# Computer Vision 1 AI Assignment 1: Photometric Stereo & Color Spaces

### February 04, 2016

All the files should be zipped and sent to **computervision1.uva@gmail.com** before **17-02-2016**, **23.59** (Amsterdam Time).

## 1 Photometric Stereo

This assignment involves implementing the photometric stereo in matlab as described in algorithm 5.1 (a scan of the algorithm and related chapter from the book "Computer Vision: A Modern Approach" can be found in Course Materials). Assume that the images reside in the same directory of the script (so you do not have to send them along with your script if the filenames remain unchanged).

1. [**5 pts**] Create a function that is called without arguments. Two figures must be plotted:

   - [2.5 *pts*] one showing the surface normals (using MATLAB's *quiver3*)
   - [2.5 *pts*] one showing the reconstructed shape

   Try to structure your code well, and explain what steps you take in comments.

You can make assumptions about the direction and distance of the light source: the light source is far away, the directions are approximately frontal, left-above, right-above, right-below, left-below, and equal for all pixels per image. It is now the task to represent this with directional (unit) vectors, yielding the **V**'s up to a scale factor. Then, try out several scalar multiplications of the unit vector to see what gives good results.

# 2 Color Spaces

1. **[2 pts]** Create a function that is called with two arguments. The first argument should specify the image name and the second argument should specify the color space that one wants to visualize the given image.

   - Visualize the given image for three channels in the specified color space. (For each channel of the specified color space show a figure.)

**Opponent Color Space**

2. **[1 pts]** Convert the color space of a given image into *Opponent Color Space* by the following equation:

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

**rgb Color Space**

3. **[1 pts]** Convert the color space of a given image into normalized *rgb Color Space* by the following equation:

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

**HSV Color Space**

4. **[1 pts]** Convert the color space of a given image into HSV Color Space. Use MATLAB's built-in function *rgb2hsv*.