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COMPUTATIONAL PHOTOGRAPHY
ASSIGNMENT 5

Submission deadline for the exercises: Thursday, 7. June 2018 before 11:59.

Instructions: Upload the source code to your solution **(no images please, just the plain code)** in the ILIAS system at:
ILIAS Computational Photography SoSe2018

5.1 Noise ($5+5+5+5=20$ points)

This week we have studied the camera sensors and electronics. The result of the limitation of the sensor and electronics is camera noise. In this exercise your task is to apply the acquired knowledge to make the resulting images better.

- Calculate the average dark frame, the average image and use the obtained dark frame to improve the quality of the averaged image.
- Compute a 3×3 Gaussian blur on the image `images{1}` manually (**hint:** don't use matlab's built in convolution functions ;)).
- Explain why averaging improves the image quality.
- Explain how you would calculate the fixed pattern noise for a given camera.

General tips:

- Functions to load the images and exposure times are supplied. All images are stored in a cell array which is a container for storing various data types, in this case 3-dimensional matrices. Cell arrays are indexed like vectors or matrices but use curly braces {}, e.g. `images{3}` would yield the third image. Normal matrix indexing is also possible, e.g. `images{6}(:,:,3)` references the blue channel of image 6.
- Sometimes working in Matlab is much simplified by using "conditional indices" instead of looping through elements. E.g. `variable==val` gives a matrix of 0's and 1's of the same size as `variable`, whose elements are 1's if corresponding elements in matrix `variable` are equal to `val`.
- Instead of working on 3D-matrices all the time you can extract the color layers to separate variables and work with three 2D-matrices, or you can index every channel separately. This saves you some stress with indexing errors.
- For the theoretical part you can submit your explanation in one of the following ways:
  - Add it as a comment in the code.
  - Write a PDF/txt file containing the explanation.

Links:

- Camera noise can be found in more detail at
  http://www.cambridgeincolour.com/tutorials/image-noise.htm