Analyzing and Reducing the Damage of Dataset Bias to Face Recognition with Synthetic Data

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Presented by
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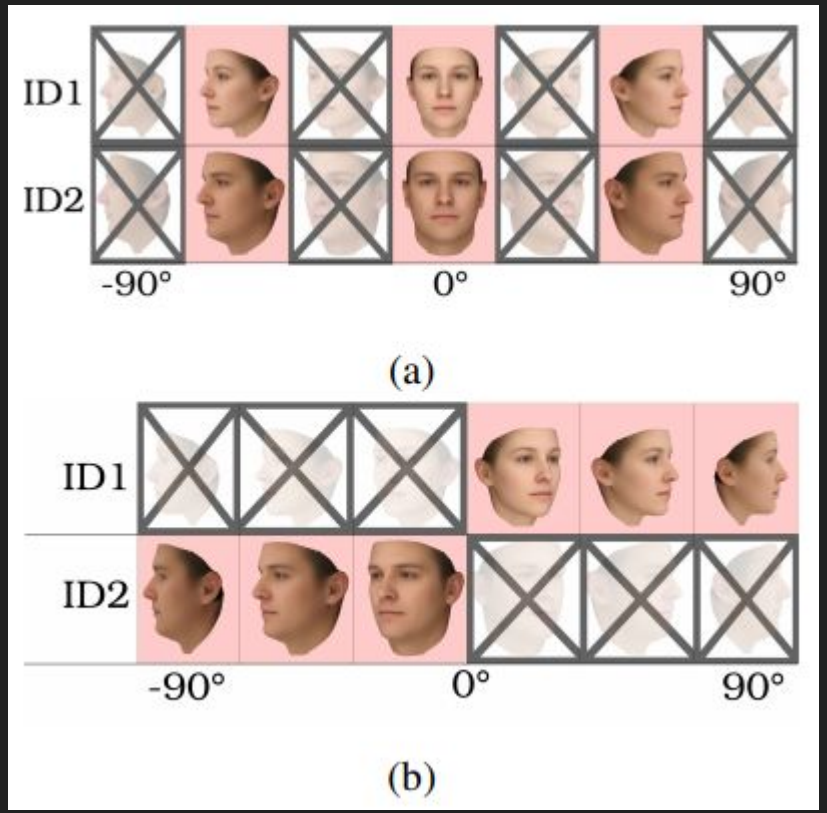
Table of content

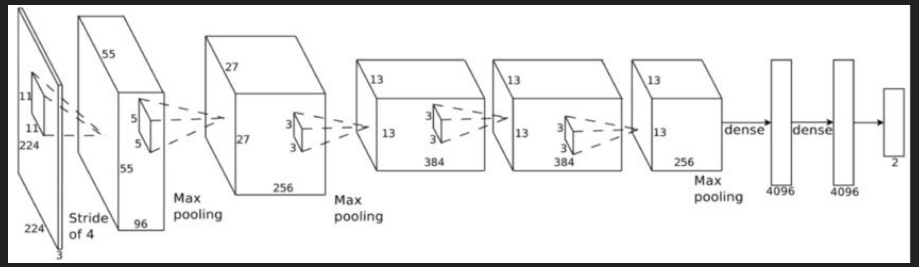
Motivation

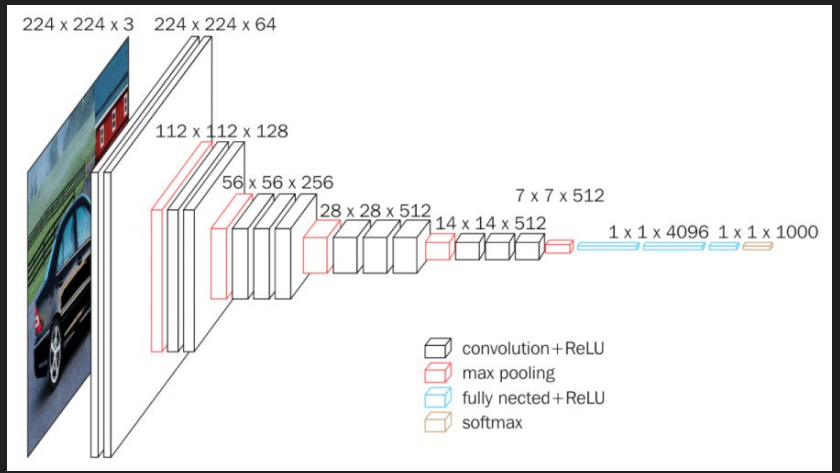
- Facial recognition
- Deep learning suffers dataset bias
- Large size of datasets
- Analyzing dataset bias



