Masked Correlation Filters for Partially Occluded Face Recognition

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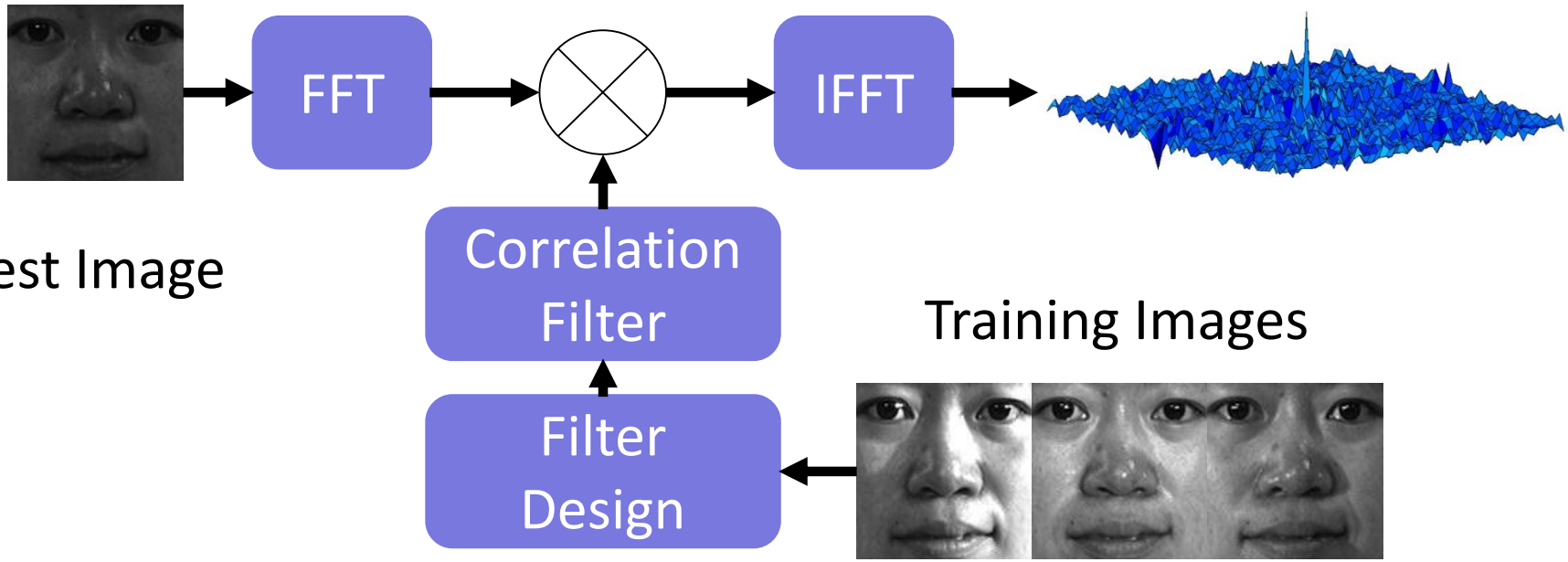
Electrical & Computer ENGINEERING

Partial Occlusions of Faces

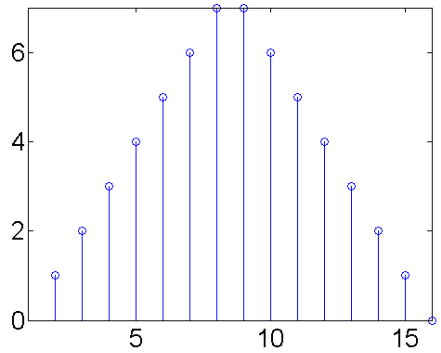
Correlation Filters



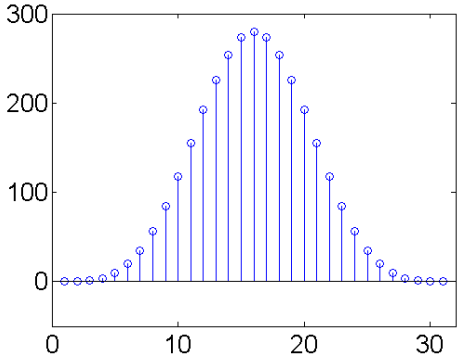
T. Sim, S. Baker, and M. Bsat, “The CMU pose, illumination, and expression (PIE) database,” in Automatic Face and Gesture Recognition, 2002, 2002, pp. 46–51.

