

Face Recognition Performance

Role of Demographic Information

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Explore impact of demographics on face recognition performance

- Commercial matchers
 - COTS-A (Asia)
 - COTS-B (North America)
 - COTS-C (Europe)
- Non-trainable matchers
 - Local Binary Patterns (LBP) *Tan and Triggs 2010*
 - Gabor Wavelets
- Trainable matcher
 - Spectrally Sampled Structural Subspace Features (4SF) *Klare 2011*
- Eight cohorts across three demographics isolated:
 - Race (White, Black, Hispanic)
 - Gender (male and female)
 - Age (18 to 30 years old, 30 to 50 y.o., 50 to 70 y.o.)

- Confirm previous biases reported in COTS algorithms
NIST: FRVT 2002, MBE 2010
- Understand if performance on different cohorts is a function of
 - Unbalanced training
 - Inherent difficulty of the demographic cohort
- Determine if performance on a cohort can be improved by training exclusively on that cohort

- Experiment 1:
 - Measure COTS FRS performance within each demographic cohort
 - Goal: Confirm previous biases (MBE 2010) on a different dataset
- Experiment 2:
 - Measure performance of non-trainable face recognition algorithms
 - Goal: Understand inherent (or a priori) difficulty of each cohort
- Experiment 3:
 - Train several versions of the 4SF algorithm (one for each cohort)
 - Apply each version of 4SF to test sets from each cohort
 - Goal: Investigate influence of a training set on recognition performance
 - Goal: Leverage demographics to improve FR performance through demographic-based training

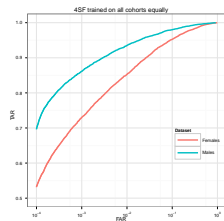
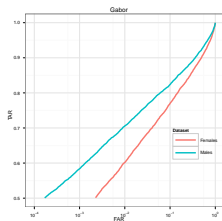
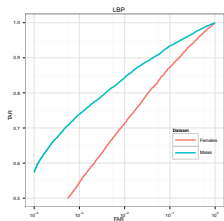
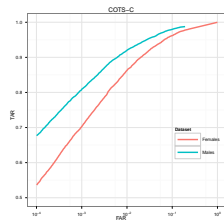
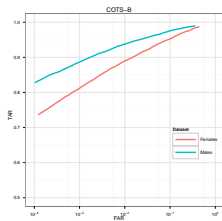
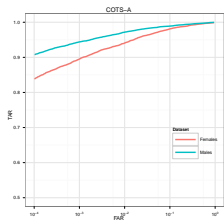
Demographic	Cohort	# Training	# Testing
Gender	Female	7995	7996
	Male	7996	7998
Race	African	7993	7992
	Caucasian	7997	8000
	Hispanic	1384	1425
Age	18 to 30	7998	7999
	30 to 50	7995	7997
	50 to 70	2801	2853

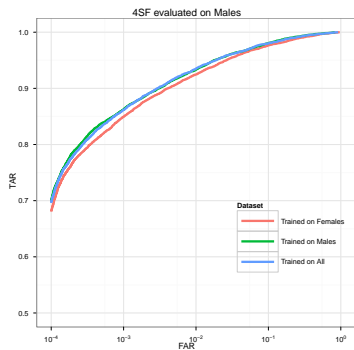
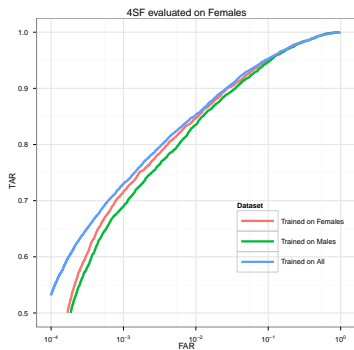
Table: Distribution of subjects by demographic category. Two images per subject. Disjoint Training and Testing sets. Order of 200,000 face images.



Demographic	Cohort	# Training	# Testing
Gender	Female	7995	7996
Gender	Male	7996	7998





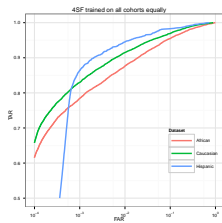
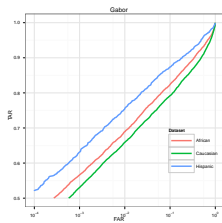
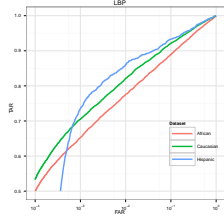
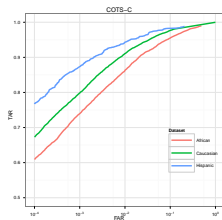
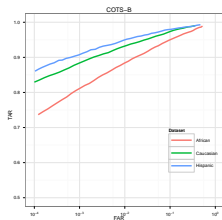
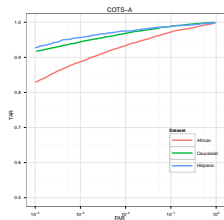


