Using Challenge Problems To Accelerate Biometric Technology

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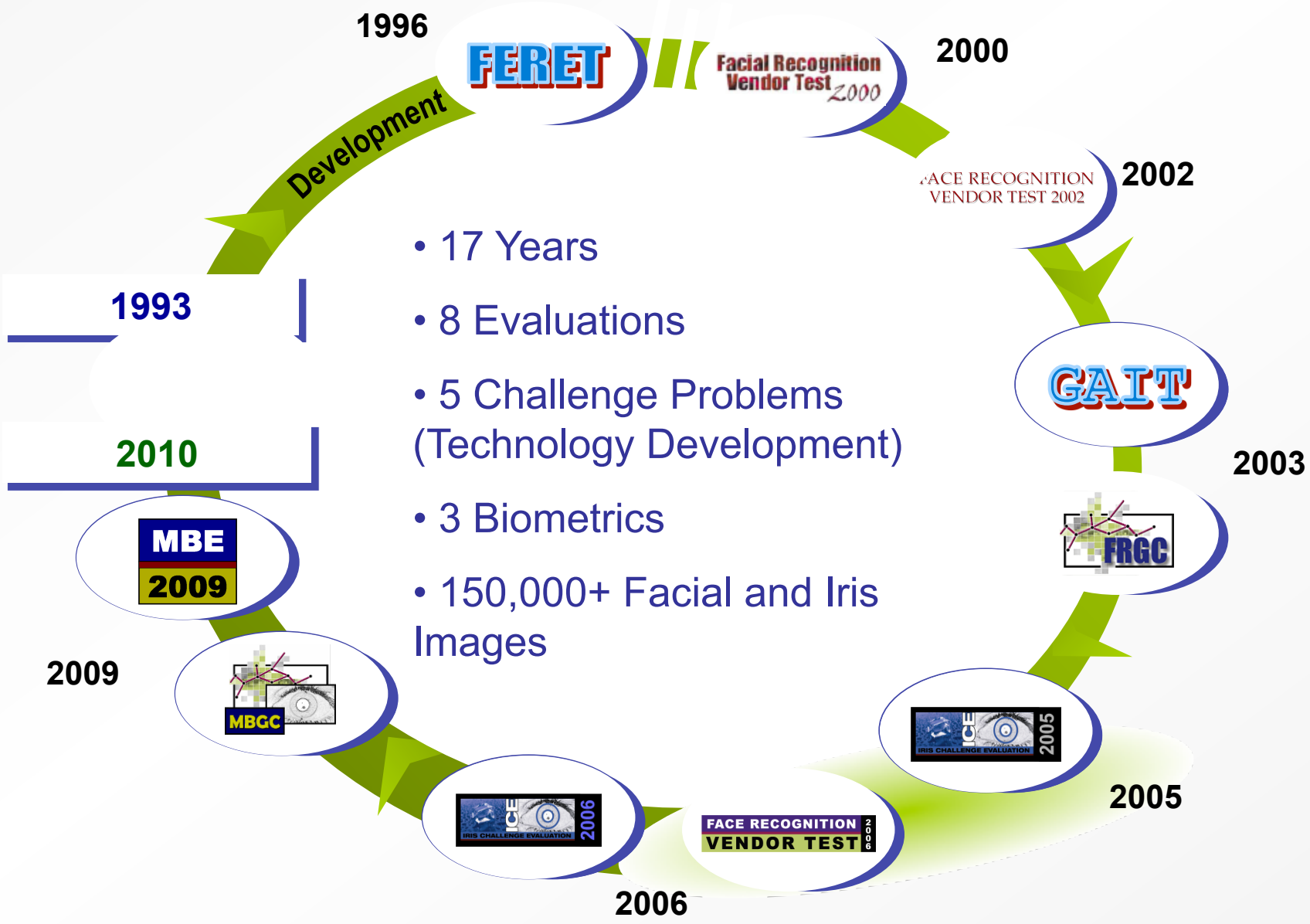
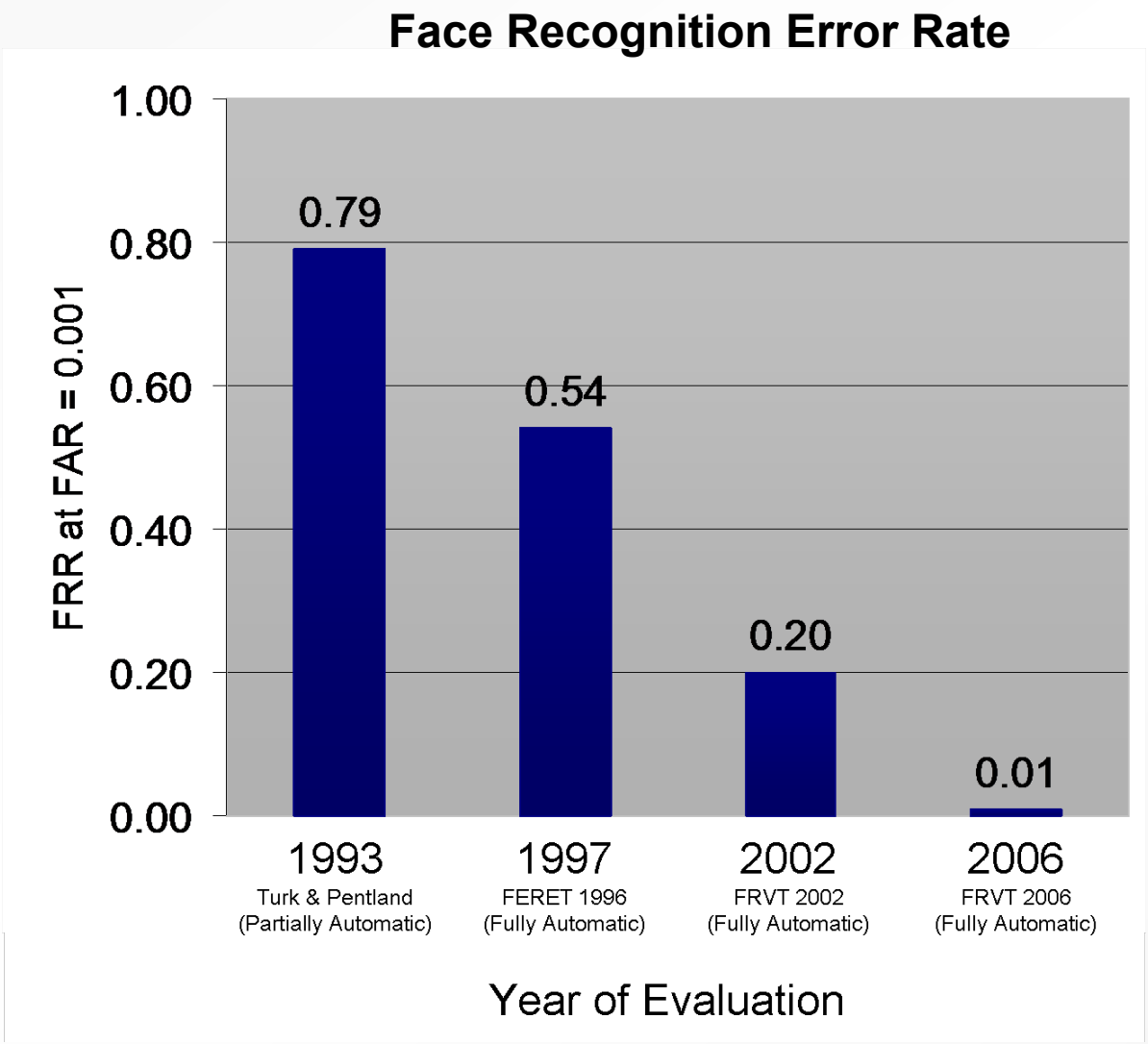
Technology Progress



