



Pattern Recognition without Features

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Issues

- Selection of Features
- Training Process

Commonality



Reference



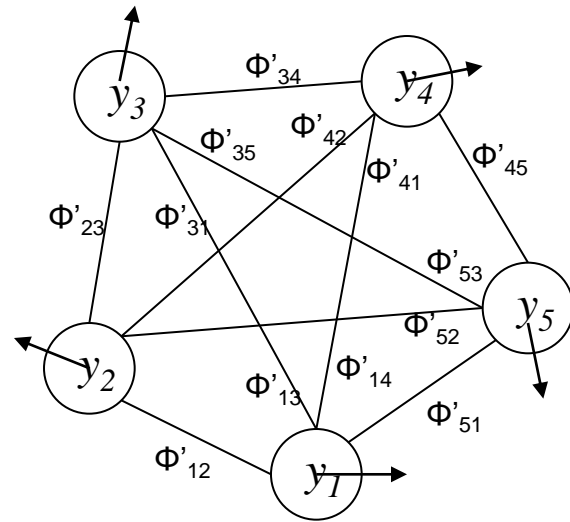
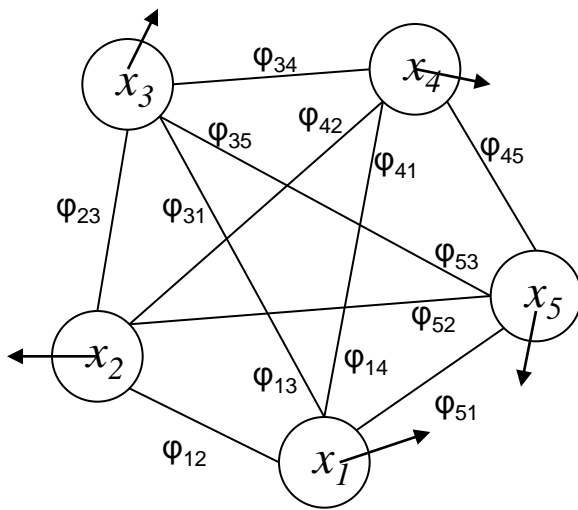
Candidate



Graphical Similarity Representation

- Pixels are represented as nodes
- Nodes possess the properties:
 - Location of pixel
 - Brightness gradient orientation
- A relationship exists between a pair of nodes if their properties and relative orientation match that of a pair in a second image.
- A maximal clique is the largest subset of nodes that all match and possess an orientation relationship with each other.

