Face Recognition Grand Challenge

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NIST

Sponsors:

ITIC TWSG FBI

21 Sept 2004

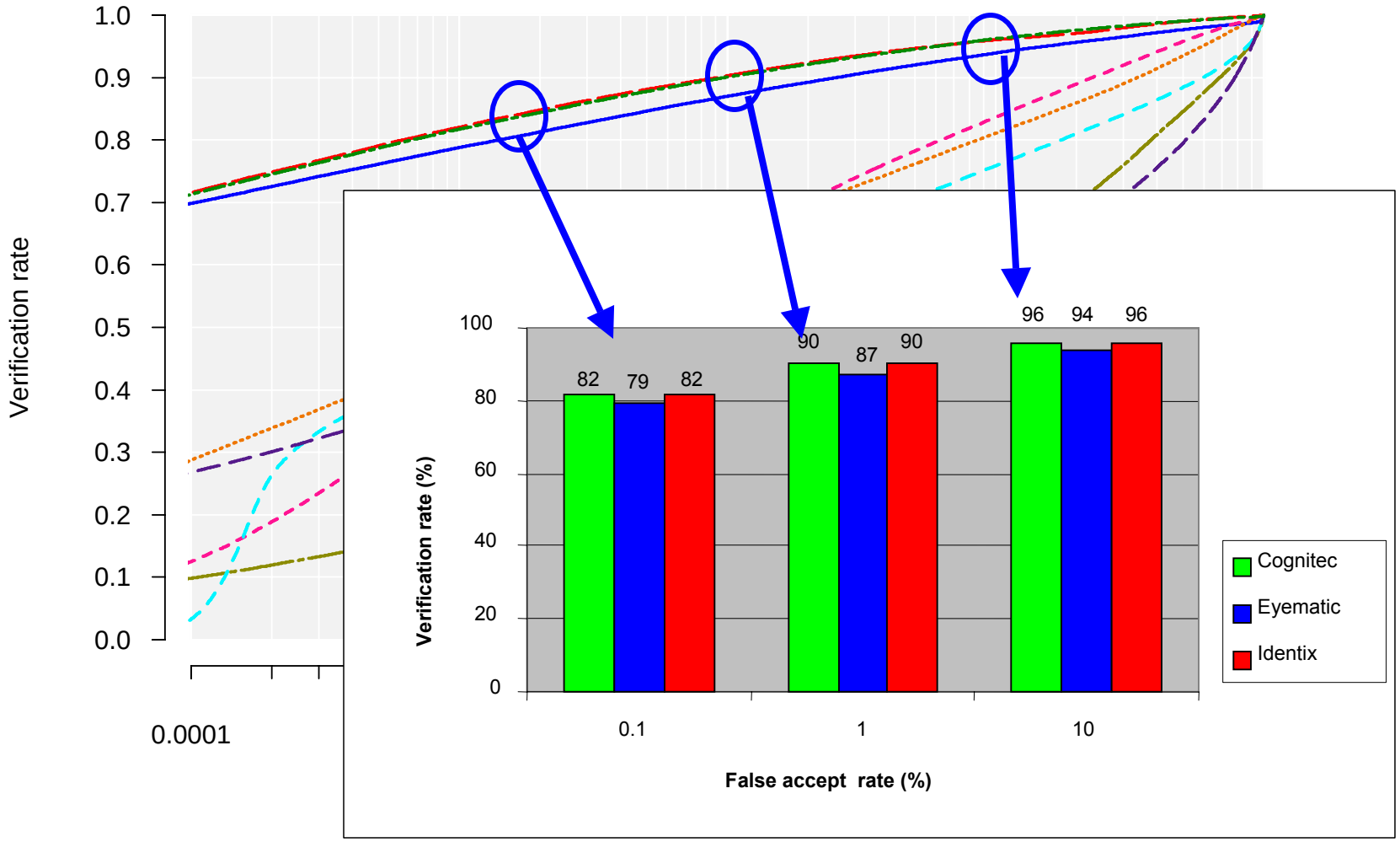
Grand Challenge Evaluation Team

- P. Jonathon Phillips—Director, FRGC
- Patrick Flynn—Notre Dame
- Todd Scruggs—SAIC
- Joe Marques—Mitre
- Kevin Bowyer—Notre Dame
- Jin Chang—Notre Dame
- Kevin Hoffman—SAIC
- Jaesik Min—Notre Dame
- William Worek—SIAC

Face Recognition Grand Challenge

Develop still and 3D algorithms to improve performance an order of magnitude.

Verification - HCInt



Select Point to Measure

- **Verification rate at :**
  - False accept rate = 0.1%
- **Current:**
  - 20% error rate (80% verification rate)
- **Goal:**
  - 2% error rate (98% verification rate)

Measuring Accuracy w/Error Rate of 2%

- Non-match scores:
  - Sufficient
- Match scores:
  - Need to design collection for sufficient number

1,000 match scores	=	~ 20 errors
10,000 match scores	=	~ 200 errors
50,000 match scores	=	~ 1,000 errors

- Allows for error ellipses
- Minimal demographic analysis

Data Collection

Fall Semester

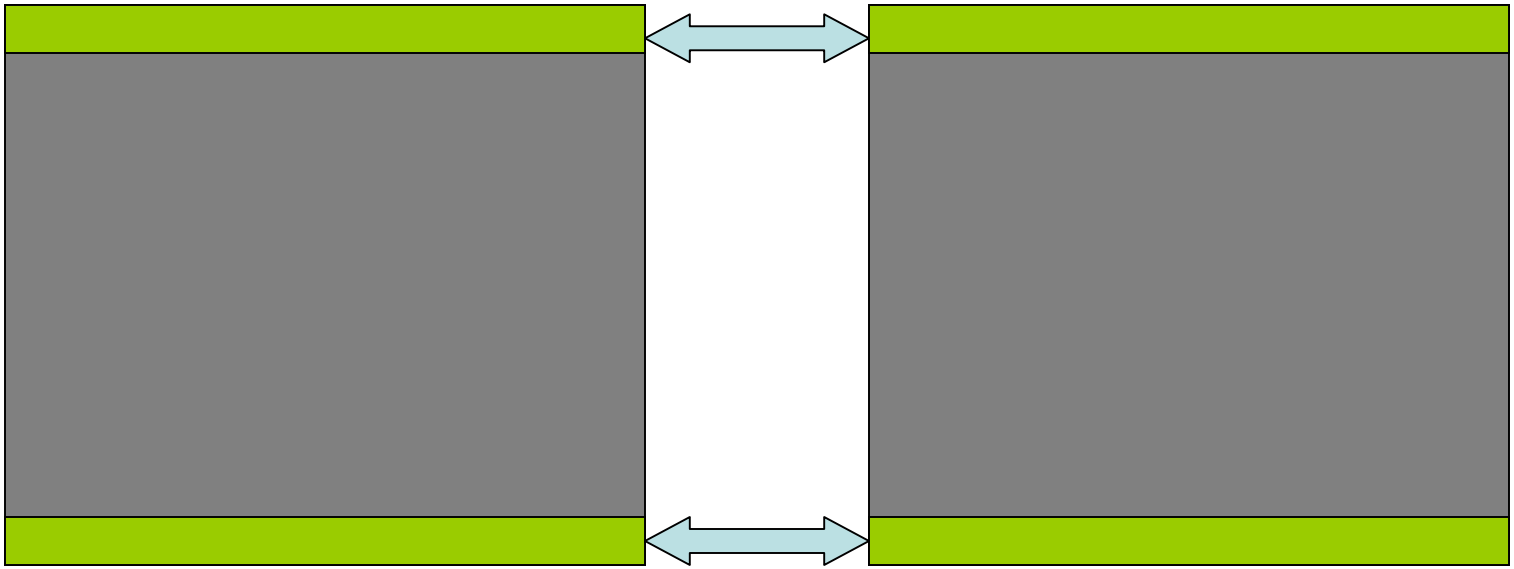
(Gallery)