Improved FR Performance

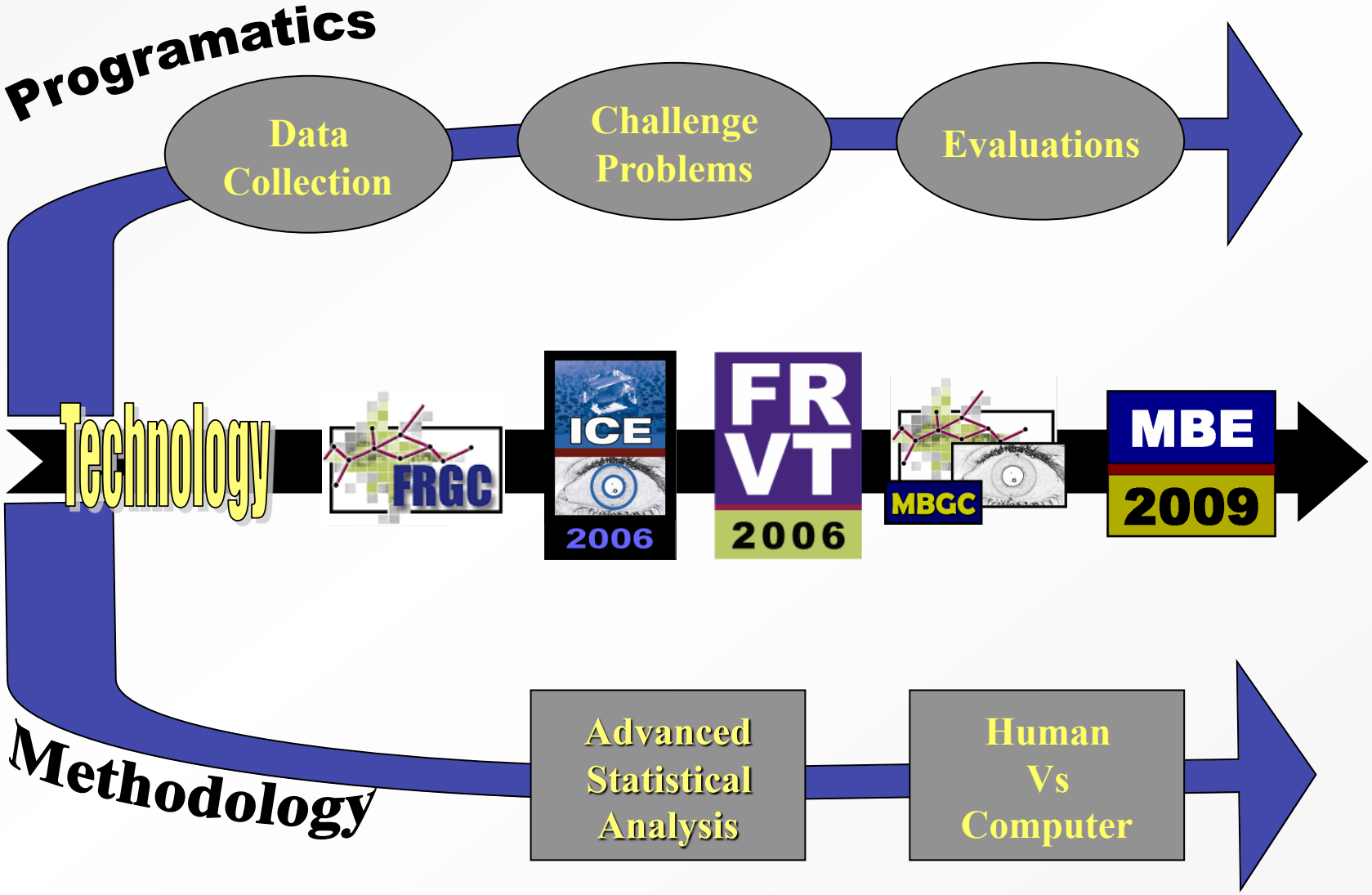


Single Still

Controlled

Different Days

Advancing Technology and Methodology



Methodological Progress

1994: First Modern Technology Evaluation

2001: Re-sampling Techniques

Development

FERET

Facial Recognition Vendor Test 2000

