# MATLAB Project 1 – Using the Fourier Transform in Image Processing

For this project you need to have the image processing toolbox installed in your Matlab.

Once you start Matlab, the toolbox should be automatically loaded. You can find online documentation here: http://www.mathworks.com/products/image/

You will use two images, the "rice.png" and the "lena.png". These will be emailed to you.

## Calculate the FFT of an image

Input image "rice.png" using the matlab command **"imread"**.

*img=imread('circles.png');*

You can display the image using the matlab command **"imshow"**.

In order to perform FFT we need to

a) Convert the image, which is stored using integer values in the range [0,255], to double precision. We do this using the command **"im2double"**.

*imgD=im2double(img);*

b) Remove the DC component using the following code:

*mean=mean2(imgD);*

*imgD=imgD-mean;*

Please try to understand what is the DC component and why we need to remove it.

Now perform FFT to the image and plot the resulting magnitude using the **"imagesc"** or **"surf"** (whichever you like) as well the resulting phase. In order to separate the

magnitude you need to use the **“abs”** command. For separating the phase please use the **“angle”** command.

## “Sampling” an image - Aliasing

Upsampling an image tends to increase the high frequencies and thus it may create aliasing effects.

Downsampling removes high frequencies and it may allow the upsampled image to have reduced aliasing artifacts.

Because we want to observe the real effect of upsampling and downsampling on the images, do not use any anti-aliasing method. So your matlab command should look like this:

Upsampled Image =(original_Image, 2.0, “Antialiasing”, false);

Repeat the steps described in the FFT section and plot the magnitude and the phase of the Fourier response. What do you observe?

Now re-sample the images to their original size, repeat the aforementioned steps and plot the resulting image, the magnitude and the phase of the Fourier response.

What are the differences between the original image and these ones? Can you observe these differences also on the plots of the two magnitudes?

## Magnitude and Phase in FFT

Here we will try to understand the visual importance of the magnitude and phase of the Fourier response.

In order to answer that, we two other images the “lena.png” and the ‘rice.png’.

Calculate the Fourier response for both of the images.

“Extract” the magnitudes and the phases for both of the responses.

Construct two new responses using a) the magnitude of the image “rice.png” and the phase of the image “lena.png” and b) the magnitude of the “lena.png” and the phase of the “rice.png”.

Perform Inverse Fourier and project the real part of the resulting images using the **“imshow”** command. What do you observe?