

# Systematic Evaluation of Binary Feature Descriptors

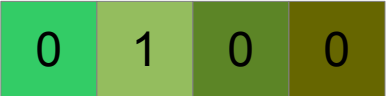
## **Global Maximum**

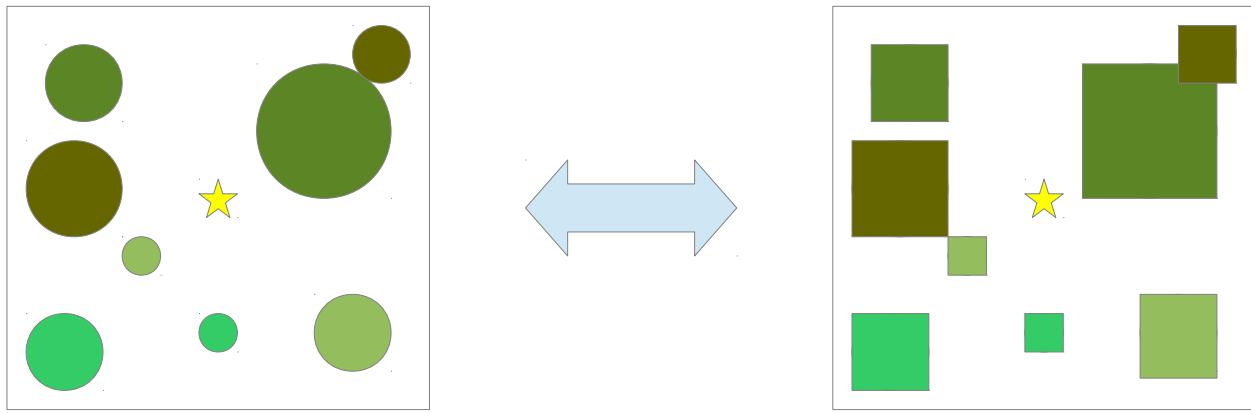
Mark Muth  
Thomas Schöps

# Overview

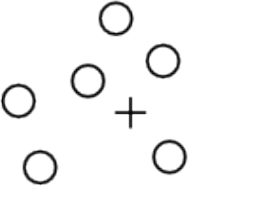
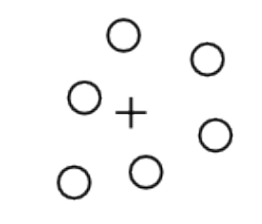
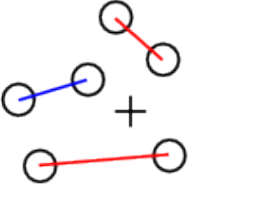
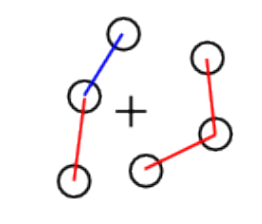
- **Aim:** compute a good binary descriptor and evaluate it against common descriptors
- **Presentation:**
  - Method overview
  - Descriptor optimization visualization
  - Evaluation
  - Future work

# Input Parameters

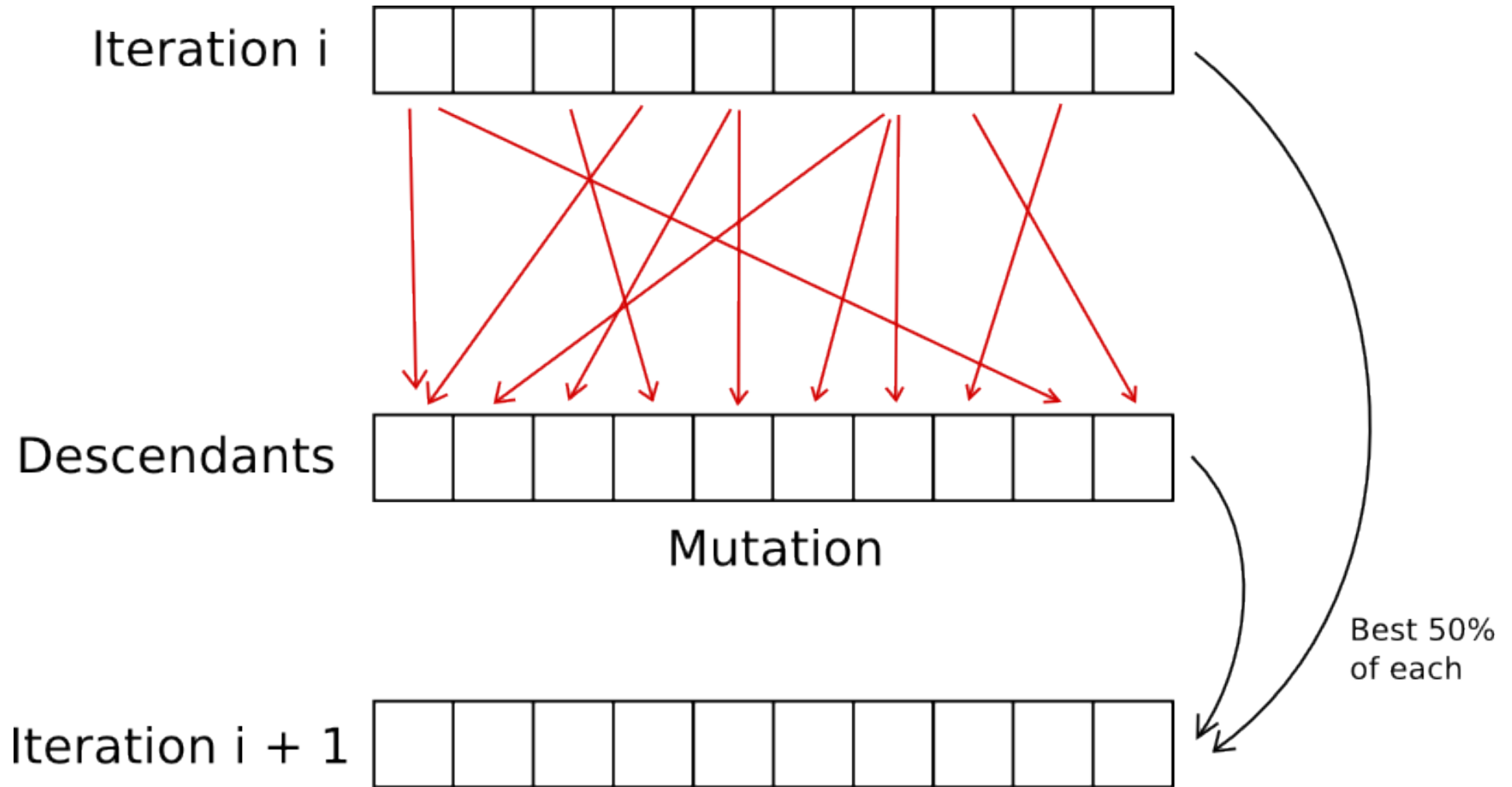
- Descriptor size (number of bytes) 
- *Future work:* Sampling method (→ performance)