VGGNet(16) 2014 and AlexNet 2012

- AlexNet DCNN
- VGGNet DCNN
- ~62 million vs ~152 million params

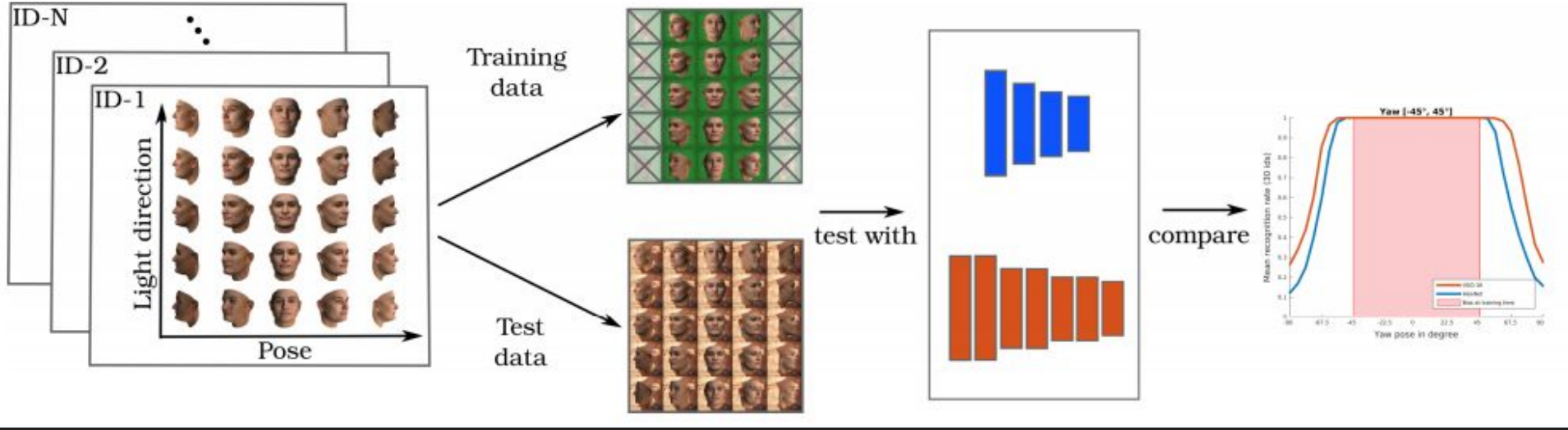




Synthetic data generation

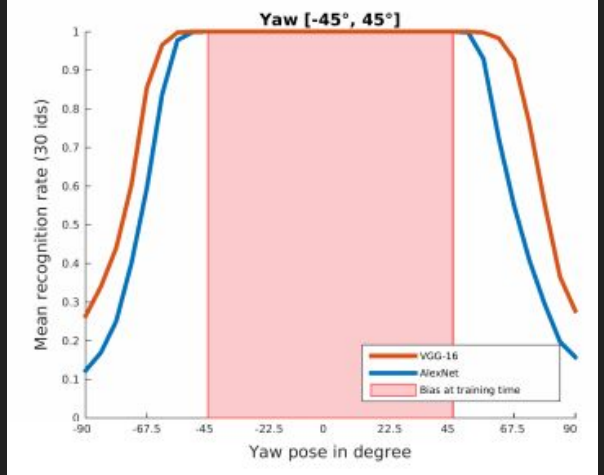
- Face image generator
- 3D Morphable Model
- Basel Face Model 2017
- 2D images from 3D model
- Random parameters
- Infinite faces

Test setup

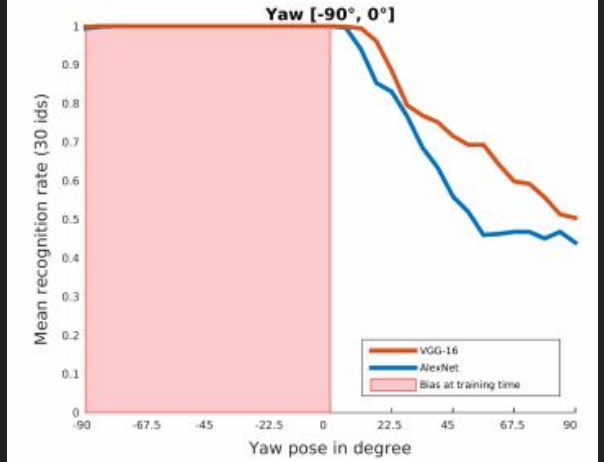

ID-N
ID-2
ID-1
Light direction
Pose
Training data
Test data
test with
compare
Yaw [-45°, 45°]
Mean recognition rate (3D ids)
Yaw pose in degree

Damage of biased dataset

- Range of yaw
- Both DCNN struggle with unseen poses
- Confirms assumptions about DCNNs



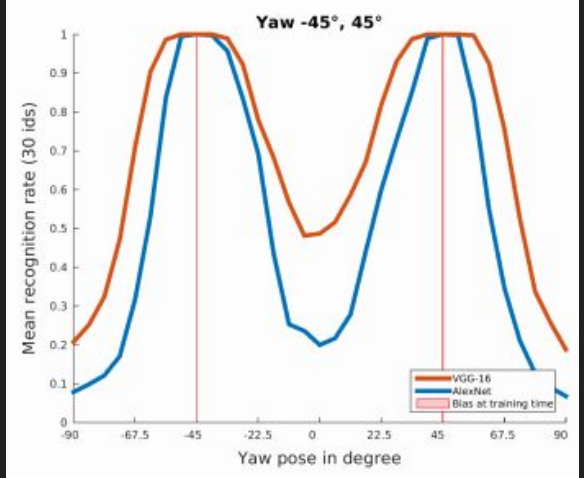
(a)