15 Weeks

Spring Semester

(Probes)

15 Weeks



200 People

200 People

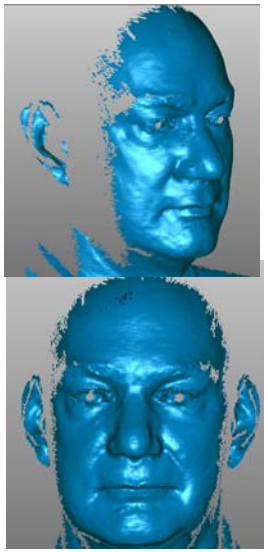
All match scores ~ 50,000

Modes Examined

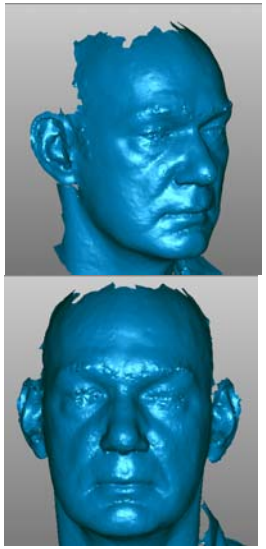
Single Still

Multiple Stills

Outdoor/ Uncontrolled

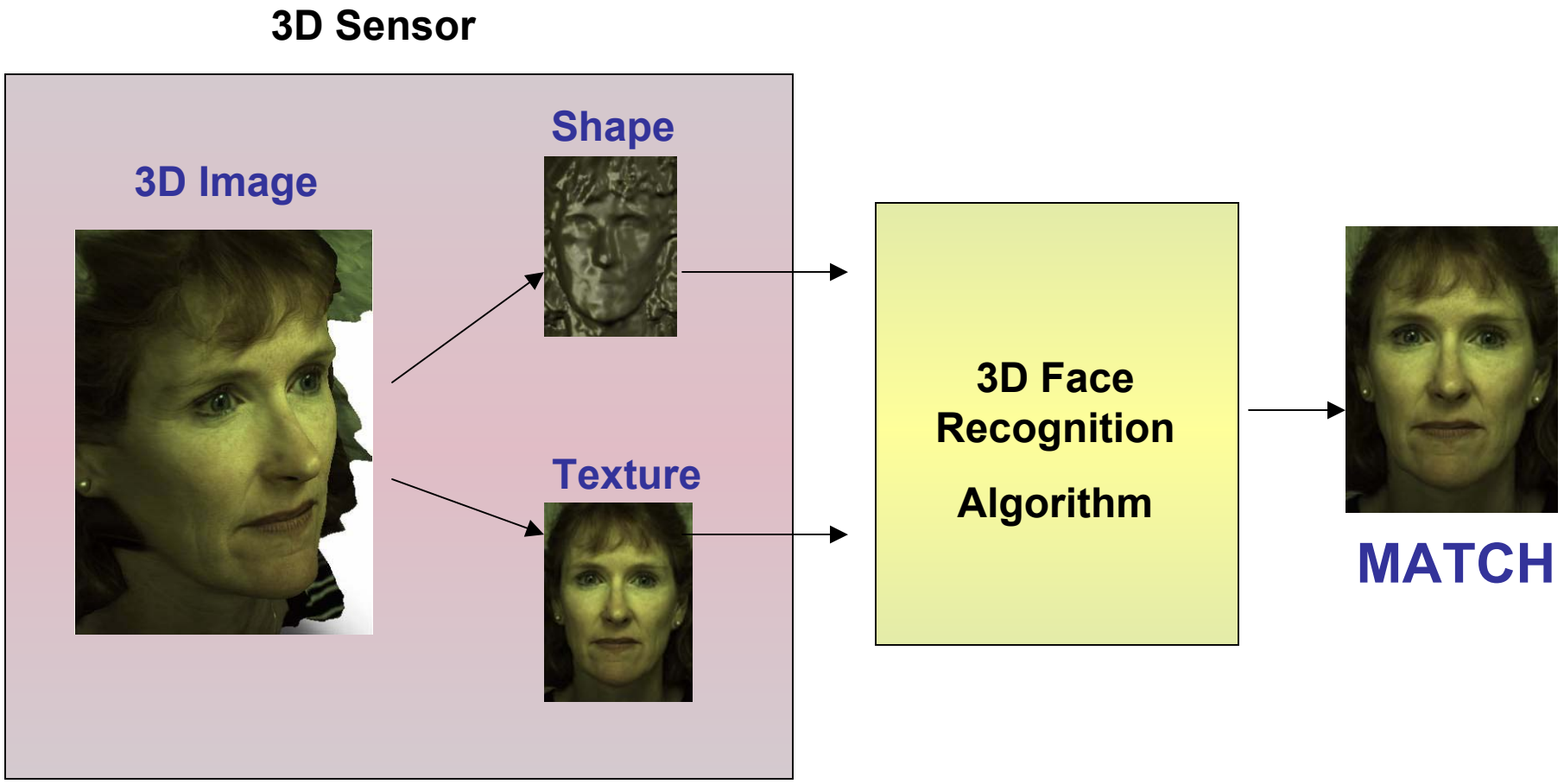


3D Single view



3D Full Face

3D Images


3D Sensor
3D Image
Shape
Texture
3D Face Recognition Algorithm
MATCH

Measure Progress on:

- Indoor cooperative face recognition
- Outdoor cooperative face recognition
- Comparison of still & 3D face recognition
- Effect of multiple images
- Effect of High Dynamic Range cameras on outdoor face recognition
- Comparison between human and machine performance

Grand Challenge Architecture

Accuracy of:

3D Sensors

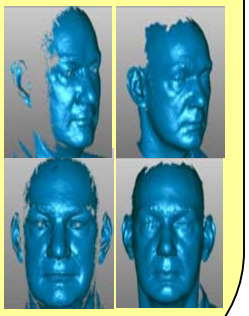

3D from stills


Comparison

Algorithms/
Systems

Modes





Human
Performance

Preprocessing/
Reconstruction
Compression

Image Quality
Measures

Meta data
- eye coordinates
- pose
- gender

Advanced
Statistical
Analysis

Programmatic

- **Two Challenge Problems**
  - Facilitate development
  - Systematically measure progress
- **FR Challenge Grand Challenge Evaluation**
  - Independent evaluation Aug/Sep '05

Challenge Problem

- **Experimental Data set**
  - Training set
  - Validation set
- **Set of Experiments**
  - Target & Query sets
- **Biometric Experimentation Environment (BEE)**
  - Infrastructure for Experiments
- **Scoring Routines**
- **Baseline Algorithms**

