

A User Guide

A Novel Family of Edge Preserving Anisotropic Filters

In this study, new anisotropic image filters are introduced and their performances are compared with existing isotropic and anisotropic filters. The developed filters were examined according to their image noise removing performances in terms of standard image quality metrics, as well as the edge preserving properties of the filtered images. Mathematical inferences of anisotropic filters are made based on the minimization of the Polyakov action energy integral. New anisotropic metrics are found by means of Finsler metrics that minimize the corresponding integral. The new metrics perform filtering by updating the image with anisotropic Laplace-Beltrami flow. After filtering, it was observed that the introduced metrics perform well against other anisotropic metrics. It is also observed that the developed New Randers, New Normalized Miron, and New Metric filters preserve edges better than other filters, making it a plausible noise removal tool prior to edge detection in image processing. The source codes of proposed filters are publicly available at <https://github.com/HAYDARKILIC>.

As you can see below, the main panel of the application is seen. In general, the filtering performances and edge protection performances of any image are compared by using isotropic and anisotropic filters.

The screenshot displays the main panel of the application, which is designed for comparing the performance of different image filters. The interface is organized into several sections:

- Image Path:** A text input field for specifying the image to be processed, accompanied by a "Select Image" button.
- Noise Controls:** Two input fields for "Gaussian Noise" and "Salt Pepper Noise", both currently set to 0. A toggle switch for "Add Noise" is currently in the "Off" position.
- Filter Selection:** Two dropdown menus labeled "I. Filter Selection" and "II. Filter Selection", both currently set to "Gauss".
- Algorithm Selection:** A dropdown menu labeled "Algorithm Selection" currently set to "Genetic Algorithm".
- Scale and Step Parameters:** Input fields for "I. Scale Parameter", "II. Scale Parameter", "I. Step Size", and "II. Step Size", all currently set to 0.
- Algorithm Toggle:** A toggle switch labeled "Algorithm" is currently in the "Off" position.
- Image Display Area:** Two large empty rectangular boxes labeled "Original Image" and "Noisy Image" are provided for visual comparison.
- Iteration and Calculation:** An "Iteration Number" input field is set to 0, and a "Start Calculation" button is located below it.
- Statistical Results:** A section at the bottom containing two columns of results for "I. Filter Results" and "II. Filter Results". Each column includes input fields for MSE, PSNR, and SSIM, all currently showing 0.
- Results Panel:** A large section on the right labeled "Results" containing eight smaller image display areas arranged in a 4x2 grid. The top row shows "I. Filtered Image" and "II. Filtered". The second row shows "Original Image C" and "Noisy Image C". The third row shows "I. Filter Cann" and "II. Filter Cann". The bottom row shows "I. Filtered Image" and "II. Filtered". Each of these smaller images has a set of interactive icons (hand, zoom, pan, etc.) to its right.

You can select any picture on your computer from the following section of the main panel by pressing the "Select Image" button. You can also add Gaussian or Salt Pepper Noise in this section. No noise will be added if you don't turn the "Add Noise" switch to "On".

Image Path

Select Image

Gaussian Noise Salt Pepper Noise Add Noise Off ☐ On

When you turn the switch to the "On" position, the noise image will automatically appear as below.

Image Path

Select Image


Gaussian Noise Salt Pepper Noise Add Noise Off ☐ On

I. Filter Selection II. Filter Selection Algorithm Selection

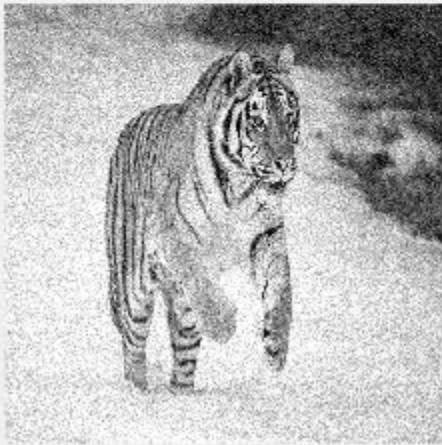
I. Scale Parameter II. Scale Parameter Algorithm Off ☐ On

