

Anatomy of a Challenge Problem for Face Recognition

Dr. P. Jonathon Phillips



My Background

- FERET 1993-1997
 - Challenge problem and evaluation
- FRVT 2000
 - Evaluation
- FRVT 2002
 - Evaluation
- Gait Challenge 2002-2003
 - Challenge problem
- Face Recognition Grand Challenge 2004-2006
 - Challenge problem
- FRVT 2006
 - Evaluation
- Iris Challenge Evaluation (ICE) 2005-2006
 - Challenge problem

Facial Recognition
Vendor Test *2000*

FR₀
VT₀



Background

Face Recognition Tasks

Verification:



Claimed Identity



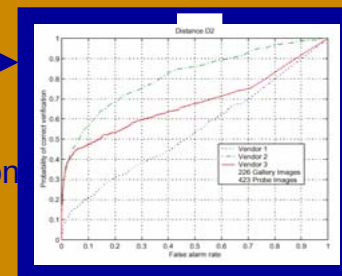
Verification Algorithm



Accept or Reject

Verification Rate

Receiver Operator Characteristic



False Accept

Identification:



Identity Unknown



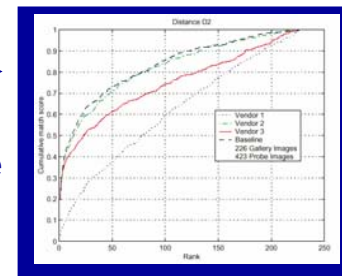
Identification Algorithm



Estimate Identity

ID Rate

Cumulative Match Characteristic



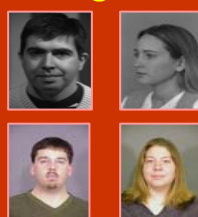
Watch List:



Unknown Individual

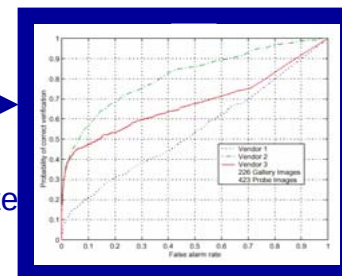


WL Algorithm



On List?

ID Rate



Receiver Operator Characteristic

Two Measures

Decision: Same person?