Two Challenge Problems

- **Ver1.0a**
  - Released 5 May 2004
  - 275 Subjects; 943 Subject sessions; 7544 Recordings
- **Ver2.0**
  - Release 27 September 2004
  - 625 Subjects; 50,000 Recordings; 70 Gbytes

Grand Challenge Schedule

Date	Activity
Aug-Sep '05	Face Recognition Grand Challenge Evaluation
Jun '05	Proposed FRGC Workshop at CVPR
Sep '04–May '05	Collect evaluation data – Notre Dame
Feb '05	Third challenge problem workshop
27 September '04	Release challenge problem v2.0
10 September '04	Second challenge problem workshop • Participants present results
Jan '02-May '04	Collect data for challenge problem v2.0 – Notre Dame
5 May '04	Release challenge problem v1.0
5 May '04	First challenge problem workshop • Explain challenge problem in detail

Summary of Status

- 42 Participant groups
- 23 Participant groups attending 2nd workshop
- 107 People on bbs
- 75 People attending 2nd workshop

Results Submitted

- 10 Groups submitted by 10 August
  - Carnegie Mellon University
  - Cognitec Systems Corp
  - Geometrix
  - Identix Corp
  - Neven Vision
  - New Jersey Institute of Technology
  - Rutgers
  - University of Houston
  - University of Maryland
  - Viisage Technology
- 3 Groups submitted since 20 August

Number of Results by Experiment

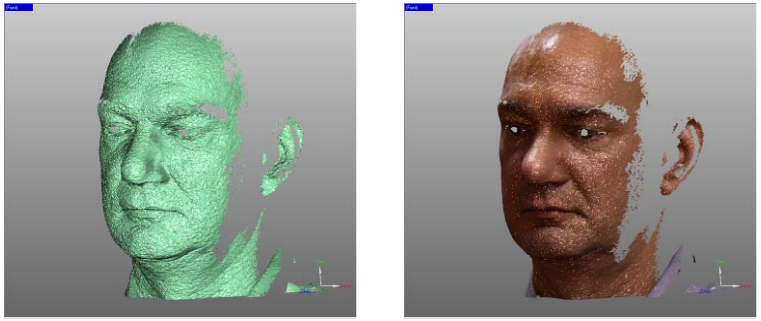
	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6
Number	12	3	6	9	1	1

