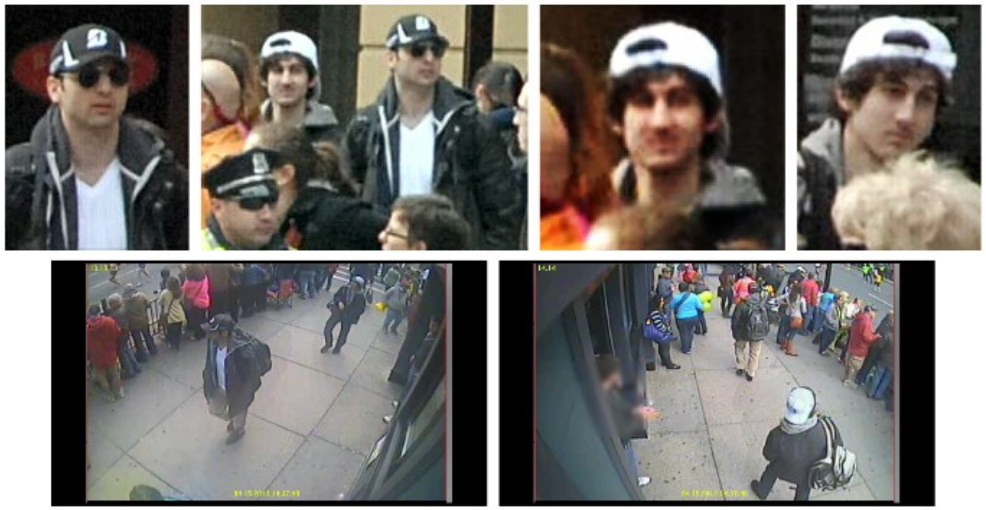
Massachusetts
Institute of
Technology

Subtasks of Unconstrained Face Recognition

Leibo*, Liao*, and Poggio

* = equal contribution



The Boston Marathon Bombings – Investigation Timeline

April 15th 2:49 p.m. Explosions near Boston Marathon finish line.

April 18th 5:00 p.m. Two suspects revealed.

April 18th 10:48 p.m. Manhunt begins after shooting and carjacking.

April 19th 6:45 a.m. Suspects positively identified.

April 19th 8:42 p.m. Dzhokhar Tsarnaev captured.

Opportunity for Facial Recognition

(Klontz & Jain 2013)

Unconstrained face recognition

Unconstrained face recognition

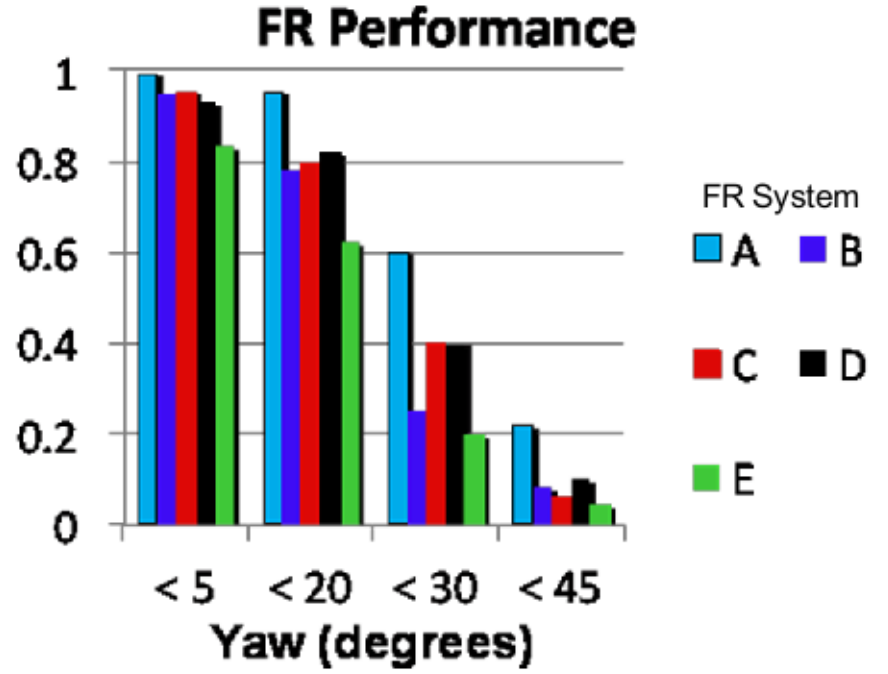
OFFICE OF THE DIRECTOR OF NATIONAL INTELLIGENCE

