

Lab 4: Nonlinear Filters



Primary Goal: Compare the mean and median filters for denoising.

Secondary Goal: Practice critical writing and displaying statistics.

Your goal is to run the mean and median filters on noisy color images and discuss how the results change with the image size. You may pick any color image from the web, but please pick a PG-rated image. It would be best if the image dimensions are roughly square (width=height).

1.) First add 5% salt & pepper noise to your color image and run the 5x5 mean and median filters. Note `medfilt2` is built for grayscale images, so you will have to median filter each RGB band separately, similar to the previous lab. Create an appropriate subplot that displays the noisy image, the mean filtered image, and the median filtered image. These are the only 3 images you will have to include in your report.

2.) Next use the `imresize` command to create 4 versions of your original noise-free image with the following sizes:

500x500

1000x1000

2000x2000

4000x4000

Add 5% salt & pepper noise to each of these images and then denoise them using the mean and median filters. Record the runtime of each filter using the `tic` and `toc` commands. Also compute the RMSE and SNR for each filtered image. You will have to think carefully about how to display your results in a table (or multiple tables). You do not need to include the images in your report.

3.) Finally, create a plot that shows the runtimes vs. the image size. Plot the mean and median filter runtimes on the same axes. Make sure the two lines are distinct in the plot and include a legend. Remember to label your axes using `xlabel` and `ylabel`.

Note: The major challenge of this lab is to organize all your data. I suggest creating a Matlab script that first resizes the image, adds noise, filters, and then computes all the statistics. You can then simply change the image size and re-run the script.

What to Include in Your Report

1. *[5 points]* A figure that displays your noisy image, the mean filtered image, and the median filtered image. Be sure to include titles on each image and a caption on your figure.
2. *[5 points]* Data table(s) showing the RMSE, SNR, and runtimes for the 4 different image sizes. Include a caption on each data table.
3. *[5 points]* A figure showing a plot of the runtimes of the filters on the same axes. Include a legend in your plot and a caption on your figure. Be sure your axes are labeled and the plotted lines are distinct.
4. *[5 points]* Write a paragraph that briefly describes the relative performance of the mean and median filters in terms of visual quality, RMSE, SNR, and runtime. Refer to your tables and figures in your text.