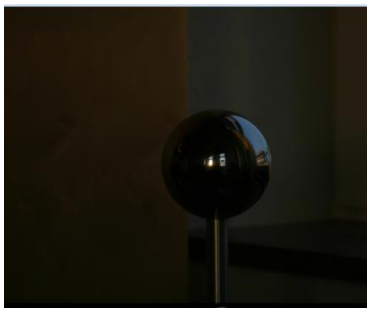
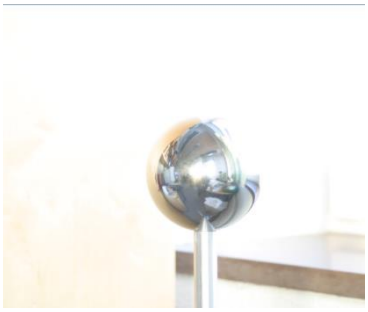
TNM087 Bildbehandling och bildanalys – MT 2014

Lab 1: High Dynamic Range Imaging

Overview:

Different exposure times were used to produce a series of input images. The first images in the series are very dark and the images at the end are very light as you can see from these examples

In the lab you use the method described in the Szeliski-book and the original article to produce a HDR-image with floating point pixel values that can describe the pixel values in much greater detail than the usual 8 bits-per pixel format. The resulting HDR image has to be processed before it can be shown on a monitor or be printed on paper. You might use the Matlab command tonemap to produce a low-dynamic version which should be similar to the following image

Preparation:

Read Chapter 10.2 High dynamic range imaging in the Szeliski book or read the original article (pdf in the Kursdokument part of Lisam).

Task:

On Lisam you find a series of images in tiff format (in the zip-file). They contain images of the same scene. The exposure time increases by a factor of two between two of them. There you will also find a Matlab m-file makegfun.m and a matfile gfun.mat. After running makegfun.m or loading gfun.mat you will have a matrix gfun of size 256x3. This function characterizes the relation between pixel values, exposure time and irradiance (one curve for the R, G and the B channel). It uses base 2 logarithm as explained in Eq. (10.5) in the book.

- Plot the functions and their exponentials: plot(gfun) and plot(2.^gfun)

The exposure times is increased by a factor of two between two images: $t_{j+1}/t_j = 2$ in the notation of the book. Read in the images; find the point with the highest intensity value in one of the first (darkest) images, the point with the lowest value in the last (lightest) image and a median gray point somewhere in image 9. Selecting the image values (either from one channel or the intensity) at these three positions for all images gives you three sequences of pixel values, each of them with 14 elements.

- Plot these sequences and explain their behavior.
- Use Eqs. (10.4) and (10.5) to convert the original images to the exposure images at the right side of Eq. (10.4)

Pixels with very low or very high values are not reliable (why?) and should therefore be weighted down by the algorithm (see for example Eq. (10.7).

- For every image in the sequence create a mask or a weight image describing how this image should be used in the final merging step.

You now have image pairs with values $E_i t_j$ (from Eq. 10.4) and weights w_{ij}

- Estimate the values E_i (one for every image in the sequence) and use the weights w to combine them to the final estimated irradiance value h_i at position i in the image.

Collect all values h_i in the High-Dynamic-Range (HDR) image H

- Explore and explain the properties of H. To do this use the following matlab commands (in that order): imshow, imagesc, imtool (convert to gray scale and load the converted image into imtool) and finally tonemap and imshow
- If you want to save the image for further processing use save (if you continue working in Matlab) or hdrwrite if you want to export it to other image processing systems.

At: S:\TN\M\TNM087-MT\Labs\Lab1 you find other HDR images in the HDR format. You can either work with them in Matlab or HDR programs like Luminance (at http://qtpfsgui.sourceforge.net/) to explore different HDR tonemap algorithms. Also use different combinations of thresholding and gamma-mapping (imadjust) to illustrate the problem of mapping HDR-images to low-dynnamic-range (LDR) displays.

Many more HDR images are available at: http://taniapouli.co.uk/research/statistics/

Report:

Document what you have done by submitting your Matlab code and a short (max 1 page of text) description of what you have done. Illustrate your tonemapping experiments with some examples. If you work as a group you should submit one version of your code and one report/person. In this case you should also list all members in the group