Computer Vision

Assignment 3

This is the third assignment for your computer vision course. After finishing this assignment, you are expected to know:

- The concept of 2-D FFT and inverse 2-D FFT and its application in analyzing the frequency content of digital images.
- Designing Butterworth lowpass filters and analyzing ringing effects by varying filter order and cutoff frequency.
- Calculating PSNR metric for image quality assessment.

Instructions

- Please provide a proper answer for each part of the questions.
- Use the cells beneath each question for your answer.
- Feel free to add more cells whenever needed.

Good luck!

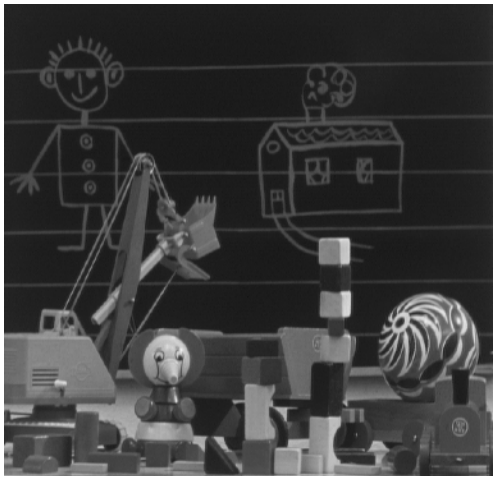
Question 1 (15 points)

For the image toys.gif

A) Read and display the image.

B) Compute the 2-D FFT of the image and display one full-scaled copy of the magnitude spectrum.

C) Compute and display properly the inverse 2-D FFT of the phase component of the spectrum only.



toys.gif

Question 2 (15 points)

For the image pepper.jpg, it is required to study the ringing effect of the Butterworth lowpass filter. Design the following filters and investigate the effect of changing the filter order and cutoff frequency on ringing. You need to display the filtered images and the shape of the filters in the spatial domain. A cross-sectional view of the filters in the spatial domain is required. Make sure to display the figures in a neat and organized way.

Filter Number	Order	Cutoff Frequency
1	1	50
2	1	150
3	5	50
4	5	150

pepper.jpg

Question 3 (20 points)

For the image prob2_s2012.gif

A) Compute and display the magnitude spectrum of the image.

B) Investigate the image in the spatial and frequency domains and determine the type of noise that is corrupting the image.

C) Design the proper filter and use it to restore the original image.

D) Based on the filter in part C, can you display the noise component in the spatial domain? If so, show the image that represents the noise.

prob2_s2012.gif

Question 4 (20 points)

For the image trucknoise.gif

A) Display the magnitude spectrum of the image.

B) Determine the type of noise in the frequency domain.

C) Can you remove the noise? Which type of filter is needed?

D) Display the noise-removed image and compute the PSNR of the image (truck.gif is the original image)

trucknoise.gif

truck.gif