Aliasing

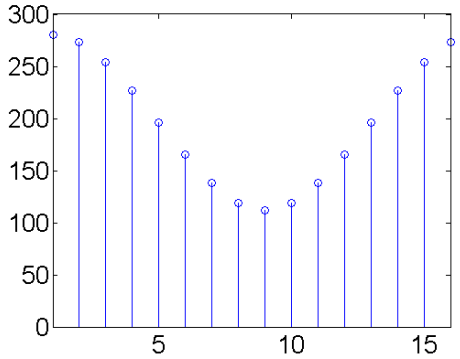
- Aliasing is a problem which results from traditional CF formulation being designed using circular correlation



Input Signal



Linear Correlation



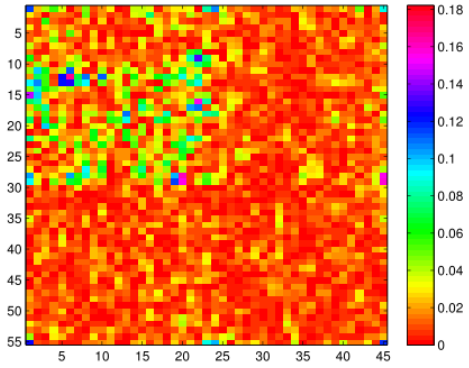
Circular Correlation

Zero-Padding Images

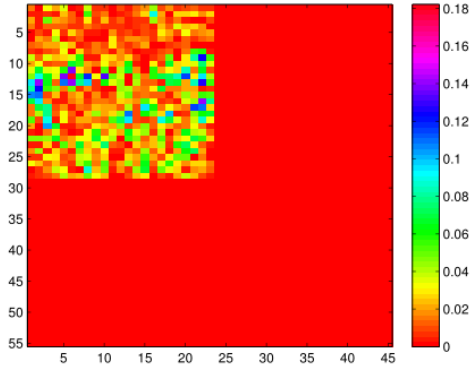
- In order to deal with aliasing, signals can be zero-padded
- Our training and testing images are zero-padded

Zero Aliasing vs Conventional Correlation Filters

- ZACFs remove aliasing by removing energy in the tail of the filter
- Shown below are 2D impulse responses of a traditional CF and a ZACF



Traditional CF

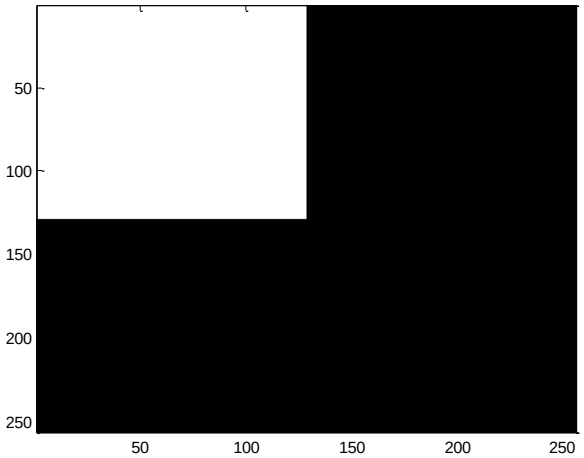


ZACF

J. A. Fernandez, V. N. Boddetti, A. Rodriguez, and B. V. K. Vijaya Kumar, "Zero-aliasing correlation filters for object recognition," Pattern Analysis and Machine Intelligence, IEEE Transactions on, 2014.

