Simulation on Shape from Shading

EE 702 Course Project Choice-1

Submission deadline - February 14, 2014

1. Setting up simulation environment

(a) The source is to be located at infinity. Choose a source direction, say $\hat{s}$. Assume viewing direction is same as $\hat{s}$.
(b) Assume a known lambertian surface $z = z(x, y)$. Our aim is to recreate $z(x, y)$ from its orthographic projection.
(c) Calculate the normal $\hat{n}$ at each point on the surface and hence calculate $E(x, y) = \hat{n}.\hat{s}$
(d) Save $E(x, y)$ and $\hat{s}$. The surface recovery is to be done using only these two quantities.
(e) Also save the value of $z(x, y)$, (p, q) and (f, g) on a closed curve. These will be used as boundary conditions in various equations.

2. Recovery of shape from shading

(a) Obtain estimates $\hat{p}$, $\hat{q}$ and $\hat{z}$ and compare with the original data.
(b) Change the value of λ used in the objective function and repeat the previous step. Comment on the effect of λ on error in estimates.
(c) Add additive white gaussian noise to $E(x, y)$ and do reconstruction.
(d) Observe the effect of varying noise variance(σ^2) on reconstruction error.
(e) Obtain estimate of $z(x, y)$ using equations in (f, g).
(f) Perturb $\hat{s}$ and observe its effect on reconstruction of $z(x, y)$.
(g) Assume viewing direction is different from $\hat{s}$ and obtain estimate of $z(x, y)$.
(h) Put two sources with relative strength α and β, i.e, $E(x, y) = \alpha\hat{n}.\hat{s_1} + \beta\hat{n}.\hat{s_2}$. Assume $\hat{s}_1$ and $\hat{s}_2$ are known. Recover $z(x, y)$.
(i) Experiment with real data e.g, from internet or your own images.