Detecting Blurred Ground-based Sky/Cloud Images

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# Table of contents

1. Dataset

2. Methodology
   - Proposed Framework
   - Metrics for Blur Detection

3. Experiment

4. Results
Introduction

- Cloud observation has an important role in various areas like weather forecast, meteorology research, and solar energy forecasting.
- Nowadays, ground-based observation devices are preferred over their satellite counterparts [1]. These whole sky imagers (WSIs) provide images with high temporal and spatial resolution at a low cost [2].
- However, these images are also prone to high noise and blur due to many reasons.
- Blurry images may lead to false detection of cloud pixels in sky/cloud image segmentation [3] and image classification [4] tasks.
- Therefore, it is important to detect the blurred images before proceeding with further imaging analysis.
### Dataset

- The images in the experiments are captured by a ground based sky camera situated in New Delhi, India [2].
- This camera captures images at regular 5 minute intervals throughout the day.
- However, considered only day-time images in this study.
Examples from Dataset

Blurred images

Non-blurred images
For detection of blur in sky/cloud images, use of an external marker is proposed. The marker should be static and have sharp distinct boundaries. The proposed framework works as follows:

- Add an external static marker in the field of view of captured images.
- Analyse the whole- and cropped- version (with marker) of the captured image.
- Detect if the external static marker is blurred or not using a blur-detection metric.
Proposed Framework
After many experiments, the most competitive results given by Laplacian operator [5] and Fast Fourier transform (FFT) [6].

Laplacian operator is a second order derivative operator often used to detect edges in pictures. It highlights regions of an image that contain rapid intensity changes.

Fast Fourier transform (FFT) calculates the frequencies at different points in the image. This algorithm is based on the set level of frequencies determined by the user, that decides whether the image is blurry or not. If the amount of high frequency in the image is low, then the image is declared to be blurred.
These metrics require a threshold to categorise the image as blurred or non-blurred.

This selection of the threshold is critical and done by the user [5].

For this experiment, manually selected the value of these thresholds in our experiments: $+12$ for the Laplacian method and $-4$ for the FFT method.
• Evaluate the performance of the framework using both Laplacian operator and Fast Fourier Transform operator.
• Compute the blur metric for both entire image and cropped version of the image containing the marker.
• Using this computed blur metric, classification of image as blurred and non-blurred.
• Use an image repository of 100 sky/cloud images and manually label each image as blurred or non-blurred. These labels act as the ground-truth in our classification framework.
Results

| Image Analyzed               | Accuracy (Laplacian) | Accuracy (FFT) |
|-----------------------------|----------------------|----------------|
| Complete Image              | 64%                  | 61%            |
| Cropped Image w/Marker      | **94%**              | **92%**        |

Blur detection accuracy for Laplacian and FFT methods for complete image vs only marker portion of the image. Better accuracies are depicted in boldface.

- The accuracy of detection of blur increases significantly for the cropped-image of the pole for both the algorithms.
- Furthermore, the Laplacian operator performs better than the FFT operator.
- Propose the use of Laplacian operator on the cropped version of the image (containing marker) to identify the blurred images.
Conclusion

- Propose a technique of automatically identifying blurred images in an image repository.
- Using an external static marker, obtained good accuracy in identifying the blurred images.

Future work:
- Extend this approach to nighttime images
- Use other external markers.
| Reference                                                                                       |
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