1996

2000

FACE RECOGNITION VENDOR TEST 2002

2002: First Evaluation with 100k+ samples

1993

2002

GAIT

2004: Statistical Modeling

2010

FRGC

2003

2009: Biometric Completeness

MBE 2009

2009

2006

ICE 2005

ICE 2006

FACE RECOGNITION VENDOR TEST 2006

2008: Covariate Focus on Quality

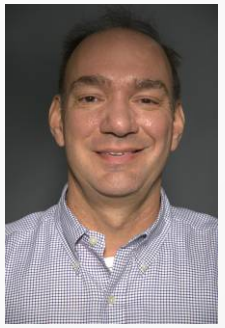
2007: Iris Meta-analysis

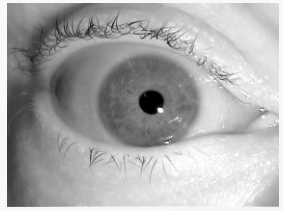
2004: Human & Computer Performance

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

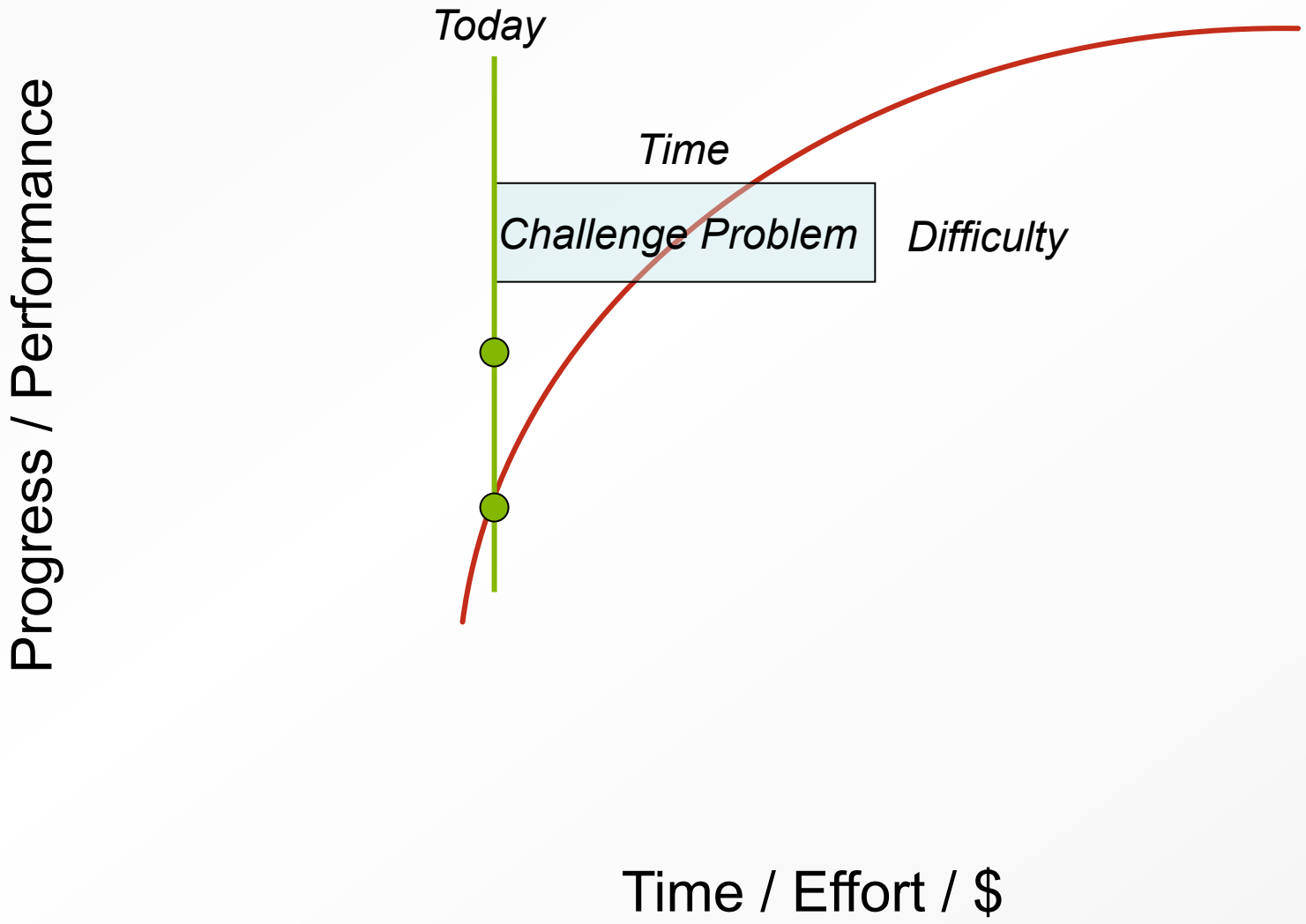




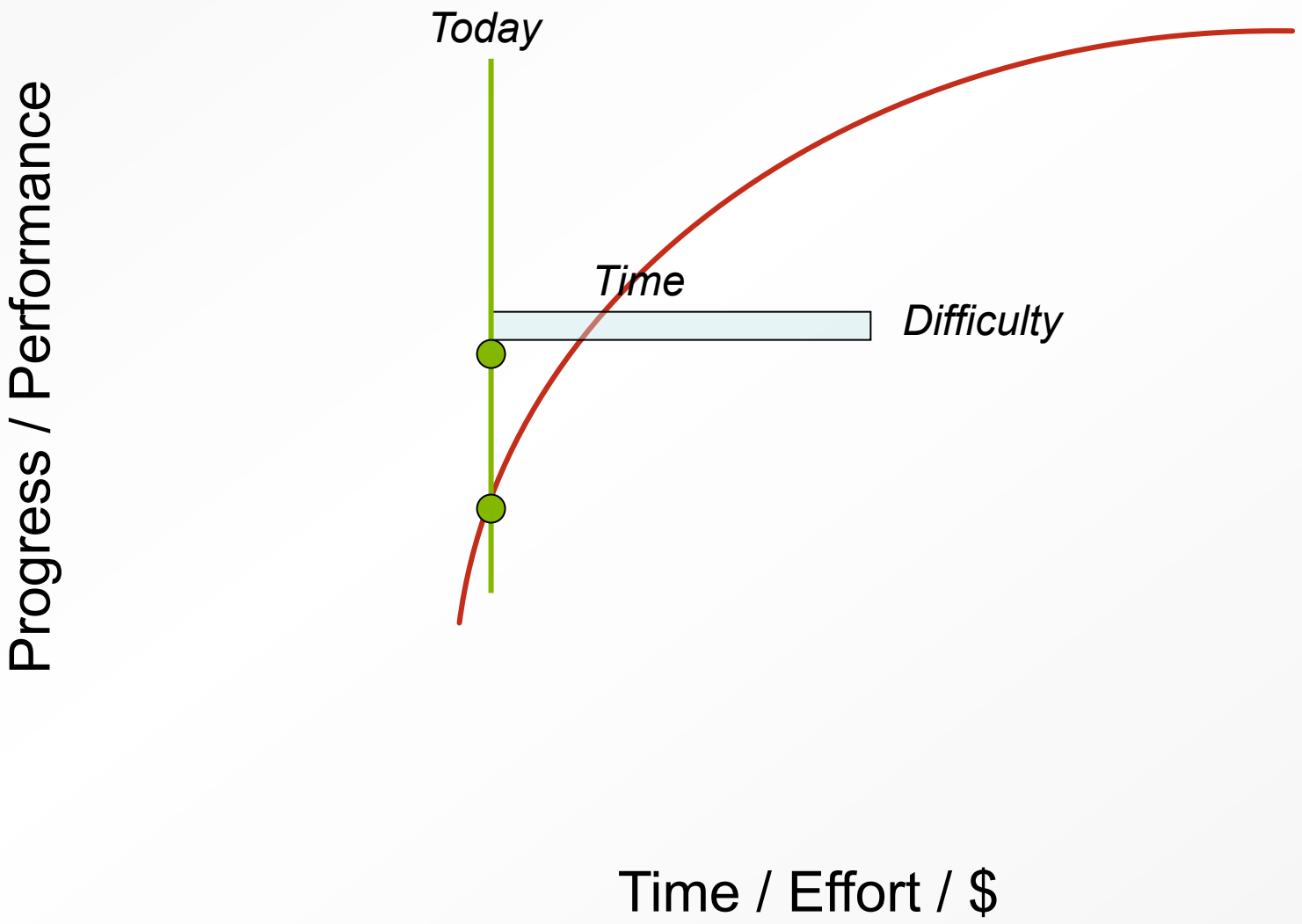
What Is A Challenge Problem?