LEADING INTELLIGENCE INTEGRATION

Janus Program Concept

Advance the state-of-the-art in face recognition from using mugshots to working with operationally relevant image sources (i.e., media in the wild) using model-based recognition

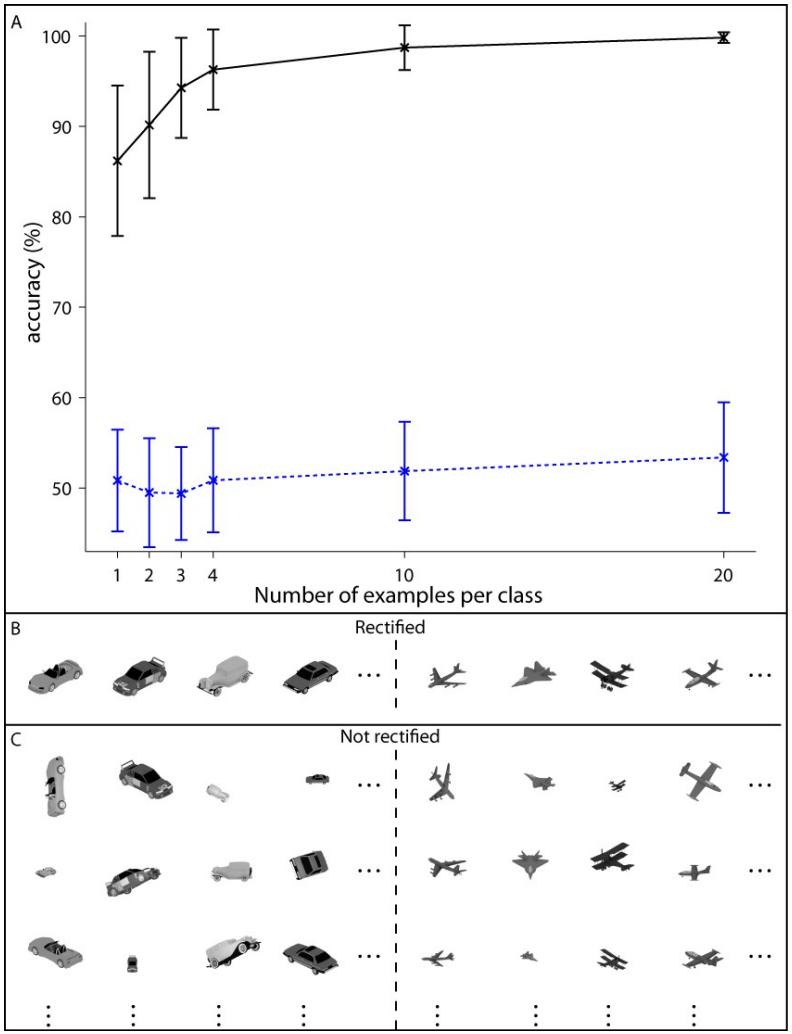
Unconstrained face recognition



Negative impact on performance (higher better) when changing just a single factor (yaw)
-- NIST Multiple Biometric Evaluation 2010

