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4 Fourier transform and phase correlation

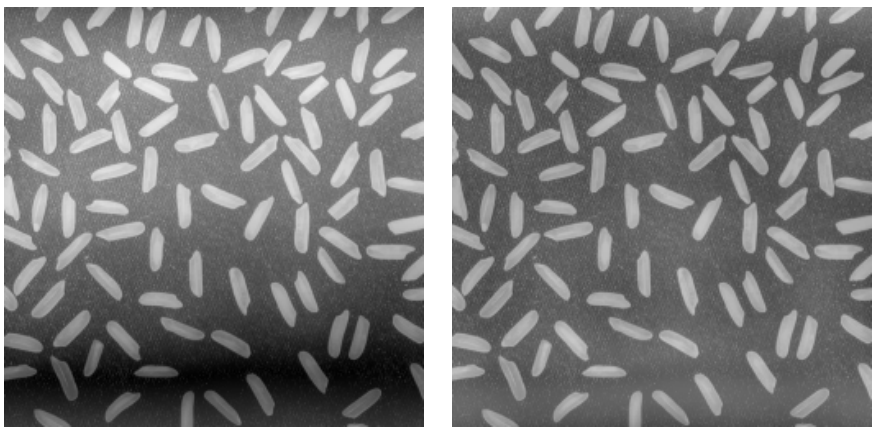
Testat

Name, forename:	Date:
Matr.Nr.:	Signature:

Exercise 1 Fourier transform

The aim of this experiment: Image enhancement of non-uniform illumination for improved segmentation via Discrete Fourier Transform (DFT).

The left image in figure 1 shows a couple of rice corns (`rice_wave.png`), while the background illumination is brighter in the center of the image than at the bottom. Due to the non-uniform illumination with light and dark regions, the contrast between background and rice corns is weak. By testing several global threshold values for segmentation, you will see that an intensity based approach does not result in unambiguously separated rice corns.



Graphic: The MathWorks Inc.

Figure 1: **Left**: original image showing non-uniform illumination; **Right**: frequency-filtered image with uniform background

The varying background intensity, caused by the non-uniform illumination, can be modelled by a homogeneous background which is superimposed by illumination fluctuations. These illumination fluctuations can be separated and suppressed by filtering appropriate frequencies within the frequency domain:

1. Compute and visualize the DFT by using `Frice = fft2(Iin);`
2. Which frequencies (ω_{hor}, ω_{vert}) represent the non-uniform illumination? Modify the image in frequency domain to get rid of the non-uniform background.
3. Apply inverse Fourier transform to view the result: `Iuni = abs(ifft2(Frice));`
4. Finally, display a 3D surface plot of the removed non-uniform illumination distribution without the rice corns by using the MATLAB function `mesh`.

The result with damped illumination fluctuation after inverse Fourier transform is depicted in the right image of figure 1.
Write your result into a file called `rice_uniform.png`.

Exercise 2 Pattern matching

Given is a series of images as shown in figure 2. The aim of this exercise is to find the position within two overlapping images were the second image matches with the first to build a panorama ("photo stitching") by using phase correlation.

Figure 2: Example image series to be merged to create a panorama.

1. Implement the phase correlation of two images by applying a two-dimensional DFT in MATLAB. Take care of correct zero-padding of both images and use the MATLAB function `conj` to generate the complex conjugate matrix to correlate with.
2. Analyse the resulting correlation map `c` after inverse DFT by displaying it as a surface mesh (`mesh`) and explain the result.
3. Determine the position of the maximum correlation. This can be done by using the MATLAB functions `max` and `find`.
4. Merge both input images together at the matching position.
5. Repeat the previews steps to write a panorama generator.