Total Experiments: 32

Example subject session

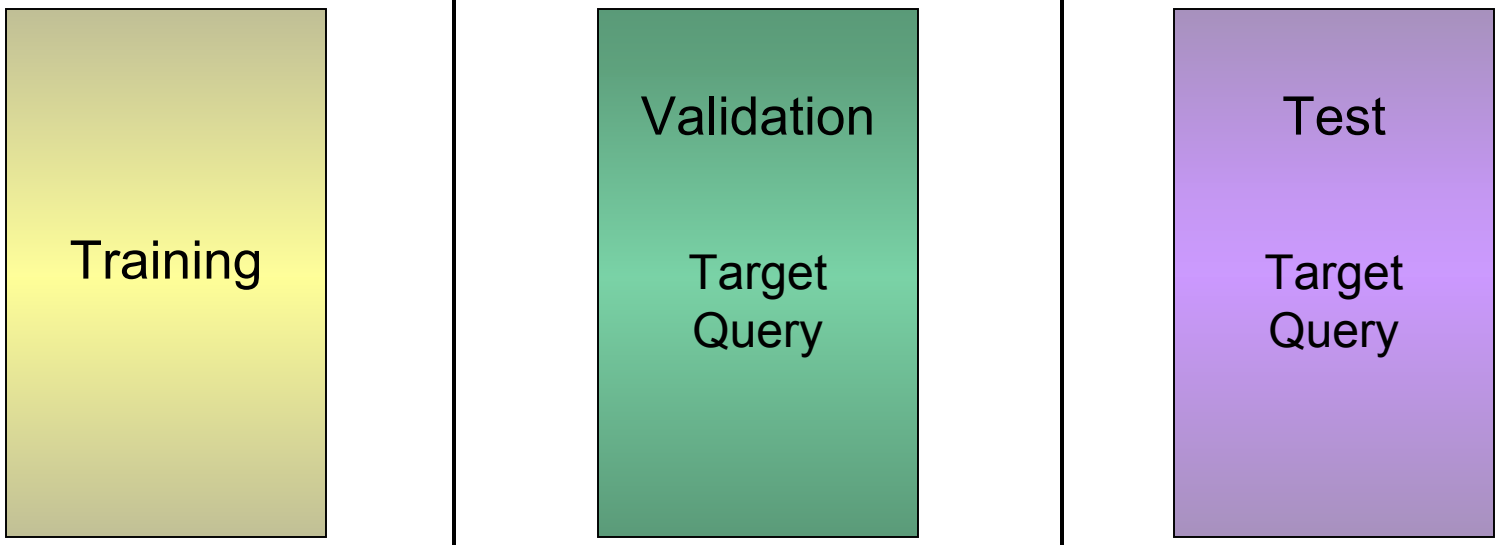
Controlled Still

Uncontrolled Still

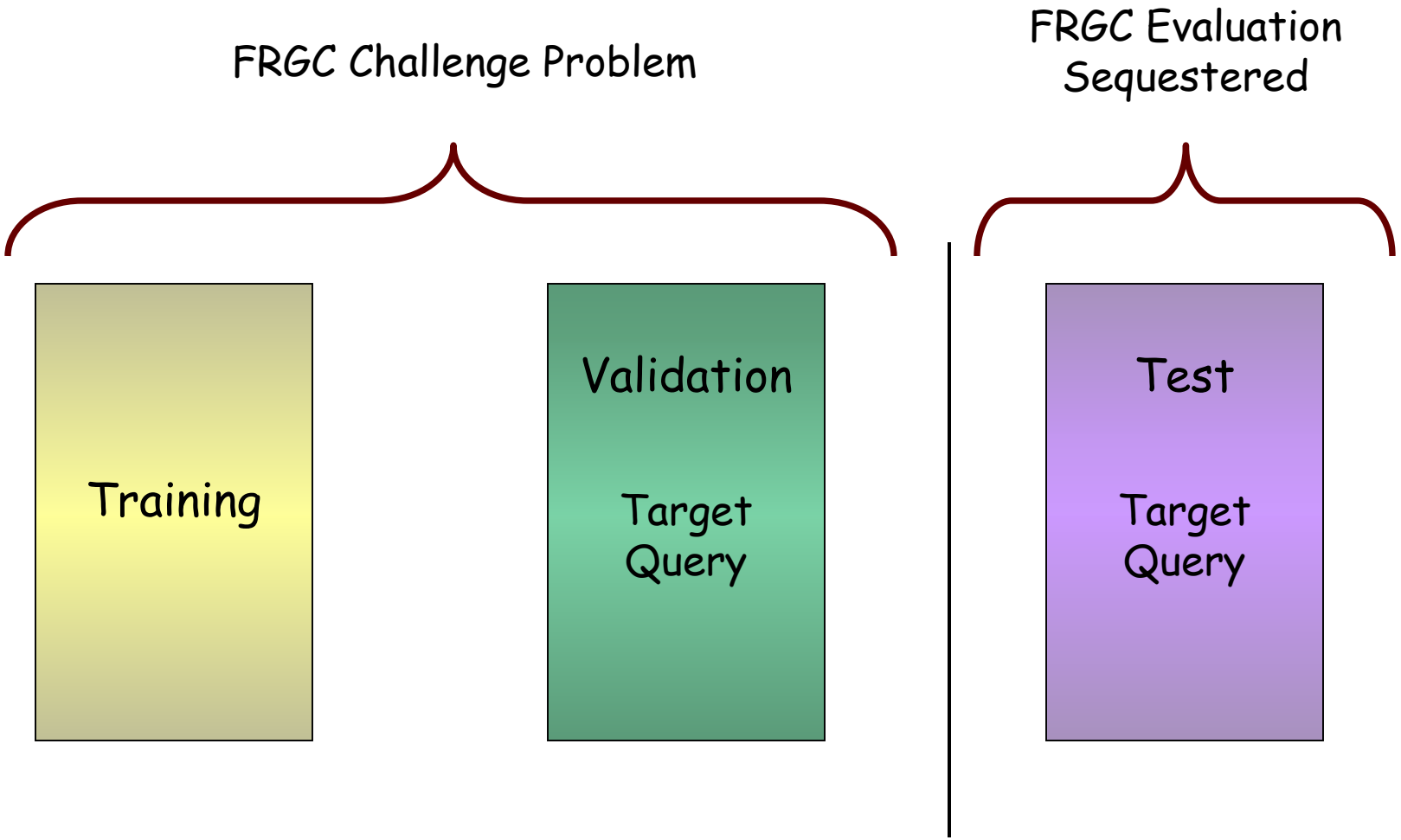


3D Image

Three Data Sets



Three Data Sets

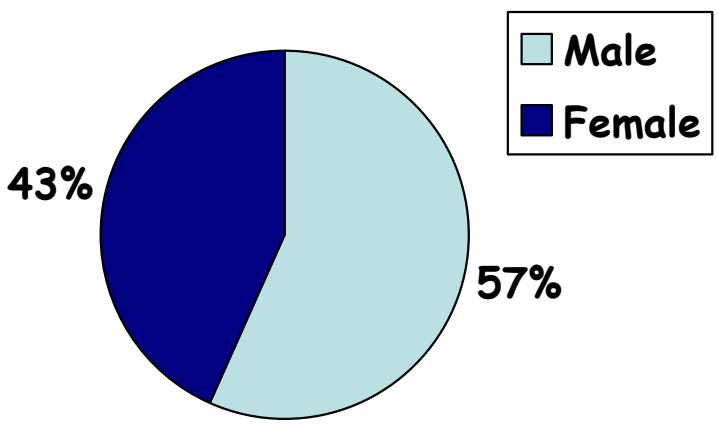


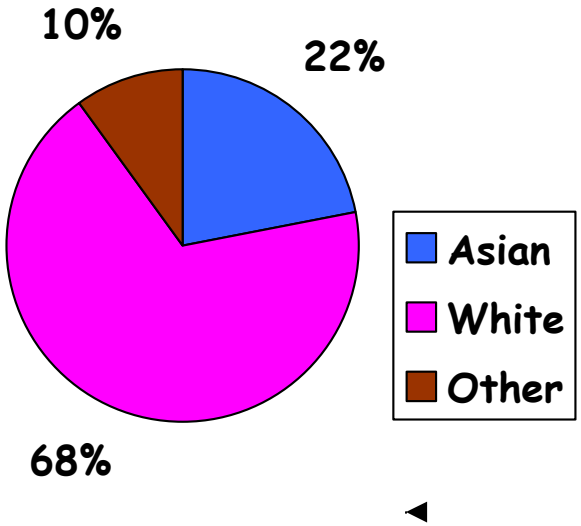
Training and Validation Partitions

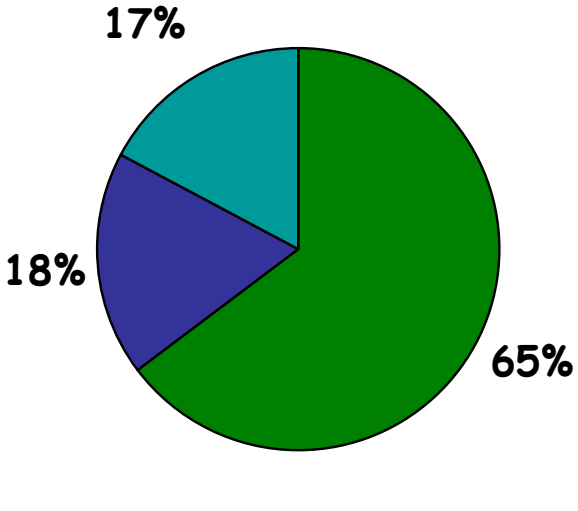
Training	Validation
- Academic Year 2002-03	- Academic Year 2003-04
- 12,776 Large Still Training	- 16,028 Controlled Stills - 8,014 Uncontrolled Stills
- 943 3D Subject Sessions	- 4,007 3D Scans

Demographics

(ver2.0 Validation Partition)







Size of Faces
(ver2.0 Validation Partition)

