A Multiscale and Multi-Perturbation Blind Forensic Technique For Median Detecting

Digital Image Processing

INDIAN INSTITUTE OF TECHNOLOGY BHILAI

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OUTLINE

1.Motivation
2.Median Filtering Artifacts
3.Proposed Approach
4.Experiments
5.Conclusion

MOTIVATION

- Replaces the central pixel by the median of values in a neighborhood defined by a sliding mask.
- Can be used to tamper images and hide traces of tampering.
- Median Filter Detecting method is very useful for checking tampered images helping in areas of laws, press and scientific publications

MEDIAN FILTERING ARTIFACTS

- A well known artifact of median filtering is the streaking artifacts(Streaking: redundant pixels in some image areas)
- In median filtered images, the probability of 2 pixels in a given distance have the same value is high due to the nature of the median filtering.

STREAKING EFFECT

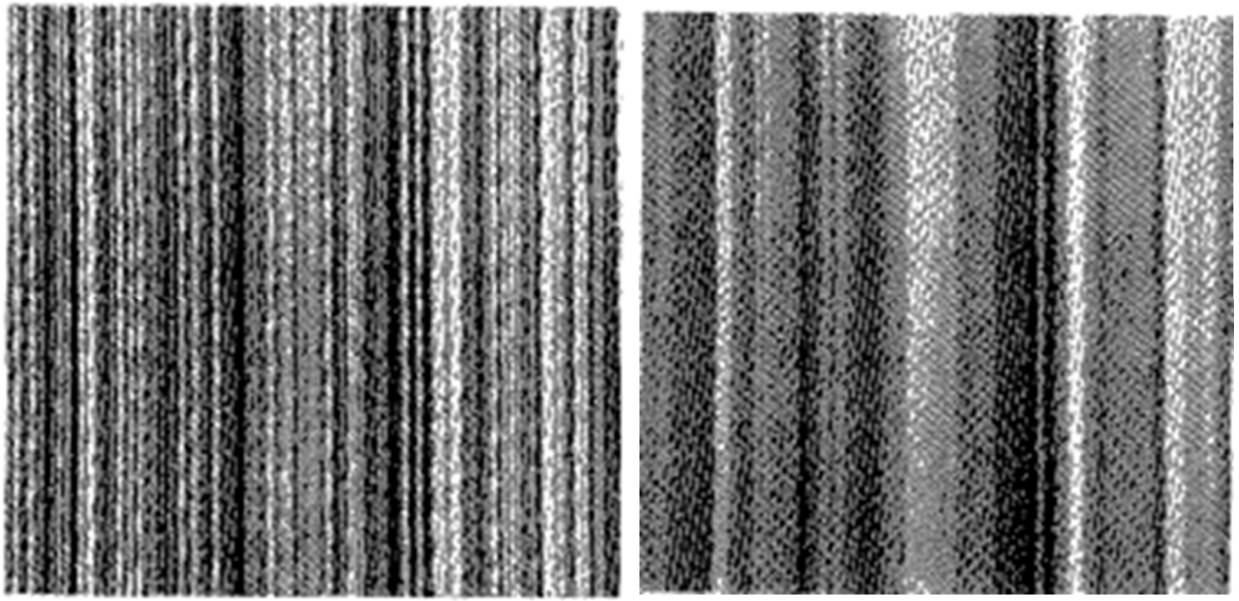

Figure 1: Figure: (left) original image (right) streaking visible as similar pixels in some areas of the image after median filtering

HYPOTHESIS

- **“Images never filtered have different behavior from already filtered images”**
- In this paper different size **median filter** is applied on original images and again filter is applied on previous filtered images

PROPOSED APPROACH

- Highlight the presence of median filtering by emphasizing streaking artifacts through multiple and multi-scale perturbations gauged with IQMS(Image Quality Metrics)
- 8 IQMS are used in this work.
- Two class margin-based classifier (SVM) is used to discriminate between the pristine(unfiltered) and median filtered images

IQM USED IN THIS APPROACH

Given an input image, we compare it to its multiple perturbation Filtered version by using eight bivariate image quality metrics per perturbation and scale:

- Peak Signal to Noise Ratio
- Structural Content
- Average Difference
- Maximum Difference
- Normalized Cross Correlation
- Normalized Absolute Error
- Structural Similarity
- Mean Squared Error