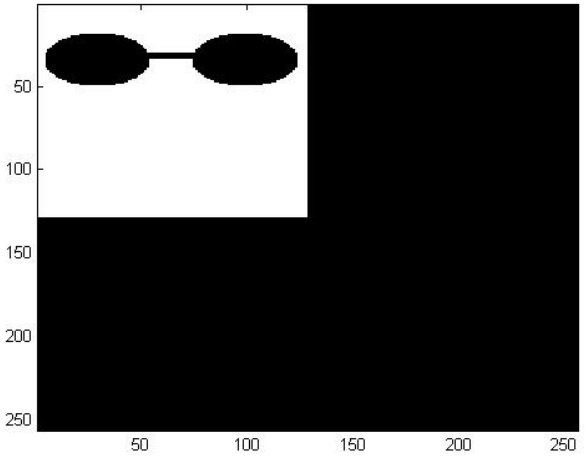
Zero Aliasing Correlation Filters (ZACF)

- Removes aliasing effects
- Sets the tail of the template to zero
- $\boldsymbol{A}^{+}\overline{\boldsymbol{h}} = \boldsymbol{0}$
- $\boldsymbol{A}$ is the IDFT matrix which when right-multiplied by a vectorized frequency domain correlation filter, results in the tail of the filter



Masked Correlation Filters (MCF)

- $\boldsymbol{A^{+}\bar{h} = 0}$
- $\boldsymbol{A}$ is the IDFT matrix which when right-multiplied by a vectorized frequency domain correlation filter, results in the zeroed regions of the filter



CMU Pose Illumination and Expression Database

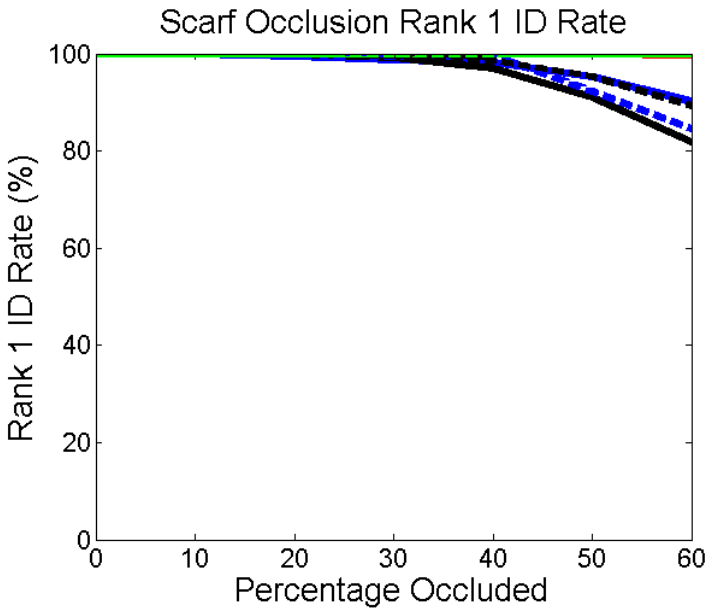
- Frontal, neutral expressions
- Varying illuminations
- PIE-lights
  - 68 classes
  - 24 images per class
  - Ambient lights on
- PIE-nolights
  - 66 classes
  - 21 images per class
  - Ambient lights off