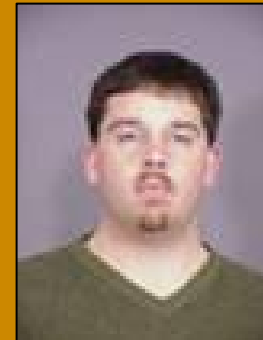


Verification Rate



Same
Person

False Accept Rate

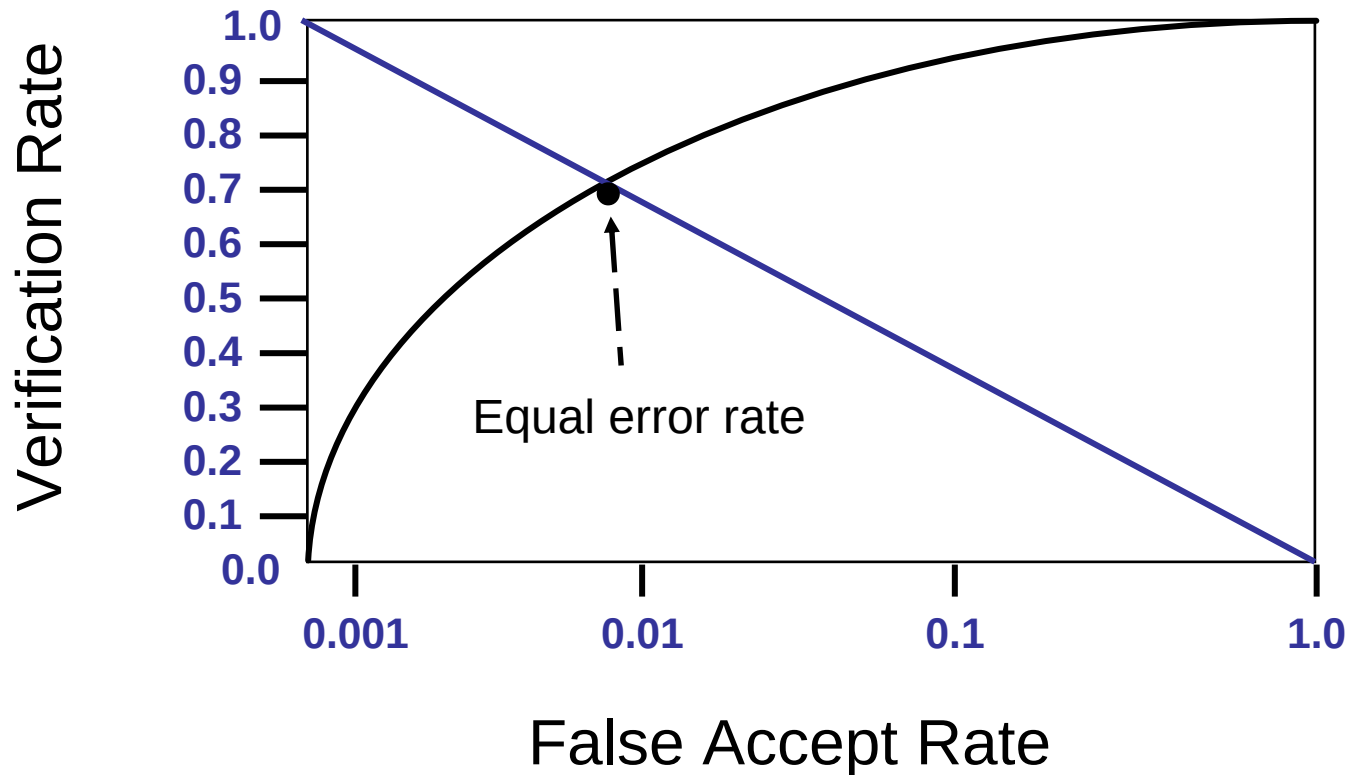


Different
People

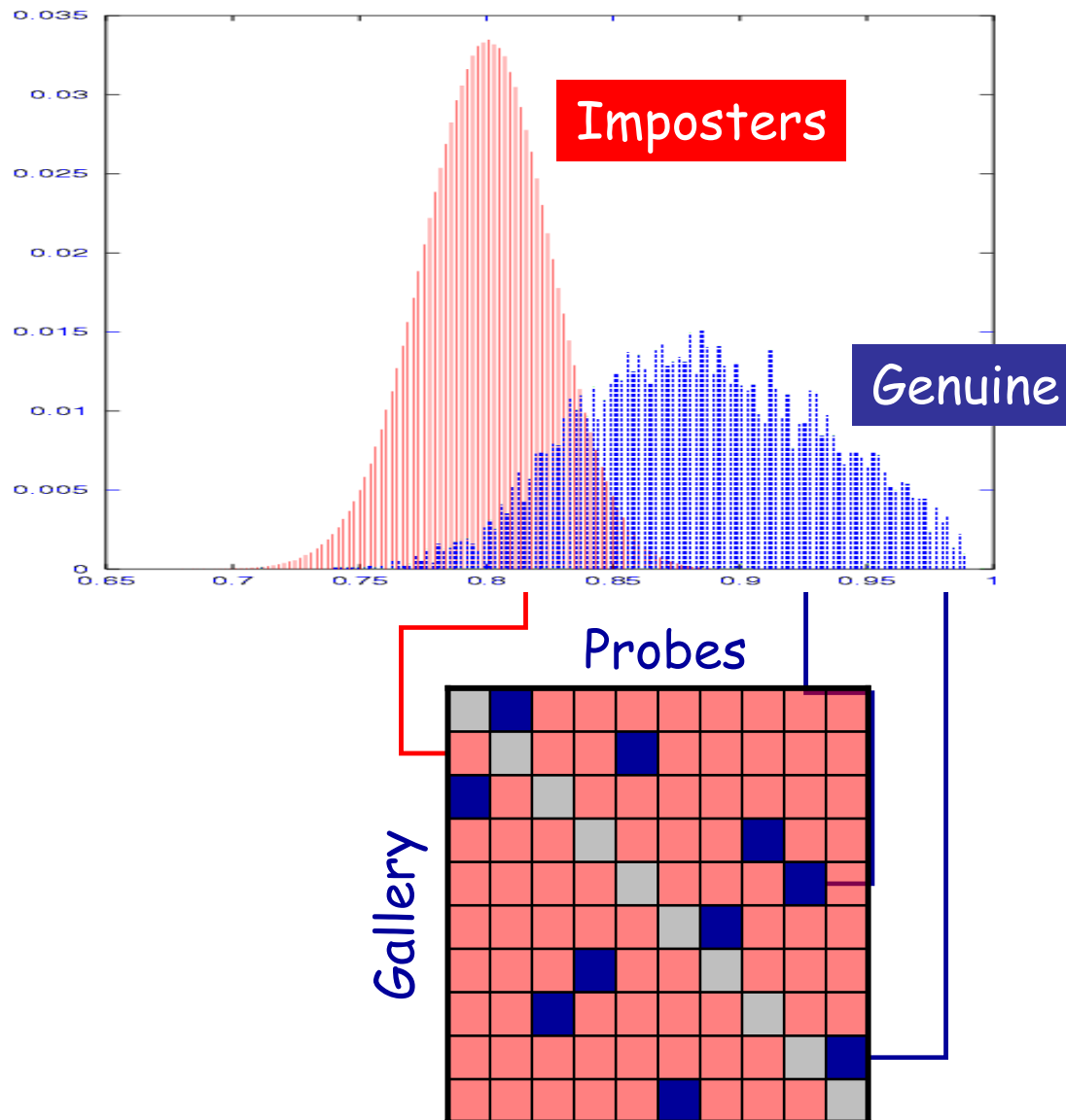
Verification Scoring

Results are reported on Receive Operating Characteristic (ROC)

Equal error rate is summary statistic



The Underlying Statistical Problem



Structure of Challenge Problem

Examples of Biometric Evaluations

- FERET – Aug 94, Mar 95, Sep 96
- FRVT – 2000, 2002
- FpTVE – Fingerprint evaluation
- FVC – Fingerprint Verification Competition
- FAC – Face Authentication Competition
- NIST Speaker Recognition Evaluations

