Automatic Lens Smear Detection

Homework 1, 2019.4.21

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Video Demo of Smear Detection Result

Original video

Variation image: White pixel means less variation

Thresholding on variation image, and find connected components.

Detected smears

(Check out the video here)

What is a lens smear?

Dirt, dust or smear on the lens that stains the picture.

We want to detect and remove the smears before using these images for building road map.

Method 1 - Overview

Assumption:

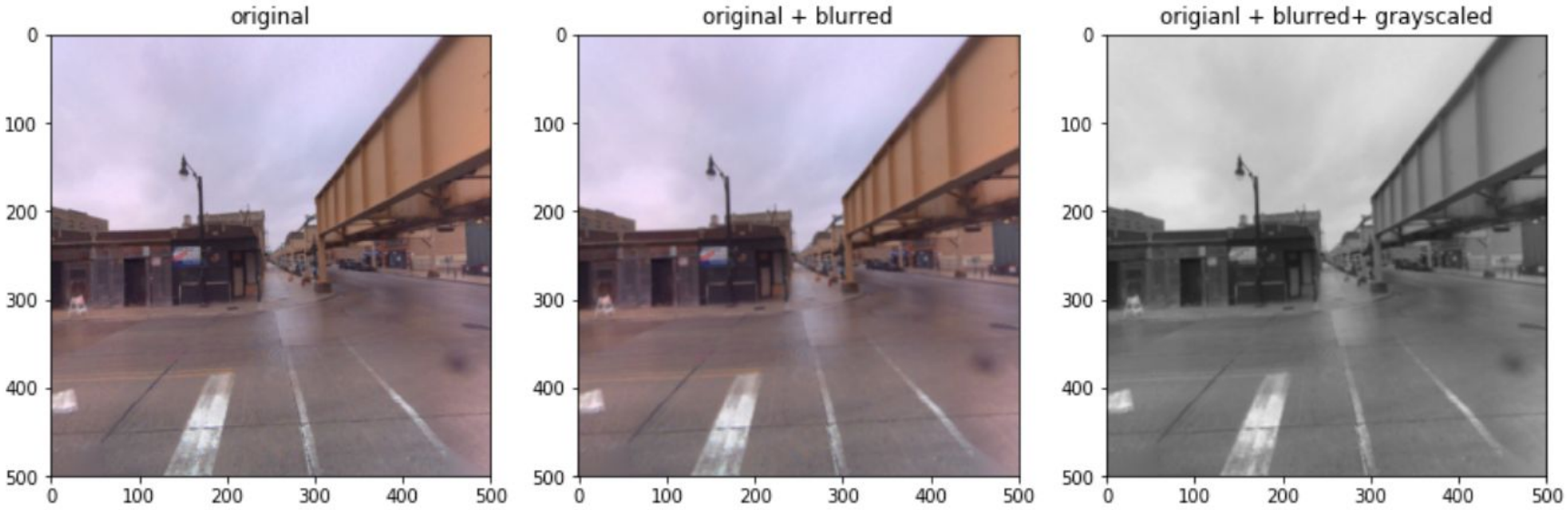
A smear is a circular-shaped region with black/white color that is different from its surroundings.

Workflow of algorithms:

Step 1: Apply Gaussian blurring to smooth the source image.
Step 2: Transform image color from RGB to gray.
Step 3: Binarize image by image thresholding algorithm.
Step 4: Do edge detection to find object contours.
Step 5: Choose connected components with proper shape and size, which are the smears.

Method 1 - Approach

Step 1-2: **Gaussion blurring** + Transform RGB to **gray**



Method 1 - Approach

Step 3: **Binarize image** by image thresholding algorithm.