- Challenge Problem
  - Open book
- Components—made available to participants
  - Data sets
  - Experiments
  - Ground truth
  - Baseline algorithm
- Similarity Matrices Submitted
  - Generated by participants
  - Scored by NIST
- NOT an independent Evaluation
  - NO sequestered data

Ideal Challenge Problem



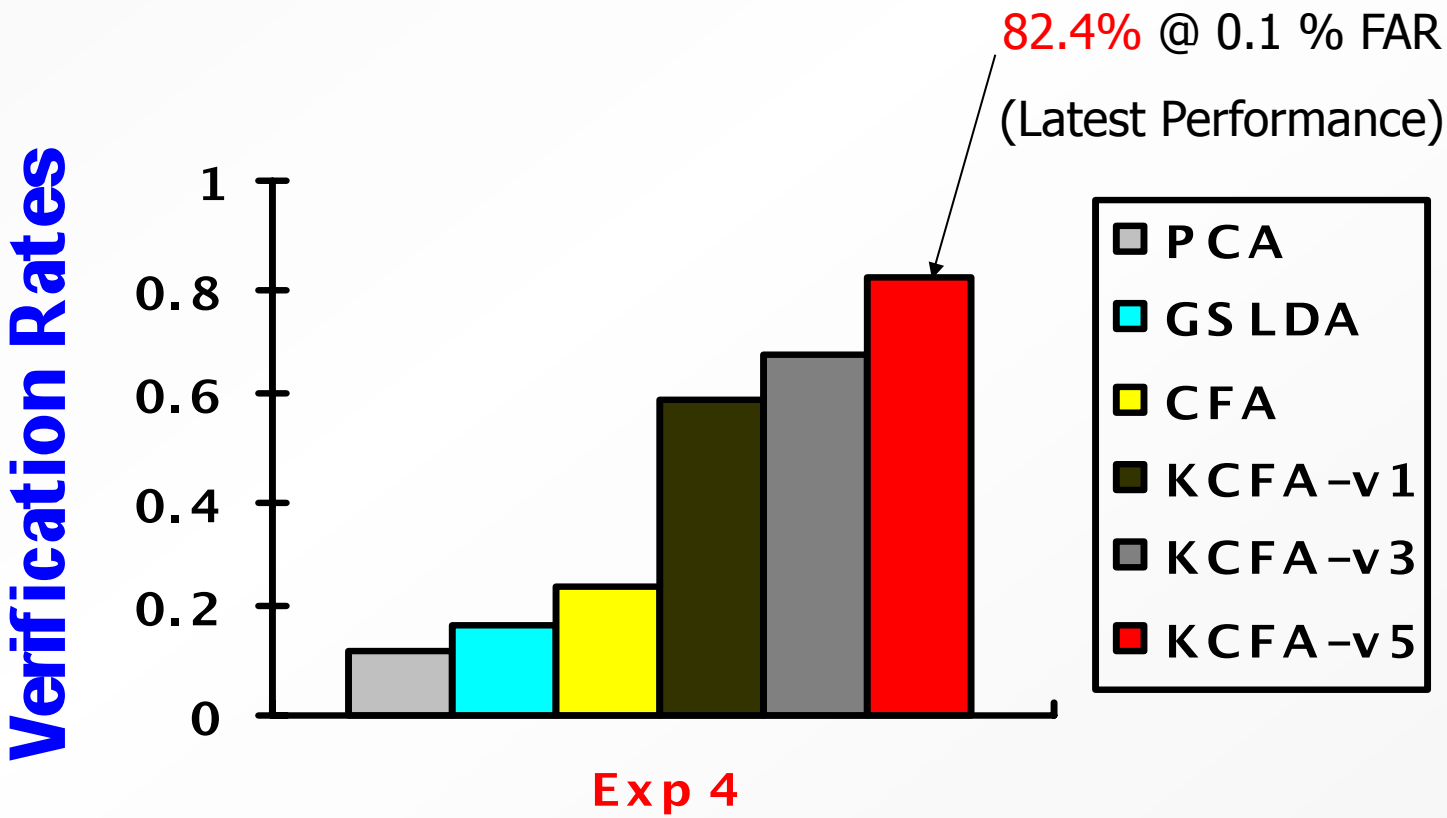
Challenge Problem Sin: Too Easy



Challenge Problem Sin: Too Little Time

Evidence of Progress through FRGC

Carnegie Mellon Innovation



Building a Challenge

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

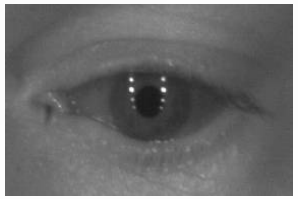
Expanding Technology

What Does Expanding Technology Do For You?

- Development of new or improved technology
- Focus research on challenge problem