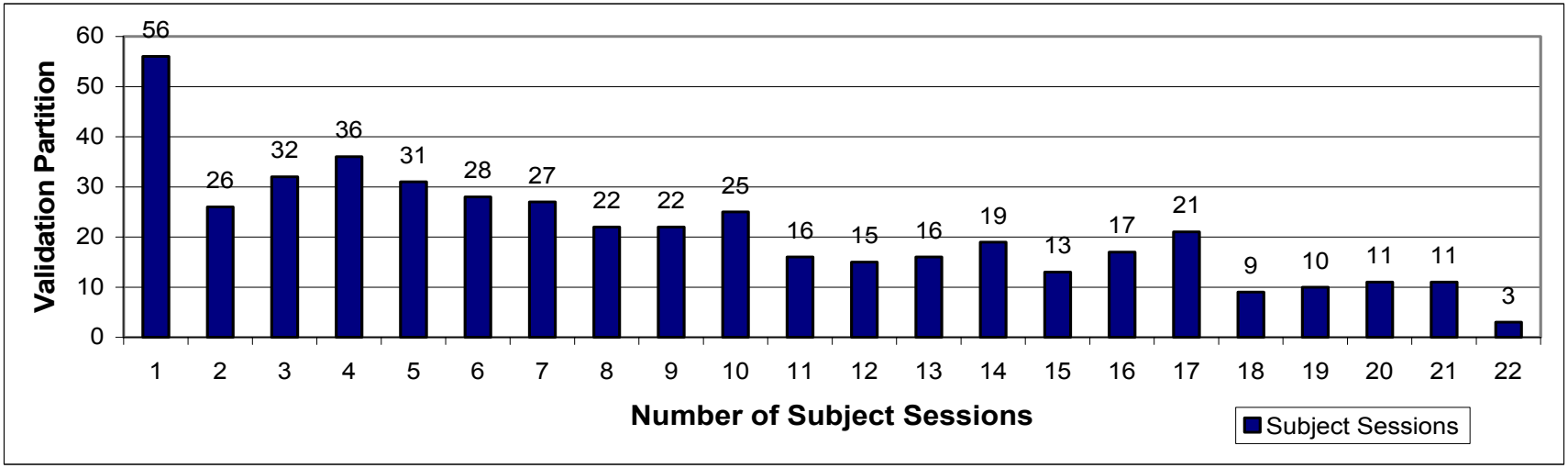
Pixels between center of eyes

	Mean	Median	Std
Controlled	261	260	19
Uncontrolled	144	143	14
3D	160	161	15

Target / Query Sets

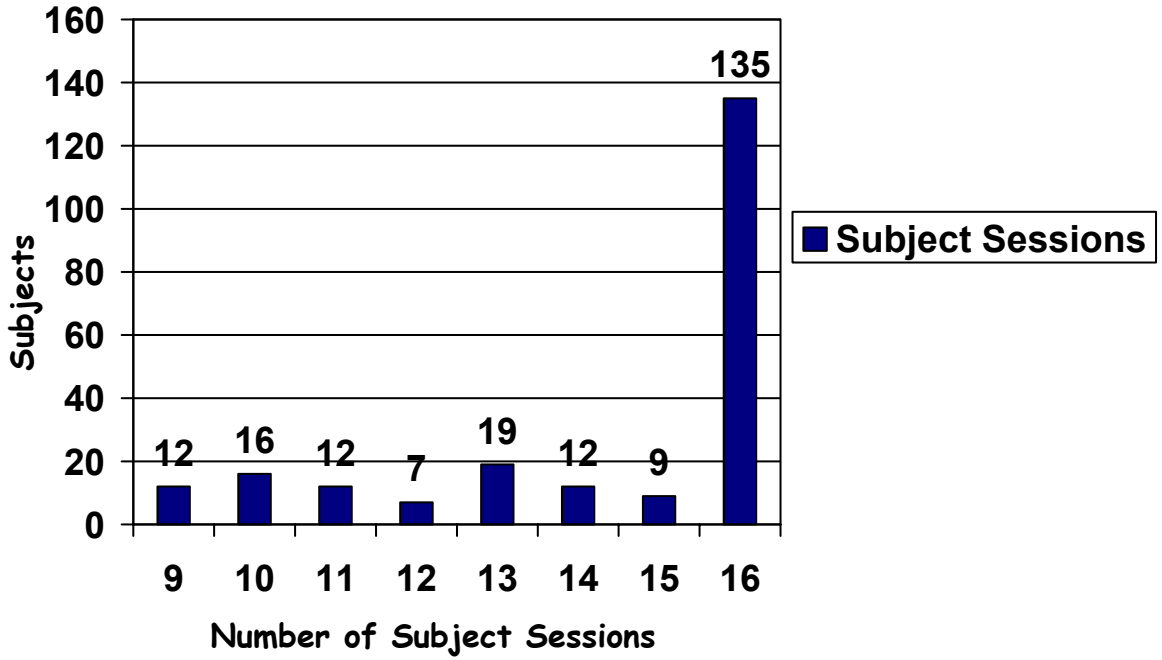
(ver2.0 Validation Partition)