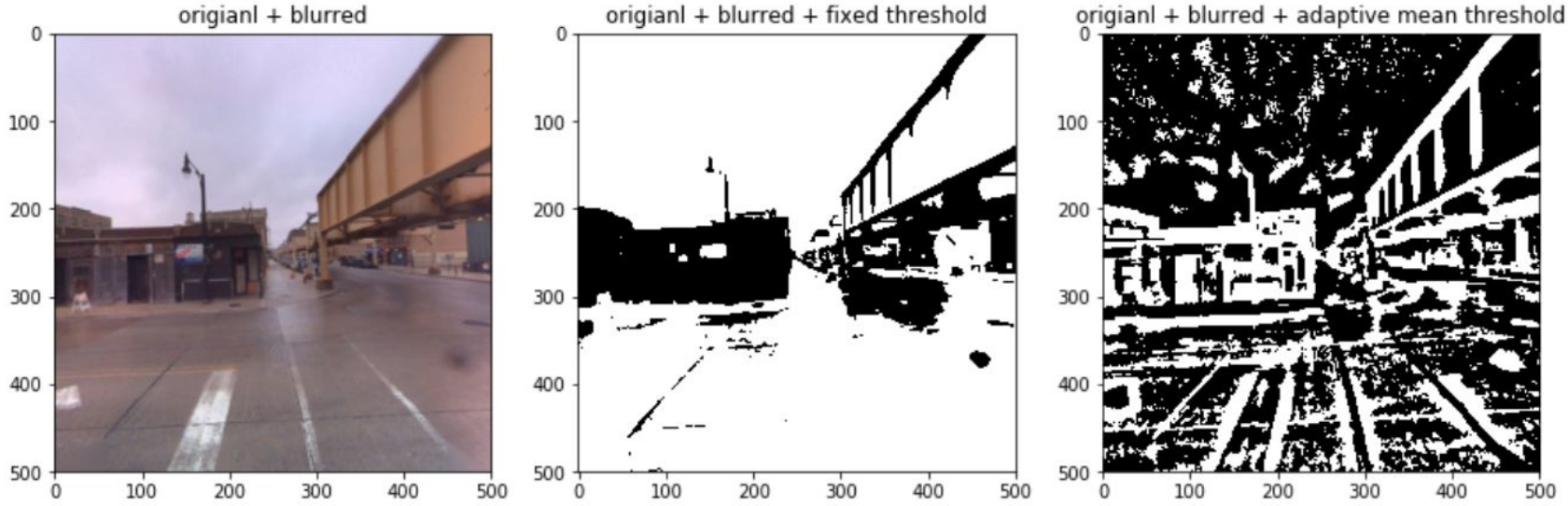


Figure: Comparison of **fixed threshold** and **adaptive mean threshold** algorithm.

Method 1 - Approach

Step 3: **Binarize image** by image thresholding algorithm.
Fixed threshold is better if we know the smear's pixel intensity.