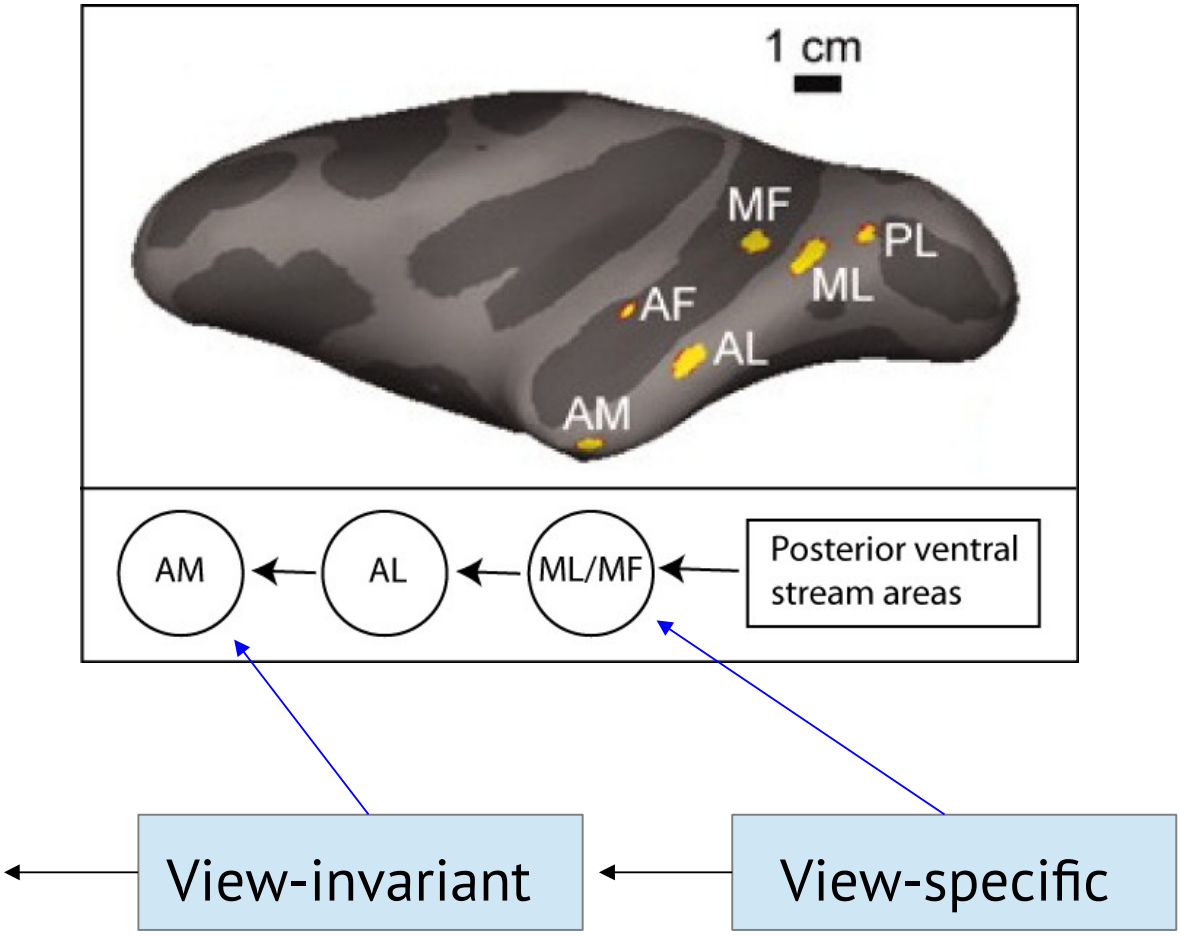
"Factors such as aging, pose, illumination, and expression (A-PIE) can not only decrease performance, they can cause its catastrophic failure"
- (IARPA JANUS announcement)

Transformations



(Anselmi et al. 2013)

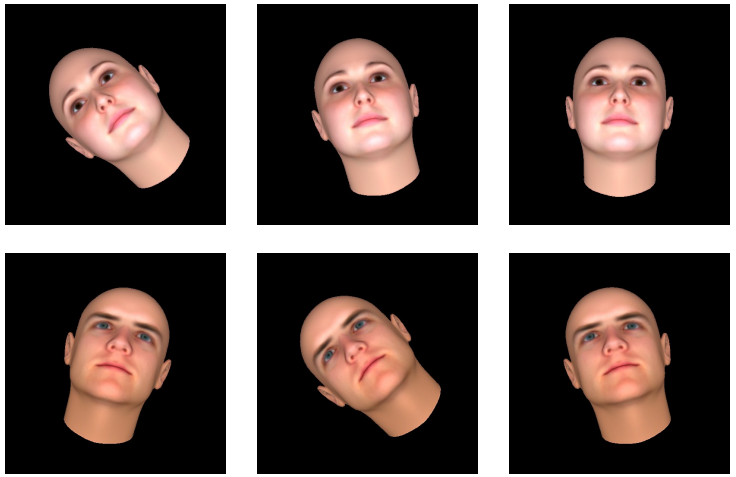
Transformations



(Freiwald & Tsao 2010)

Subtasks of unconstrained face recognition

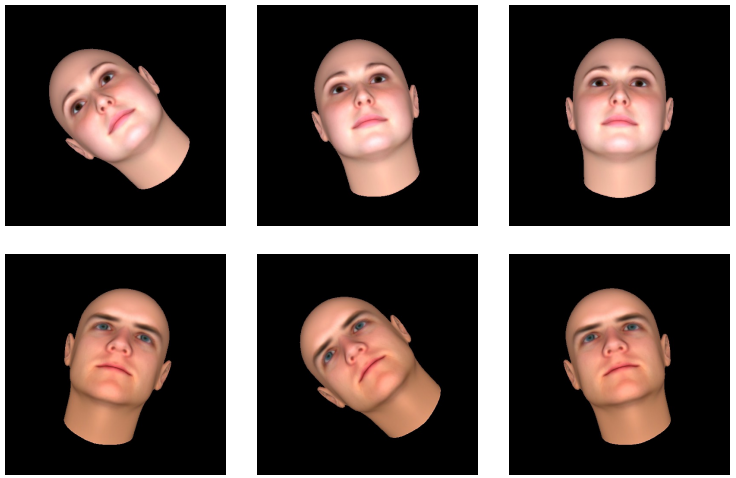
A collection of synthetic datasets constituting a partial decomposition of the unconstrained problem into subtasks



