Computer Vision 1: Photometric Stereo & Color Spaces

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All the files should be zipped and sent to **computervision1.uva@gmail.com** before **20-02-2017** , **23.59** (Amsterdam Time).

1 Photometric Stereo

In this part of the assignment, you are going to implement the photometric stereo algorithm as described in Algorithm 5.1 (Chapter 5 of the book "Computer Vision: A Modern Approach" whose snippet can be found in Course Materials).

The algorithm skeleton is provided in a template code following this instruction, you will have to edit and fill in your code in the files *get_source.m*, *compute_surface_gradient.m*, *check_integrability.m*, and *construct_surface.m*. The main script *photometric_stereo.m* would be a good start.

For the sake of simplicity, you can assume the light sources in the sample images are far way and, respectively, frontal, left-above, right-above, right-below, left-below, with equality at all pixels. The task now is to represent these assumptions with directional unit vectors, yielding the $\mathcal{V}$ up to a scale factor. Try out several scalar multiplications to see what gives good results.

Try to structure your code well, explain your implementation and results in comments.

2 Color Spaces

Create a function to convert an RGB image into the following color spaces by using the template code you are provided *ConvertColorSpace.m* and other sub-functions. Visualize the new color space channels separately in the same figure.

Opponent Color Space

$$\begin{pmatrix} O_1 \\ O_2 \\ O_3 \end{pmatrix} = \begin{pmatrix} \frac{R-G}{\sqrt{2}} \\ \frac{R+G-2B}{\sqrt{6}} \\ \frac{R+G+B}{\sqrt{3}} \end{pmatrix}$$

Normalized RGB (rgb) Color Space

$$\begin{pmatrix} r \\ g \\ b \end{pmatrix} = \begin{pmatrix} \frac{R}{R+G+B} \\ \frac{G}{R+G+B} \\ \frac{B}{R+G+B} \end{pmatrix}$$

HSV Color Space

Convert the RGB image into HSV Color Space. Use MATLAB's built-in function *rgb2hsv*.

YCbCr Color Space

Convert the RGB image into YCbCr Color Space. Use MATLAB's built-in function *rgb2ycbcr*.

Grayscale

Convert the RGB image into grayscale by using 3 different methods mentioned in `https://www.johndcook.com/blog/2009/08/24/algorithms-convert-color-grayscale/` In the end, check which method MATLAB uses for grayscale conversion, include it as well, and visualize all 4 in the same figure.