TW793: Assignment 1 — For Wednesday, 11 August

Assignment Guidelines

- Write a short report to illustrate your work. Explore and include interesting results (necessary to achieve $> 90\%$) and use full sentences to explain your reasoning.
- Reports may be handed in during the lecture on the due date.
- Feel free to discuss the work amongst one another, but write your own report and code.
- Working code has to be provided via e-mail, as an archive on the web or in an online code repository such as GitHub or BitBucket. You may use any open source language, such as Python, Octave, C#, etc.

Problem 1: Bi-linear Interpolation

Study the Wikipedia page on bilinear interpolation: `http://en.wikipedia.org/wiki/Bilinear_interpolation`

(a) Implement a function to perform bi-linear interpolation. The function should take the following parameters:

- v_{00}, v_{10}, v_{01}, v_{11} — values at coordinates $(0,0)$, $(1,0)$, $(0,1)$ and $(1,1)$.
- $x \in [0,1]$, $y \in [0,1]$ — the position at which to interpolate.

(b) Given $v_{00} = 1$, $v_{10} = 0.3$, $v_{01} = 0$ and $v_{11} = 2$, plot interpolated values over all $x \in [0,1]$, $y \in [0,1]$.

Problem 2: Image Warping

Note: For this assignment use a test image from the course website, or another of your own choosing.

A homography, H, transforms any coordinate $\boldsymbol{p}$ to a new position

$$\boldsymbol{p}' = H\boldsymbol{p}.$$

(a) Write a routine that transforms an image according to the homography

$$H = \begin{pmatrix} 0.408 & -0.913 & 10 \\ 0.913 & 0.408 & 10 \\ 0 & 0 & 1 \end{pmatrix}.$$

(i) First, use the forward mapping $\boldsymbol{p}' = H\boldsymbol{p}$. Are any artefacts visible and, if so, why?

(ii) Second, use the inverse mapping $\boldsymbol{p} = H^{-1}\boldsymbol{p}'$ with bilinear interpolation. Are the artefacts still present?

(iii) Which geometrical transformations are captured by this homography?

Problem 3: Image Rectification

Consider this image of the Merton Chapel floor.

Our aim is to remove the perspective distortion from the image, and to "view it" from above as a 500×500 image.

(a) Identify four coordinates in the distorted image that could map back to the square $(100, 100)$, $(100, 400)$, $(400, 100)$ and $(400, 400)$ in the restored image.

(b) Using these corresponding coordinates, determine the coefficients $\boldsymbol{h}$ of the homography H that would restore perspective. *Hint: $A\boldsymbol{h} = 0$; construct A as shown in the class notes.*

(c) Apply the computed homography to remove the perspective distortion.