Subtasks of unconstrained face recognition

A collection of synthetic datasets constituting a partial decomposition of the unconstrained problem into subtasks

- 400 faces
- All rendered under specific transformation conditions for each “subtask”
- Same-different tasks (like Labeled Faces in the Wild).



Subtasks of unconstrained face recognition

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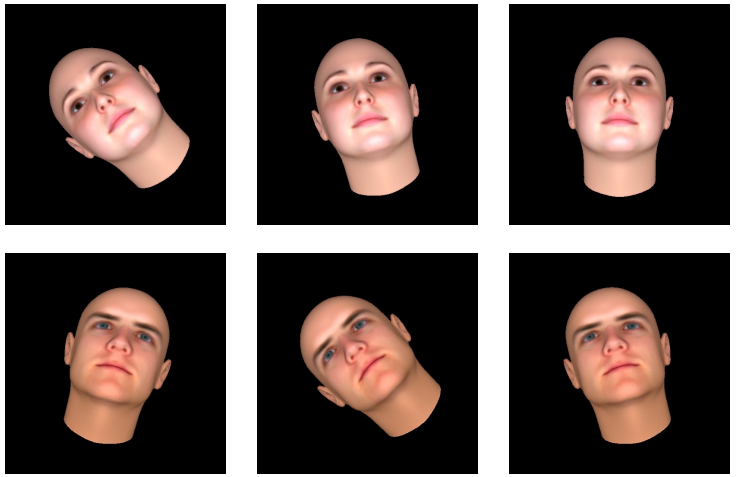
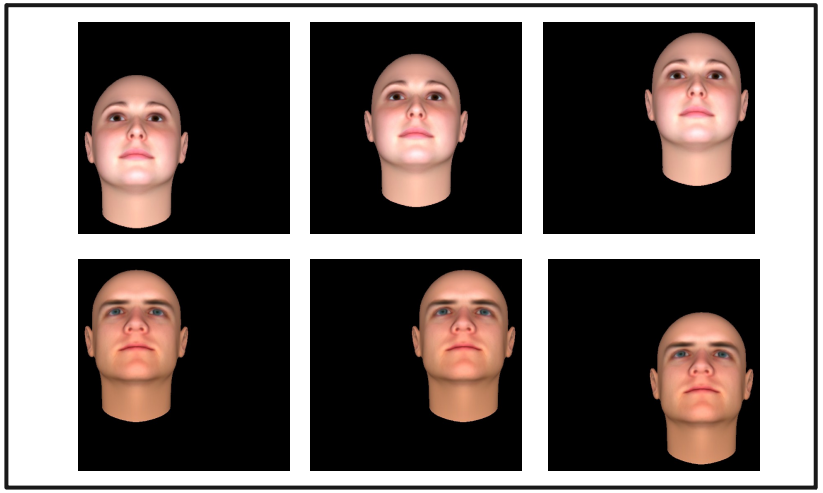
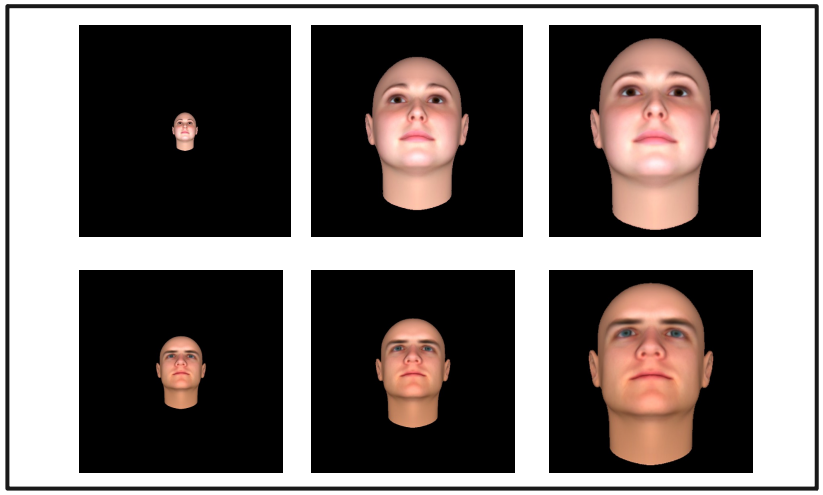
Unit tests for unconstrained face recognition