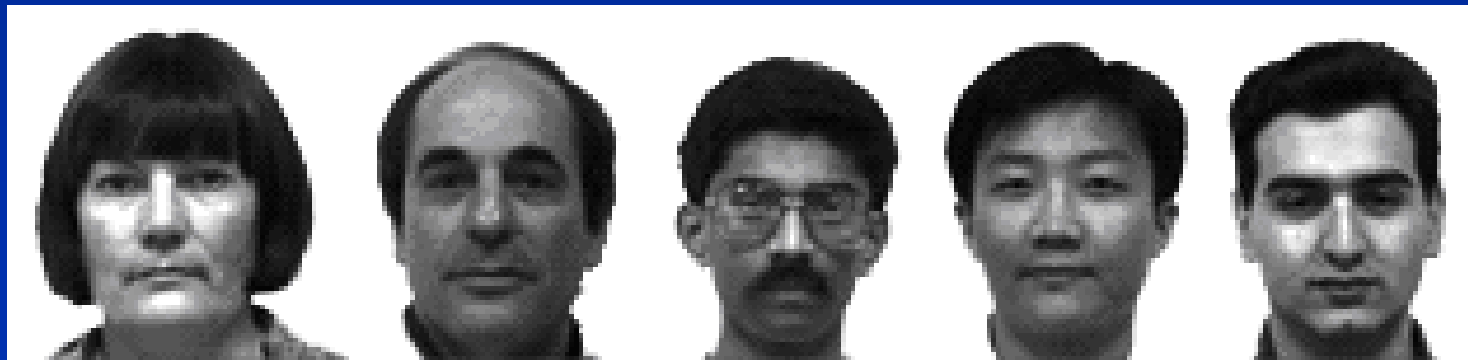
Cliques of Matching Pixels



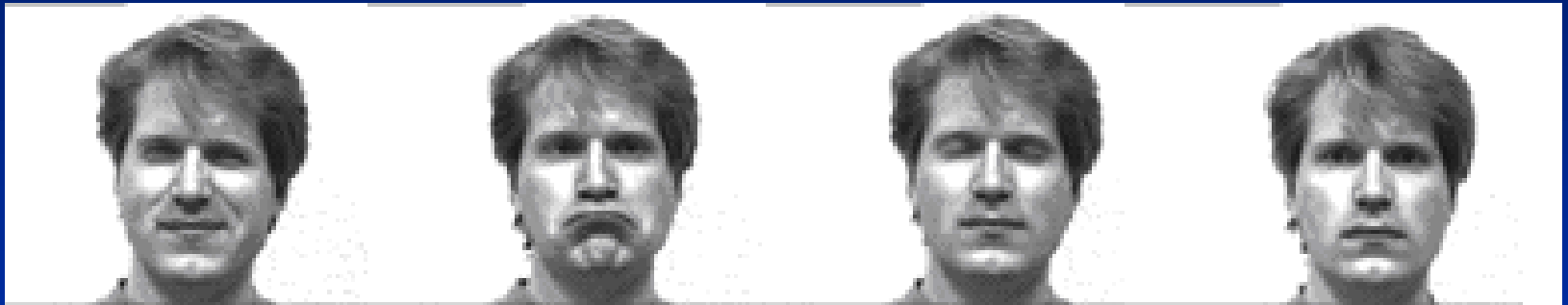
Similarity = size of maximal clique



Yale Face Database A



Yale Face Database A



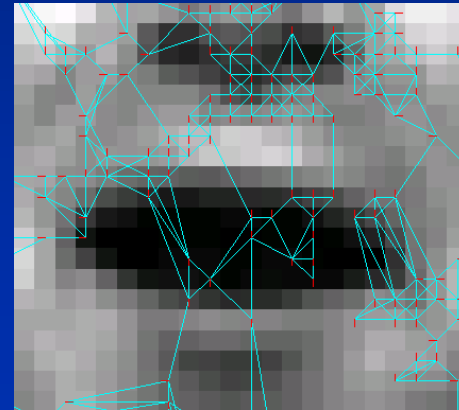
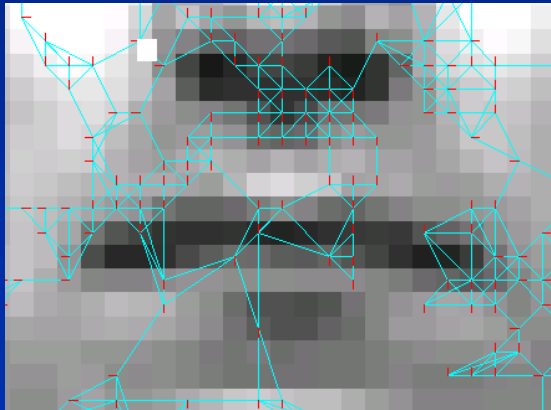
Face Matching

