

Work Sheet THREE

The aim of this computer based exercise is to reinforce the material that you have covered during the lectures. You have 2 hours to complete this worksheet, after which you will be required to complete a 30 minute test.

You may refer to your lecture notes, other reference sources, such as text book and websites and confer with your colleges to complete the exercises, however the test is a closed note assessment and must be done individually.

The image required for this worksheet can be found at:

<http://newton.ex.ac.uk/teaching/resources/jjm/pam3012/Labs/index.html>

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Exercise 1: Images in the Fourier Domain

1(a) 2-Dimensional Fourier Transform

- Open images Box-01.jpg to Box-04.jpg and Blank-01.jpg.
- These images contain simple objects that will demonstrate the 2D FT.
- Display the Fourier Transform (FT) of each image (Process/FFT/FFT).
- Note the reciprocal nature of the FT!

1(b) Image Fourier Transforms

- Open images London-01.jpg, Abdo-01.jpg and Sky-01.jpg
- These images contain very different amounts of detail
- Display the Fourier Transform (FT) of each image (Process/FFT/FFT)
- Compare the relative intensities of the FTs at different frequencies to the amount of detail in the corresponding images.

1(c) Inverse Fourier Transform

- For each of the three images in 1(b)
- Close the original image
- Perform an inverse FT on each of the images (Process/FFT/Inverse FFT)
- The original images should reappear
- This demonstrates that the original image can be recovered via the inverse FT

Exercise 2: Smoothing in the Frequency Domain

2(a) FT of Smoothed Images

- Open image trees-01.jpg
- This image contains regions of both high and low detail
- Display the Fourier Transform (FT) of each image (Process/FFT/FFT)
- Note the intensity of the FT in the high-frequency components
- Smooth the image using the 'Gaussian Blur' filter with a radius of 3
- Display the FT of the filtered image
- Note how the intensity of the high-frequency components has been reduced
- Repeat the filtering using filter radii of 5, 7 and 9. You will need to re-open the image each time (File/Open Recent)
- Compare the FTs of the filtered images. How does the degree of blurring effect the FT?

2(b) Frequency Domain Smoothing Filters

- Open image trees.jpg
- This image contains a high degree of detail
- Display the Fourier Transform (FT) of this image
- Open images LP-gaus2d-01.jpg and LP-gaus2D-02.jpg
- These are images of a Gaussian filter with two different widths
- Filter trees.jpg using each Gaussian filter in turn (You will have to re-open the image each time)

Hints:

Process/FT/Custom Filter...

Select LP-gaus2D-01 or LP-gauss2D.jpg as the filter

- Note the relationship between the width of the filter and the degree of smoothing/blurring

Exercise 3: Sharpening in the Frequency Domain**3(a) Frequency Domain Sharpening Filters**

- Open image Abdo-01.jpg
- This image contains a high degree of detail
- Display the Fourier Transform (FT) of this image
- Open images HP-gaus2d-01.jpg and HP-gaus2D-02.jpg
- These are images of a Gaussian filter with two different widths
- Filter trees.jpg using each Gaussian filter in turn (You will have to re-open the image each time)

Hints:

Process/FT/Custom Filter...

Select HP-gaus2D-01 or HP-gauss2D.jpg as the filter

- You will have to perform 'post-processing' (windowing) to enhance the contrast of the sharpened image
- Note the relationship between the width of the filter and the degree of smoothing/blurring