# Optimization Parameters

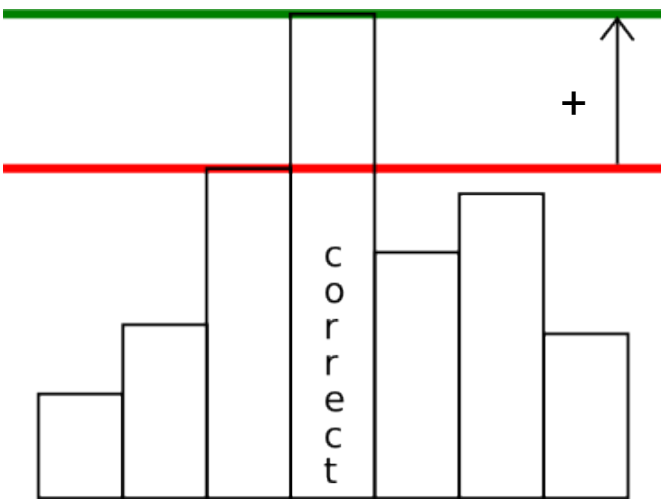
Stage	Example		Parameters
Source Images	Image 1 - Grayscale - Gaussian Blur	Image 2 - Grayscale - Median Filter - Edge detection	- Number of images <b>For every image:</b> - Filter list - Filter parameters
Sampling			<b>For every sample:</b> - Position - Averaging radius
Descriptor Calculation			<b>For every bit:</b> - Compare operation - Arity (binary, trinary, ...) - Sample indices - Weights

# Optimization Process

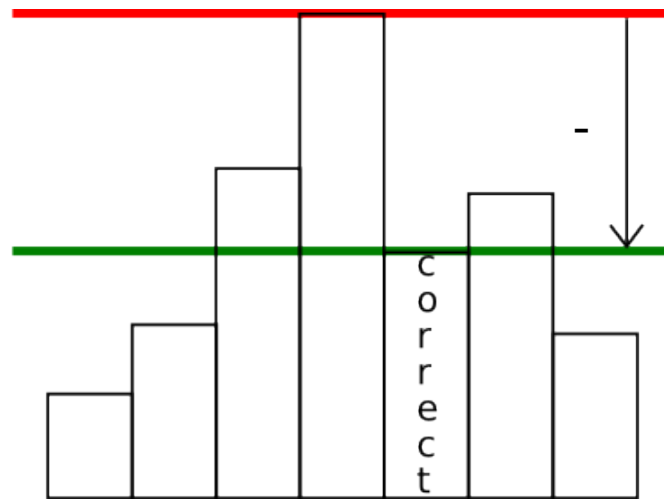


# Optimization Metric: Distinctiveness

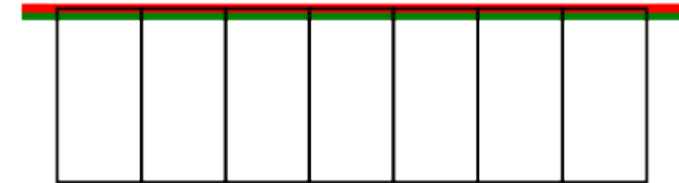
Brute-Force keypoint matching, then sum over all:



**correct** match is best



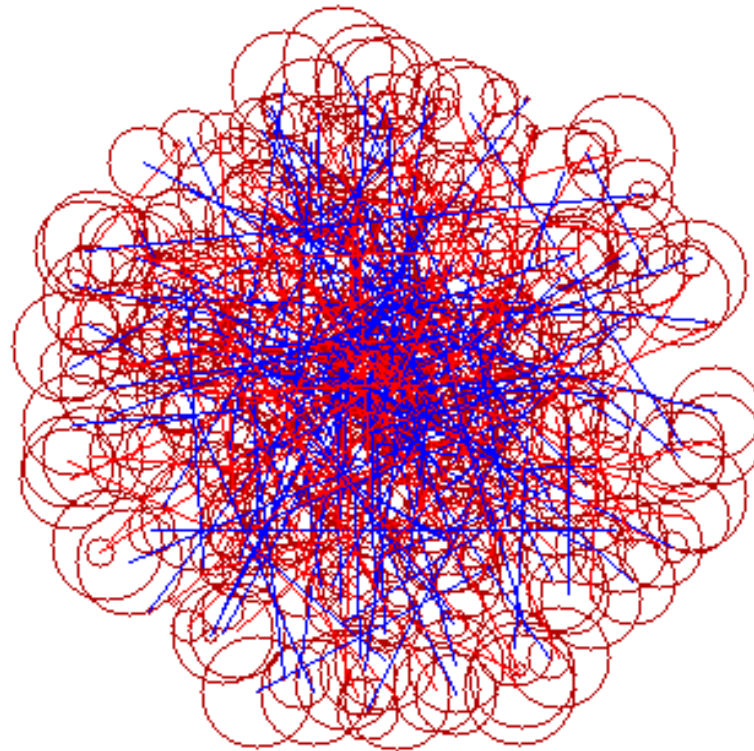
**wrong** match is best



(all matches are equal)