METHOD

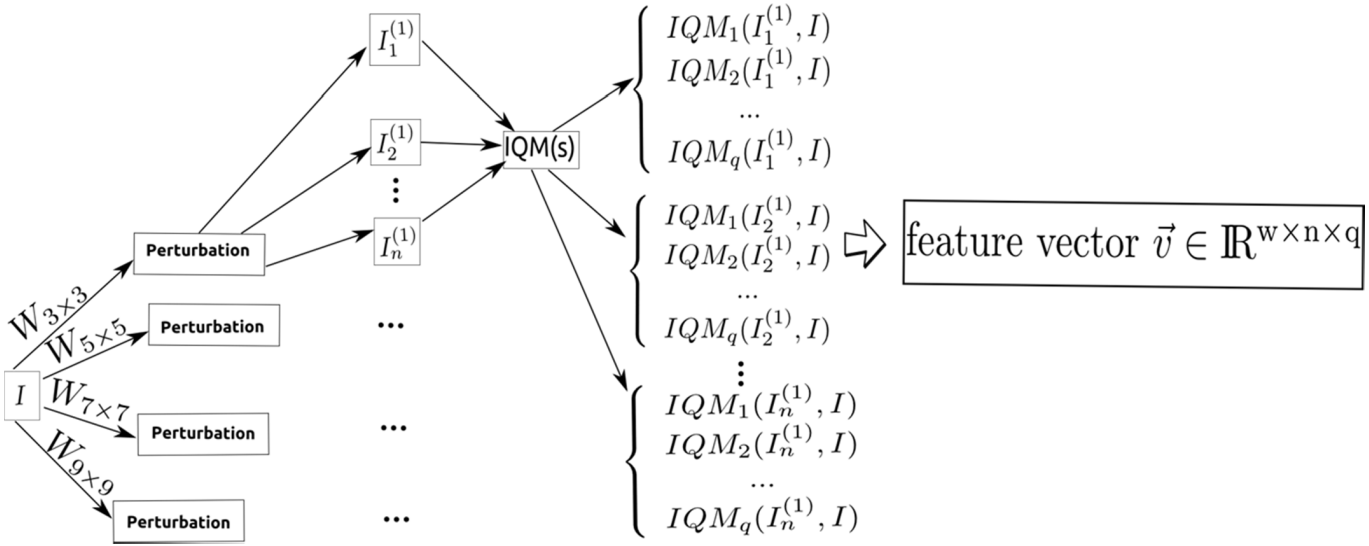

Figure 2: **Conversion of an image into feature vector.**

Source- "A Multi-scale and Multi-Perturbation Blind Forensic Technique For Median Detecting". 19th Iberoamerican Congress on Pattern Recognition