reference



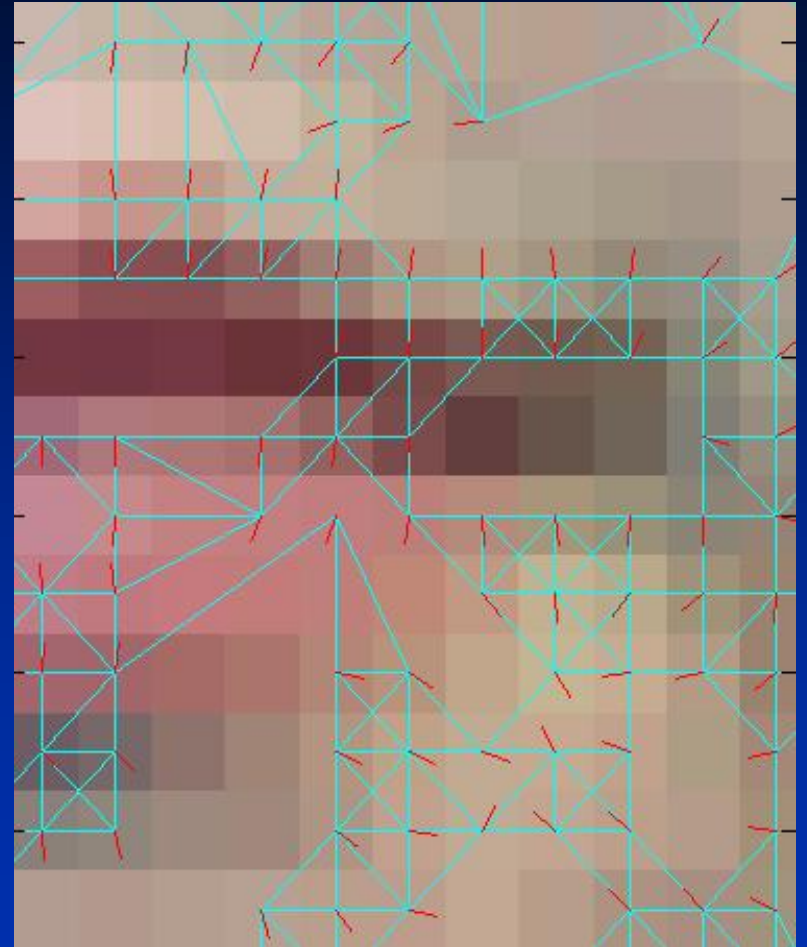
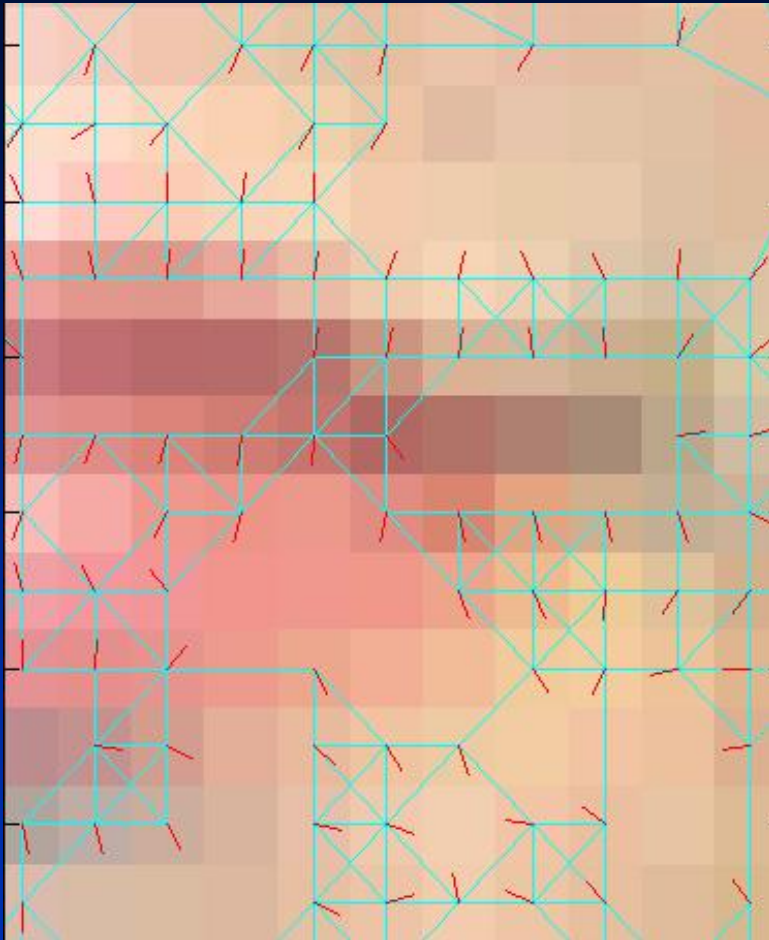
1764
points

