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IIIT Vadodara
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CS405/CS803 Computer Vision
Lab#7: Depth Estimation using Photometric Stereo

Q. 1: Use the set of sphere images generated in Lab-5 and estimate the p and q matrices based on Photometric Stereo (PS) method discussed in class. Let us assume Lambertian surface, i.e., constant albedo ρ, then PS for n images can be formulated at each pixel location (x, y) as,

$$\begin{bmatrix} E_1(x,y) \\ E_2(x,y) \\ . \\ . \\ . \\ E_n(x,y) \end{bmatrix} = \begin{bmatrix} \frac{-ps_1}{\sqrt{1+ps_1^2+qs_1^2}} & \frac{-qs_1}{\sqrt{1+ps_1^2+qs_1^2}} & \frac{1}{\sqrt{1+ps_1^2+qs_1^2}} \\ \frac{-ps_2}{\sqrt{1+ps_2^2+qs_2^2}} & \frac{-qs_2}{\sqrt{1+ps_2^2+qs_2^2}} & \frac{1}{\sqrt{1+ps_2^2+qs_2^2}} \\ . & . & . \\ . & . & . \\ . & . & . \\ \frac{-ps_n}{\sqrt{1+ps_n^2+qs_n^2}} & \frac{-qs_n}{\sqrt{1+ps_n^2+qs_n^2}} & \frac{1}{\sqrt{1+ps_n^2+qs_n^2}} \end{bmatrix} \begin{bmatrix} \frac{-p}{\sqrt{1+p^2+q^2}} \\ \frac{-q}{\sqrt{1+p^2+q^2}} \\ \frac{-1}{\sqrt{1+p^2+q^2}} \end{bmatrix},$$

where, $\{E_1, E_2, ..., E_n\}$ are set of n sphere images constructed using known source positions $\{ps_1, ps_2, ..., ps_n\}, \{qs_1, qs_2, ..., qs_n\}$. Use singular values decomposition (SVD) in order to solve for the p and q matrices. Now, use these estimated p and q matrices to estimate the depths (COV approach Lab-6) at each point the Sphere scene. Comment on the result when compared to Lab-6.