CMU PIE Training Sets

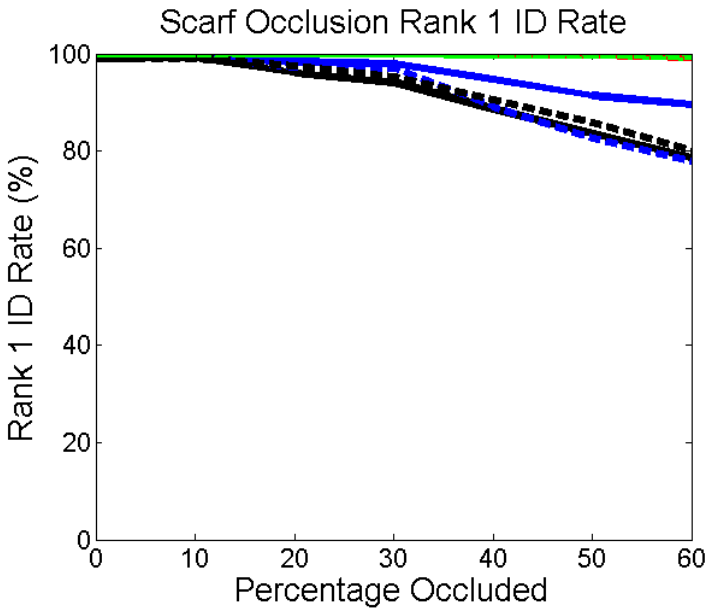
- 3 Images used for Training
- Left Illumination
- Frontal Illumination
- Right Illumination