# Optimization Visualization



Iteration 0: 122

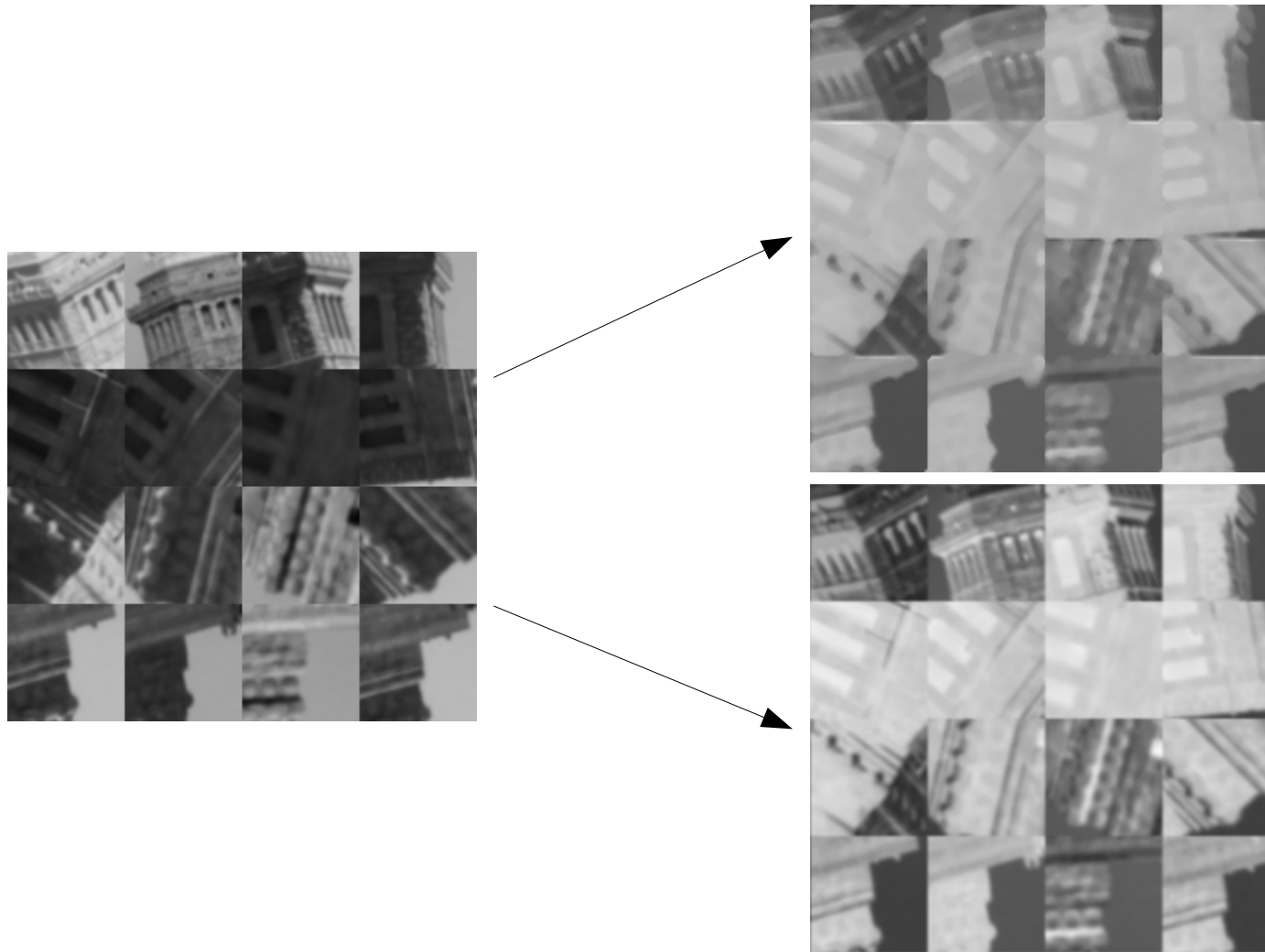
# Overview: Filters

- Gaussian blur
- Median filter
- Gabor filter
- Gradient magnitude



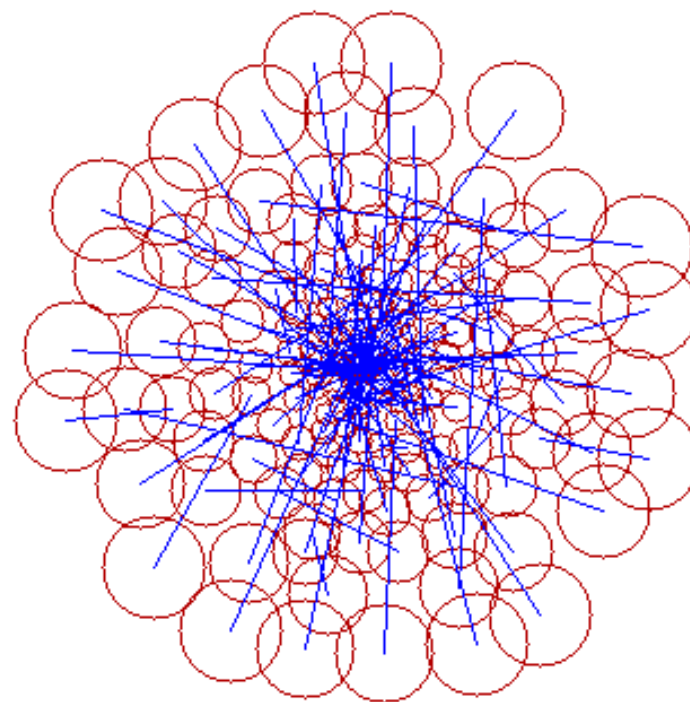


# Filters used in optimized descriptor



# Overview: Descriptors

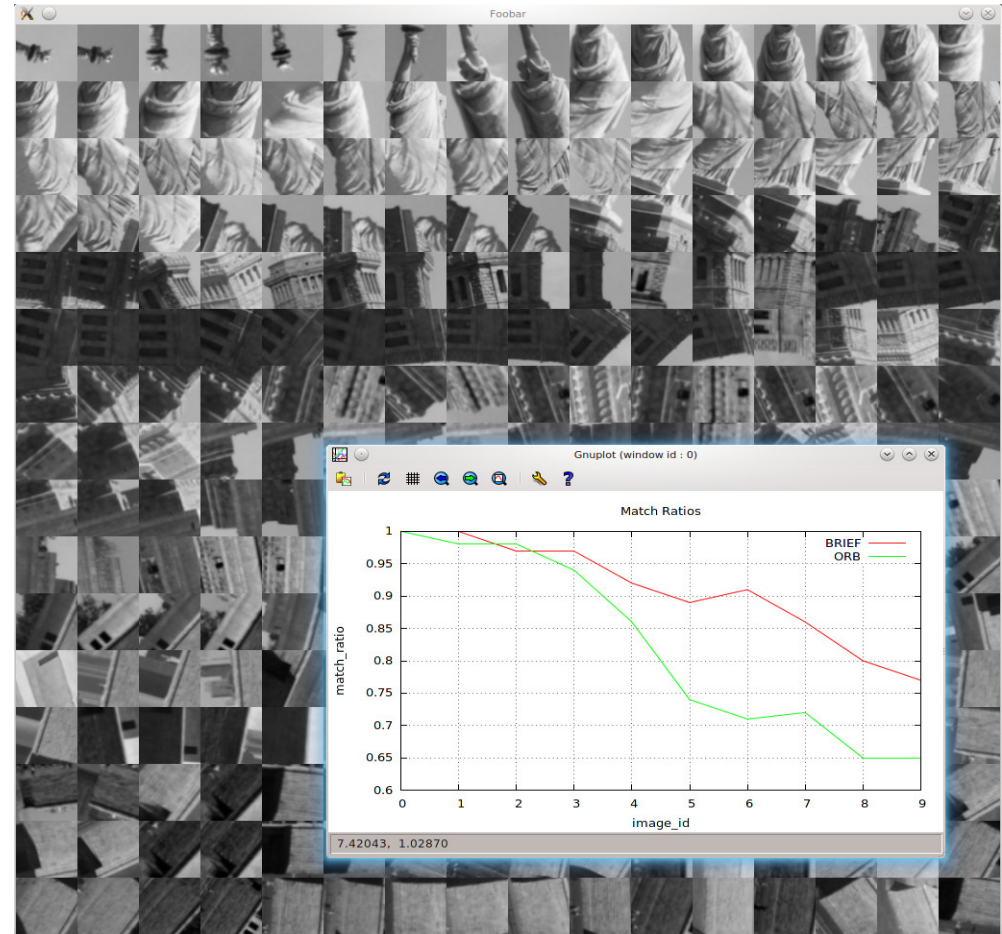