Gradient
Directions



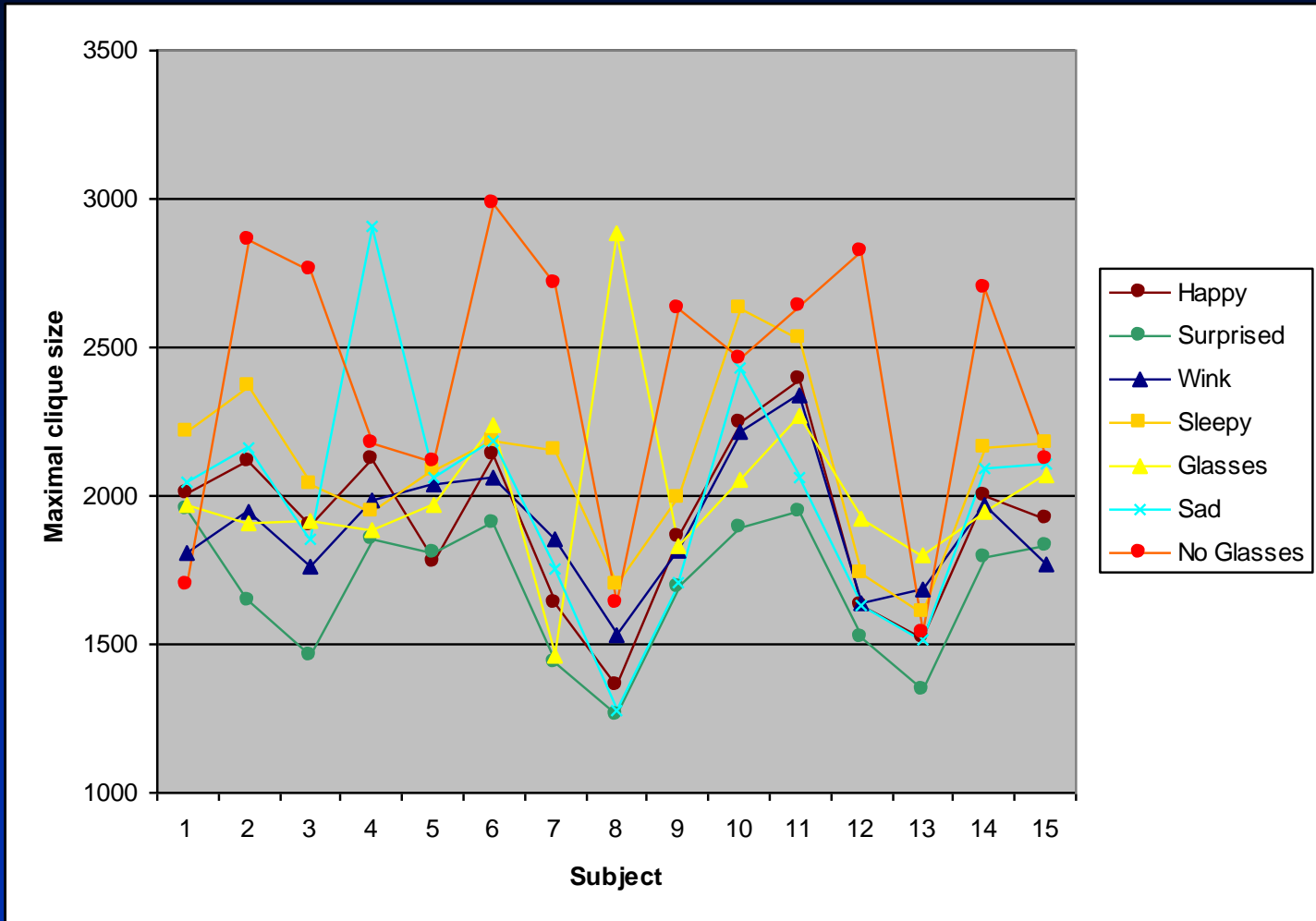
Relative orientation $\varepsilon_1 < 19^\circ$; Gradient direction $\varepsilon_2 < 55^\circ$;

Matching



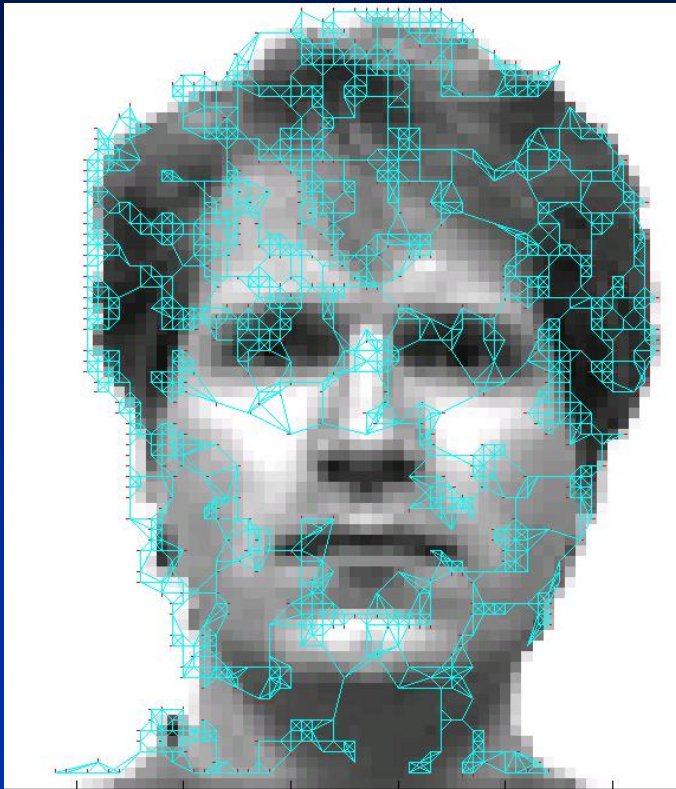
Close-up showing matching gradient orientations