- Large community working on problem
- Solutions from novel approaches

Portal Recognition Cont.

120 pixels
across iris



2k

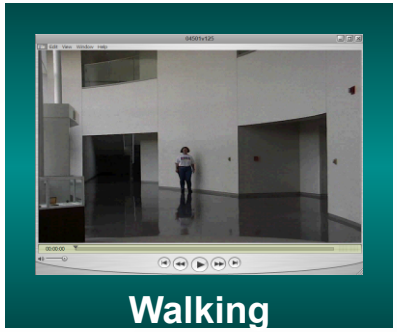
Near Infrared (NIR) Video Sequence

High Definition (HD) Video Sequence

Example of Expanding Technology: Recognition from Unconstrained Video

- Still versus Video

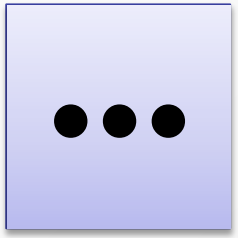
- Video versus Video



Expanding Science

What Does Expanding Science Do For You?

- Increases fundamental knowledge of biometric modalities.
- Human and computer performance
- Covariate analysis
- Analysis of results on large data set
- Underlying properties of a biometric

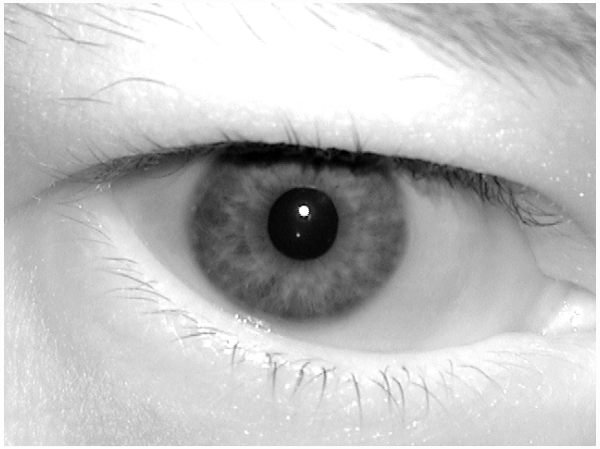


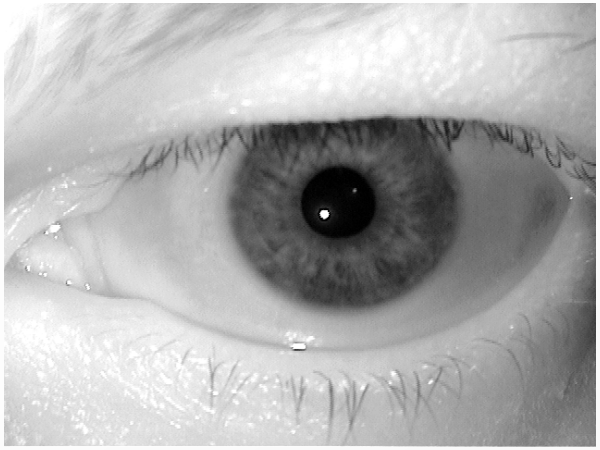
Example of Expanding Science: Iris Biometric Stability

