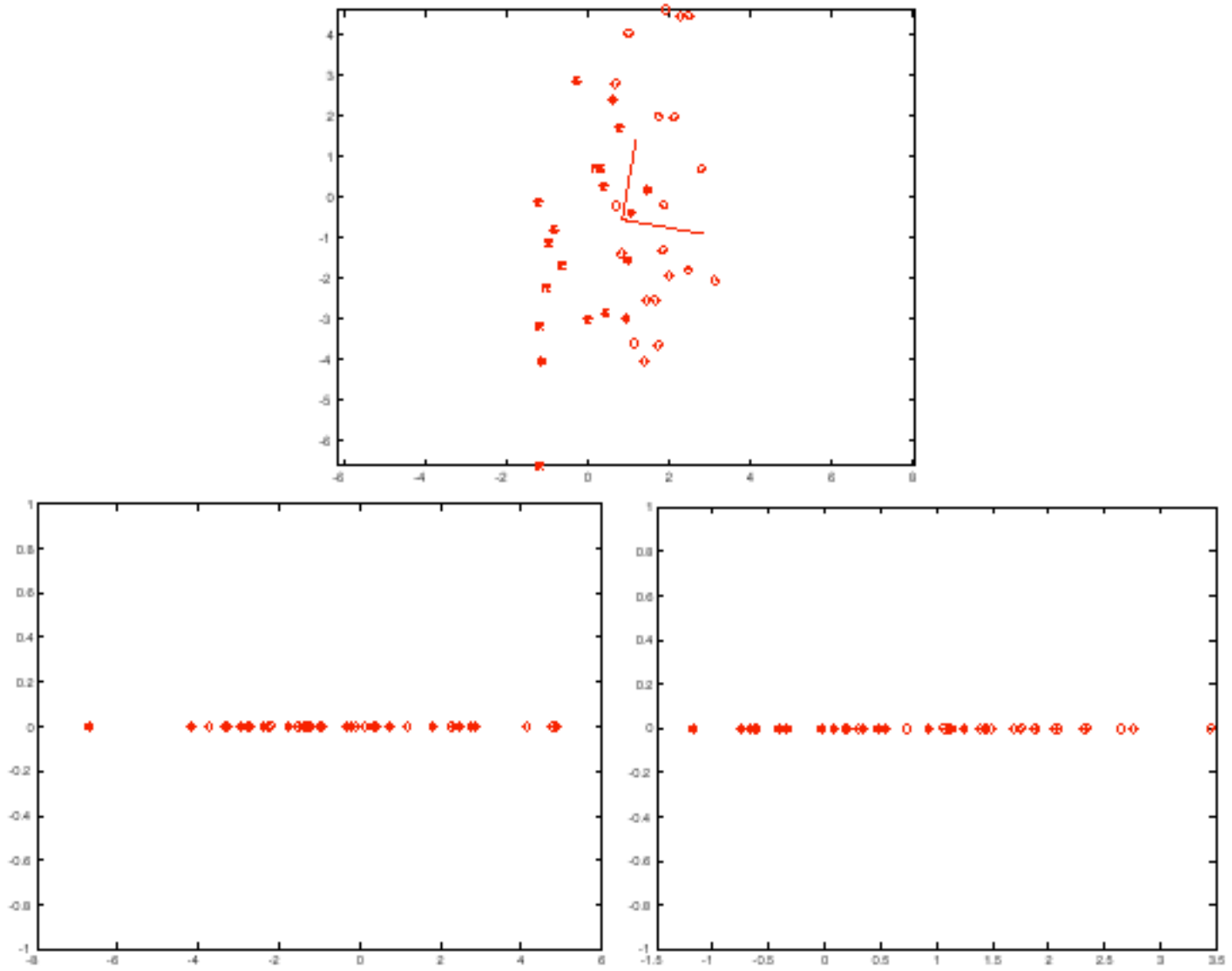
Difficulties with PCA

- Projection may suppress important detail
  - smallest variance directions may not be unimportant
- Method does not take discriminative task into account
  - typically, we wish to compute features that allow good discrimination
  - not the same as largest variance