I. Step Size II. Step Size

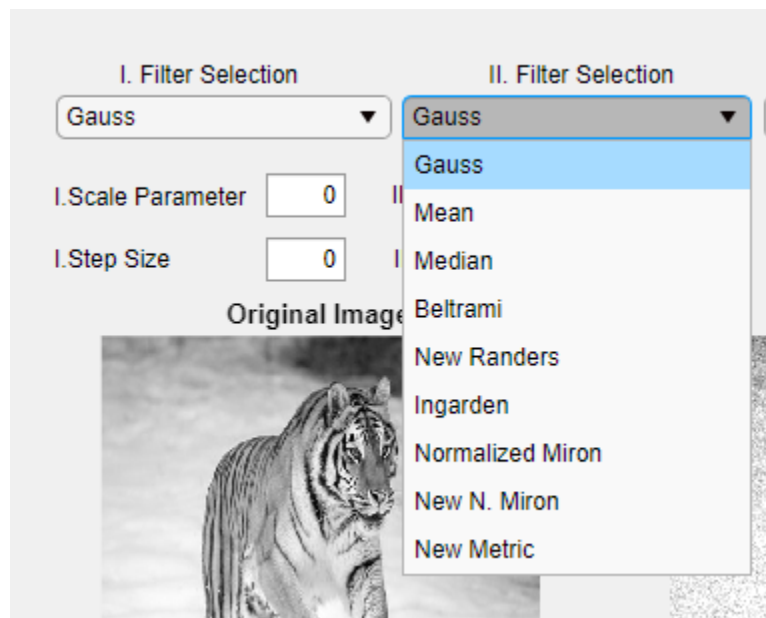
Original Image



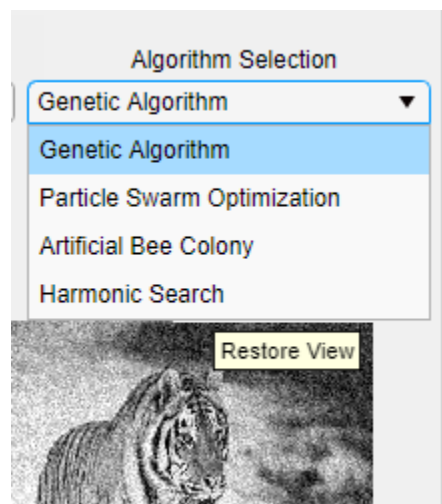
Noisy Image



Then you can choose which two filters you want to compare from the section below.



If you want an optimization algorithm to calculate everything automatically, you should leave the "scale parameter" and "step size" fields blank and set the "Algorithm" switch to "On". However, if you do not want this, you should fill in the "scale parameter" and "step size" sections for each filter and set the "Algorithm" switch to "Off". You can choose the algorithm as follows.



After all that, if you fill in the "iteration number" and press the "Start Calculation" button, the calculations will start as follows.


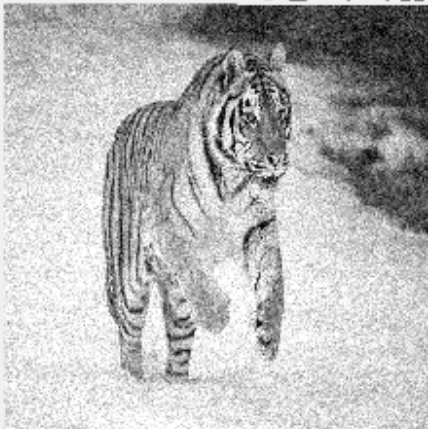
Image Path

Gaussian Noise Salt Pepper Noise Add Noise ☐ Off ☐ On

I. Filter Selection II. Filter Selection Algorithm Selection

I.Scale Parameter II.Scale Parameter Algorithm ☐ Off ☐ On

I.Step Size II.Step Size

Original Image  Noisy Image 

Iteration Number

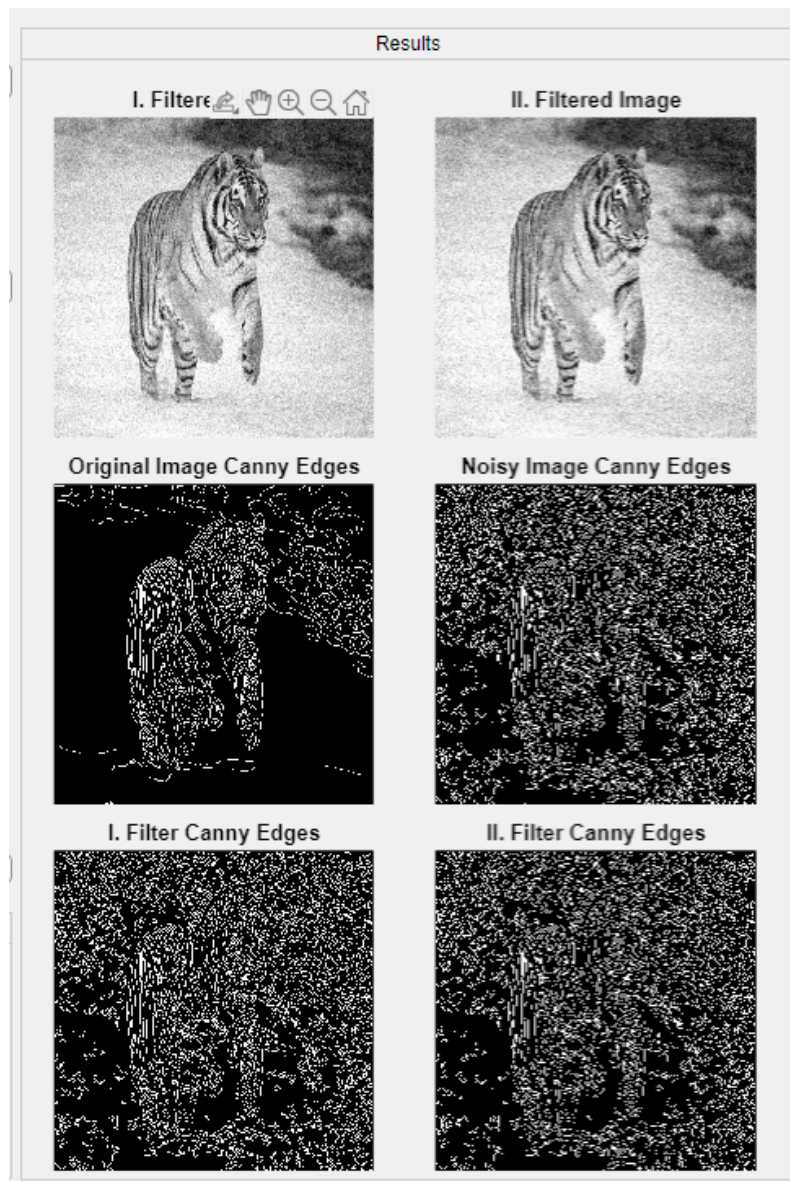
Calculating...