Affine subtasks

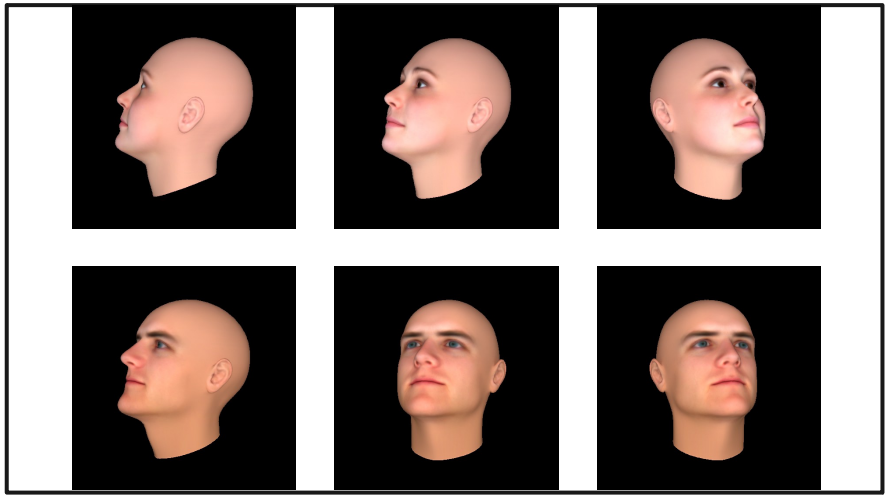
- Translation
- Scaling
- In-plane rotation