"Empirical Evidence for Iris Match Score Degradation with Time Lapse in ICE 2006" S. Baker, P. J. Flynn, K. W. Bowyer, and Dr. P. Jonathon Phillips, *NISTIR 7630,* 2009

Motivation

- **Iris biometrics assumption: The iris is stable throughout one's life. Is this claim accurate?**





Introduction

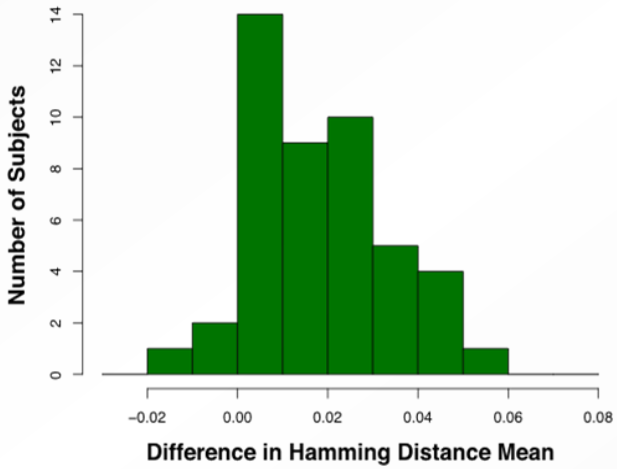
- 23 subjects
  - 46 irises
  - Collected 2004 through 2008.
- Three iris recognition algorithms
  - IrisBee baseline algorithm
  - ICE 2006 Algorithm B
  - VeriEye

Experiment

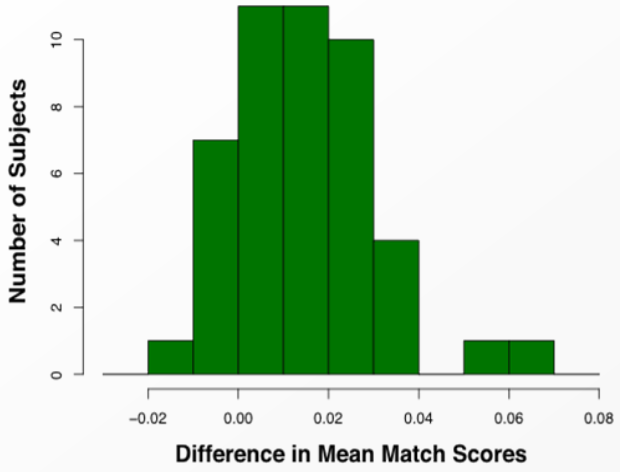
- Computed match (genuine) scores
  - for images acquired less than 120 days apart (short-time-lapse).
  - for images acquired more than 1200 days apart (long-time-lapse).
- Compared short-time-lapse and long-time-lapse
  - Mean of match score distribution
  - Median of match score distribution

Results

- **IrisBee** Algorithm
  - **43 of 46** irises showed degradation, p-value = 2.311×10^{-10}
  - mean match score
- **ICE 2006** Cambridge Cam-2 Algorithm
  - **38 of 46** irises showed degradation, p-value = 9.2477×10^{-6}
- **VeriEye** Algorithm
  - **40 of 46** irises showed degradation, p-value = 3.103×10^{-7}



IrisBee



ICE 2006 Cam-2

Iris Stability

- First study
  - One sensor
  - Limited subjects
- Recommend further studies
- Template aging as observed in other biometrics
- Multi-lab criteria

Conclusions

- Biometric technology has experienced significant progress over the last 15 years.
- Challenge Problems are Key for advancing the ‘State of the Art’.
- Science is Key to advancing Technology.

Questions?

Example of Expanding Technology: Portal Recognition

High Definition (HD) Video Camera

Near Infrared (NIR) Video Cameras