Artificial Occlusions

Scarf Results

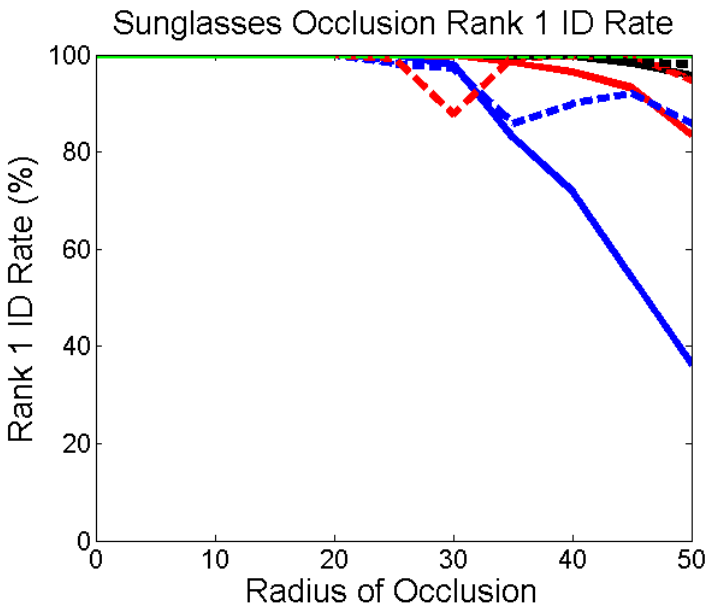


PIE-lights

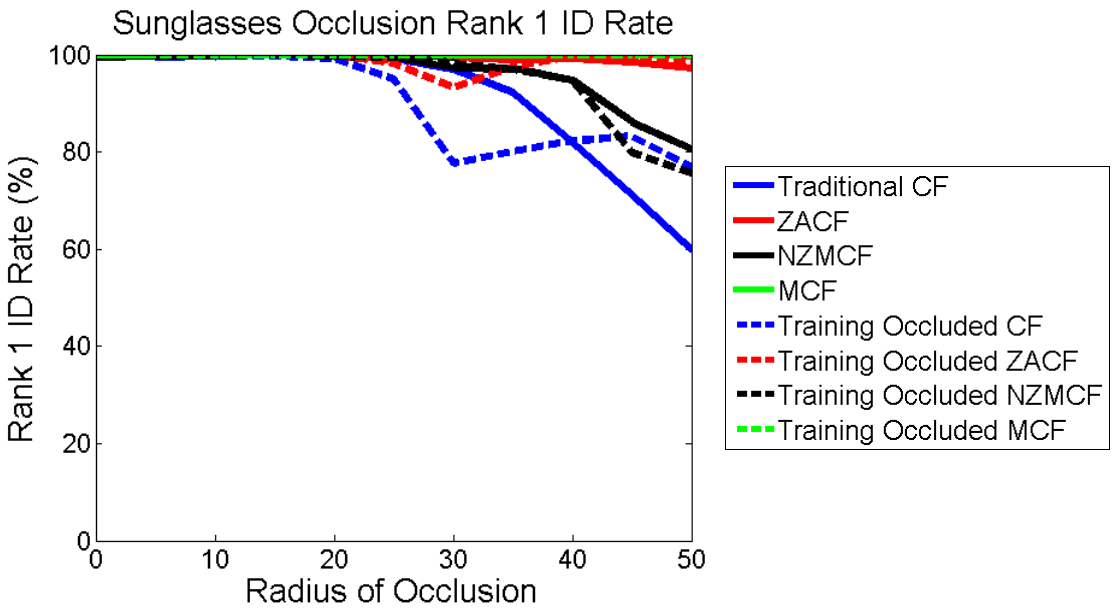


PIE-nolights

Sunglasses Results



PIE-lights



PIE-nolights

AR Database

- Frontal Neutral Expression
- Varying Lighting
- 2 Types of Occlusion
  - Sunglasses
  - Scarf