466 Subjects; 4,007 Subject sessions; 32,056 Recordings



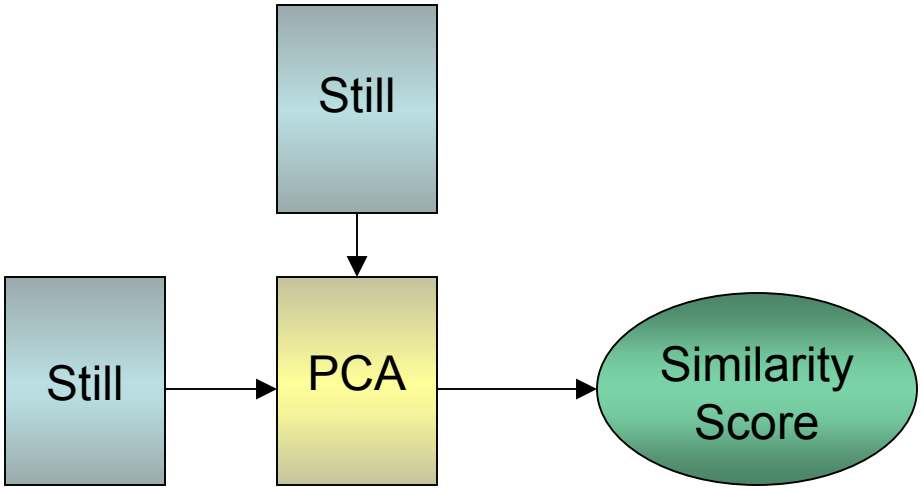
Large Still Training Set

222 Subjects; 100 Subject sessions; 12,776 Recordings



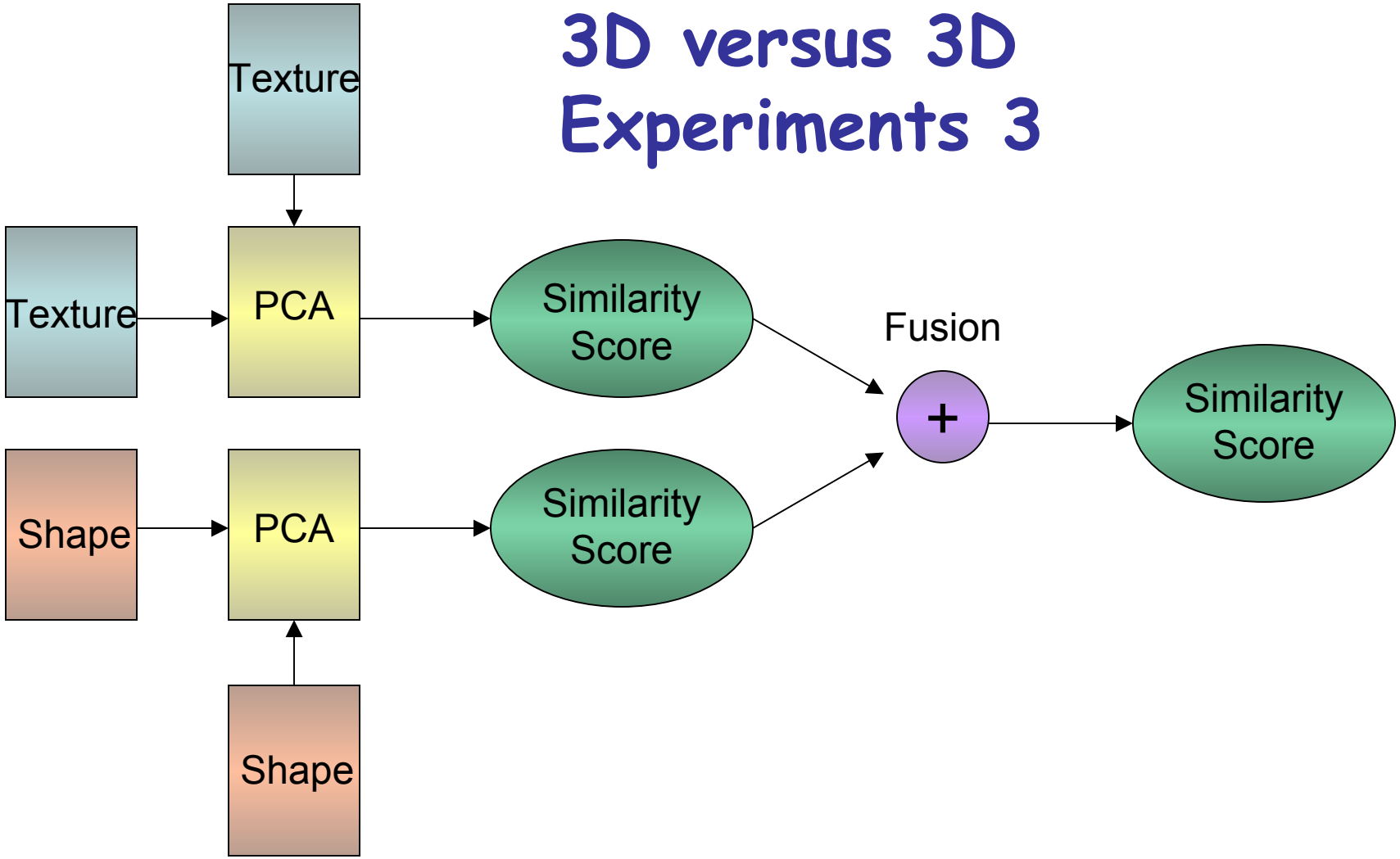
Baseline Algorithms

