EE702 - Assignment 1

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Problem Statement

Consider a smooth surface $z = z(x, y)$, say a spherical/parabolic one (try a conical shaped object with cone pointing to viewer at a later stage). Let $\hat{s} = (0, 0, 1)$ and viewing direction $\hat{v} = (0, 0, 1)$. Assuming the image to be:

$$E(x, y) = (\hat{n} \cdot \hat{s})^{\alpha} + \text{noise} \tag{1}$$

Generate the image $E(x, y)$ and save the gradient map (f, g or p, q).

Tasks

(a) Now, assuming an appropriate regularizer, recover $p(x, y)$, $q(x, y)$, and depth $z(x, y)$ for the zero observation noise case (and $\alpha = 1$).

(b) Now add observation noise in Eqn. (1) and repeat (a) for various noise levels.

(c) Now change $\alpha \in [1, 2]$ in small steps and repeat (a).

(d) Now assume that $\hat{s}$ is not known exactly. Say $\hat{s} = (\epsilon_1, \epsilon_2, 1)$ where ϵ is small. Repeat experiment (a) and (b).

(e) Repeat (a,b) for different regularization/smoothness constraints.

(f) Now take a picture of an arbitrary object (matte and smooth surface) and try to recover the shape.

(g) Now consider the results of all the above experiments and put forward your learning outcome within 100-200 words.

– or –

(h) Those who are very keen to use deep learning-based methods may alternatively try to recover the shape from shading by appropriately designing a network architecture and a loss function.