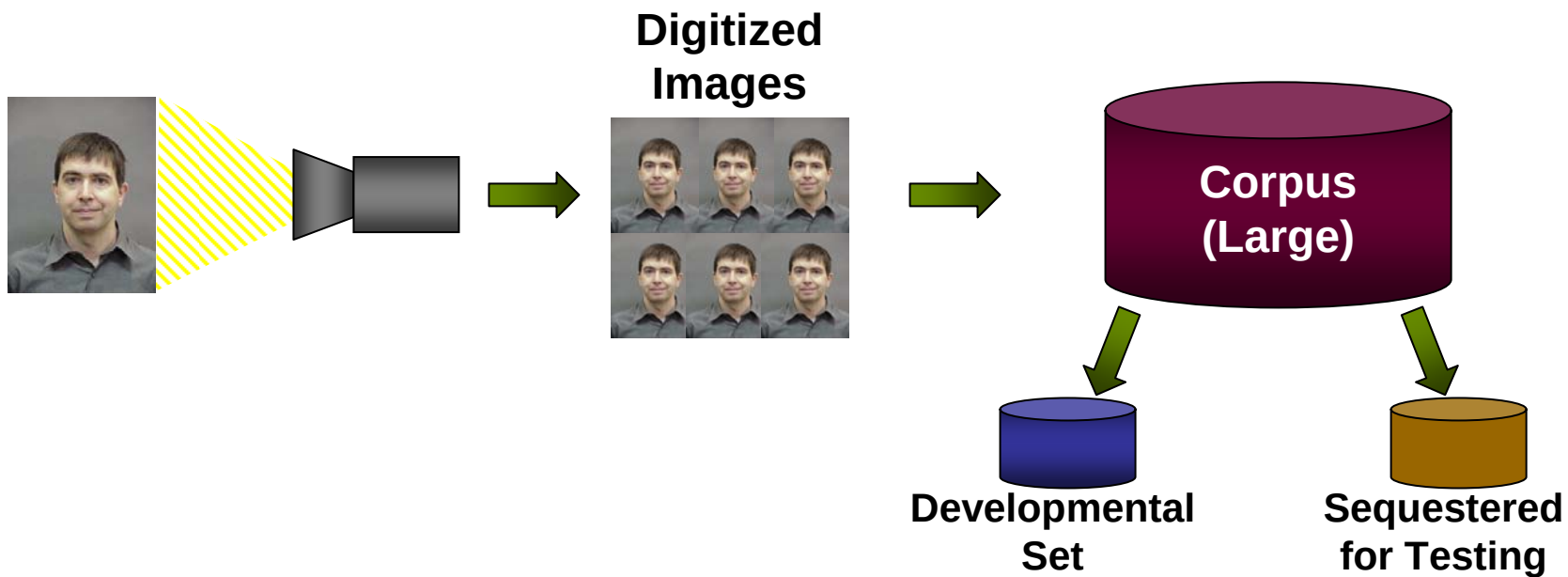


**Facial Recognition
Vendor Test** 2000

**FACE RECOGNITION
VENDOR TEST 2002**



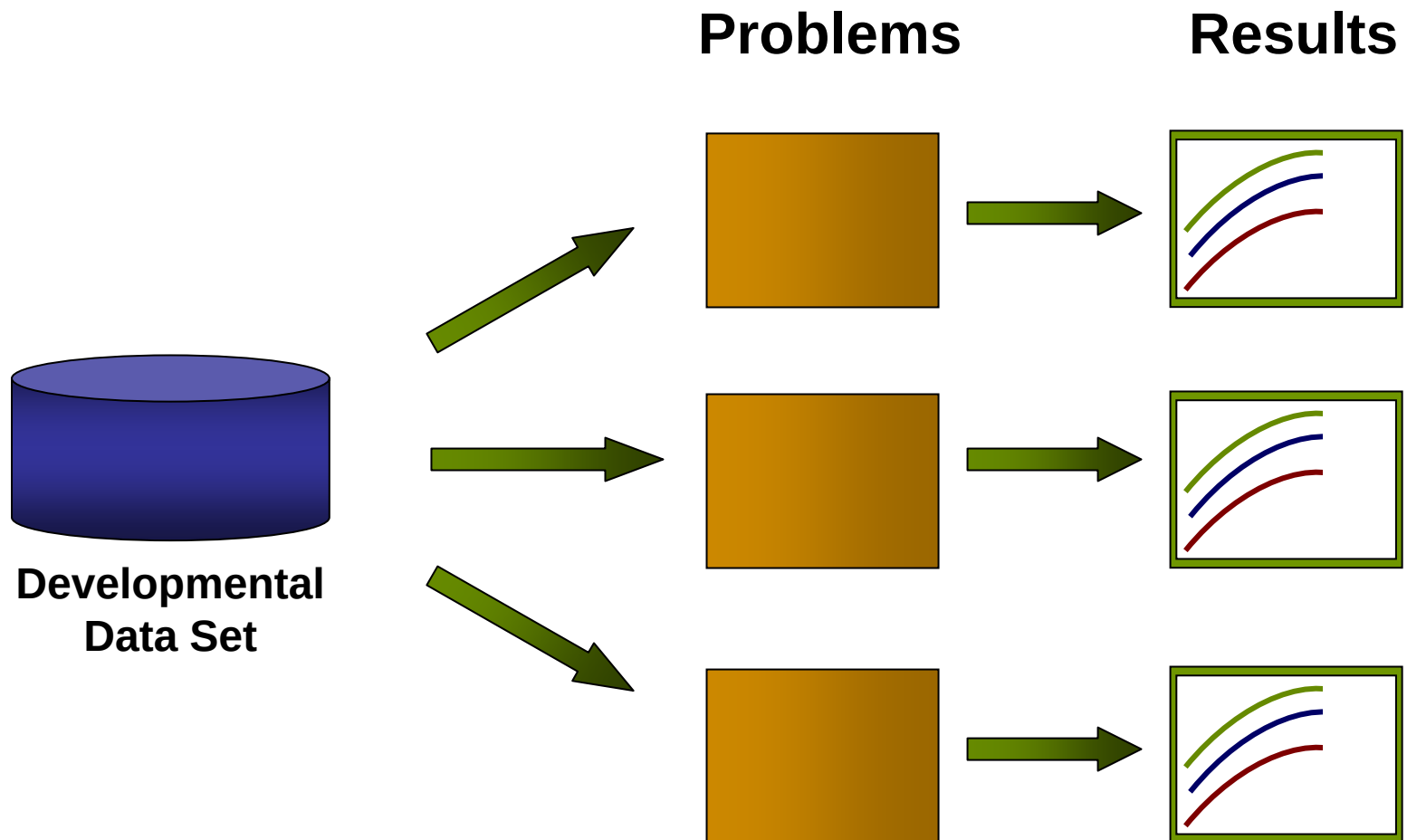
Data Collection



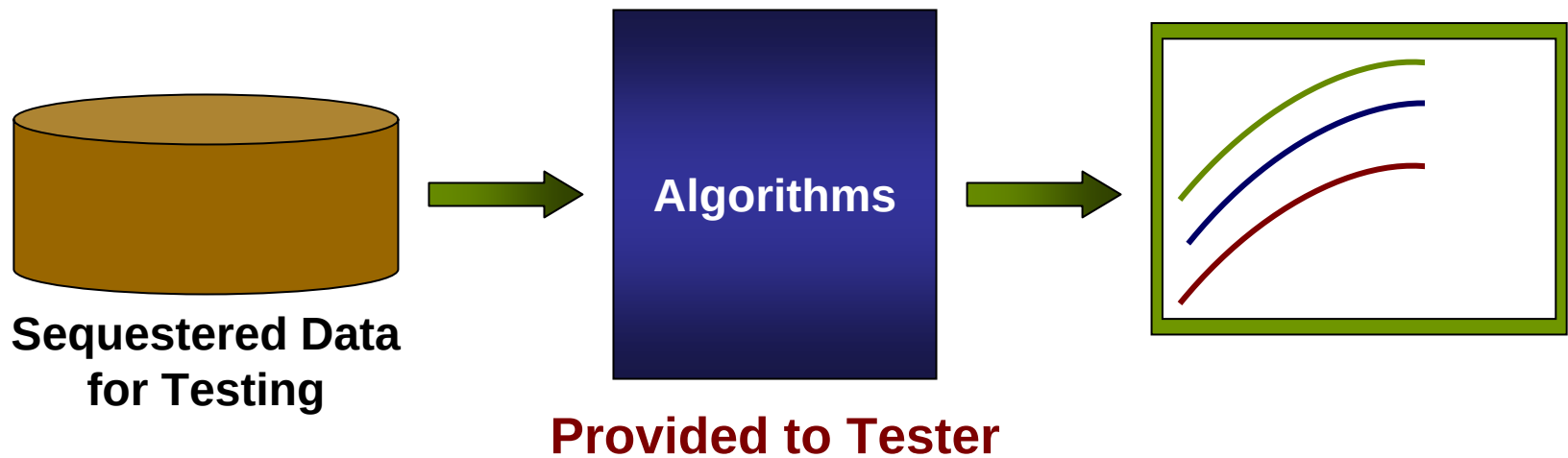
Data Collection

- 20+ year life span
- Goal of evaluation
- Start collection prior to program
- Broadly distribute data

