Camera Forensics

Jean-Baptiste Boin, Tiffany Jou
Psych 221, Winter
03/20/2013
Goal

- Classify real vs. fake images
- Localize tampered region in fake images
Background

- Camera Forensics
  - Exploit periodicity of Color Filter Array

- Unknown sampling lattice + Unknown interpolation
  - Expectation-Maximization (EM)
Algorithm

- Sliding blocks: 64x64
  - 32 pixels increments
- EM
- Localization: Clustering
- Classification
Algorithm: EM

- Probability map: Fourier Transform
- Alphas
  - Describe interpolation
FFT

- Assume Bayer pattern
- Normal FFT block: high intensity in at least one of 3 points
- Pick the one with highest intensity
- Normalize this value with max value
- “FFT peak”: represents block
- 3 color channels
- alpha vector for every block
- Find median alpha vector of image
- Calculate the norm between alpha vector of each block with median
- Tampered region= large norm values
alphas
Algorithm: Clustering

- 27-dim vector per block
- 2-cluster k-means

Initialization
- Use min FFT peak block as centroid for one cluster
- Find other centroid far away

Force one cluster to be smaller than the other

Different weights between FFT peaks and alphas
Results: Clustering
Results: Clustering
Results: Clustering
Weight sequence
Assumptions

- Only one tampered zone

- Tampered zone is not too small
  - Block size = 64 x 64
  - Lower bound for detection

- Tampered zone is not too big
  - < 60 % of image size
Algorithm: Classification

- **Goal**: separate signal from noise

- **Properties of the signal**
  - One connected component of moderate size

- **Properties of the noise**
  - Small multiple components or one very big (case of large uniform zones)

- **Introduction of parameters to classify our map properly**
Results: Real Image 1
Results: Real Image 2
Results: Real Image 3
Algorithm: Classification

- Parameters
  - Smallest admissible noise
  - Comparison signal to total noise
  - Maximum size of our signal

- Apply for each of the 5 block maps

- Keep the only connected component that verifies our constraints

- If none of them does, the image is classified it as real
Results: Image 1
Results: Image 1
Results: Image 1
Results: Image 2
Results: Image 2
Results: Image 3
Results: Image 3
Results: Image 3
Results: Classification

- 140 given images (70 tampered, 70 untampered)
- Based on test images, we choose our parameters to achieve the best performances
- Degree of freedom on our sets of parameters depending on our priorities: Pareto curve
Results: Classification
Analysis - Reasons of failure

- Size of tampered region
- Sliding blocks of 64x64
- Large uniform zone in real images
  - No peaks, constant
Analysis - Reasons of failure
Ideas for Improvement

- Increase or decrease sliding block size
- Decrease sliding interval
  - More time
- Detect uniform regions
  - Process differently
Conclusion

- Main goal: detect local tampering in image
- For images that follow assumptions, classification & localization works well
- Classify between cameras
  - Use alpha values