- CustomDescriptor
- BRIEF
- ORB
- BRISK
  
- Parameter optimization for all except BRIEF (parameterless)



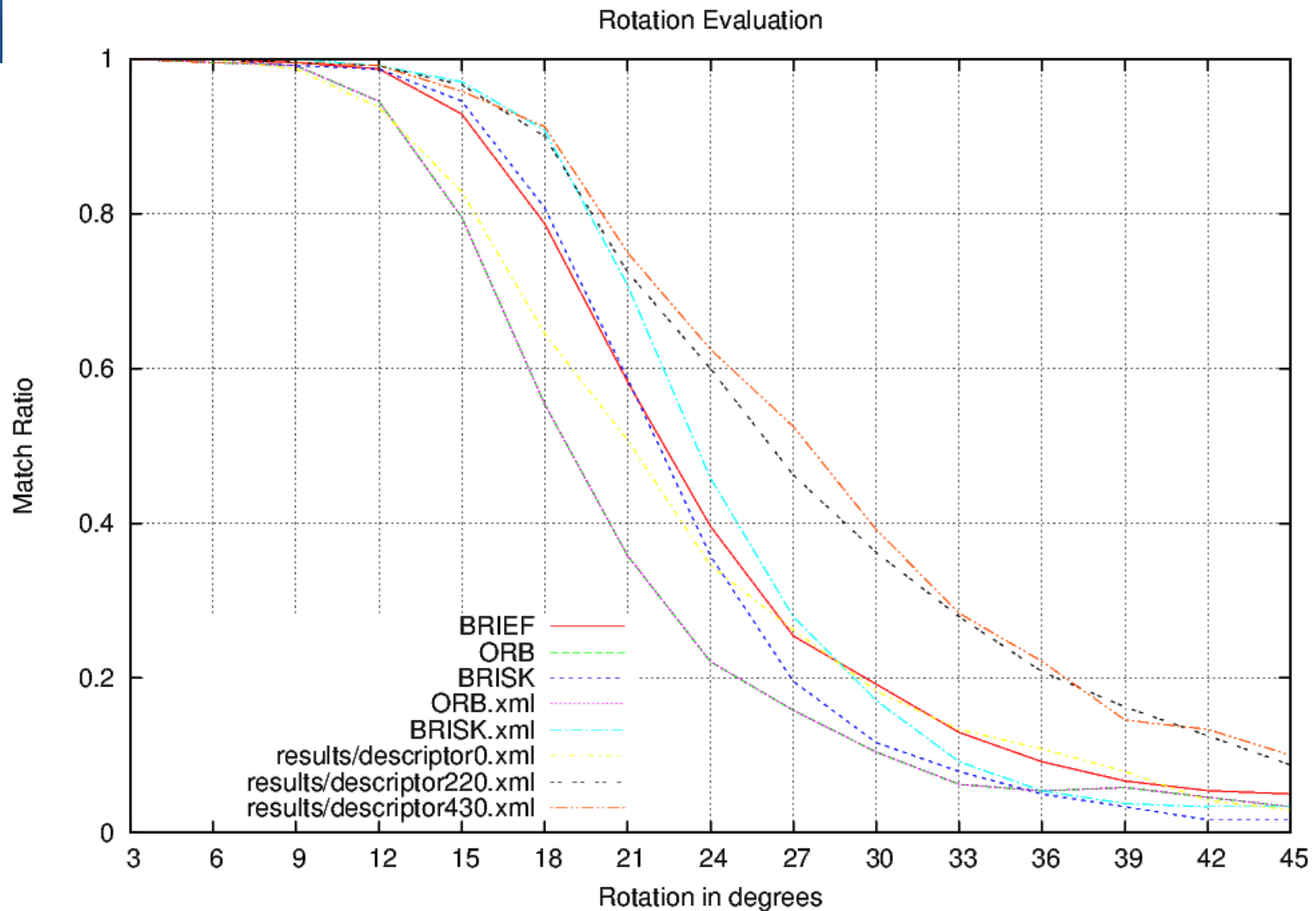
Iteration 0: -275

# Overview: Evaluation

- Rotation
- Scale
- Perspective
- Noise: Gaussian
- Noise: Salt and Pepper
- Lighting
- ROC Curves