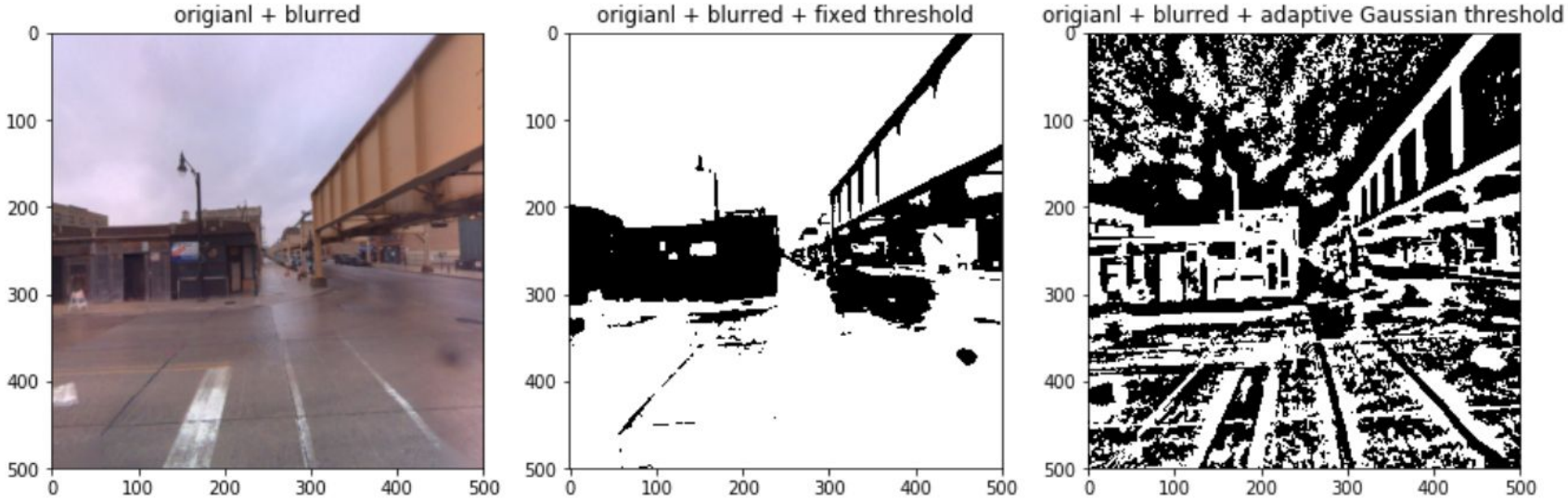
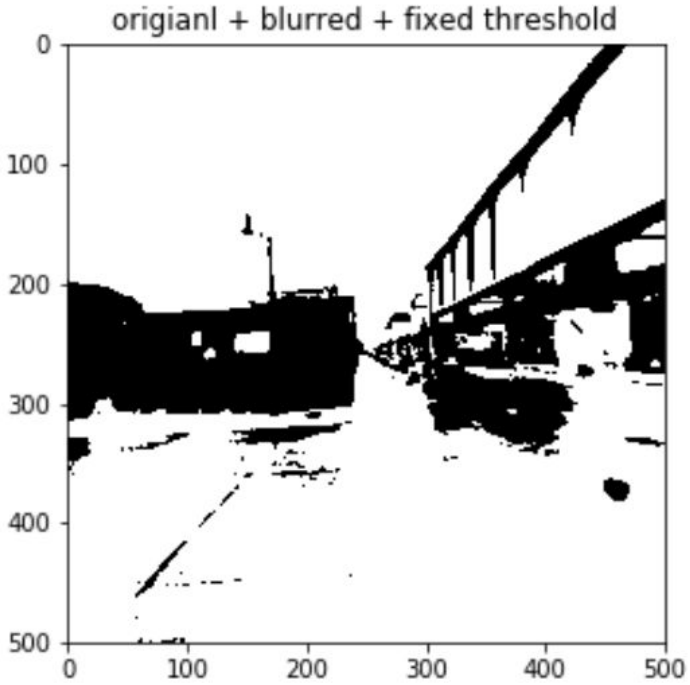
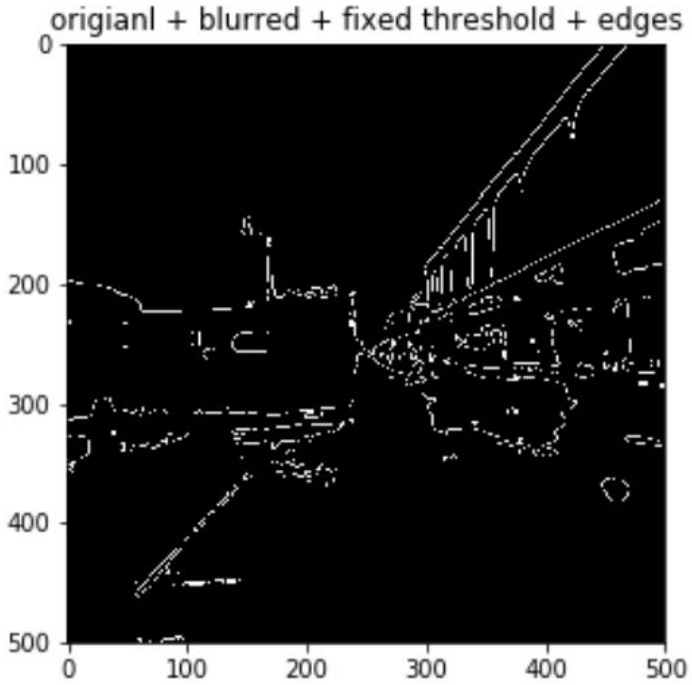


Figure: Comparison of **fixed threshold** and **adaptive Gaussion threshold** algorithm.