Results - Expressions



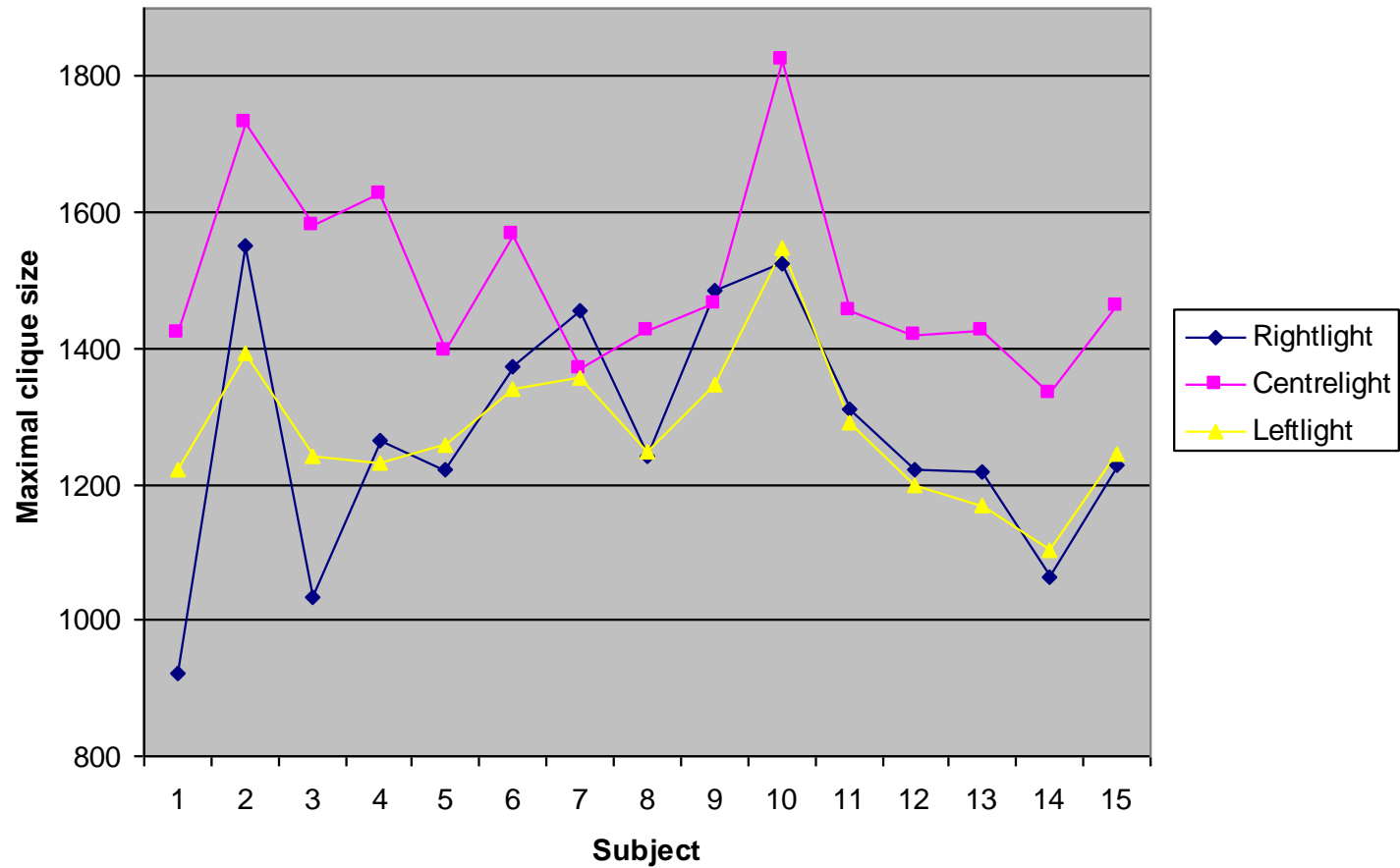
No errors

Results - Illumination



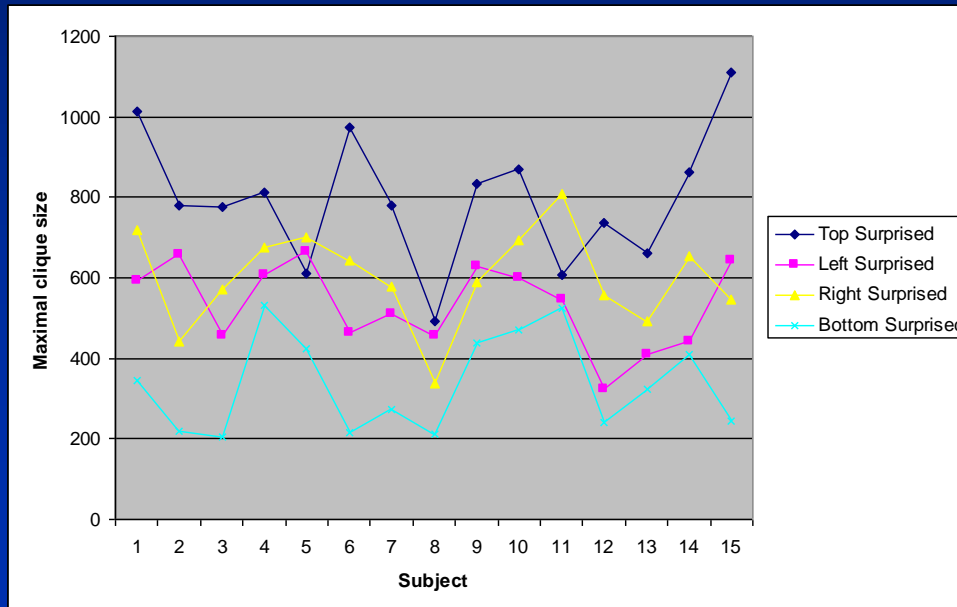
Gradient direction not affected in many areas