Challenge Problem

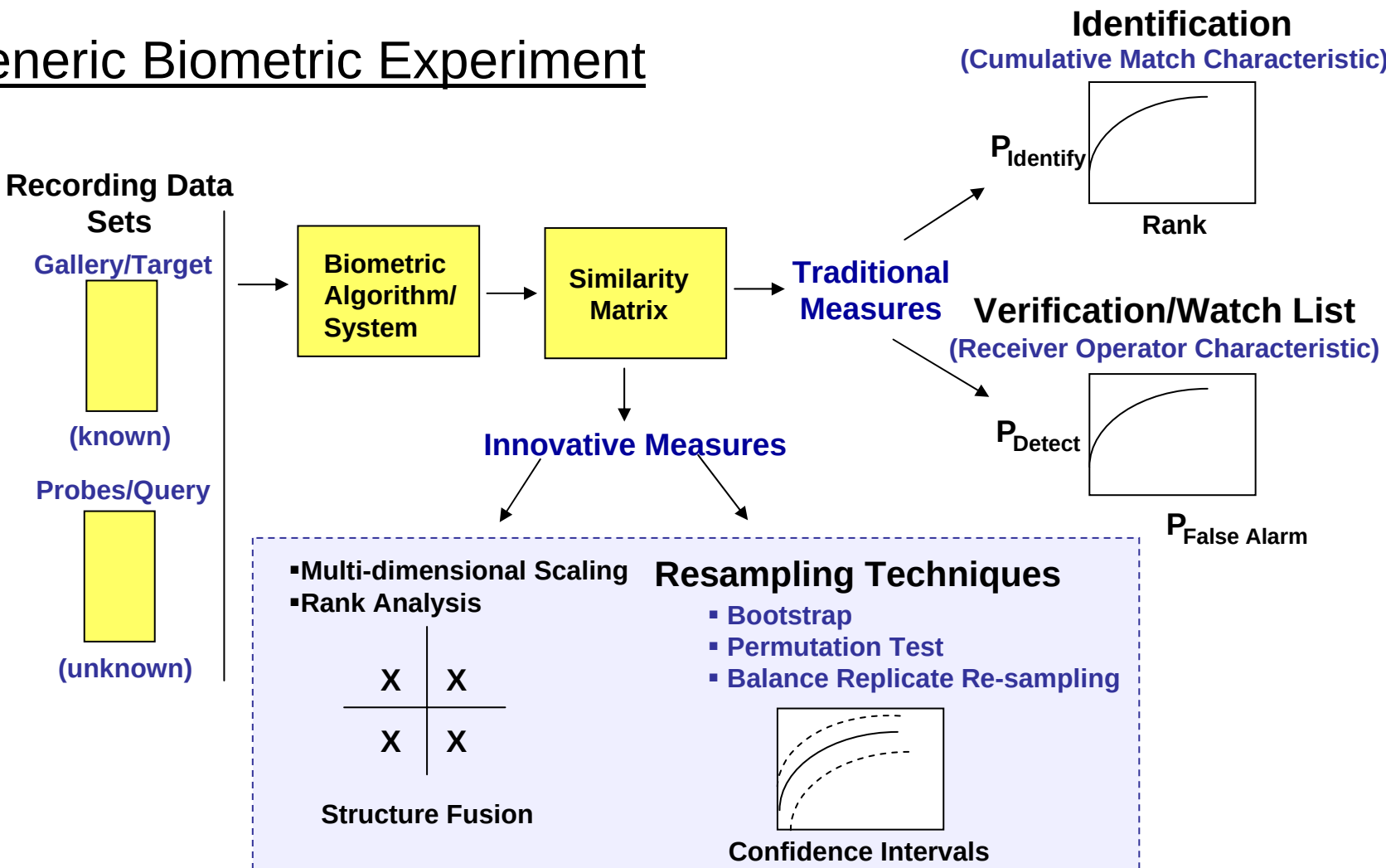


Independent Evaluations



Measuring Biometric Performance

Generic Biometric Experiment



Example

FRGC Goal and Objective



- The primary goal of the FRGC is to:

Promote and advance face recognition technology to support U.S. Government face recognition efforts

FRGC Goal and Objective



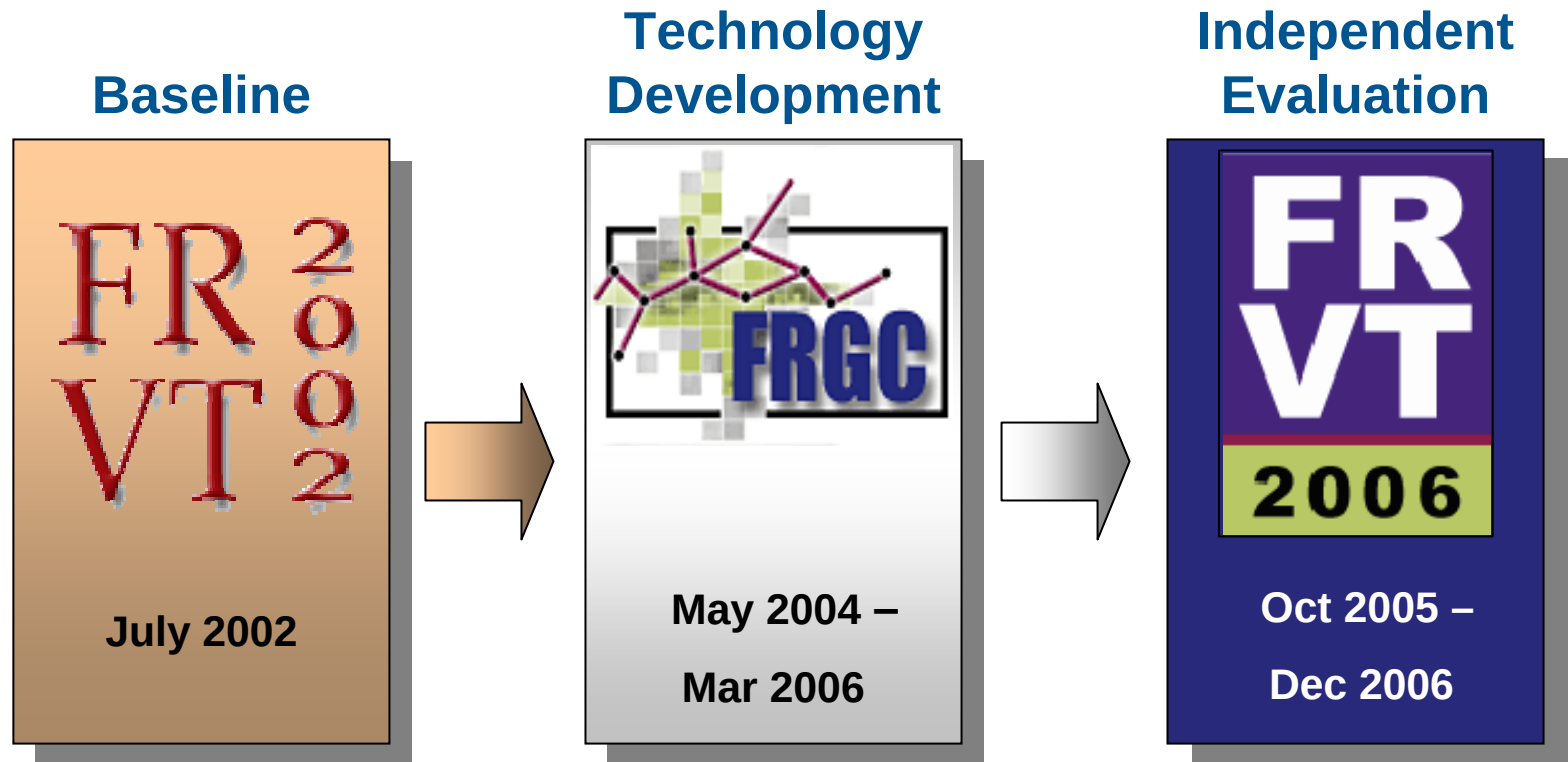
- The primary goal of the FRGC is to:

Promote and advance face recognition technology to support U.S. Government face recognition efforts

- The primary objective of the FRGC is to:

Develop still and 3D algorithms to improve performance an order of magnitude over FRVT 2002

Background



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)

FRGC Modes Examined



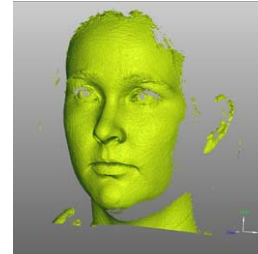
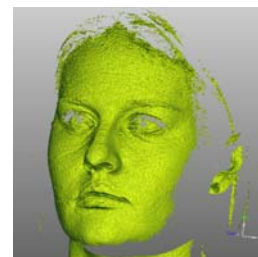
Single Still



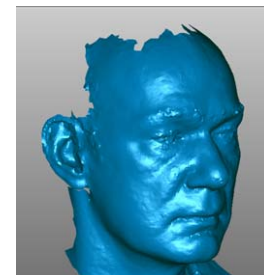
Outdoor/
Uncontrolled



Multiple Stills



3D Single
view



3D Full Face

Experiments 1, 2, 3, and 4

- **Exp 1:** Controlled indoor still versus indoor still



- **Exp 2:** Indoor multi-still versus indoor multi-still



- **Exp 3:** 3D versus 3D
 - 3t, texture channel only
 - 3s, shape channel only



+



=



- **Exp 4:** Controlled indoor still versus uncontrolled still



Size of Experiments

Exp.	Target set size	Query set size	No. Sim Scores (million)
1	16,028	16,028	257
2	4,007	4,007	16
3	4,007	4,007	16
4	16,028	8,014	128

