

# Challenge Problems

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NIST

**National Institute of  
Standards and Technology**



**NIST**

*...working with industry to foster innovation, trade, security and jobs*

# Problem Definition

- Frontal Faces
- One Face Image per Person

Problem 1: Controlled Studio Environment



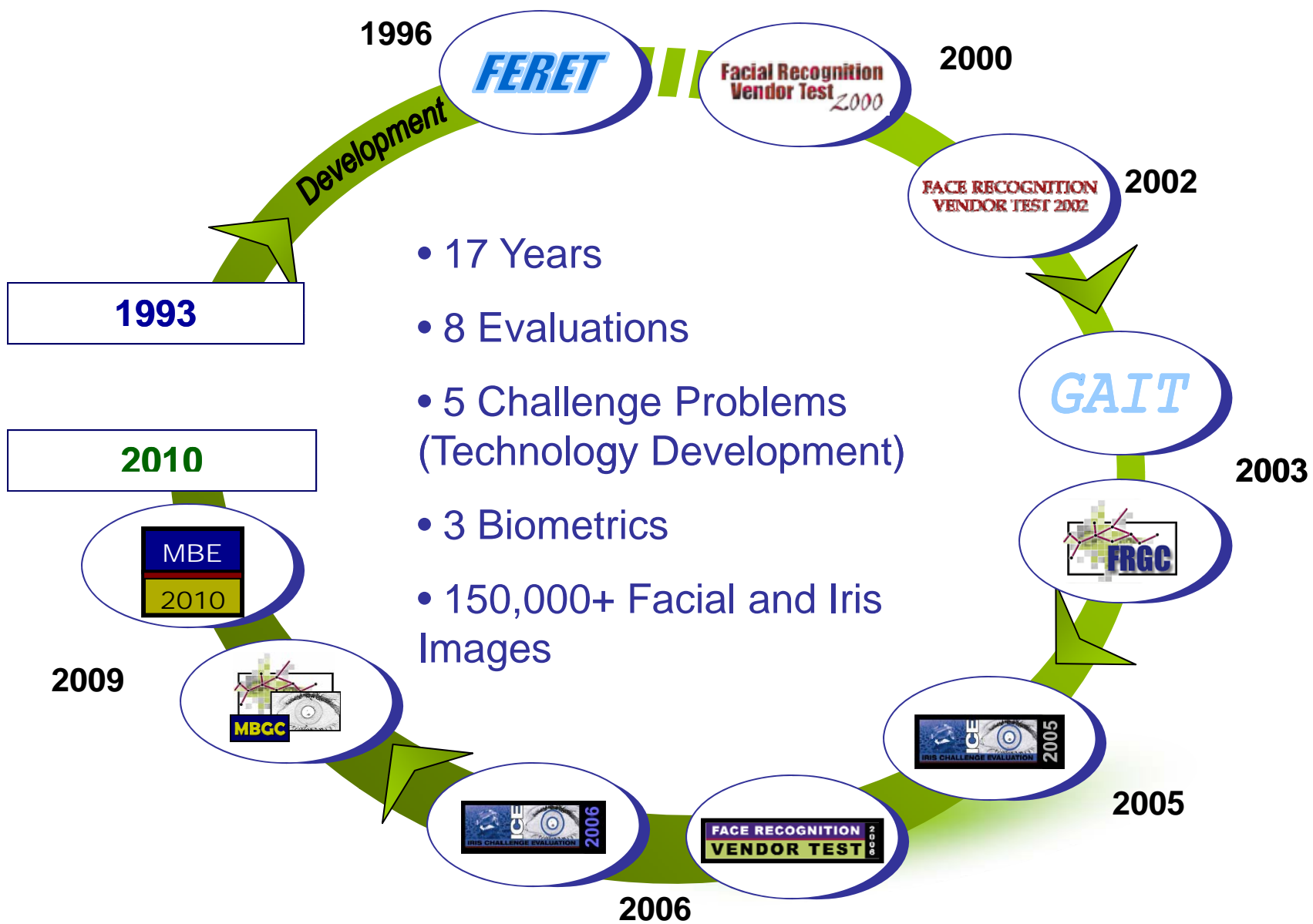
Problem 2: Studio vs. Ambient Lighting



or

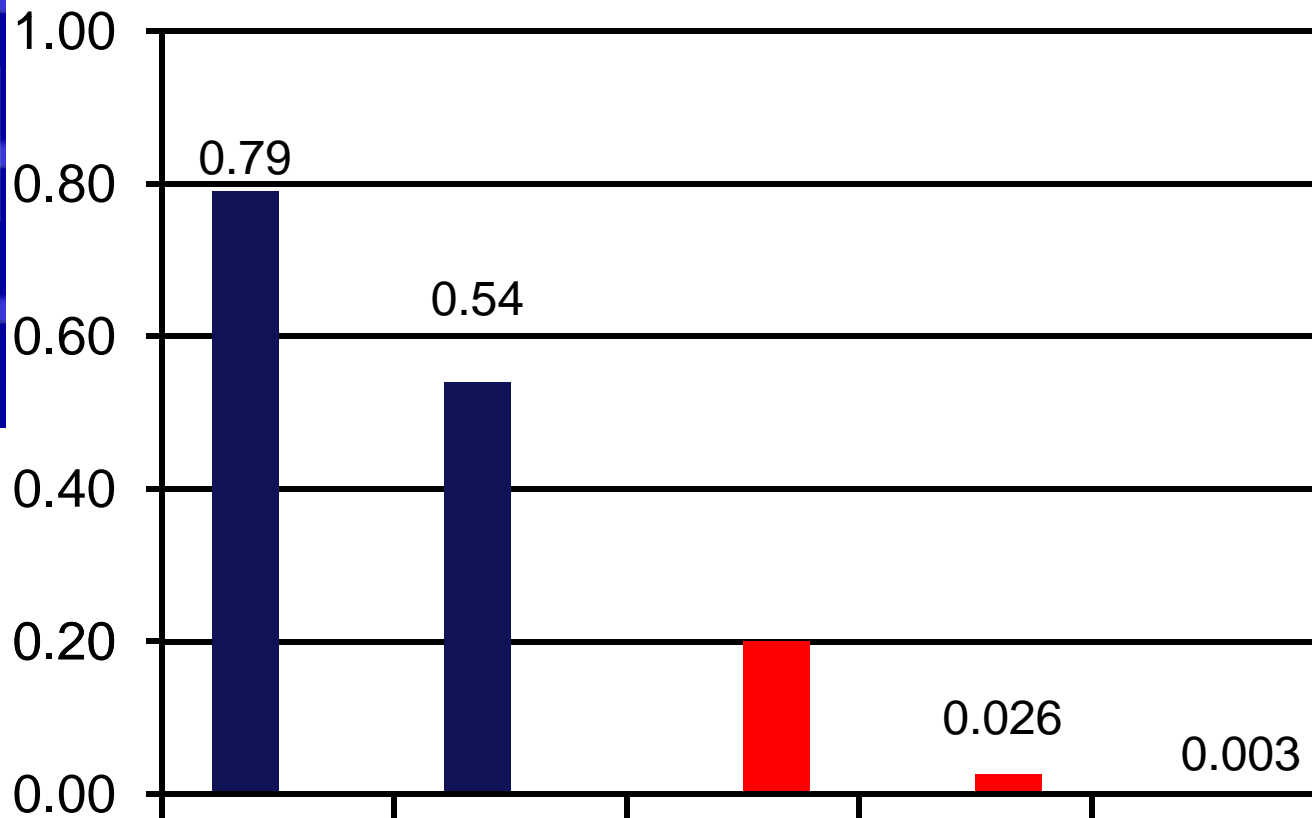


# Technology Progress

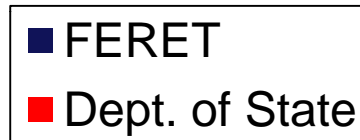


# From FERET to MBE 2010

FRR at FAR = 0.00



Data Sets



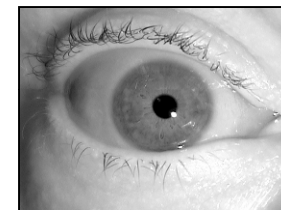
1993    1997    2002    2006    2010  
FERET    FERET    FRVT    FRVT    MBE  
(Partially Automatic)    (Fully Automatic)    (Fully Automatic)    (Fully Automatic)    (Fully Automatic)

Year of Evaluation

NIST

# Challenge Problems

- What are challenge problems?
  - A series of experiments designed to advance a technology's state-of-the-art
    - Experiments designed
    - Experiments and test data distributed to researchers
    - Researchers complete experiments and submit results
    - Scores are consolidated and reported
  - Introduction of new technology
  - Not an independent evaluation
    - NO sequestered data



# What Is An Independent Evaluation?

- Independent assessment of performance by a third party
- Algorithms submitted to tester
- Algorithms are tested on sequestered data
- Results scored by tester
- Provides snapshot of current technology state-of-the-art

# Advancing Technology and Methodology

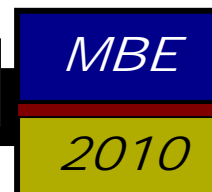
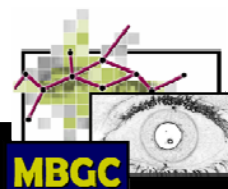
**Programatics**