Results - Illumination



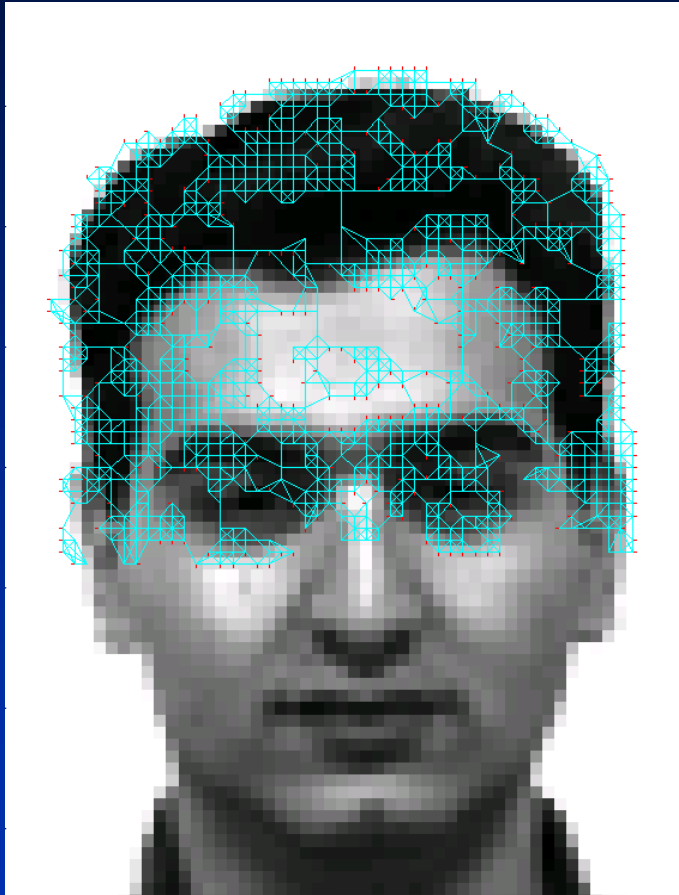
No errors

Results - Occlusions

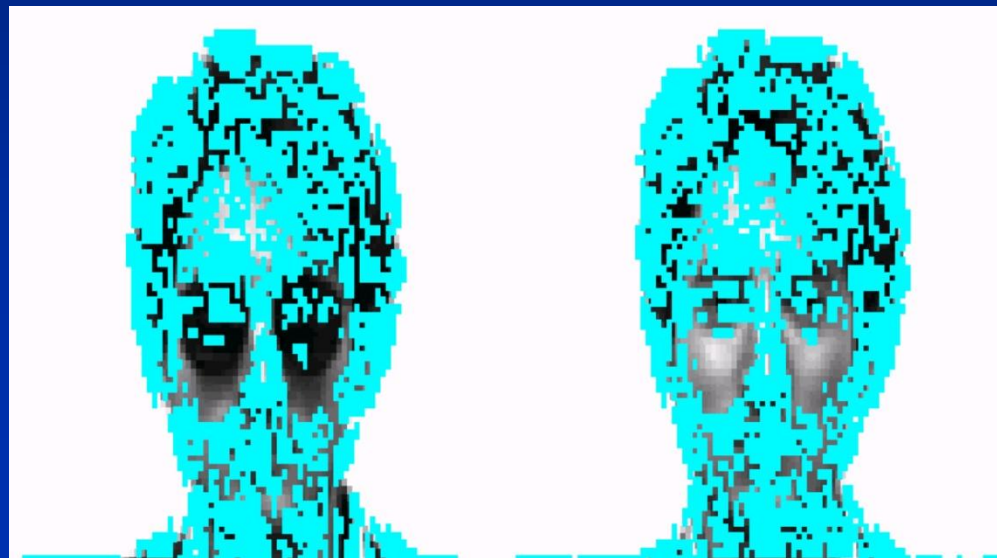


Errors - bottom:6/15

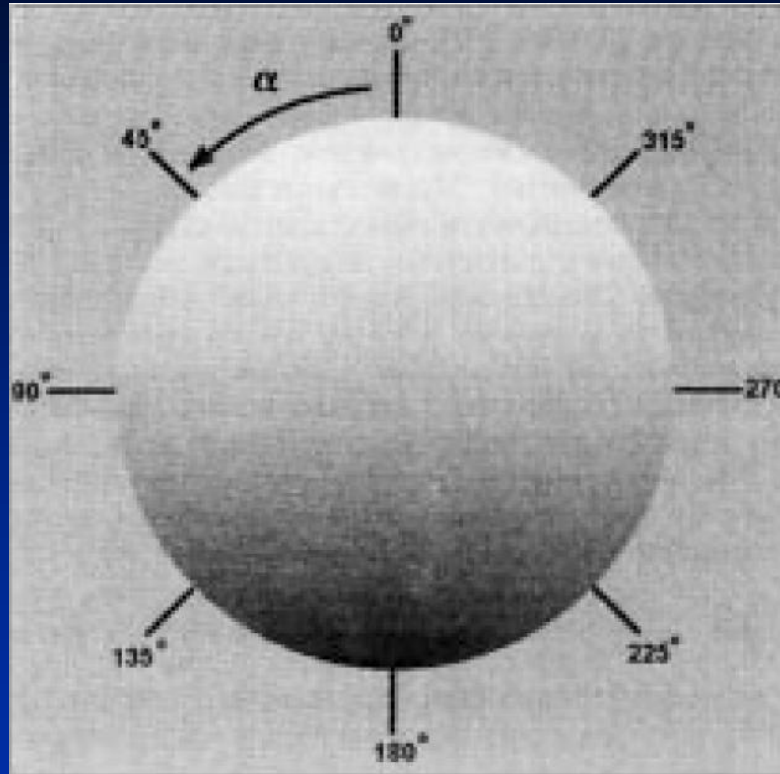
Results - Occlusions



Results - Occlusions



Neuron Sensitivity



Certain neurons are sensitive to brightness gradient vector orientation (Podvigin 2001)



Benefits of the Approach

- Avoids the need for feature selection
- No training data required
- Automatic location of match
- Displays immunity to distortions
- Potential for parallel implementation