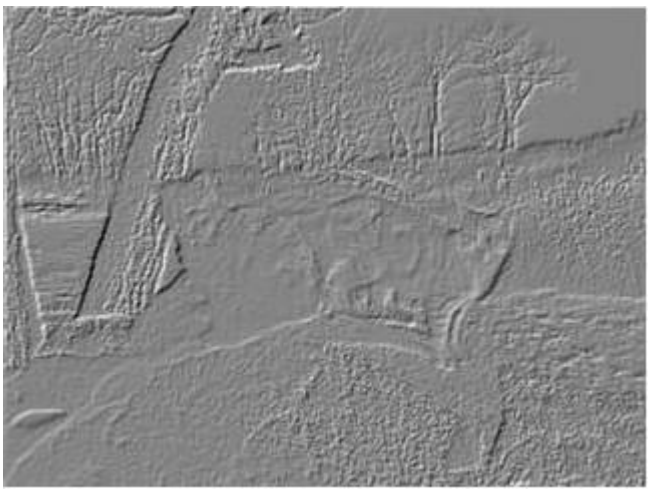
IVP Programming assignment 3

1. For the image "97.jpg", display its fourier spectrum. Identify which of the following is the result of a lowpass or highpass filtering of that image in frequency domain and try to reproduce the results.

Image 1 Image 2

2. Create a spatial filter to get the horizontal gradient of the image "**two_cats.jpg**". Create a spatial filter to get the vertical gradient of the image (read the MATLAB documentation of fspecial). Now transform both of these filters to the frequency domain. Also Transform the two_cats image to the frequency domain. Apply the appropriate operations in the frequency domain. Transform the data back into the spatial domain. Sum the horizontal and vertical gradients components together. The resulting image should look like this:



3. (a) Find (or develop) a program to add Gaussian noise to an image. You must be able to specify the noise mean and variance. (b) Find (or develop) a program to add salt-and-pepper (impulse) noise to an image. You must be able to specify the probabilities of each of the two noise components.
4. Image 1 (**img1noisy.tif**) contains impulsive noise (left side) and additive white gaussian noise (right side). Try to use a median filter and an arithmetic mean filter. In addition to these filters, try at least one other filter to remove the noise. Calculate the mean-square error:

$$E=\frac{1}{MN}\sum_{x=1}^{M}\sum_{y=1}^{N}(I_o(x,y) - I_f(x,y))^2$$

(where I_o is the original/noise-free image and I_f the noisy/filtered image), in both sides separately of the image both before and after filtering with the different filters. Compare and discuss both the numerical results and visual appearance. Finally, show 'the best possible' filtered image, where both the left and the right side are filtered with the filter that produces the minimum mean-square error. Show also the respective error image (i.e. the difference image between the original and the corrected image). (Remember to scale the error image properly!). The original noise-free image is in the file **img1original.tif**.

5. In image 2 (**img2.tif**) there is a disturbing pattern, which should be removed. The pattern is a sinusoidal component. Remove the disturbance by looking in the frequency domain for the spike corresponding to the disturbing frequency and and try to remove it from there. (Hint: The disturbing frequency can be found in the FFT by considering the orientation and frequency of the disturbance.)