Still versus Still
Experiments 1 and 4

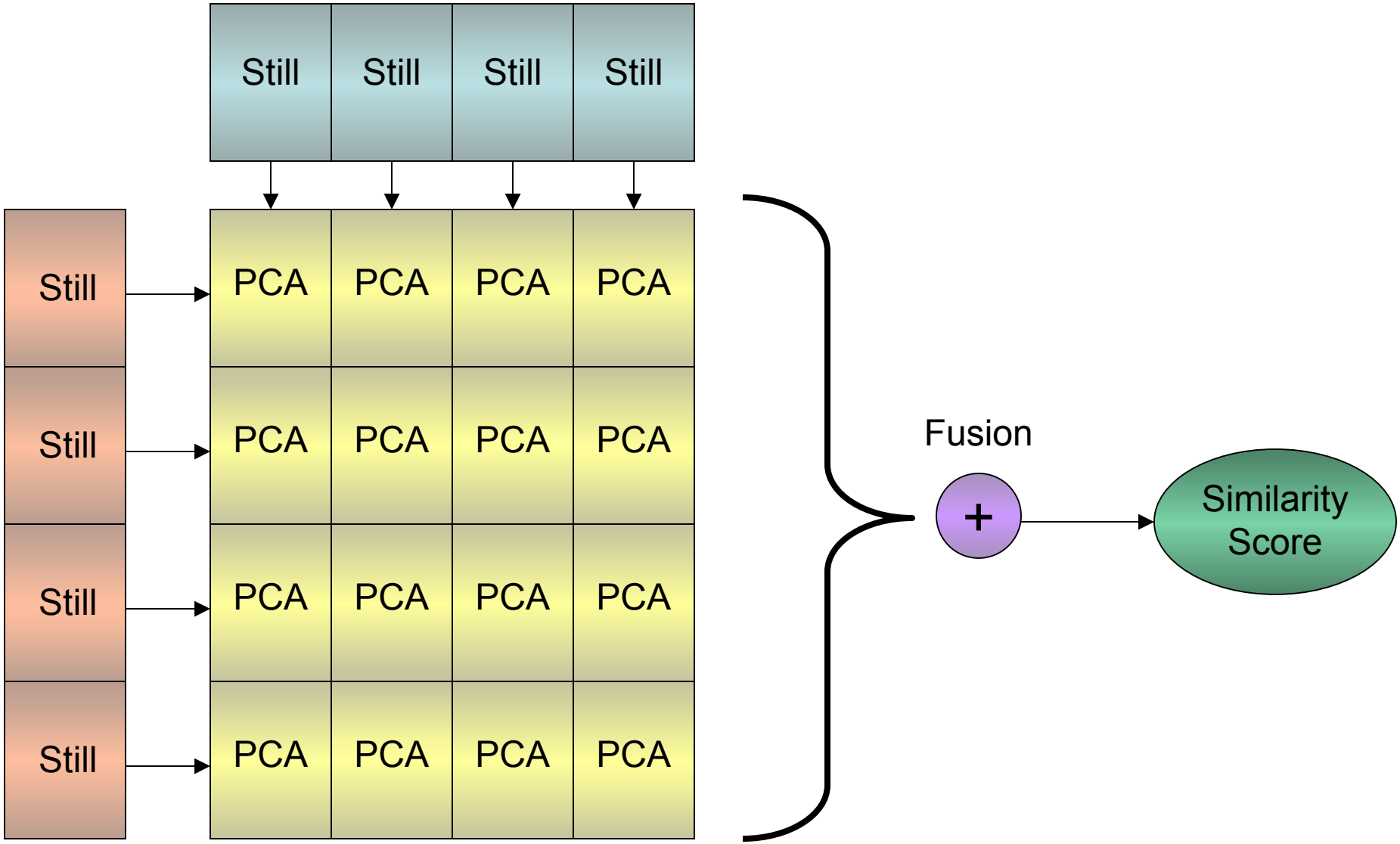


Baseline Algorithm

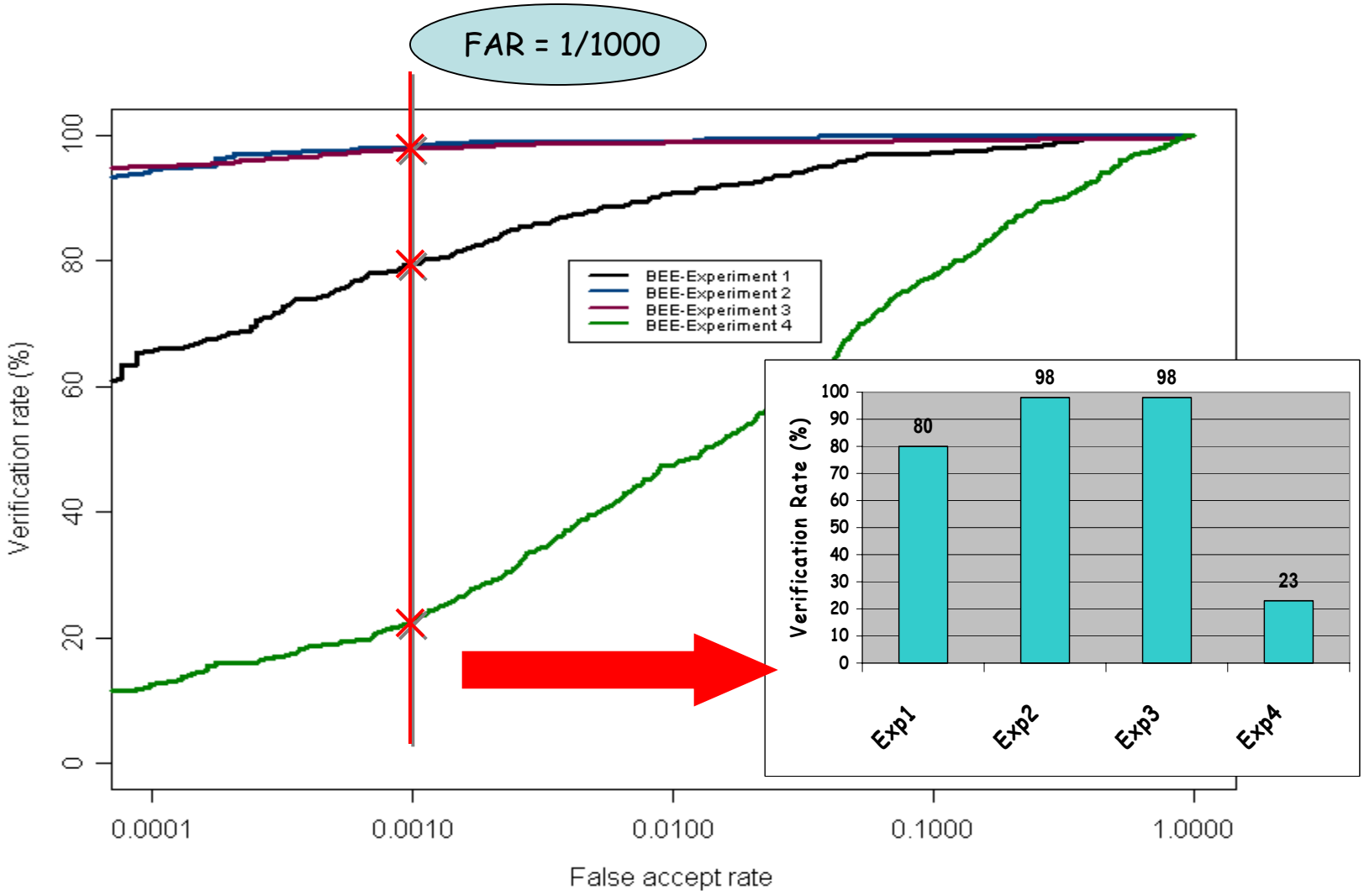
3D versus 3D Experiments 3



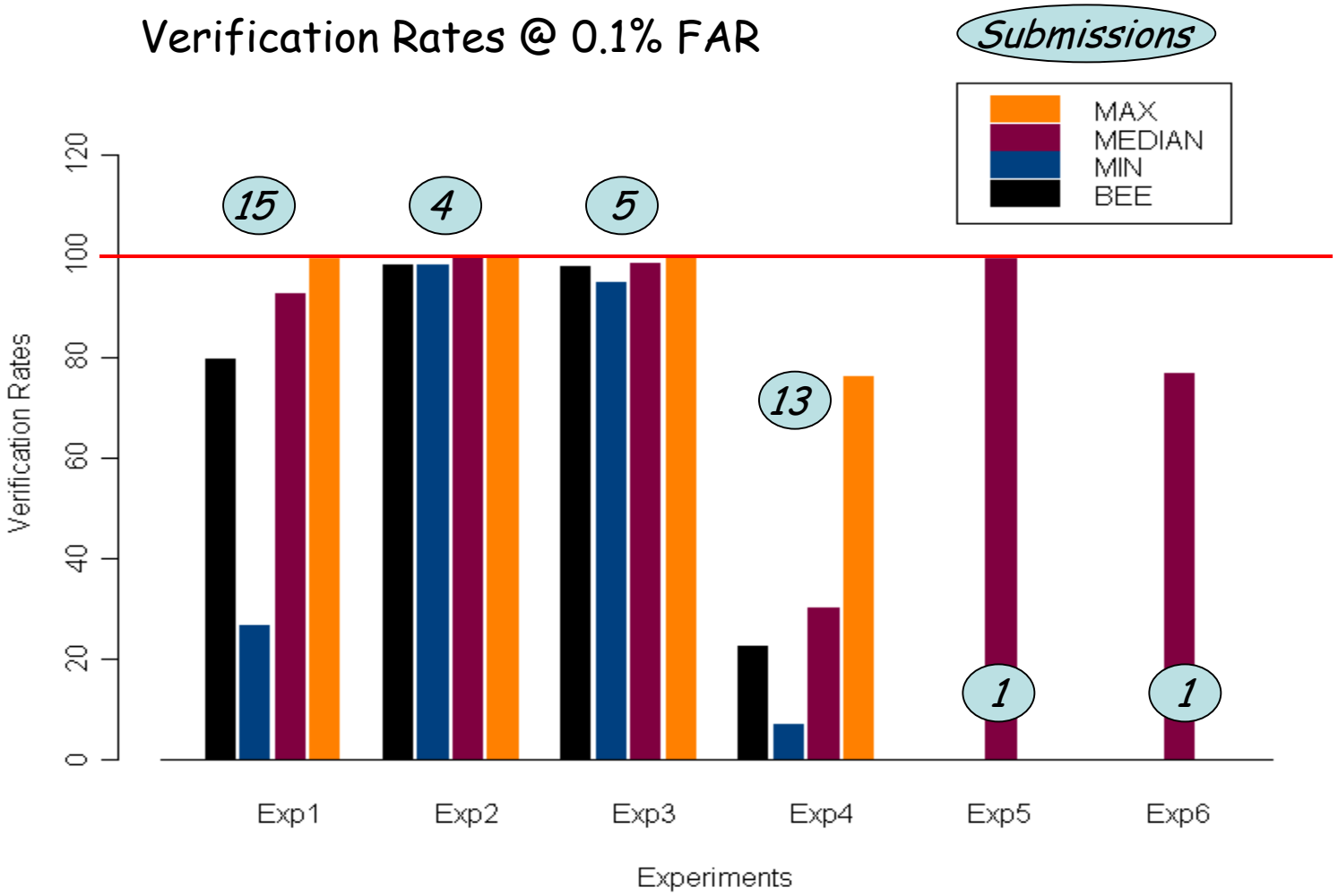
Multi-still versus Multi-still Experiment 2