Method 1 - Approach

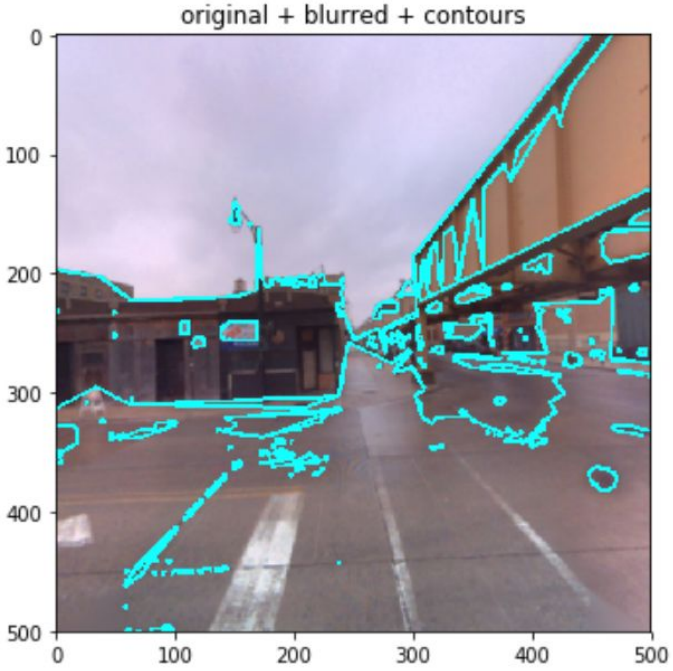
Step 4: Do **edge detection** to find object contours.