Data  
Collection

Challenge  
Problems

Evaluations

**Technology**



Experimental  
Design

Statistical  
Analysis

Human  
Vs  
Computer

**Methodology**

NIST



# Methodological Progress

1994: First Modern Technology Evaluation

2001: Re-sampling Techniques



1993

FERET

1996

Facial Recognition Vendor Test 2000

2000

FACE RECOGNITION VENDOR TEST 2002

2002: First Evaluation with 100,000+ samples

2002

GAIT

2010



2003

FRGC

2004: Statistical Modeling

2010: 1 Million + face image evaluation

MBE 2010

2010

2006

FACE RECOGNITION VENDOR TEST 2006

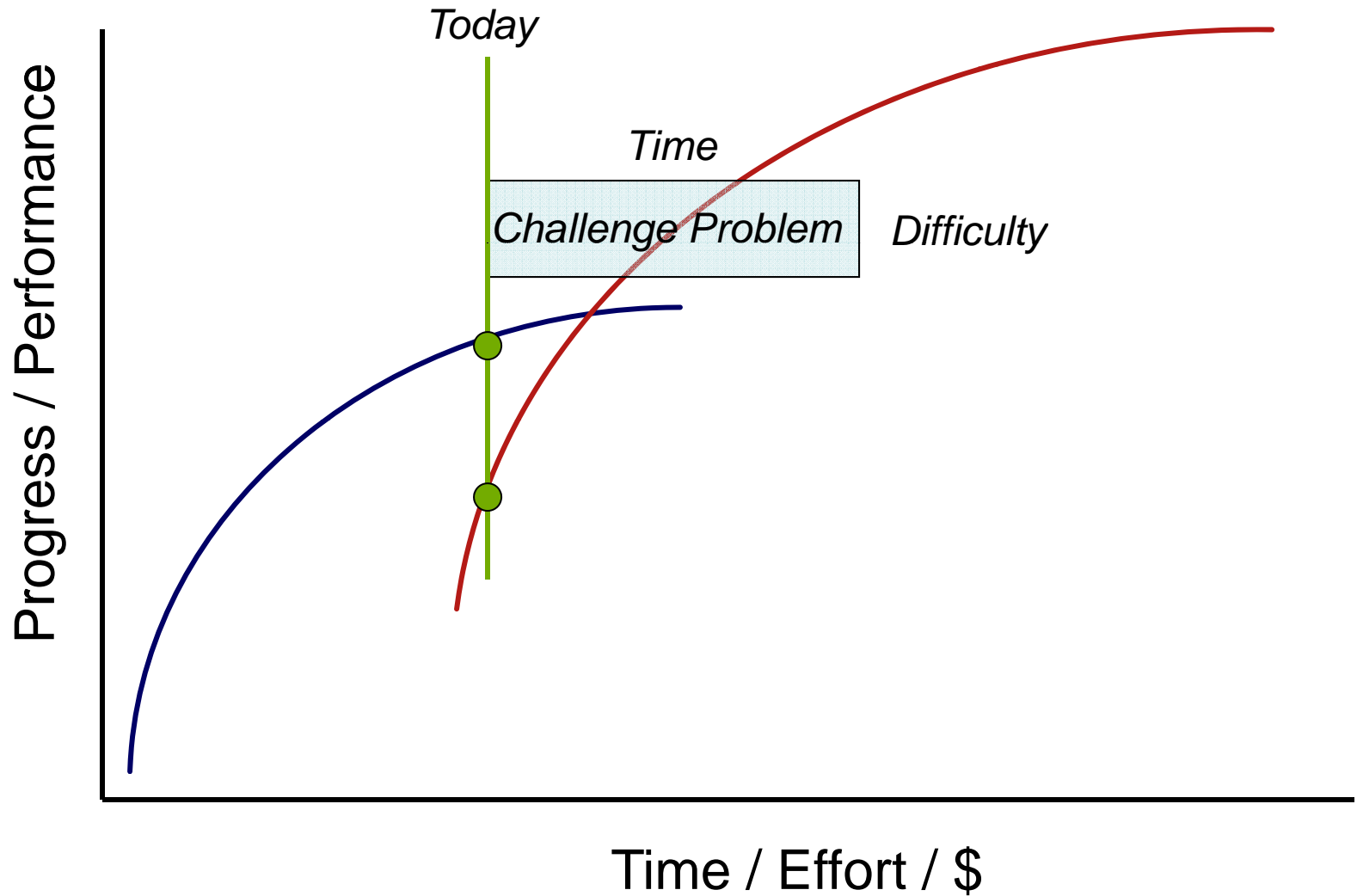
2008: Covariate Analysis of Quality

2007: Iris Meta-analysis

2004: Human & Computer Performance



# Ideal Challenge Problem

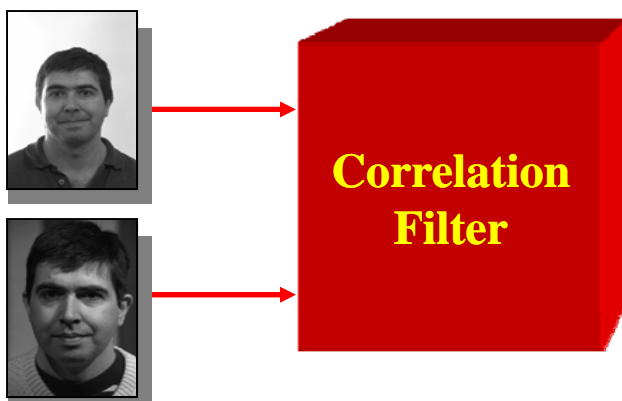


# Challenge Problems and Technology Development

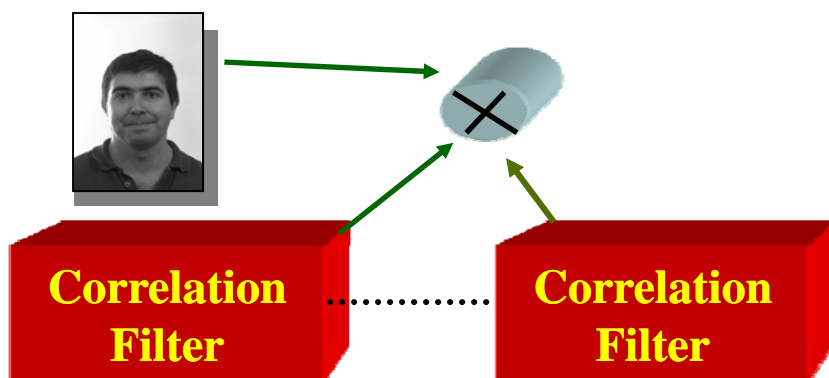
## Example: Advanced Correlation Filter Method \*