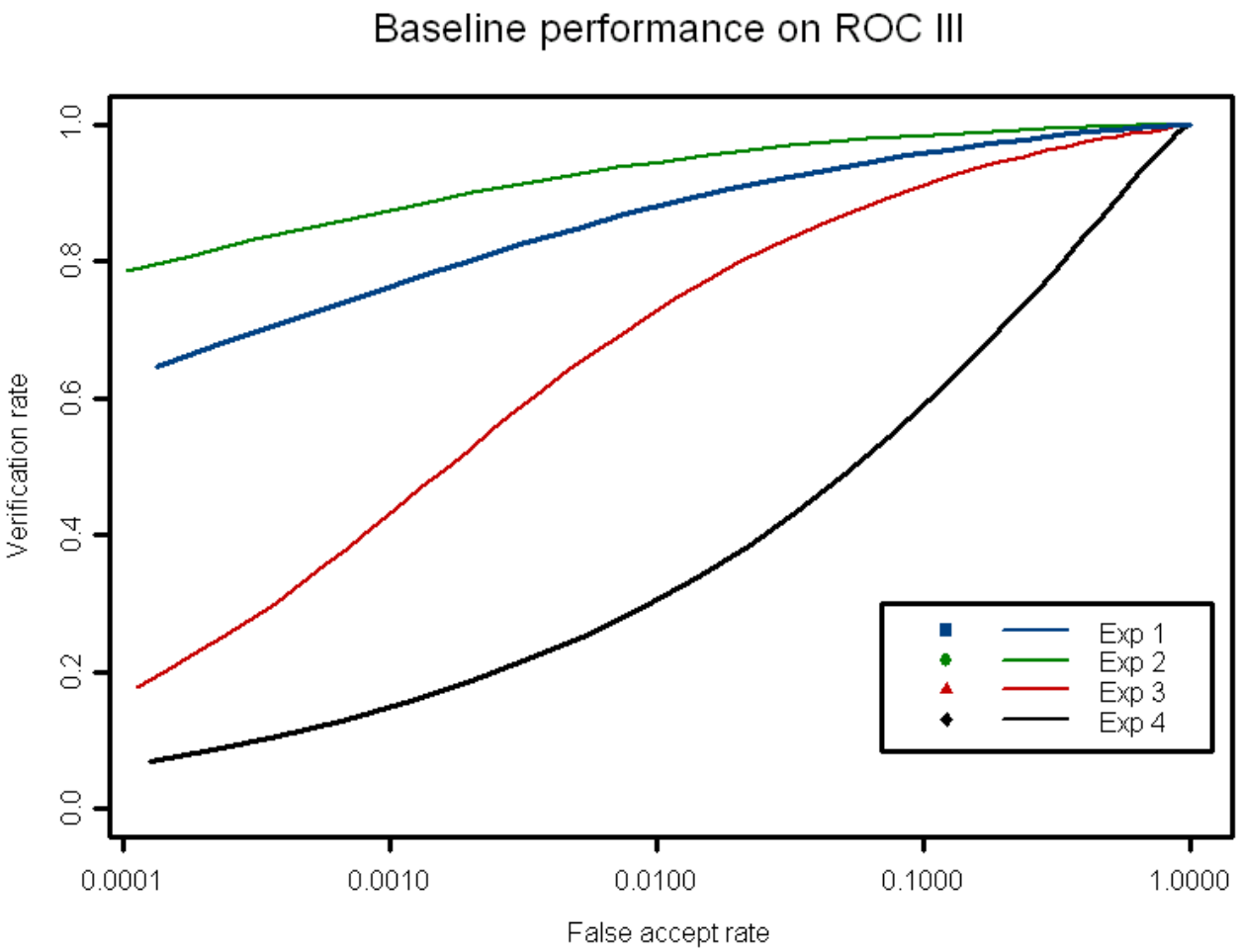
Baseline (PCA) Performance



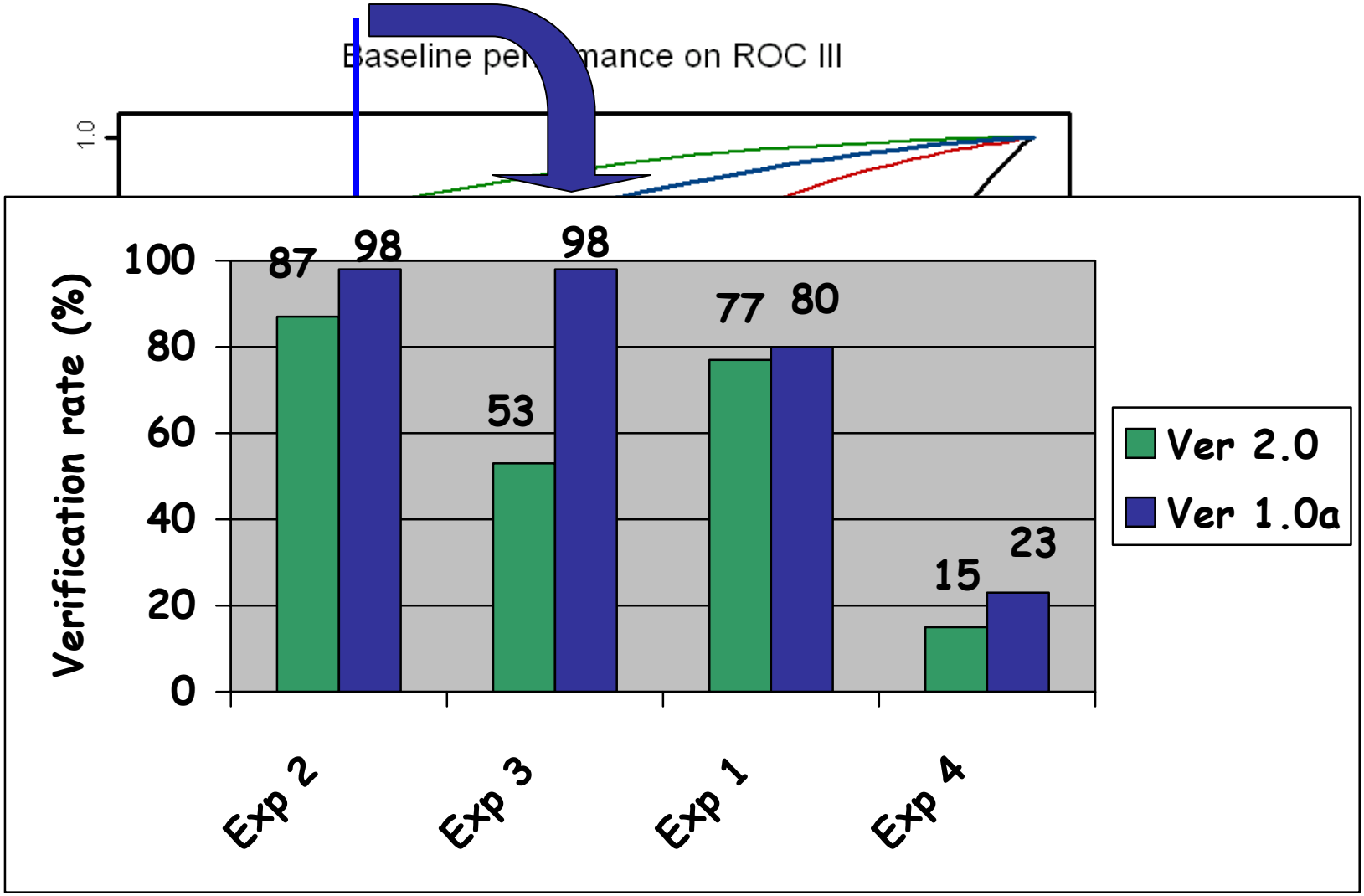
Ver 1.0a—Warm-up Problem **Very Easy**



Ver2.0 Baseline



Ver2.0 Baseline FAR = 0.1%



Bowyer's Conjecture I

One 3-D image is *more powerful* for face recognition than one 2-D image.

Phillips' Conjecture I

One high resolution 2-D image is *more powerful* for face recognition than one 3-D image.

Bowyer's Conjecture II

Using 4 or 5 well-chosen 2-D face images is *more powerful* for recognition than one 3-D face image or multi-modal 3D+2D face.

Phillips' Conjecture II

Solution to the FRGC will cause rethinking of how face recognition is deployed.

TSWG Section

Presentations by FRGC participants!!

Two Questions:

Q: Who can participate?

A: FRGC is open to Academia, Research Institutions, and Companies

Q: How do I sign up?

A: E-mail Jonathon Phillips at jonathon@nist.gov

Conclusion

- **Face Recognition Grand Challenge**
  - Order of magnitude increase in performance
  - Systematically investigate still and 3D
  - Formulate series of challenge problems
  - Face Recognition Grand Challenge Evaluation Aug/Sep '05