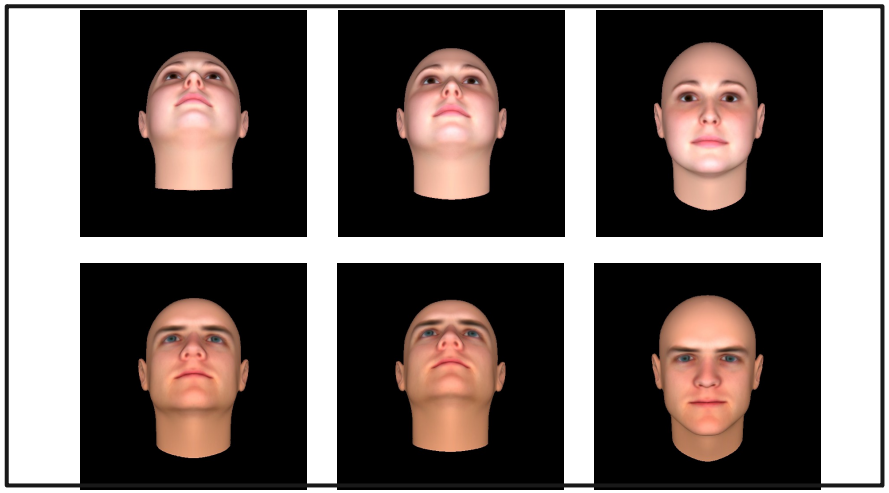


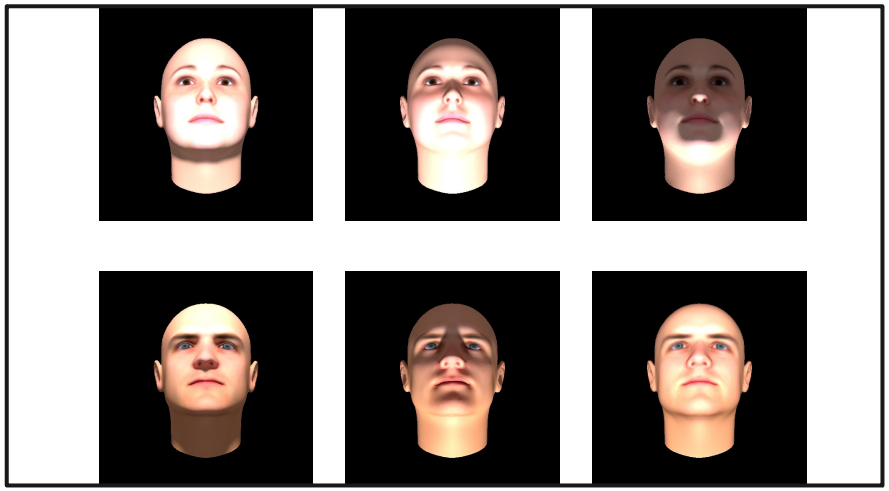


Non-affine subtasks

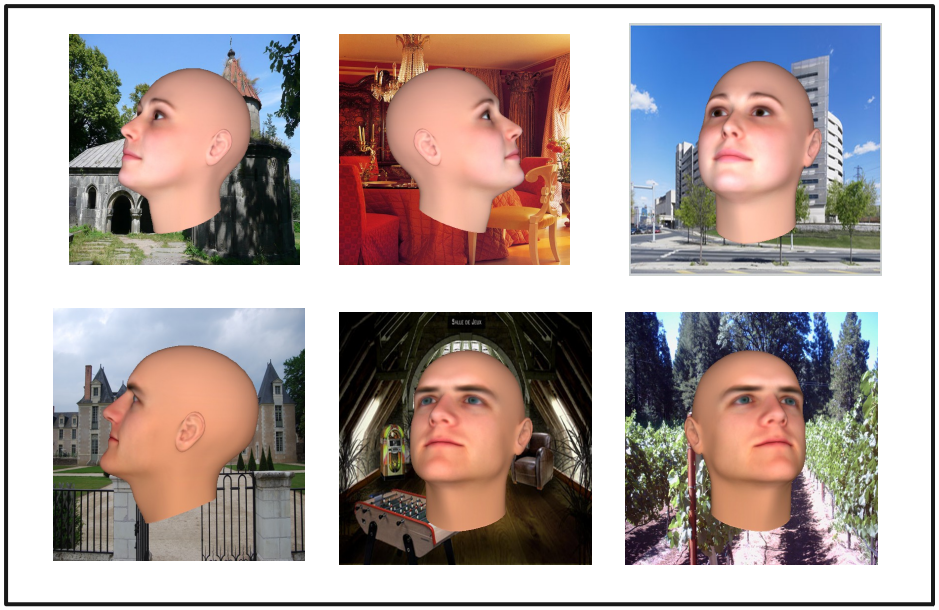
- Yaw rotation
- Pitch rotation
- Illumination