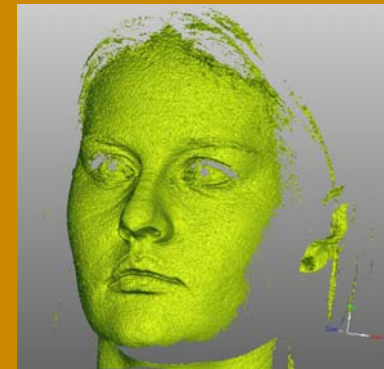
Scientific Questions

High Resolution

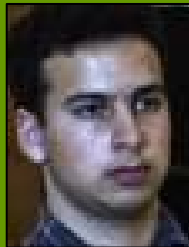


VS

3D

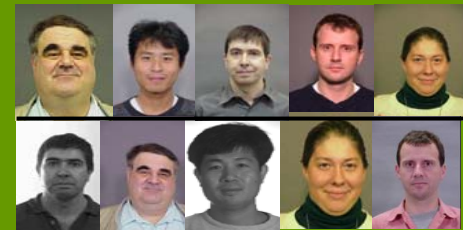


Computer Vision

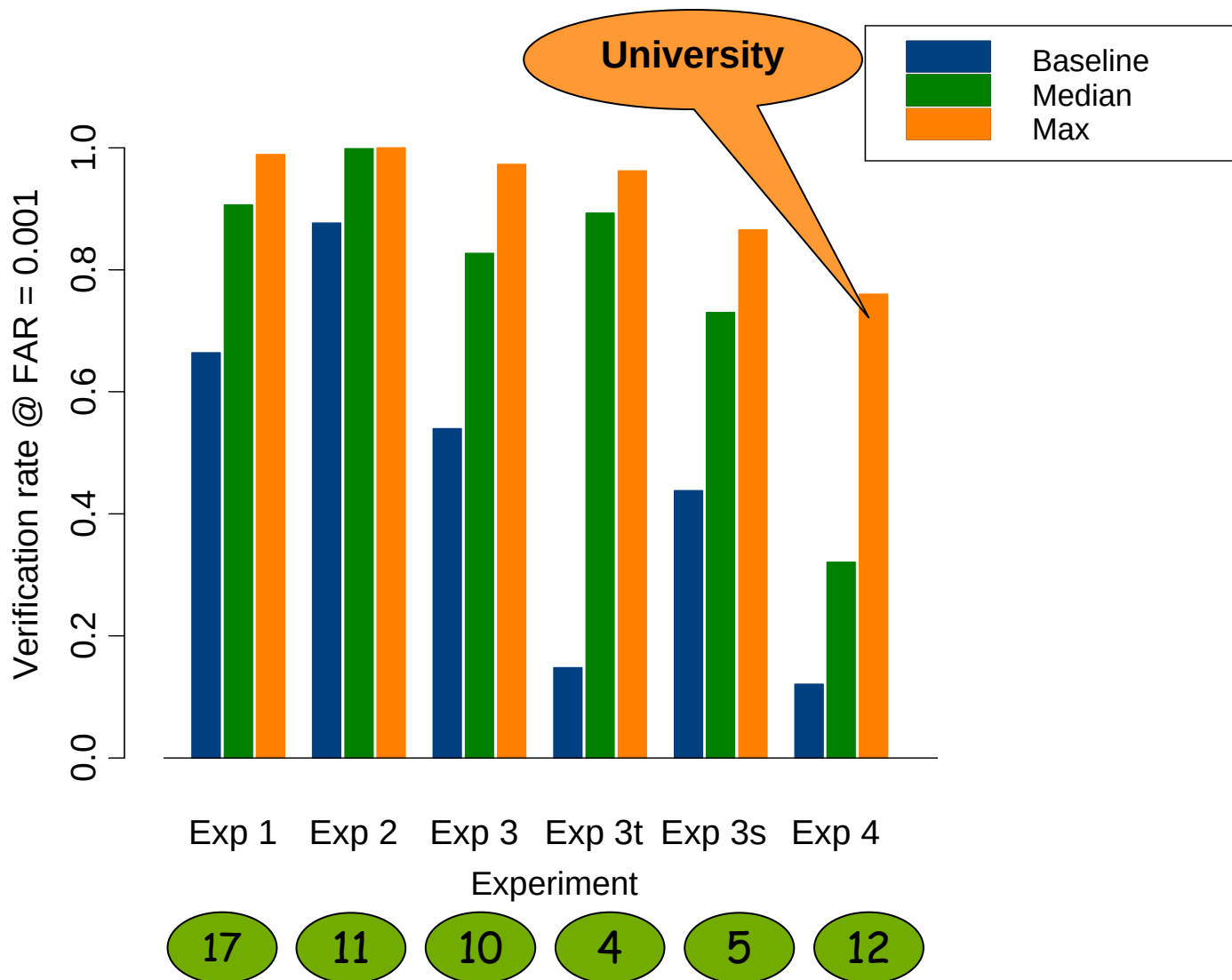


VS

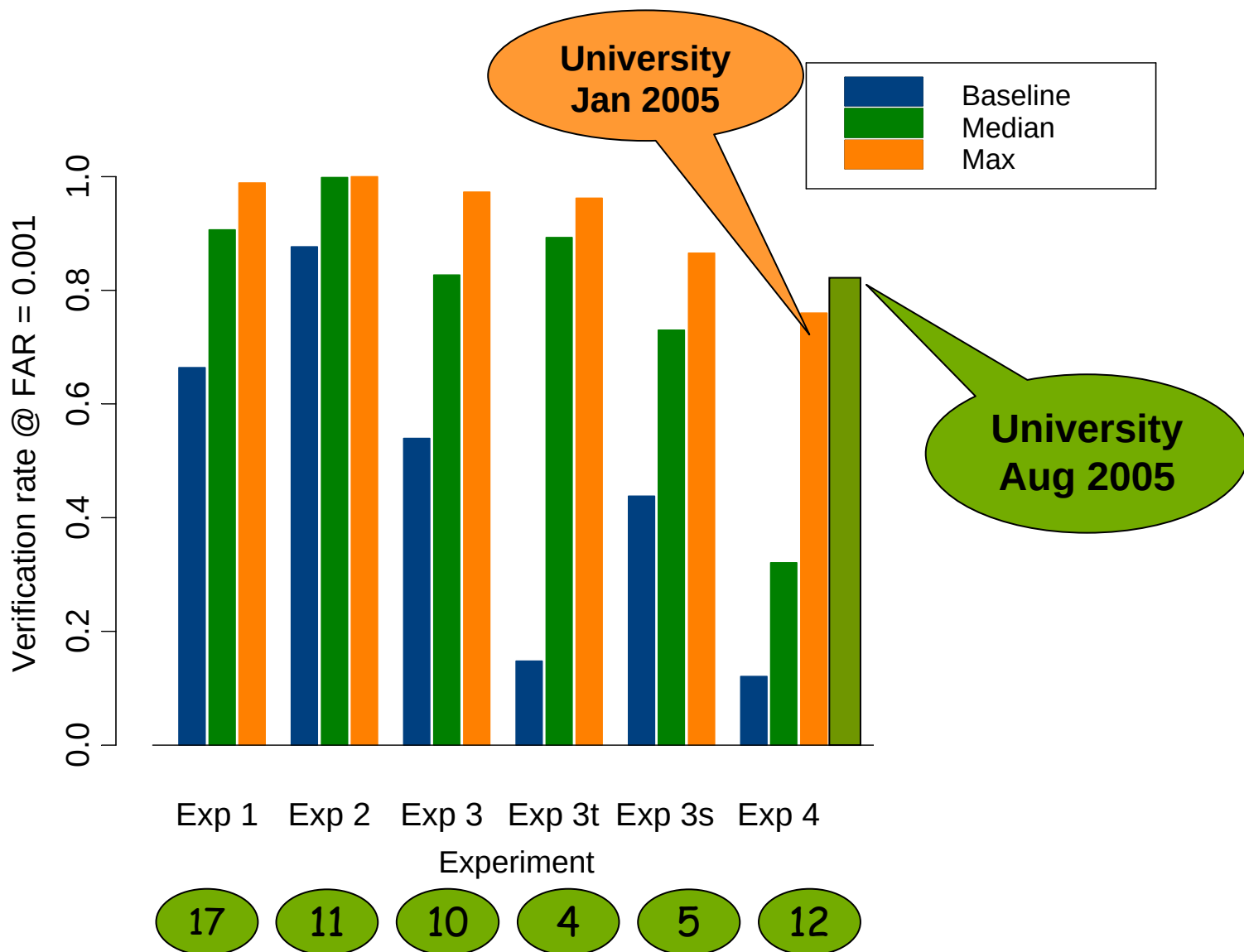
Pattern Recognition



Summary of FRGC Results – January 2005



FRGC Progress

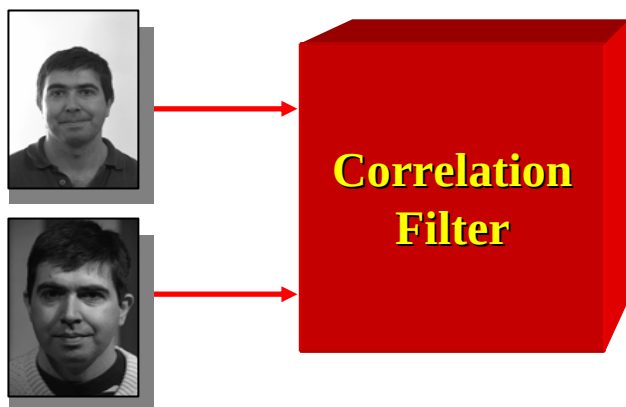


Challenge Problems and Technology Development

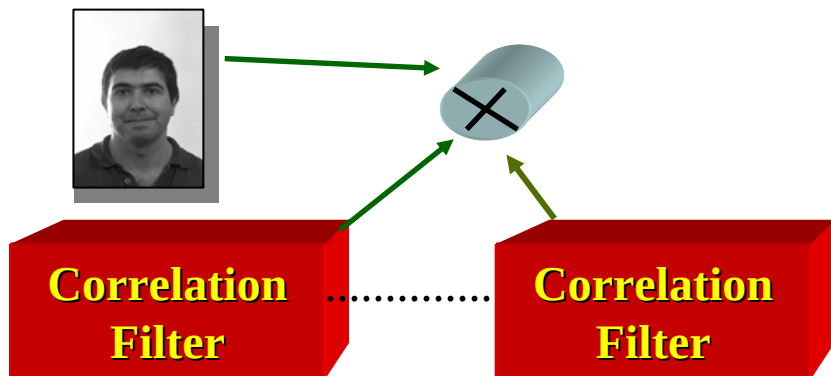
Example: Advanced Correlation Filter Method *

January 2005
MACE

Training - One Filter/Person

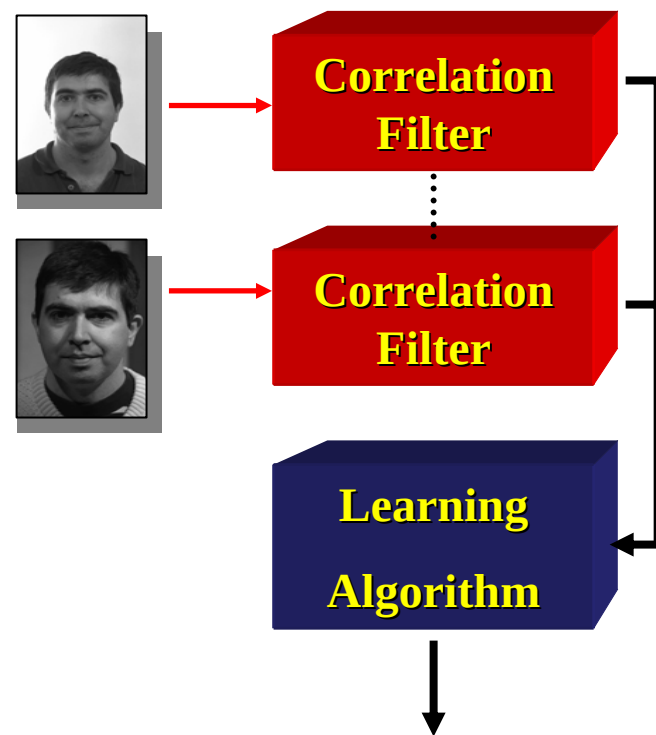


Recognition - Compare all Filters



August 2005
Keinel Correlation Filter

Offline Training



General Representation

* Xie, Savvides, Kumar 2005

Performance Goals and Progress

Independent Evaluations
(Gold Standard)

FR₀
VT₀

Starting Point 80%

Measured in
FRVT 2002

FAR = 0.1%



Performance Goals and Progress

Independent Evaluations (Gold Standard)



Goal

98%

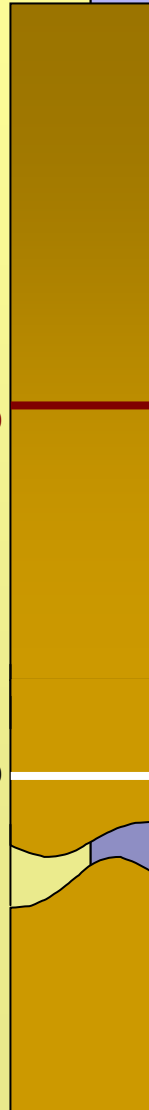
To be measured
by FRVT 2006

Starting Point 80%

FR₂₀₀₂
VT₂₀₀₂

Measured in
FRVT 2002

FAR = 0.1%



Performance Goals and Progress

Independent Evaluations (Gold Standard)



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VT₂₀₀₂

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Face Recognition Grand Challenge (Qualified Results)

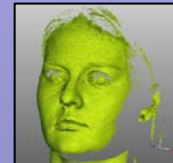
**99.99% Multi-Still
(Jan 05)**



**99% High Resolution Still
(Jan 05)**



**97% Three-Dimensional
(Jan 05)**



* First set of results after 4 months in a 12 month period

Performance Goals and Progress

Independent Evaluations (Gold Standard)



Goal 98%

To be measured
by FRVT 2006

Starting Point 80%

FR₂₀₀₂
VT₂

Measured in
FRVT 2002

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Face Recognition Grand Challenge (Qualified Results)

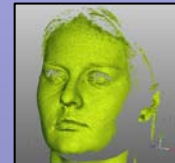
**99.99% Multi-Still
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**99% High Resolution Still
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Conclusions

