**2110431 Introduction to Digital Imaging**

**2147329 Digital Image Processing and Vision Systems**

**Homework #2**

**Deadline: October 10, 2023 @23:59**

**Submissions: only PDF version of this file**

**Use these commands in colab to download the images.**

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| --- |
| !wget https://drive.google.com/uc?id=1dhh4m9VRLUSmbaHfge2iRSW5Azkpefco -O kitty3.png  !wget https://drive.google.com/uc?id=1o0UMPTyUFzX9CaQp-BwYXgkCho1Zo6yL -O kitty55.png  !wget https://drive.google.com/uc?id=1Jk0cEtQt4HxkLcKlmTHukpb22gJZ4dmL -O noisy\_kitty55.png  !wget https://drive.google.com/uc?id=1xCNA5338nzj1GgGQ5-oBA1dKCW1Mvn21 -O hillbefore\_noise10%.jpg |

1. Apply ideal low pass filter in frequency domain on “Kitty3.png” image which has pixels. Find the minimum cutoff frequency (C) in integer that still maintain the total image power more than 99%. Where the total image power, is calculated by summing the components of spectrum power at each point , for and

is the spectrum power provided in the lecture slides

percent of the image power can be calculated from 100 x / , where is the total image power of the original image and of the filtered image

Put your results in the blank box below

Cutoff frequency (D0) =

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| --- |
|  |

=

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|  |  |
| --- | --- |
| Original Image (“kitty55.png”) | Fourier Spectrum of the original image |
|  |  |
| Fourier Spectrum of the filtered image | Filtered images ( > 99%) |
|  |  |

Put your code here:

(you can paste all the code or put only the highlighted code for this problem)

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|  |

2) There is some periodic noise in “noisy\_kitty55.png” image. Remove the periodic noise and calculate PSNR.

Show how to restore the image from periodic noise and display the result,

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What is the PSNR before adding noise (compared with “kitty55.png”)?

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|  |

PSNR of the restored image

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3. Write a paragraph (at least 300 words in Thai or English) to summarize three image applications using frequency analysis in your own words and add the references (excluded from the total word count). You will have to present and share the applications you found on Wednesday, October 3, 2023 in a discussion session.

4. Apply Gaussian low-pass filter on a noisy image, “hillbefore\_noise10%.jpg” below using cutoff frequency, D0 set to 35.

4.1. Generate the Shifted Magnitude Spectrum and put resulted image into the blank box below.

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| --- | --- |
|  |  |
| Input Image | Shifted Magnitude Spectrum |

4.2. Display the Filtered Fourier Spectrum and put the resulted image below.

|  |
| --- |
|  |
| Filtered Fourier Spectrum |

4.3. Show the Image after denoising with the Gaussian low-pass filter method and put the result in the blank box on the right side below.

|  |  |
| --- | --- |
|  |  |
| Input Image | Denoised Image |

4.4. Discuss the usage of the Gaussian low-pass filter in comparison to other methods, such as Median Blur and Linear Smoothing Filter. Explain the differences and identify which one might be superior. (Short description)