Hacettepe University Computer Engineering Department

CMP717 – Image Processing

Project

Edge Preserving Filters and Segmentation

Edge-preserving smoothing or filtering is an image processing technique that smooths away noise or textures while retaining sharp edges. Examples are the median, bilateral, guided, anisotropic diffusion, and Kuwahara filters. (*Wikipedia: https://en.wikipedia.org/wiki/Edge-preserving_smoothing*)

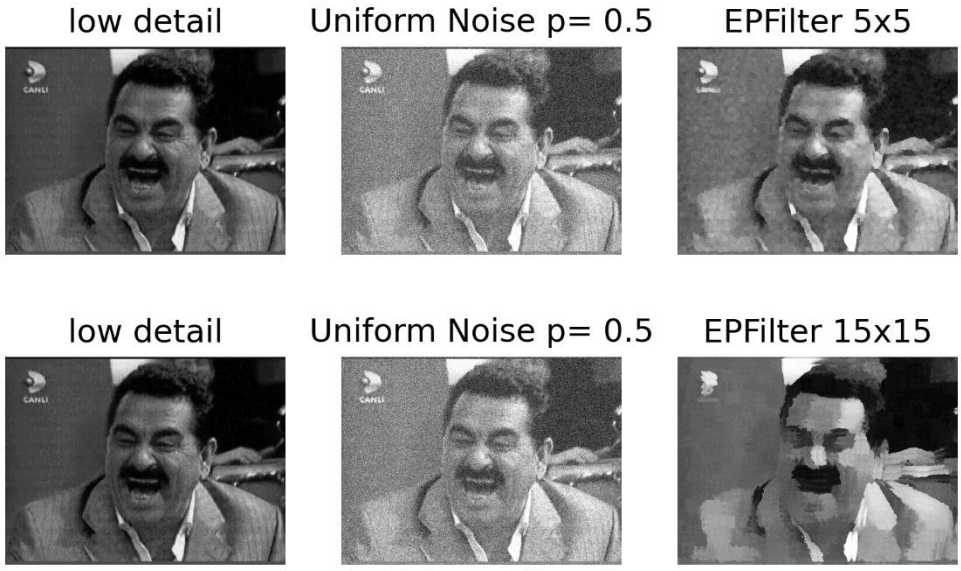
In this experiment, you will analyze and discuss the effectiveness of edge-preserving filters in some special conditions, and then will analyze the segmentation methods.

Preparation

In the first part of the project, first, you'll choose **three** filters. You may implement or find the implementation of these filters. You can use any environment (python, OpenCV, Matlab, etc.)

I'll provide a set of Medical images containing low, medium and high details.

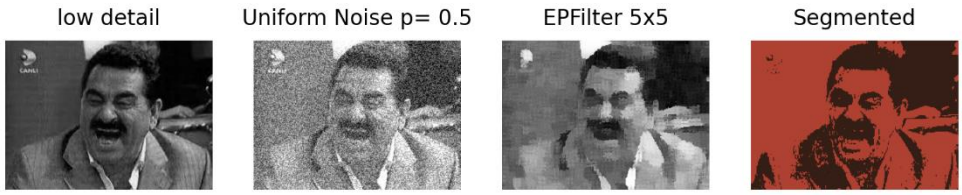
You'll add uniform noise to these images.



(Quote: When you said, "They applied me uniform noise İbrahim abi", I came and applied the edge-preserving filter.)

In the second part of the project, first, choose **three** segmentation methods - Clustering based / Split-Merge / Graph-based / Auto-Thresholding (e.g. Otsu). You can use two classes for parametric methods. Use intensity values as features. You may implement or find the implementation of these methods. You can use any environment (python, OpenCV, Matlab, etc.)

You'll add uniform noise to these images. Then you'll experiment the effect of edge-preserving filters on segmentation.



(Quote: *Look, I'm a son of a scumbag, I'm trying hard not to cry*.)

1st Step of the Experiment

You have three edge-preserving filters (A,B and C).

- You have two filter sizes 5x5 15x15. If filter sizes do not apply to your choices, change and state the situation in your report.
- Uniform noise should be distributed between 0 and 255
- Apply noise in 0.1, 0.5, and 0.8 probability. (0.1 prob means %10 of the pixels will be distorted)

You have a set of medical images.

- Change images to grayscale if it's necessary.

Experiment Flow

- Apply U noise
    - 0.1 probability
        - Apply filters (A,B,C)
            - For 5x5
            - For 15x15
    - 0.5 probability
        - Apply filters (A,B,C)
            - For 5x5
            - For 15x15
    - 0.8 probability
        - Apply filters (A,B,C)
            - For 5x5
            - For 15x15

2nd Step of the Experiment

After the first part, choose a better-performing edge-preserving filter according to your evaluation.

You have an edge-preserving filter of your choice (EPF).

- You have two filter sizes 5x5 and 15x15. If filter sizes do not apply to your choices, change and state the situation in your report.

You have Uniform Noise to apply (U).

- Uniform noise should be distributed between 0 and 255
- Apply the noise in 0.1, 0.5, and 0.8 probability. (0.1 prob means %10 of the pixels will be distorted)

You have a set of images.

- Change images to grayscale.

Experiment Flow

Image set S

- Apply U noise
    - None
        - Apply filter
            - None
            - For 5x5
            - For 15x15
    - 0.1 probability
        - Apply filter
            - None
            - For 5x5
            - For 15x15
    - 0.5 probability
        - Apply filter
            - None
            - For 5x5
            - For 15x15
    - 0.8 probability
        - Apply filter
            - None
            - For 5x5
            - For 15x15
- Apply all segmentation methods separately and present the results in your report.

Submission

Codes

Submit the codes for your experiment.

Report

Introduction:

- Briefly (in one or two paragraphs) describe the filters, noise and segmentation methods in the introduction part.

Tools:

- Which environment and preparations are needed to run your experiment?

Results:

- Necessary code samples to create the images and the outcomes(images) with proper description.

Discussion:

- What are your observations about different filter types? Different filter sizes?
- Which filter is better in different noise and detail cases? Provide your opinions and observations.
- Which segmentation method is better in different noise and detail cases? Provide your opinions and observations. This is a highly subjective point of view; just stick with your observations.

References:

- List all references you've used in the experiment.