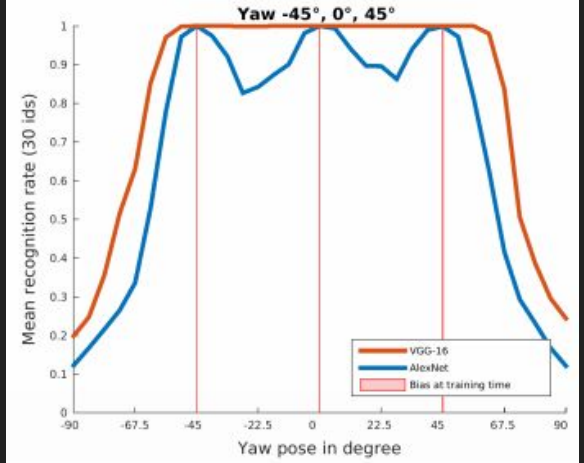
(b)

Damage of biased dataset

- Sparse sampling of yaw pose
- VGG16 better
- All correct between -45 and 45
- Both struggle outside range



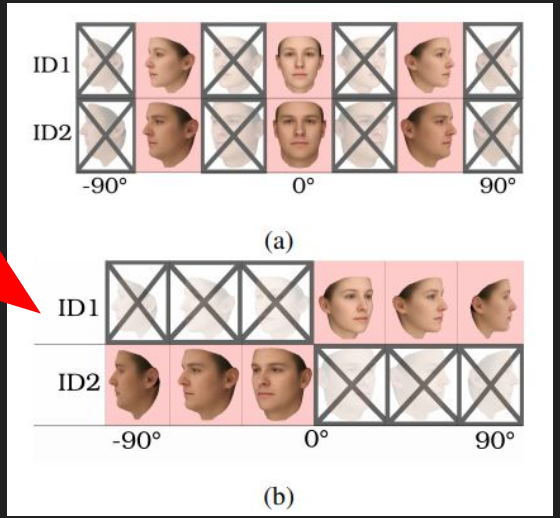
(a)

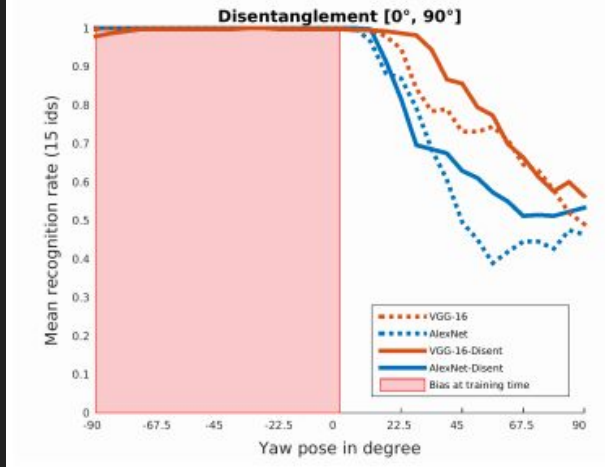


(b)

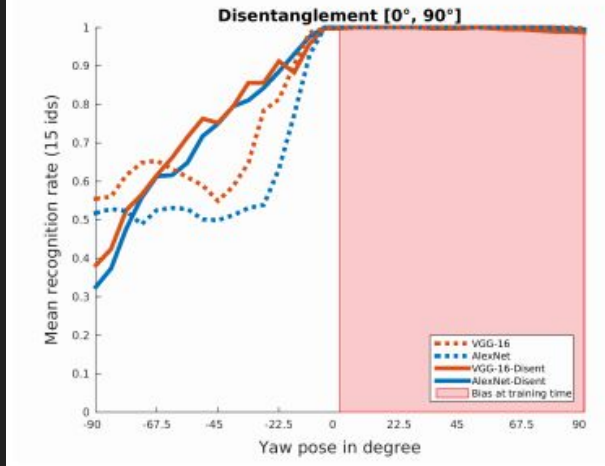
Disentanglement bias

Can DCNNs disentangle face pose from facial identity?





(a)



(b)

Using synthetic data to reduce bias

- FaceNet NN4
- Fine-tune biased datasets
- 20K identities, 100 images per
- Random image generation
- Performance increase
- Reduce real-world data
- Better generalization

Face Recognition			
Datasets	**Multi-PIE**	**LFW**	**IJB-A**
Metric	Accuracy	Accuracy	TAR
SYN-only	88.9	80.1	62.5
Real-100%	91.2	94.1	86.8
+ Primed	**93.3**	**95.8**	**90.6**
Real-25%	83.6	89.1	71.3
+ Primed	**91.3**	**93.6**	**85.0**
Real-10%	81.7	85.1	66.2
+ Primed	**91.3**	**91.8**	**83.4**

Results

- Deeper is better to find unseen yaw poses
- DCNNs are biased to dataset
- DCNNs suffer disentanglement bias
- With proposed method you can see this bias
- Proposed method reduces need for real world data