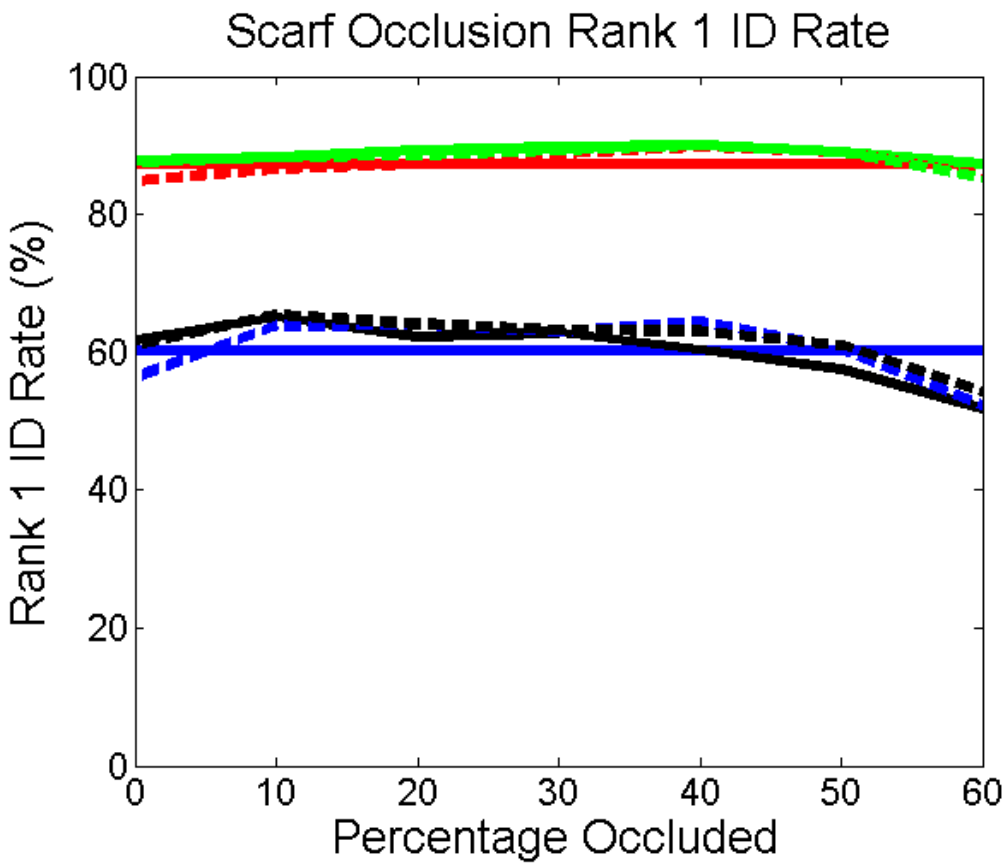
AR Training Images

- 8 Images used for Training
- Frontal Neutral Expression, with varying lighting

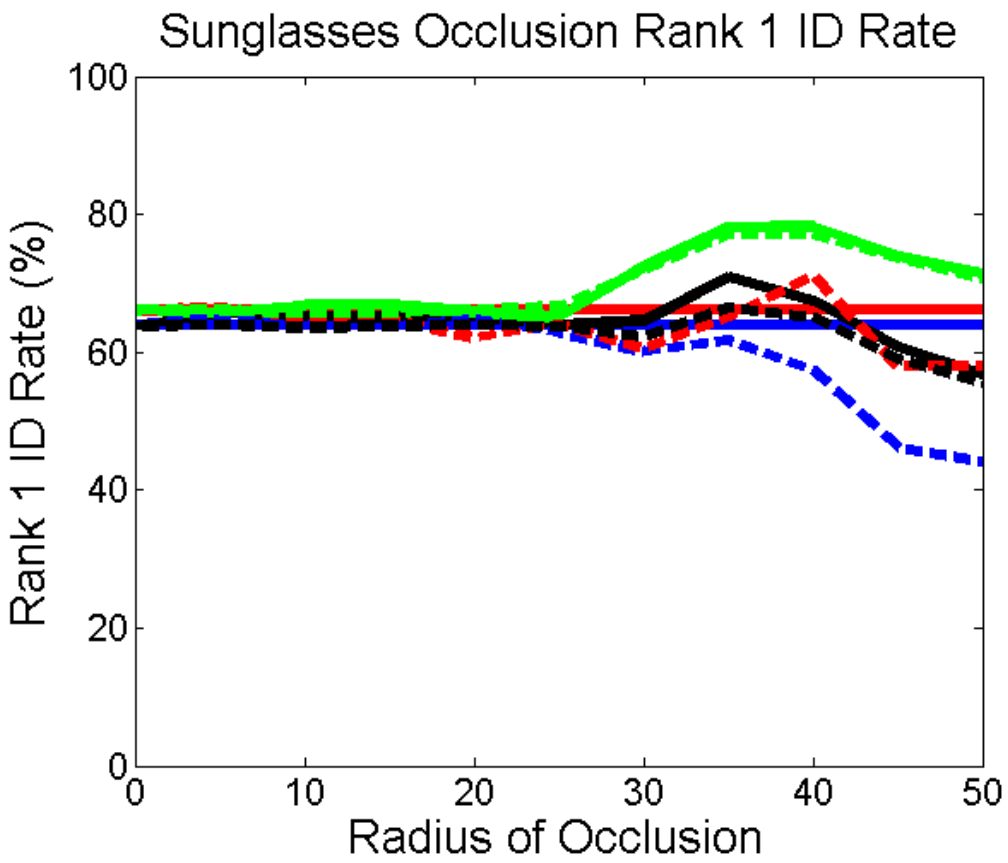
AR Testing Set

- 2 Test Sets
- Scarf Test Set: 6 Scarf Images per Subject
- Sunglasses Test Set: 6 Sunglasses Images per Subject

Scarf Results



Sunglasses Results



KACST Dataset

- 146 Classes
- Neutral expression
- 7 Images per Class
- 2 Types of Occlusion
  - Sunglasses
  - Scarf