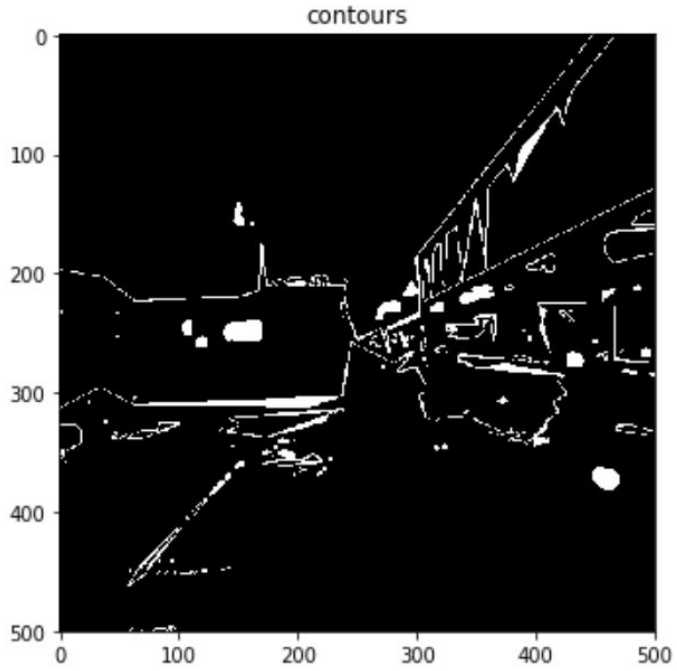




Method 1 - Approach

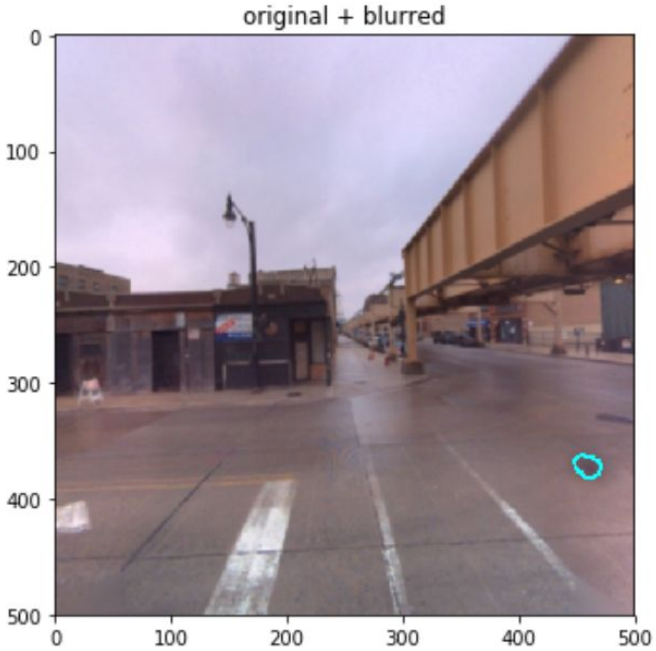
Step 5: Detect **connected components** from the edge detection result. Find contours, and analyse the shape and size.

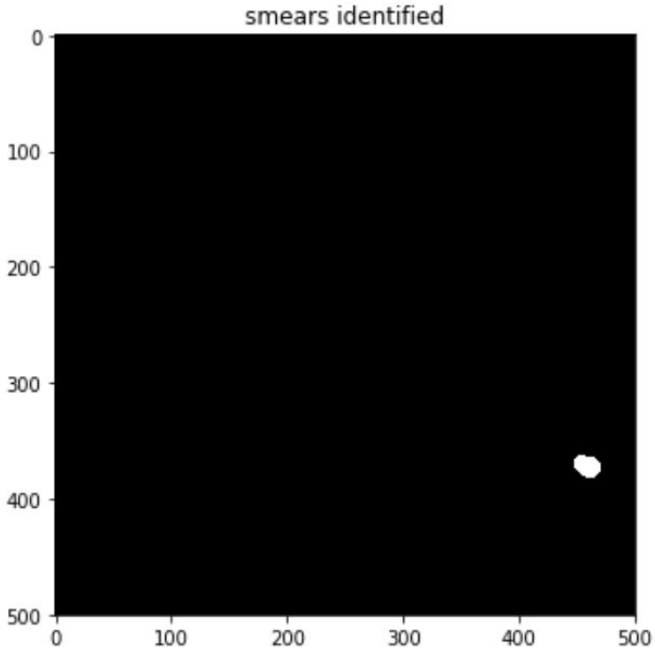




Method 1 - Result

Result: A region with circular shape and a proper size is considered as a lens smear.





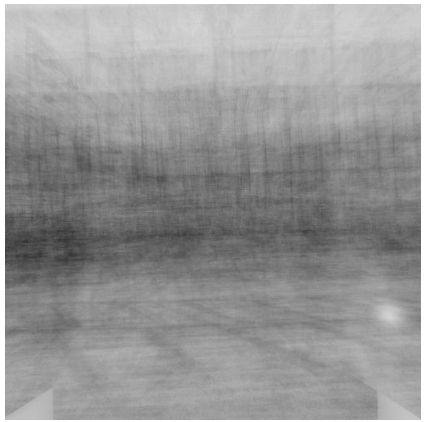
Method 2 - Approach

Assumption: A smear is at a fixed position on the lens, which keeps unchanged during the video.

Workflow of algorithms:

1. Use a window size of 500 frames to store past gray images.
2. Sum up the differences between each adjacent image pairs.

Variation image:
Whiter pixel means its corresponding pixel in video **changes less**.



3. Use Method 1 to detect smears on this image, which are white regions.

Method 2 - Result

The smear is robustly detected in the video:

Thank you!