January 2005  
MACE

Training - One Filter/Person

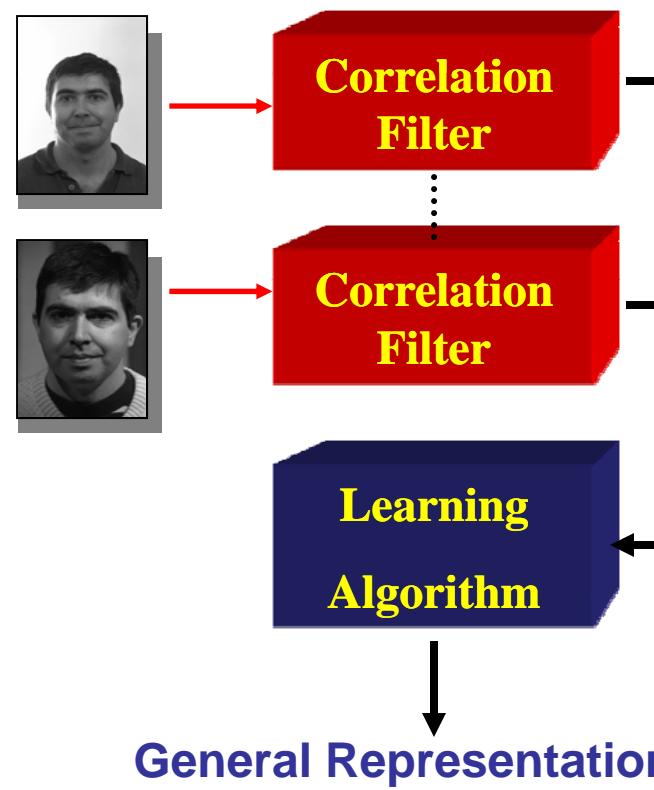


Recognition - Compare all Filters



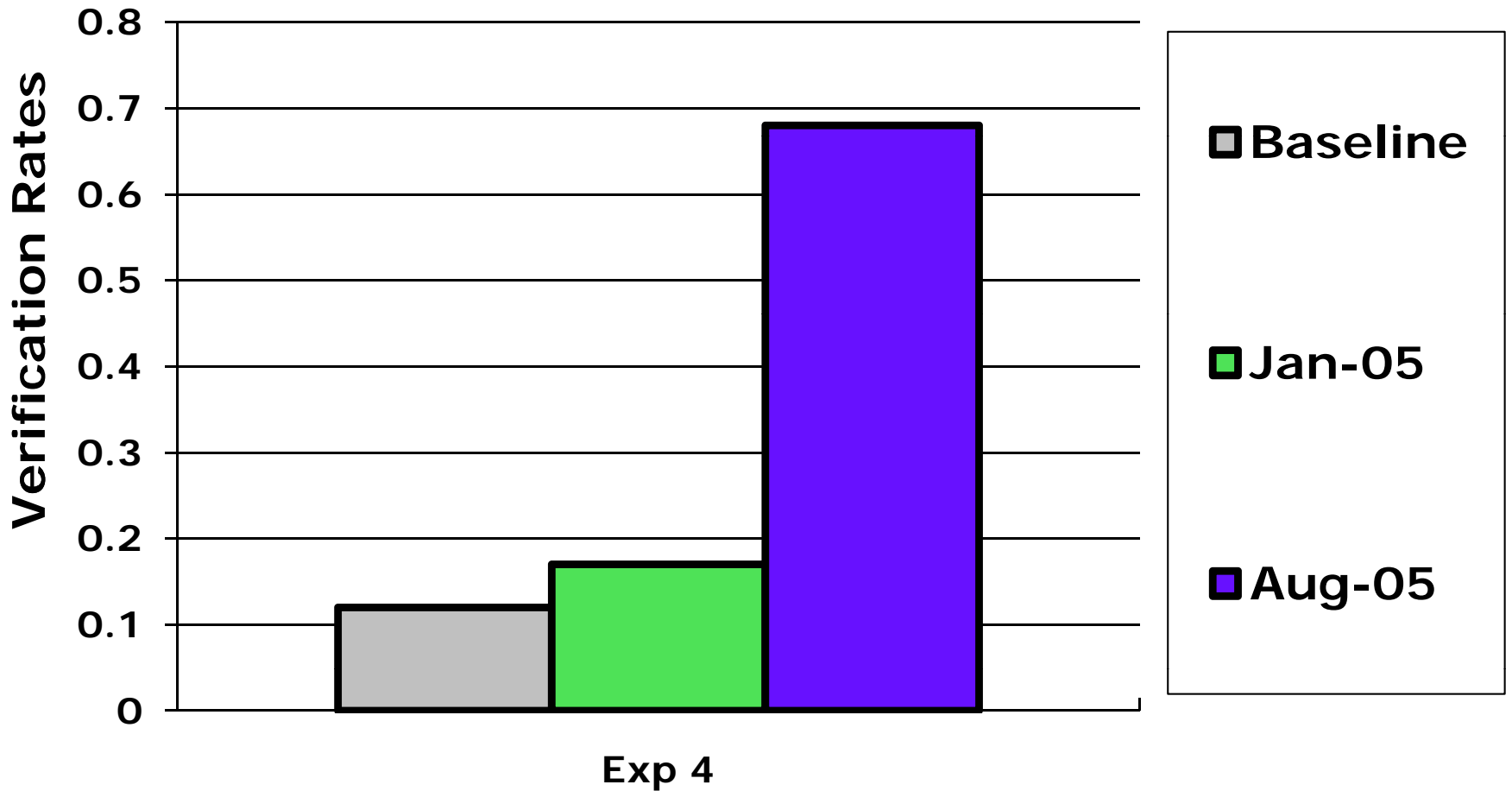
August 2005  
Kernel Correlation Filter

Offline Training



\* Xie, Savvides, Kumar 2005

# Evolution of Improvement



The logo for the National Institute of Standards and Technology (NIST) is located on the left side of the slide. It consists of a vertical yellow bar on the far left, followed by a blue bar with a white grid pattern. The letters "NIST" are written vertically in white on the blue bar.

## Building a Challenge

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

The NIST logo is located in the bottom-left corner of the slide. It consists of the letters 'NIST' in a white, sans-serif font, oriented vertically. The logo is set against a blue background with a white grid pattern. To the left of this blue area is a solid yellow vertical bar.

## Conclusion on Basic Design

- Challenge problems
  - A very powerful tool
  - **NOT** the only tool
- A well designed challenge problem
  - Advances technology
  - Good Investment
  - 10+ year life span
- Poorly designed challenge problem
  - Waste resources
  - 10+ year life span

# Summary

- Frontal Face Recognition
- Three orders of magnitude improvement
- Challenge Problems & Evaluations key components
- Development of new techniques
- Interdisciplinary Field
- Significant amount of research left
  - Face recognition from video
  - Low quality still images
  - Non-frontal stills recognition