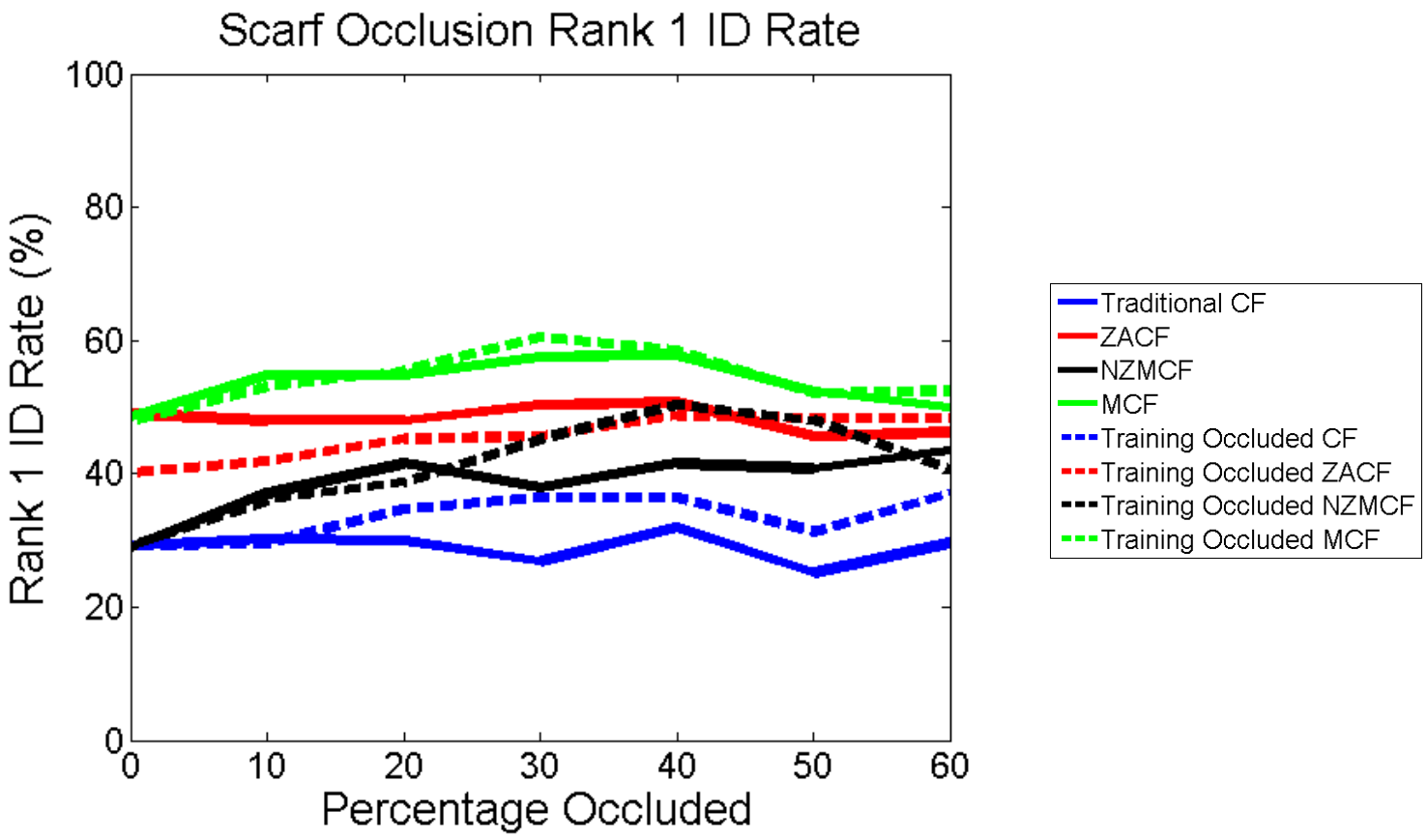
Training Images

- 4 Images per Subject
- With Shemagh
- With Cap
- Without Headwear

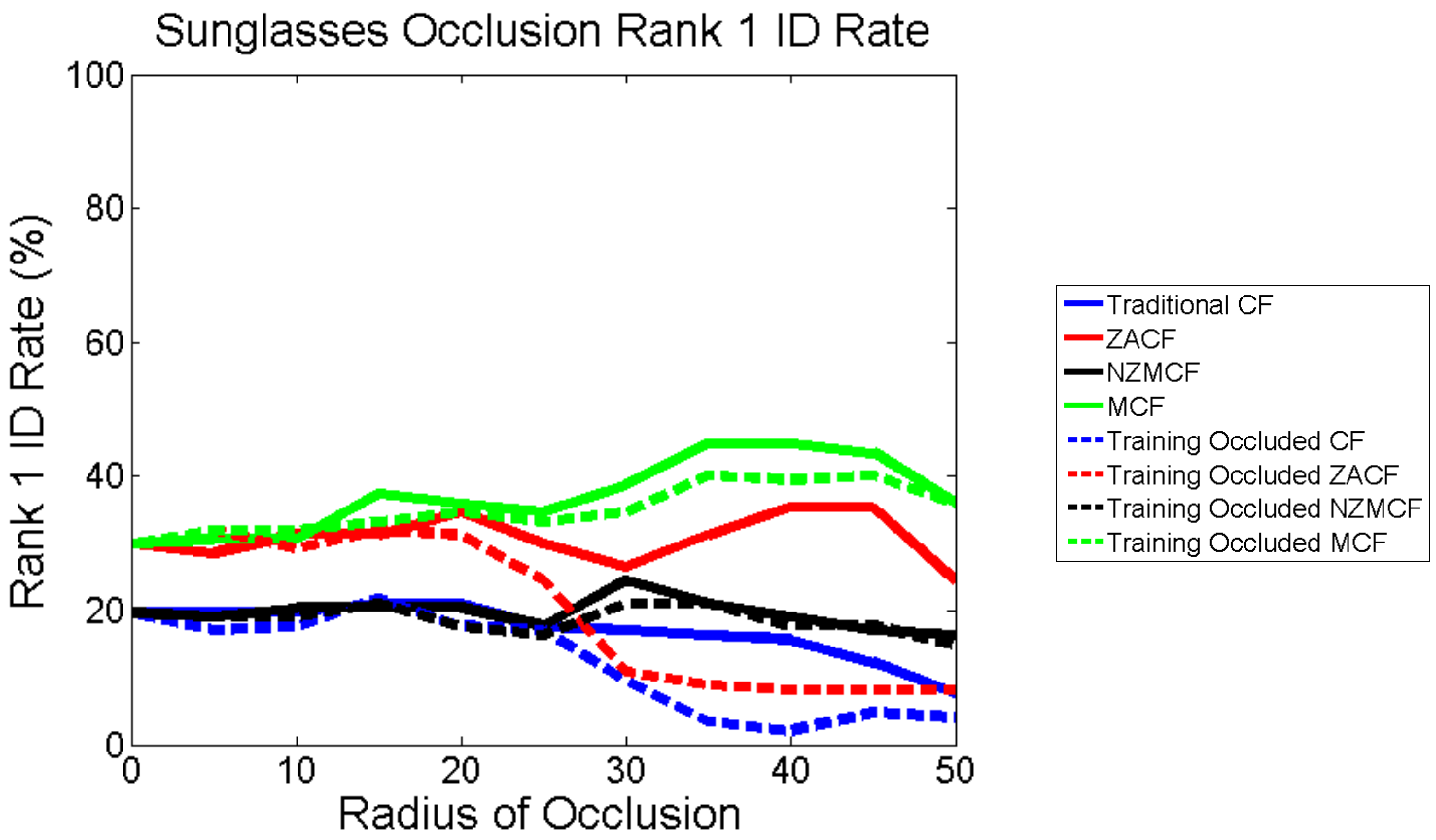
KACST Testing Set

- 2 Test Sets
- Scarf Test Set: 4 Scarf Images per Subject
- Sunglasses Test Set: 2 Sunglasses Images per Subject

Scarf Results



Sunglasses Results



Conclusions

- Inspired by the design of Zero Aliasing CFs, we designed Masked CFs for occlusion tolerant face recognition
- We showed ZACFs perform well in the face of occlusion
- MCFs perform even better than ZACFs when dealing with occlusions

Questions?