Twelve Years of Progress

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 - Evaluation

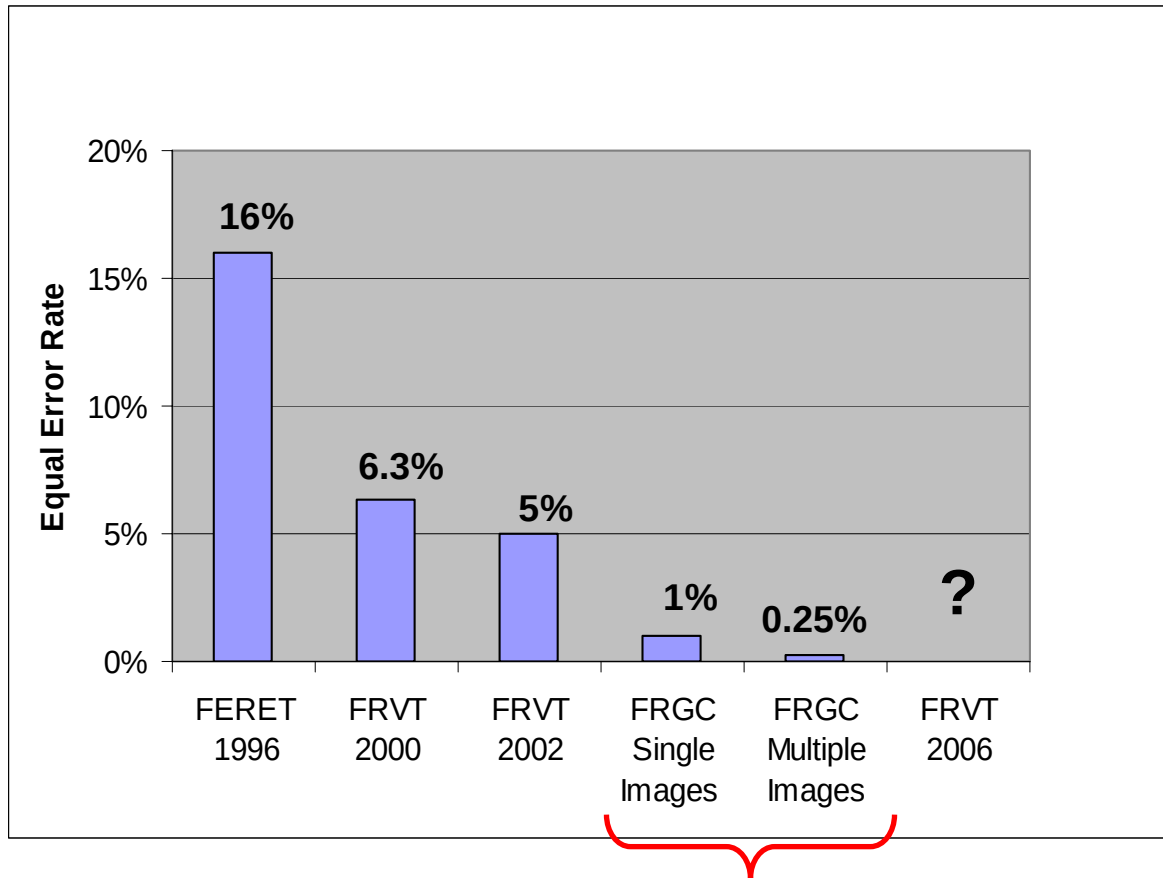
Facial Recognition
Vendor Test 2000

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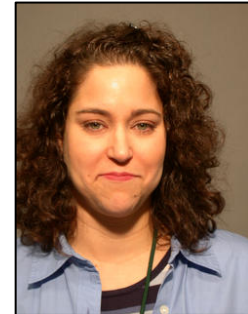


Measurement Science Leads to Innovation - Face Recognition

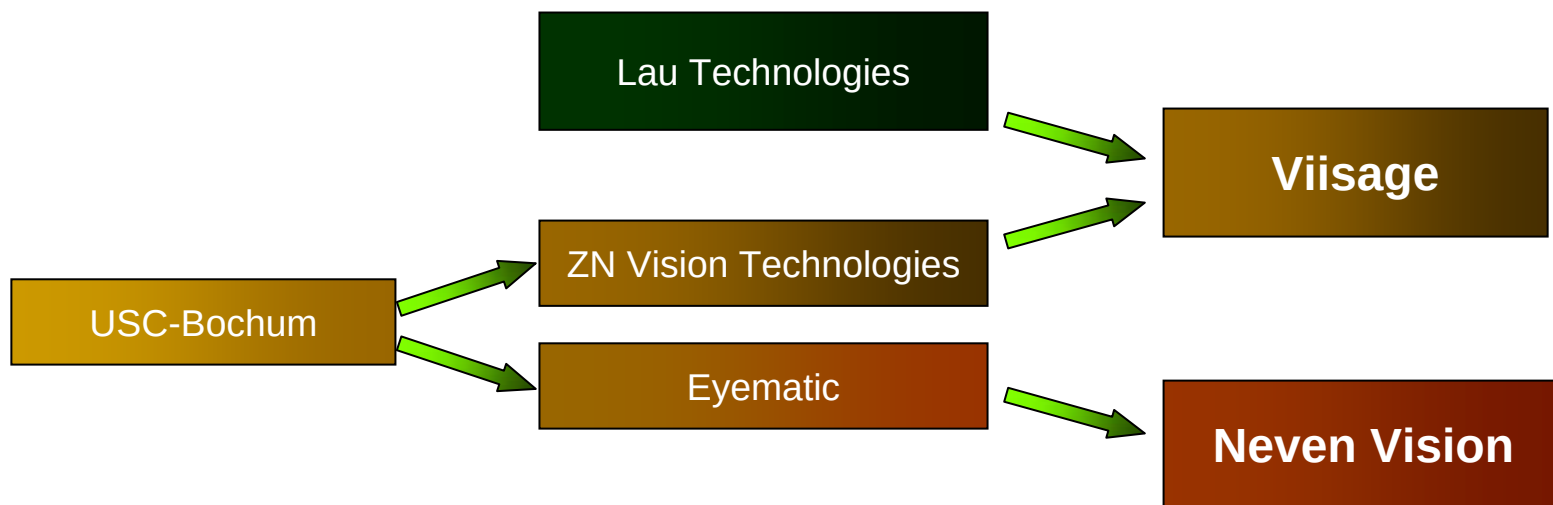
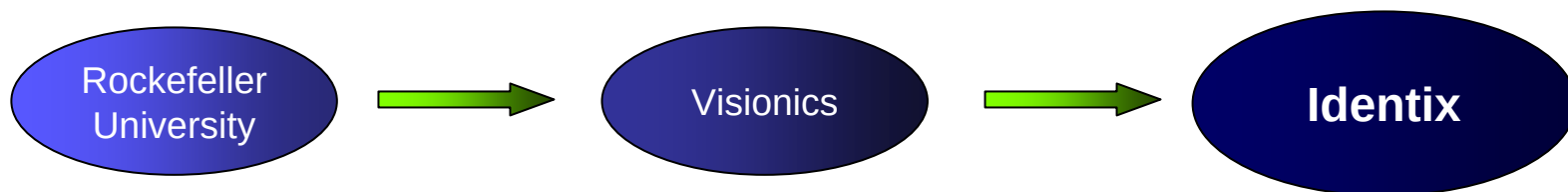
Technology Improvement 1996 - Present
Different Data Set



Qualified Jan 05



Evolution of Top Performers



Building a Challenge

- Goals—Simple and grandiose
- Setting goals—Cheat
- Competing hypothesis
- Complete infrastructure for challenge problems
- Open to all