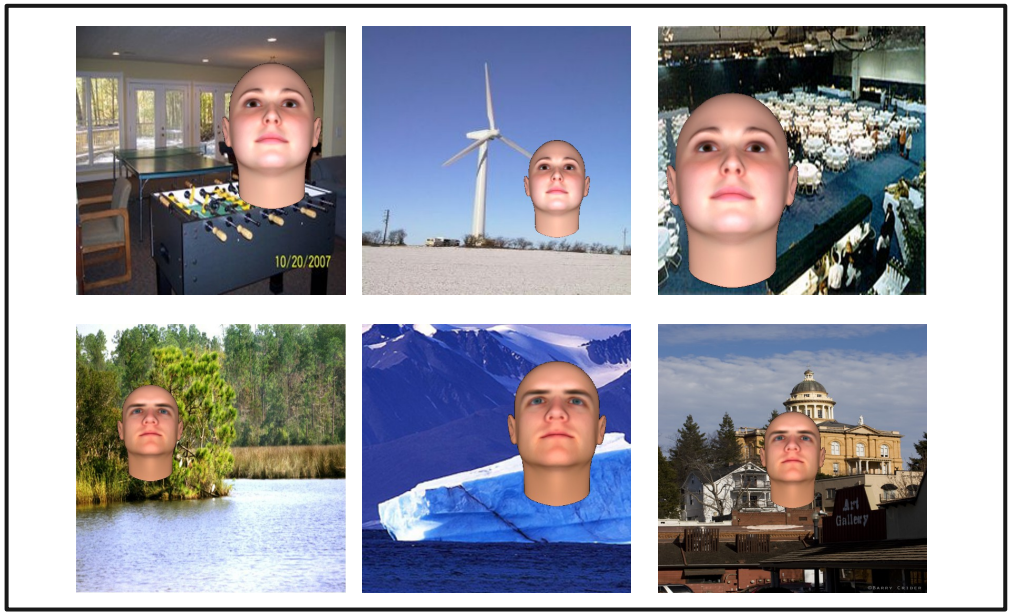


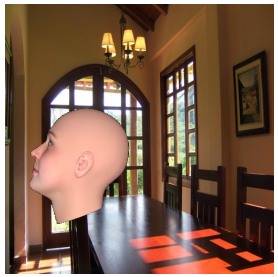


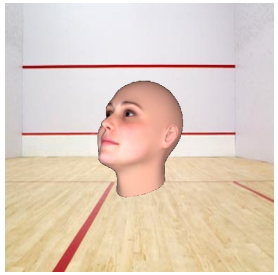
Clutter subtasks

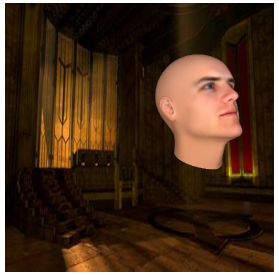


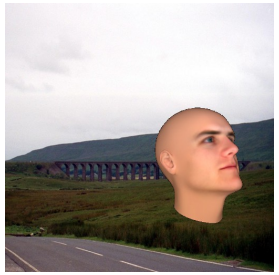
Interaction subtasks



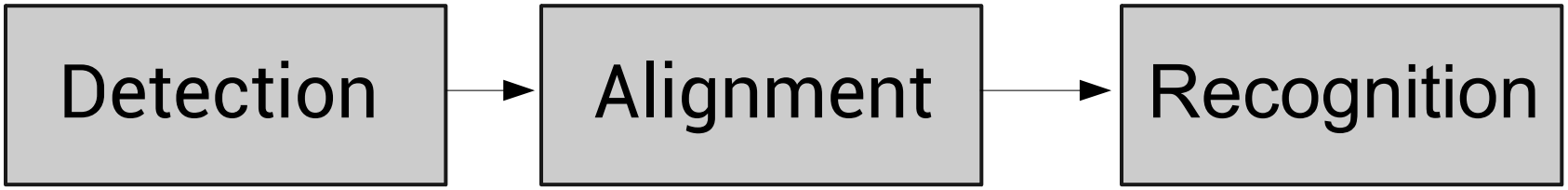






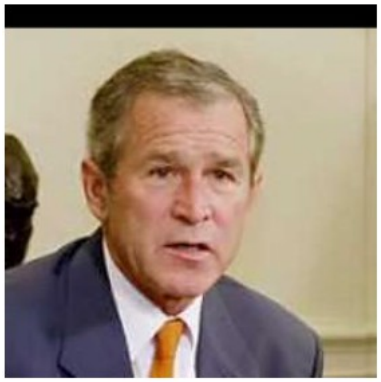


Alternative subtasks



Alternative subtasks

Detection → Alignment → Recognition



Labeled faces in the wild

-Huang et al. 2008
-Leibo et al. 2014

Alternative subtasks

Detection → Alignment → Recognition

Labeled faces in the wild

- Aligned

95+ of 123 papers on LFW indexed by Google Scholar actually used LFW-a, closely cropped

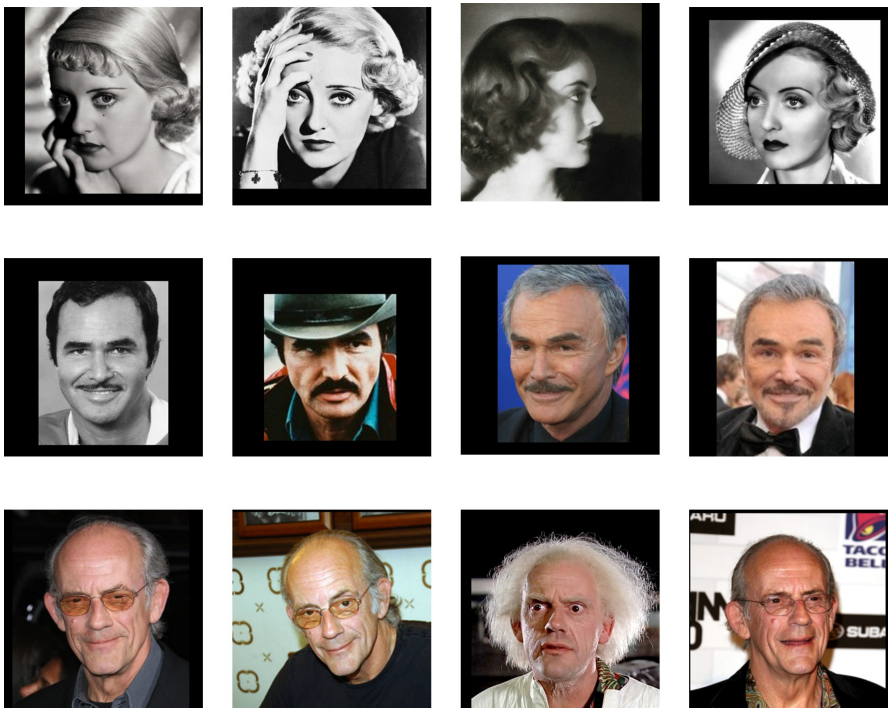
-Huang et al. 2008
-Leibo et al. 2014
-Taigman et al. Etc.