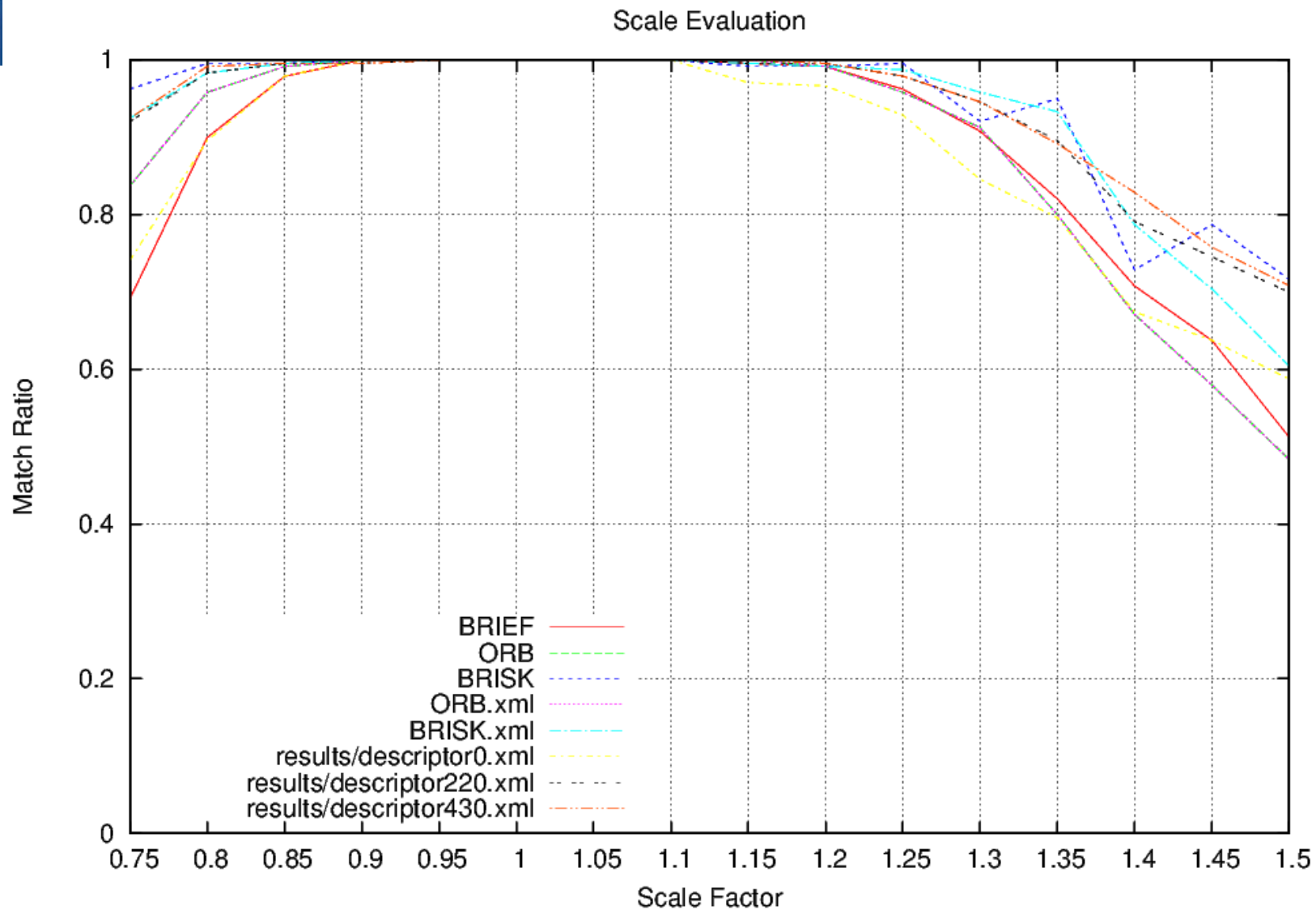


# Rotation



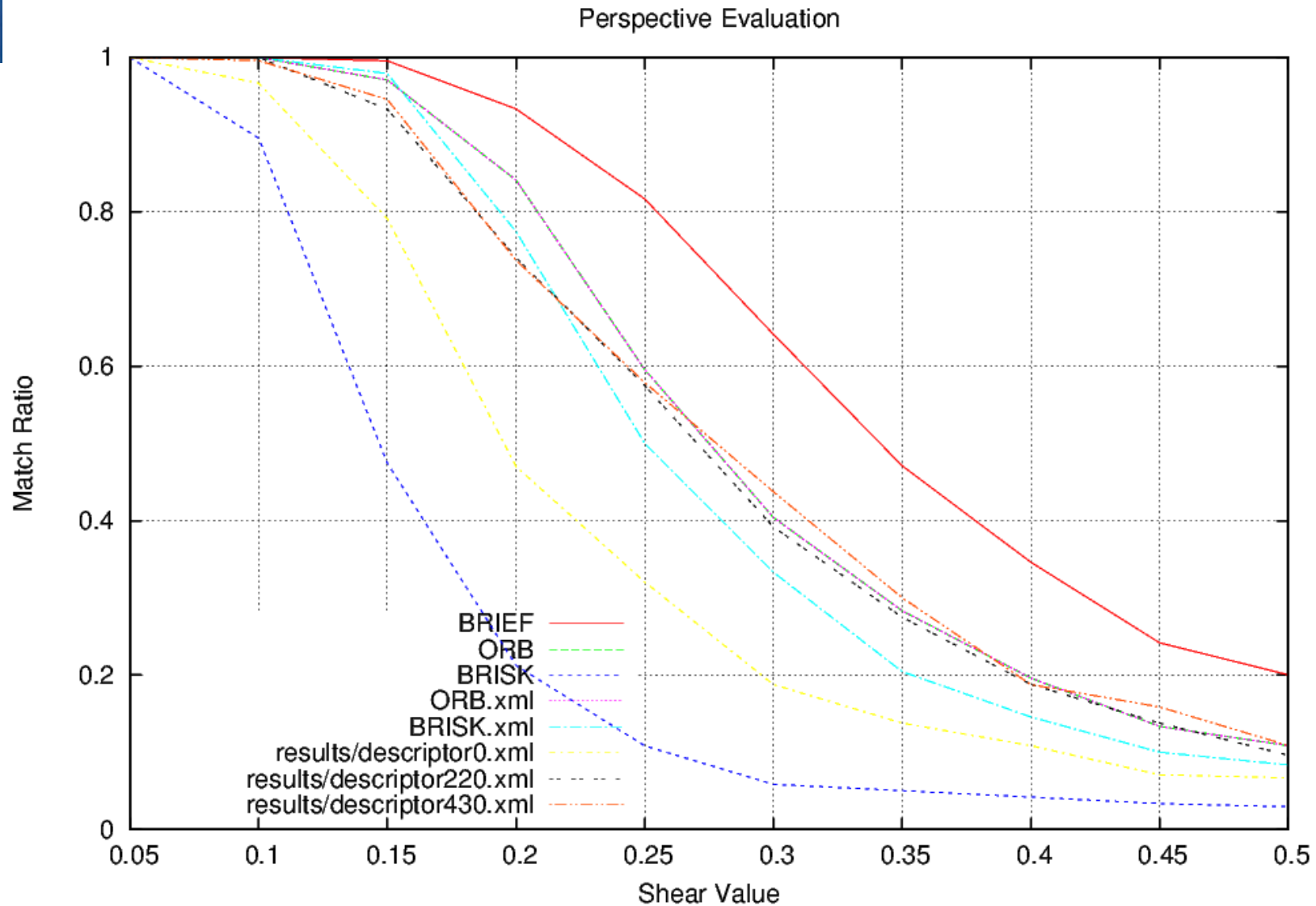


# Scale

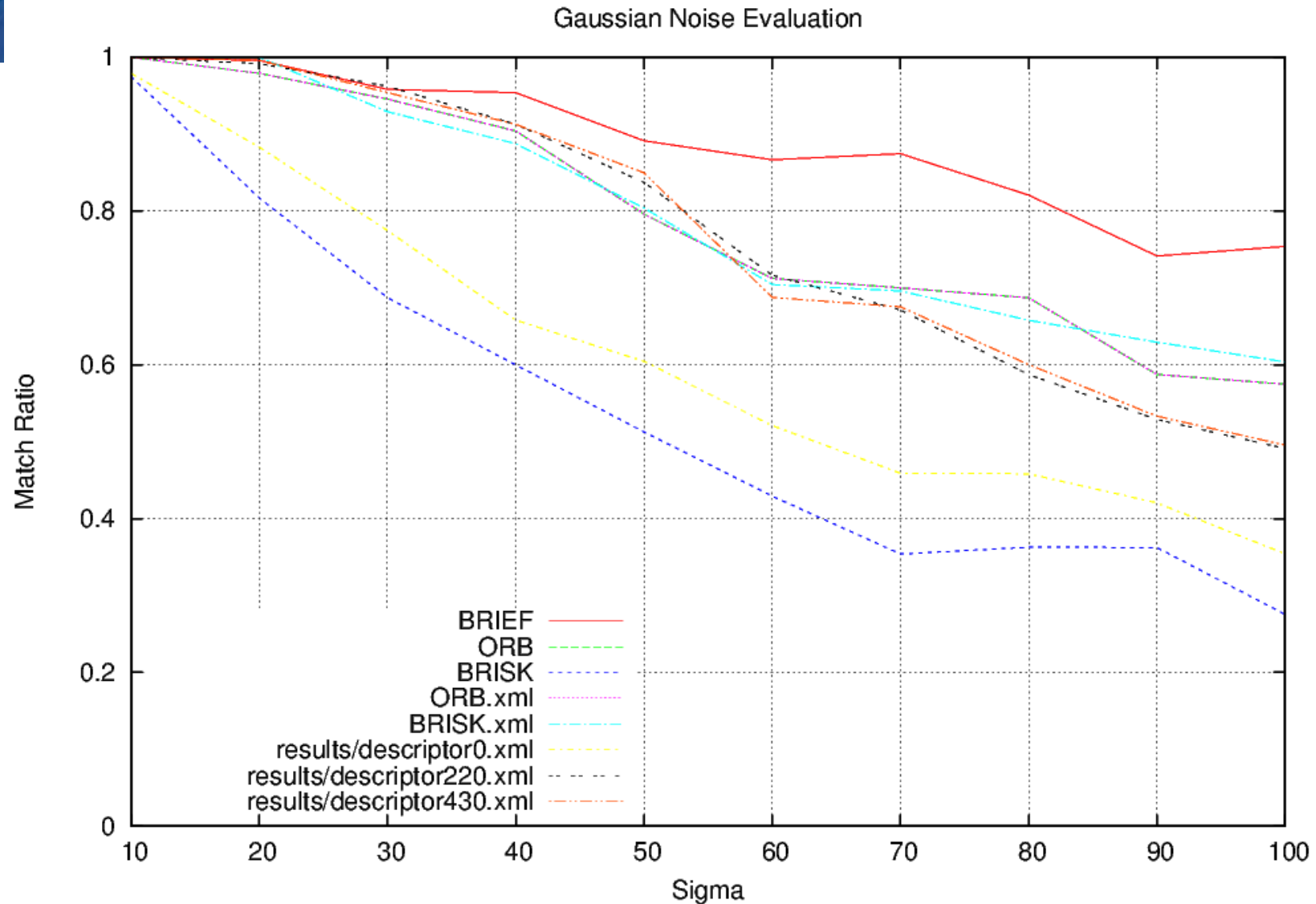