MSE PSNR SSIM

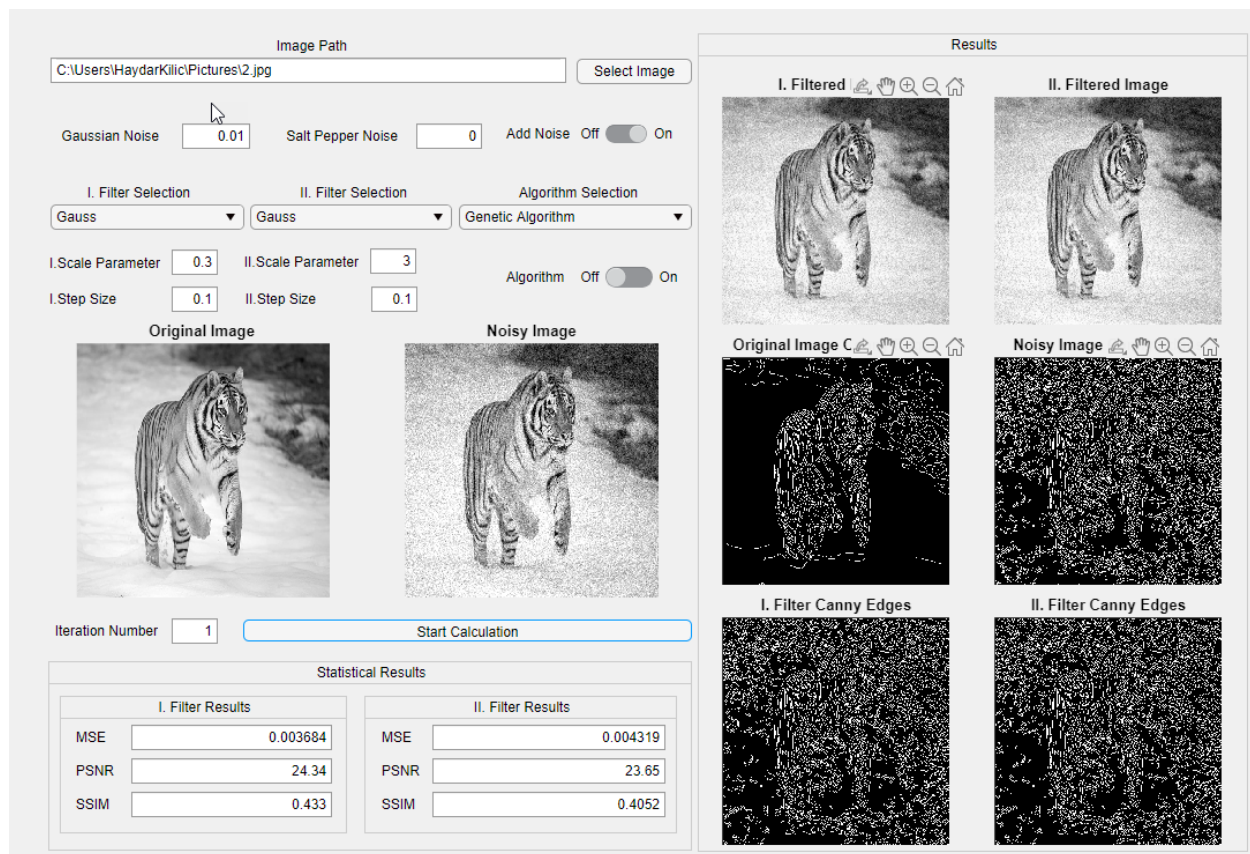
After the calculations are finished, the results will automatically appear in the "Statistical Results" section as follows.

Statistical Results					
I. Filter Results			II. Filter Results		
MSE		0.003684	MSE		0.004319
PSNR		24.34	PSNR		23.65
SSIM		0.433	SSIM		0.4052

In addition, the images and edge results obtained as a result of the filtering will appear in the section below.



After all these calculations, the final image of the main board will be as follows.



Thank you for your interest

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