Biological Instrumentation and Measurement, Fall 2008

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Problem Set #8 Due: Tuesday, November 25

1. **Contrast and histogram** Optimize contrast for visualization of the following microscope image (dark_cells.tif) taken at too low a light level.

(a) Apply histogram equalization to this image.
(b) Plot the histograms of the image before and after equalization.
(c) Display the image after equalization.

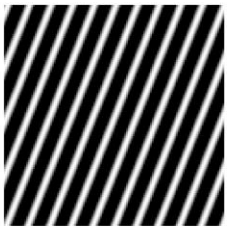
2. **Reduce image noise by low pass filter pre-processing** Create a 3x3 and a 5x5 low pass filter. Apply these filters to remove noise from the low light level cell image (noisy_cell.jpg). Try a 5x5 median filter also?

3. **Reduce image noise by median filter pre-processing**

Generating a long integration image using a CCD camera sometimes produce large intensity spikes due to cosmic rays. Try to remove the noise from this image (spiky1.tif). Can you develop a different method to remove the spikes if you have two pictures taken one after the other (spike1.tif, spike2.tif)?

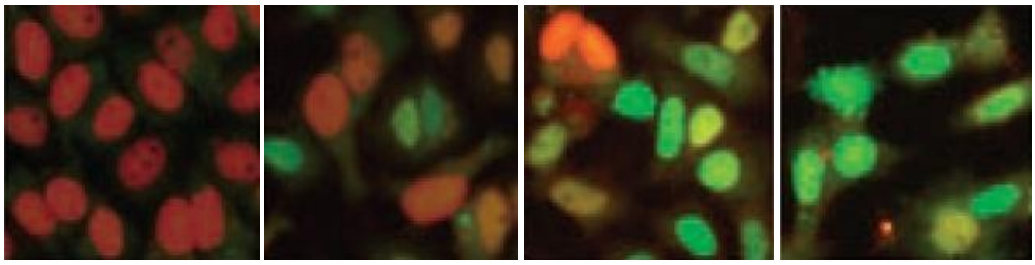
4. **Removing periodic noise by Fourier filtering**

(a) Periodic noises often occur in biological imaging (highnoise and lownoise). Can you remove the noise if you know the noise characteristics (noise)? The data files are matrix stored in fftfiles.m.



(b) Consider the case that you do not know the noise characteristics (newnoise). Can you clean up this image?

5. **Image segmentation and quantification** Four images are extracted from the Perlman et al. paper (Fig. 4).



(a) Segment the nuclei from the rest of the image. Show a "mask" image (2 bit) for each images that select only the nuclei.
(b) Develop an algorithm to measure the red vs the green intensities from each pixel within the nuclei.
(c) Create a scattered plot for each valid pixels (within the nuclei) as described in the Perlman paper for each image.