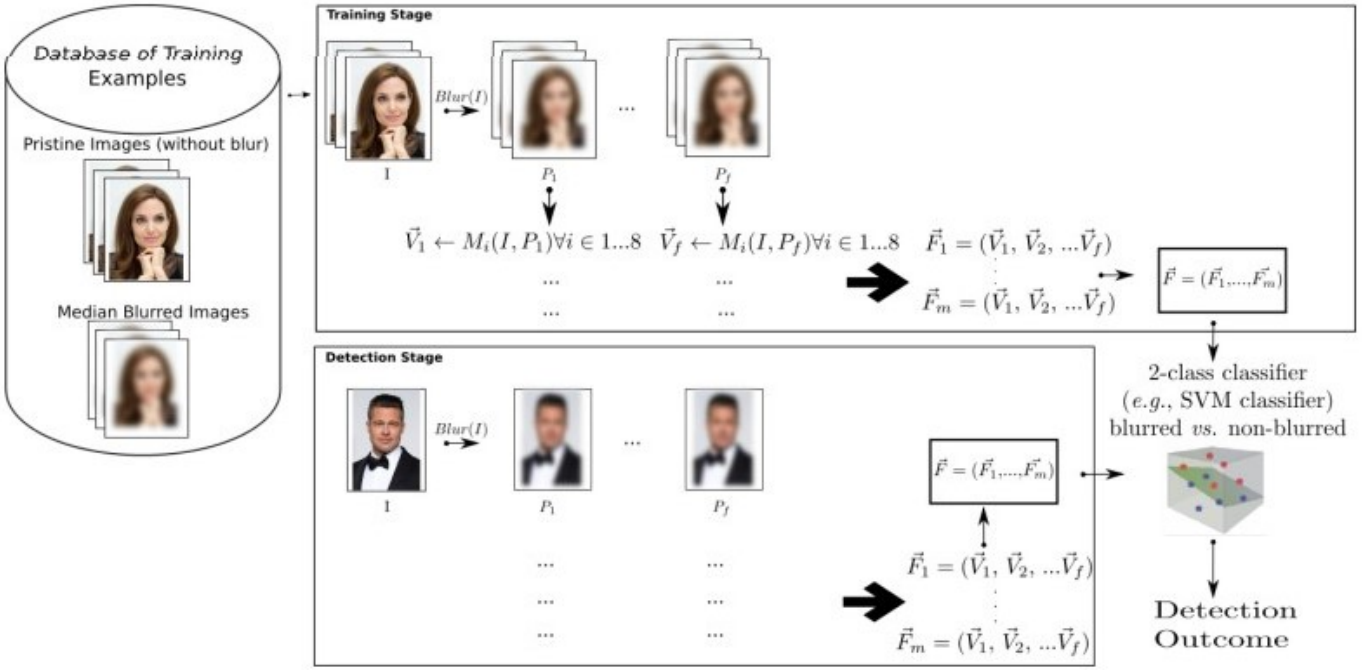

Figure 3: **Proposed technique to detect Median Filtering.**

Source- "Multi-directional and Multi-scale Perturbation Approaches for Blind Forensic Median Filtering Detection". Intelligent Data Analysis (Print), 2016.

EXPERIMENTS

1. **Tuning of parameters**
   - 5x2 cross validation
   - Compressed images.
   - Just one blurring window (3x3)
2. **Cross Dataset**
   - Train with data of previous experiment.
   - Test with new data.
   - Compressed and never compressed images.
   - Blurring windows in test dataset (3x3,5x5,7x7,9x9).
   - Comparison with the state of the art.

Pertubations	Window Size	accuracy
3	3x3	**98.8±0.22**
4	All windows(Multiscale)	98.7±0.29
3	All Windows	98.7±0.28

Table : This is result after 5X2 cross validation Experiment

Dataset :

- **CASIA compressed images-**
  https://www.kaggle.com/sophatvathana/casia-dataset
- **UCID uncompressed images-**
  https://drive.google.com/drive/folders/1–jUoVNqFPpiSc79hllHmGHNs4S-l4JU

COMPARING AGAINST STATE OF THE ART METHOD

We now turn our attention to comparing the classification results of two of the three best approaches of the proposed technique with 128 and 96 dimensional feature vectors

- **FPMW (Four Perturbations, Multiple Windows)**
- **TPMW (Three Perturbations, Multiple Windows)**

  In addition, we also experimented with the 3^{rd} approach with 24 dimensional feature vectors.
- **TPOW (Three Perturbations, One Window)**

	TPMW	FPMW	SPAM	MFF	GLF
Accuracy	82.1%	84.5%	70.1%	70.1%	65.1%
Sensitivity	92%	91%	98%	88%	99%
Specificity	72%	77%	42%	52%	31%
Precision	76%	80%	62%	64%	59%
Significant?	yes	–	yes	yes	yes

Table 1: Compressed dataset experiments results presented in paper.

	TPMW	FPMW	TPOW	SPAM	MFF	GLF
Accuracy	81%	84%	69%	70.1%	70.1%	65.1%
Sensitivity	90%	91%	80%	98%	88%	99%
Specificity	67%	72%	50%	42%	52%	31%
Precision	82%	86%	73%	62%	64%	59%
Significant?	yes	–	yes	yes	yes	yes

Table 2: Compressed dataset experiments results replicated by our group.

	TPMW	FPMW	SPAM	MFF	GLF
Accuracy	82.2%	80.8%	77.9%	74.2%	79.9%
Sensitivity	78.2%	74.4%	68.3%	76.9%	90.9%
Specificity	90.2%	91.5%	90.6%	78.6%	76.8%
Precision	88.9%	89.8%	87.9%	78.3%	79.7%
Significant?	yes	–	yes	yes	yes

Table 3: Cross dataset experiment with compressed and uncompressed images presented in paper.

	TPMW	FPMW	TPOW	SPAM	MFF	GLF
Accuracy	82%	80%	71%	77.9%	74.2%	79.9%
Sensitivity	80%	79%	71%	68.3%	76.9%	90.9%
Specificity	90%	84%	69%	90.6%	78.6%	76.8%
Precision	96%	94%	86%	87.9%	78.3%	79.7%
Significant?	yes	–	yes	yes	yes	yes

Table 4: Cross dataset experiment with compressed and uncompressed images' results replicated by our group.

CONCLUSION

- Novel approach to forensically detect median blurring traces on digital images
- Training with SVM classifier on such feature space, the method can automatically find traces of filtering even with a simplified training set

References

- https://recodbr.wordpress.com/2016/04/13/multi-directional-and-multi-scale-perturbation-approaches-for-blind-forensic-median-filtering-detection/
- youtube

THANKING YOU

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