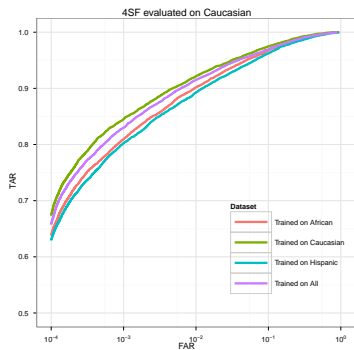
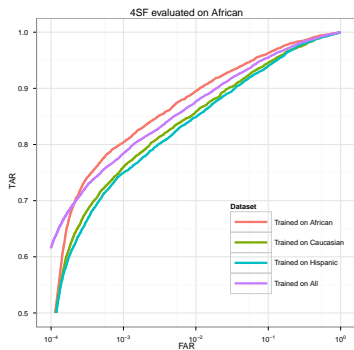
- All commercial matchers had lower performance on the female cohort.
- All non-trainable matchers had lower performance on the female cohort.
- Training on gender cohorts did not improve performance.
- Females appear to be intrinsically more difficult to match.



Demographic	Cohort	# Training	# Testing
Race	African	7993	7992
Race	Caucasian	7997	8000
Race	Hispanic	1384	1425





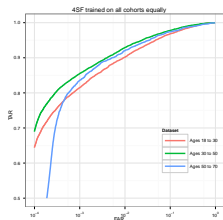
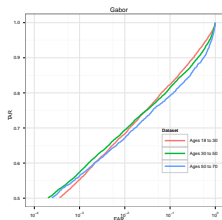
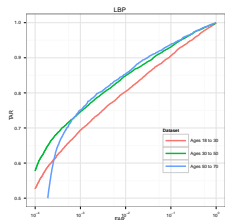
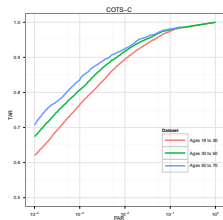
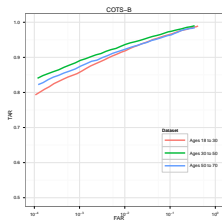
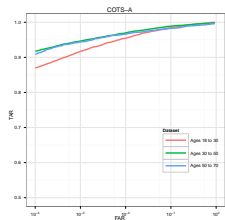


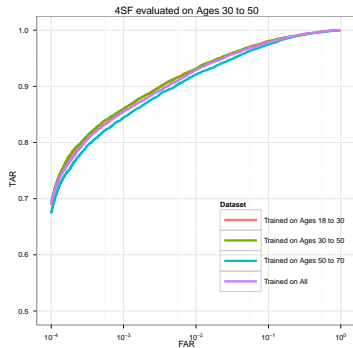
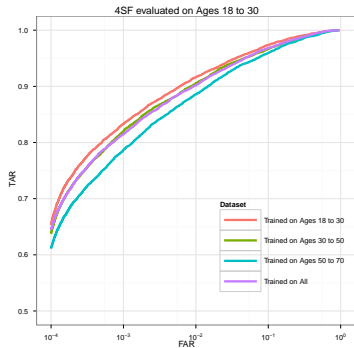
- All commercial matchers had lower performance on Black cohort.
- All non-trainable matchers had lower performance on the Black cohort.
- Training on a race cohort improved performance on that cohort at a slight detriment to other race cohorts.
- Races performance appears to be benefit from different encodings.



Demographic	Cohort	# Training	# Testing
Age	18 to 30	7998	7999
Age	30 to 50	7995	7997
Age	50 to 70	2801	2853







- All matchers had lower performance on the 18-30 cohort.
- Training on an age cohort improved performance on that cohort at a slight detriment to other cohorts.

- The Female, Black, and 18-30 cohorts were difficult for all matchers.
- Performance on race and age cohorts improves when training exclusively on a similar cohort.
- Performance on gender cohorts does not improve when training exclusively on a similar cohort.
- Training FR algorithms on datasets well distributed across all demographics is critical.

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References I



B. Klare. “Spectrally Sampled Structural Subspace Features (4SF)”. In: *Michigan State University Technical Report, MSU-CSE-11-16*. 2011.



Xiaoyang Tan and B. Triggs. “Enhanced Local Texture Feature Sets for Face Recognition Under Difficult Lighting Conditions”. In: *IEEE Trans. on Image Processing* 19.6 (2010), pp. 1635 –1650.