©Michael J. Black

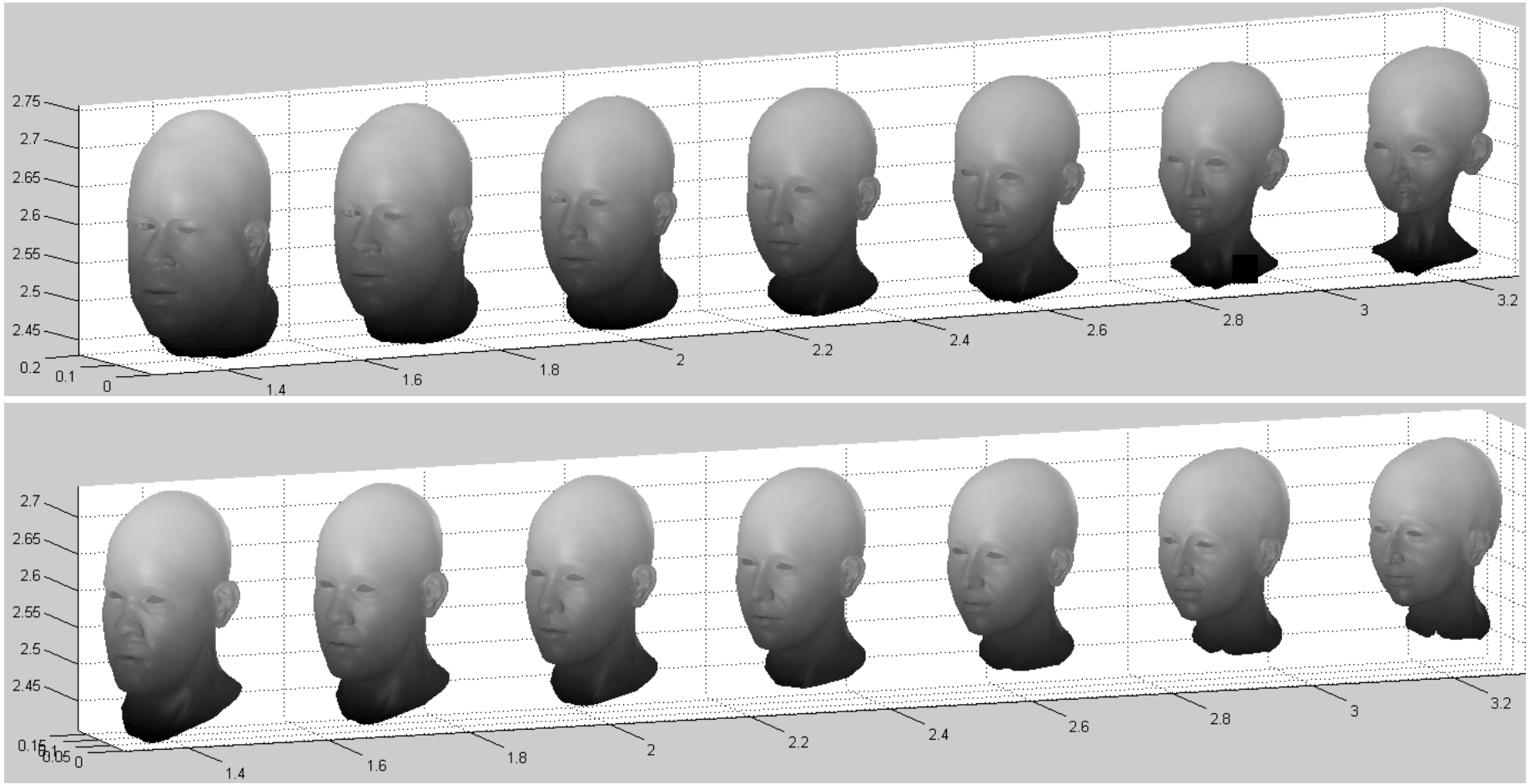


©Michael J. Black



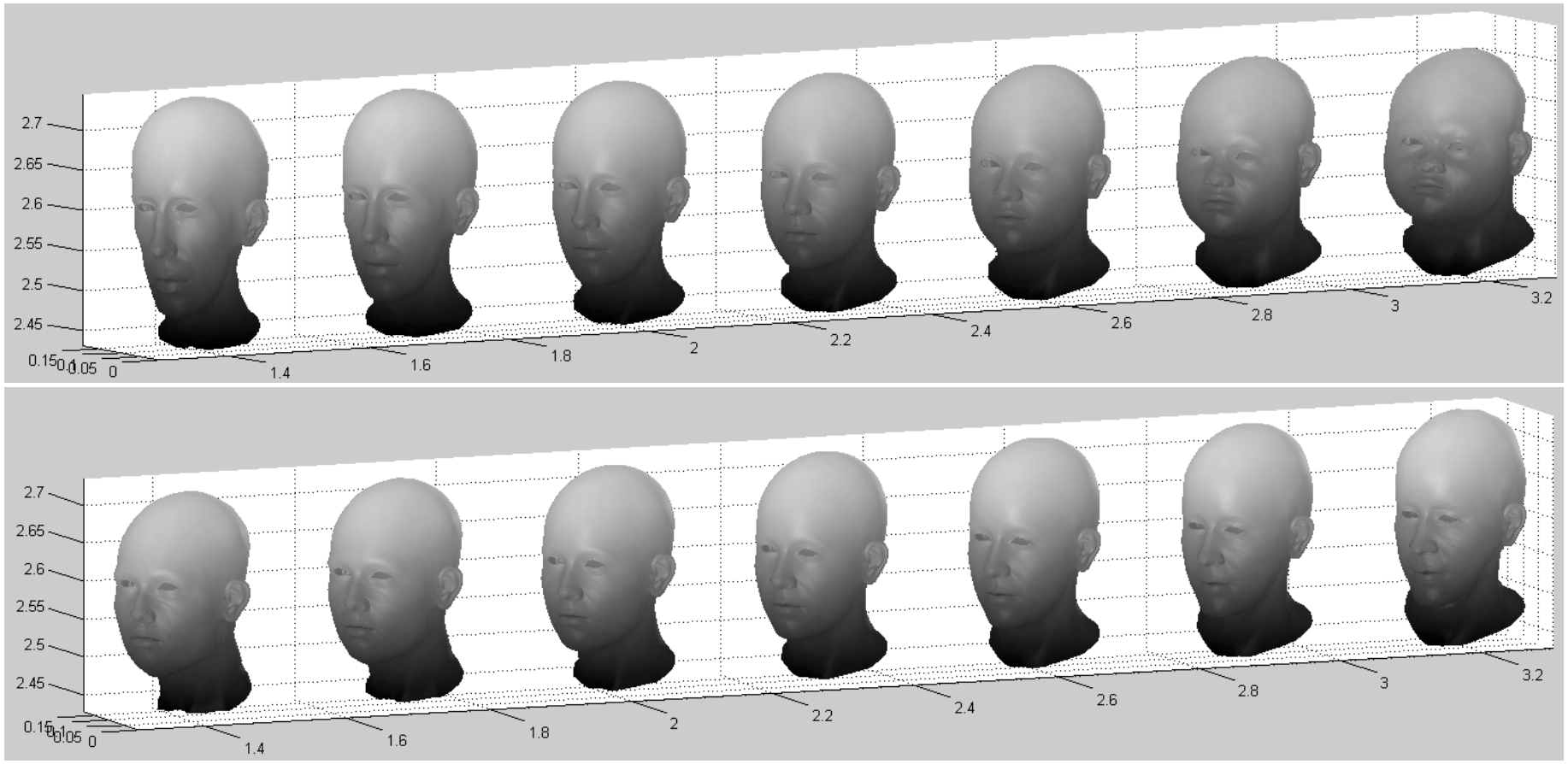
©Michael J. Black

Eigen Heads (PC 1&2)



©Michael J. Black

Eigen Heads (PC 3&4)



©Michael J. Black