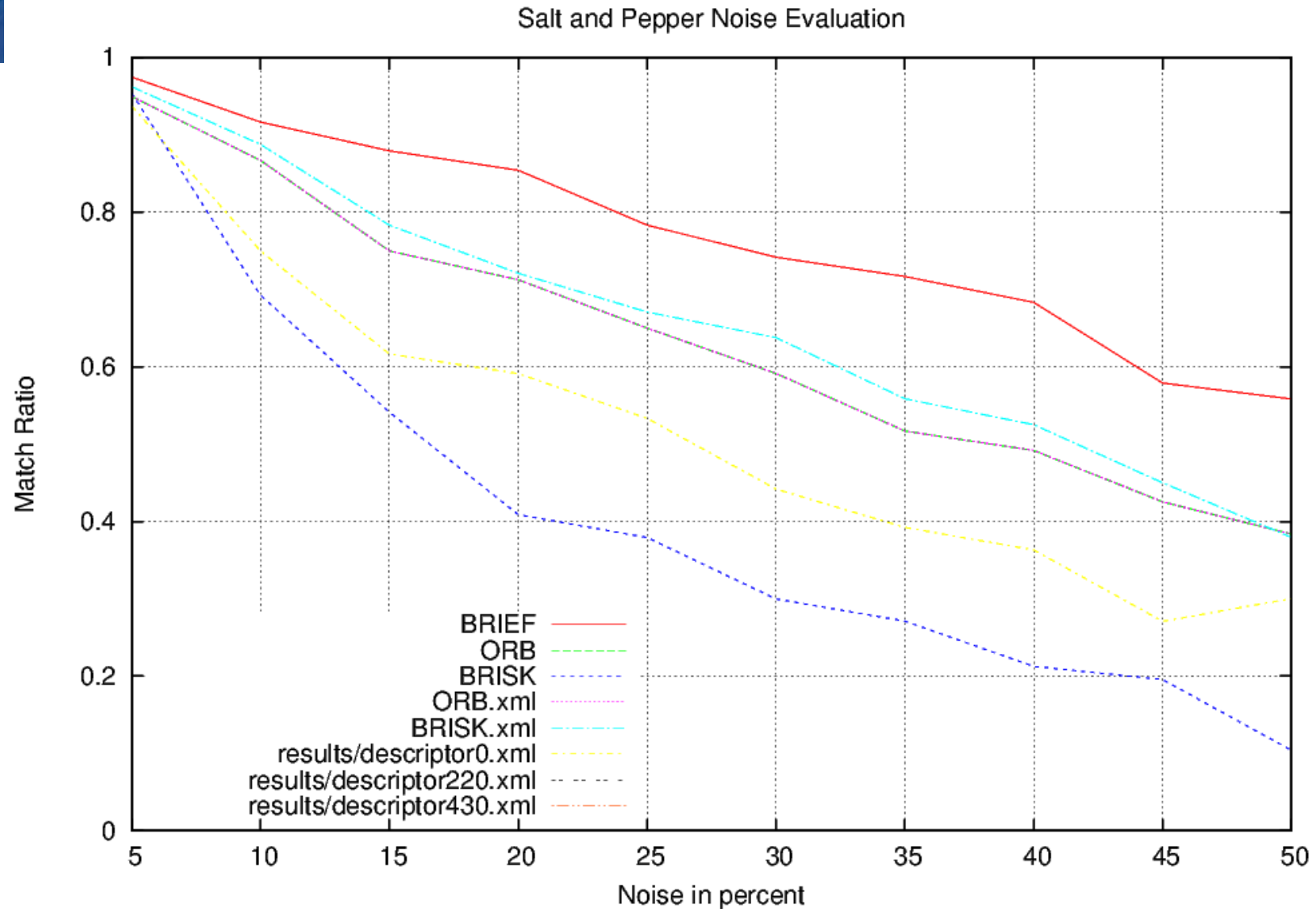
# Perspective



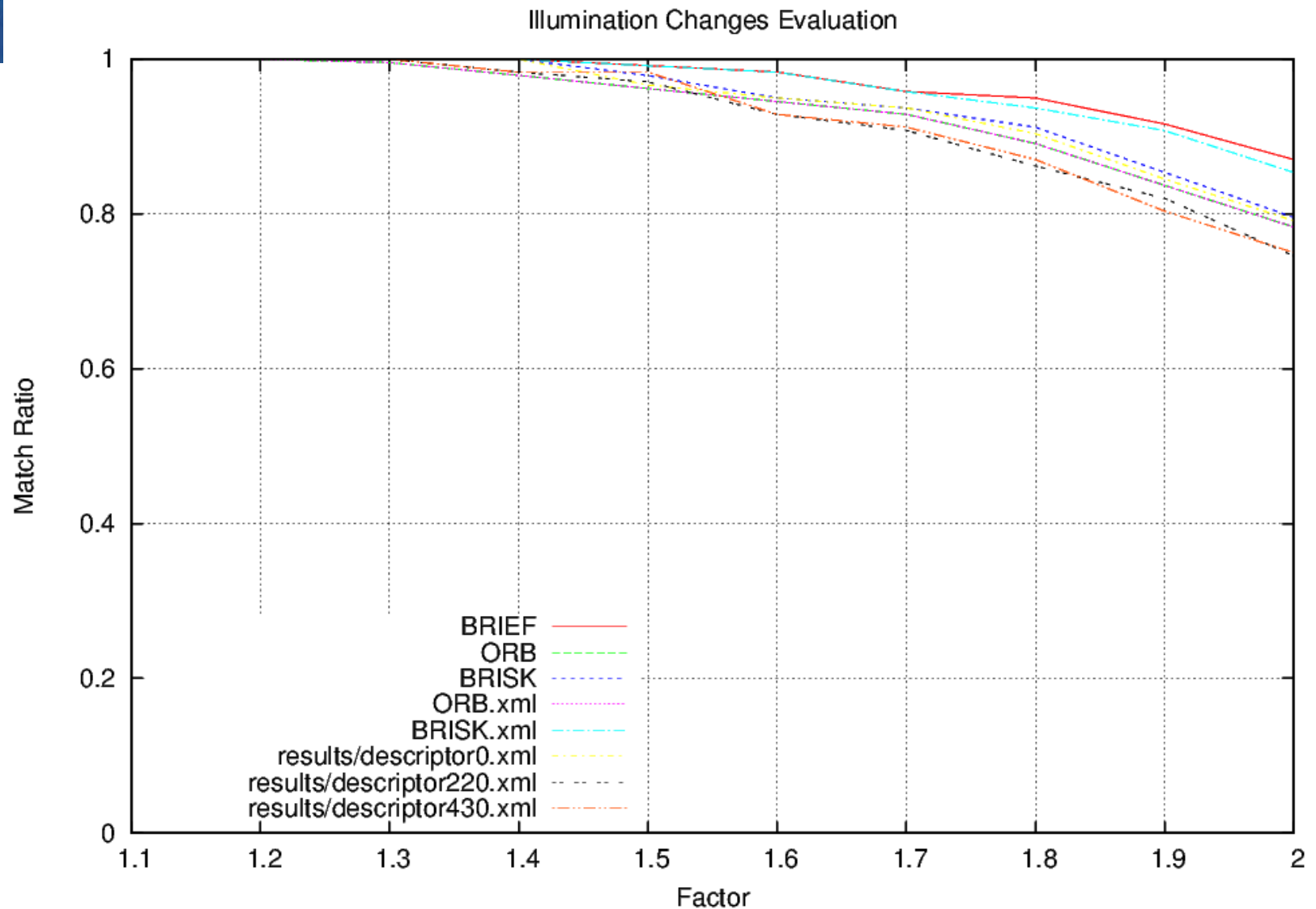
# Noise: Gaussian



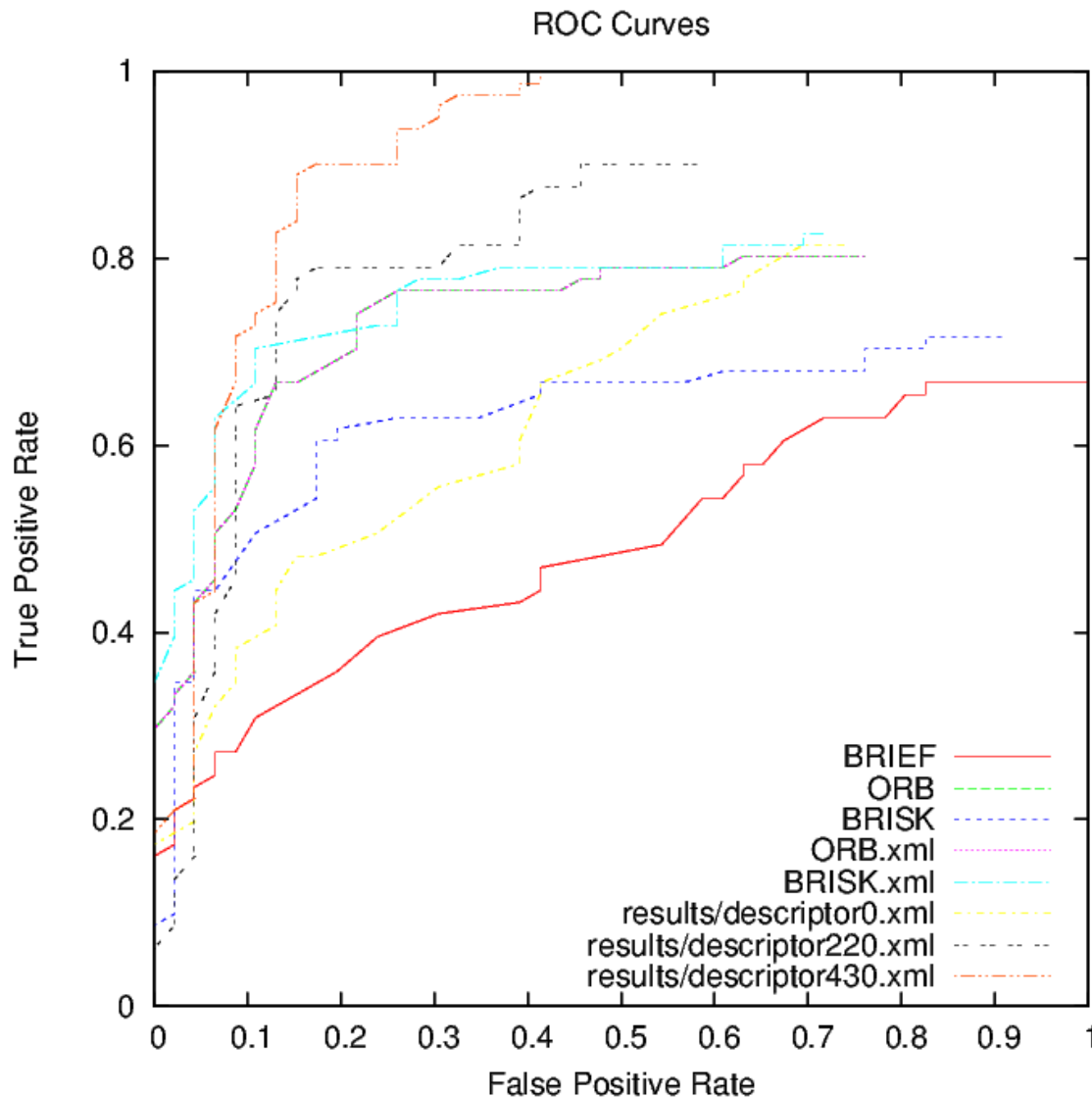
# Noise: Salt and Pepper



# Lighting



# ROC Curves





# Future work

- Avoid overfitting
- Avoid local maxima of optimization metric. Simulated annealing? Less unknowns?
- Improve handling of negative metric values. Penalty for samples which are always equal?
- Try more filters, bit parameters, etc.
- Integrate FREAK for comparison (problem: skipped some keypoints)