SUFR-in the Wild (SUFR-W)

- A new benchmark we proposed.

- Comparable to LFW.

- 13,661 images to LFW's 13,233



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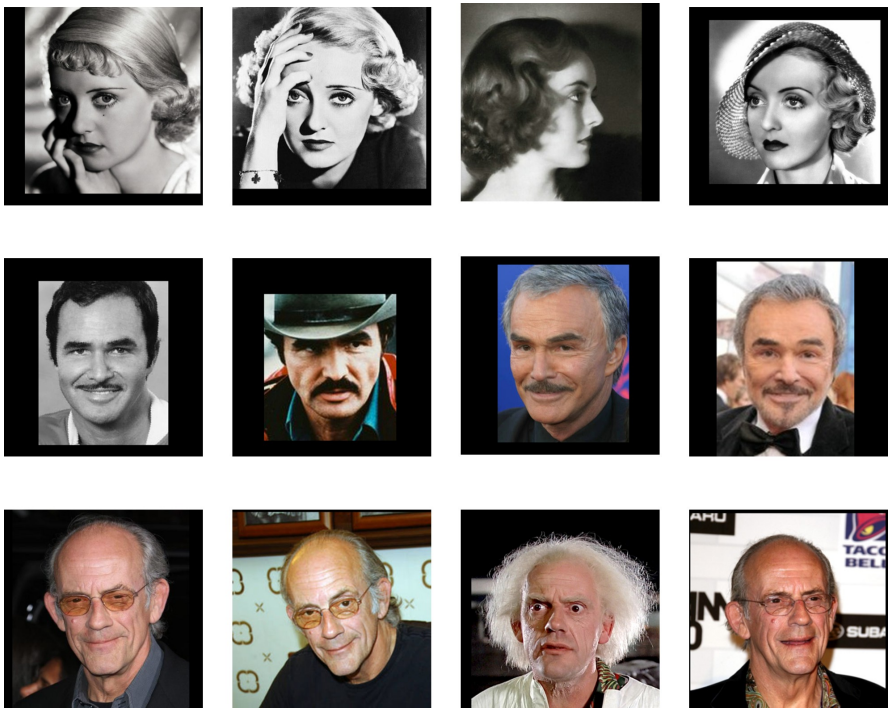

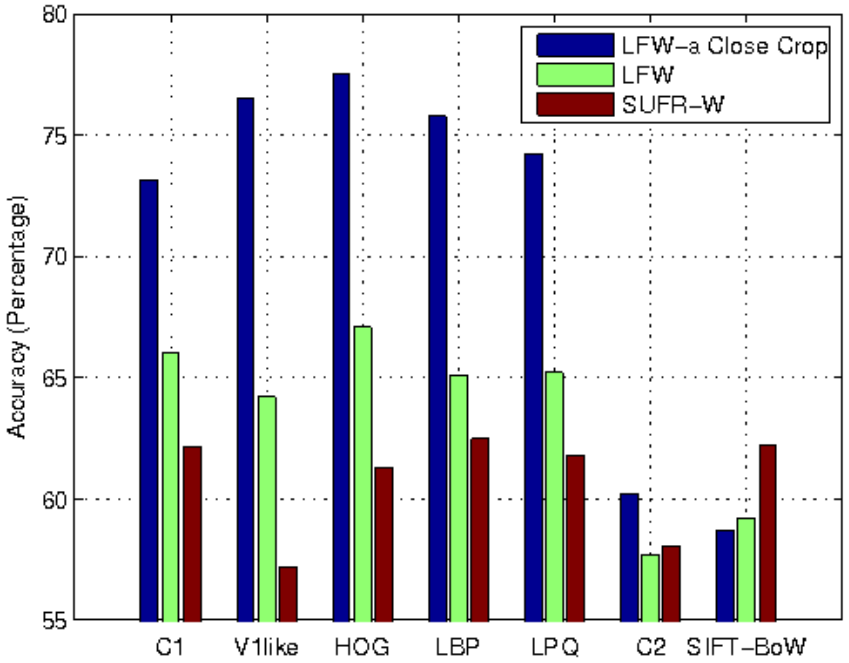

Conclusion

- We advocate an algorithm development approach combining both synthetic and natural, unconstrained data.
- Even if you will ultimately be working within a DAR pipeline, recognition systems that can handle transformation invariance is useful for recovering from errors of alignment. No single point of failure.
- More explicit connections with neuroscience and other parts of computer vision.
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All datasets available from CBMM.MIT.EDU

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