Assignment 5, 15-663

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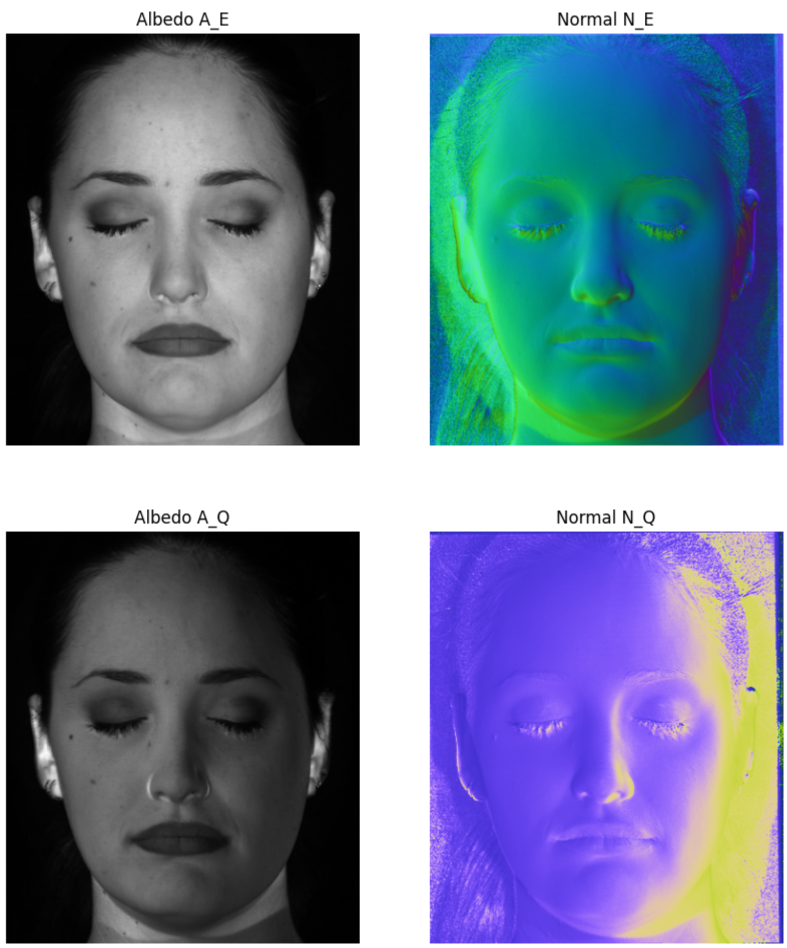
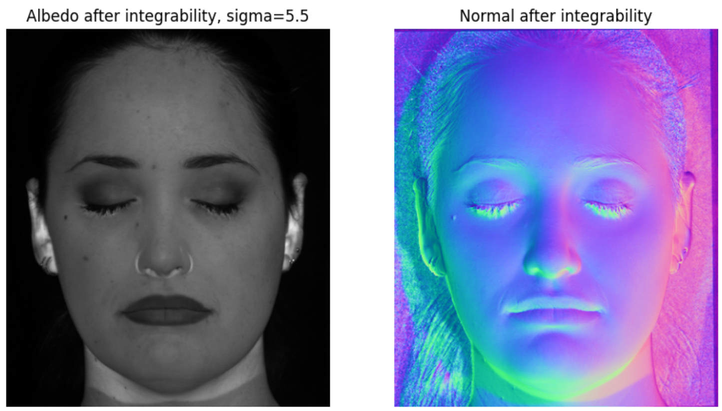
1 Photometric Stereo

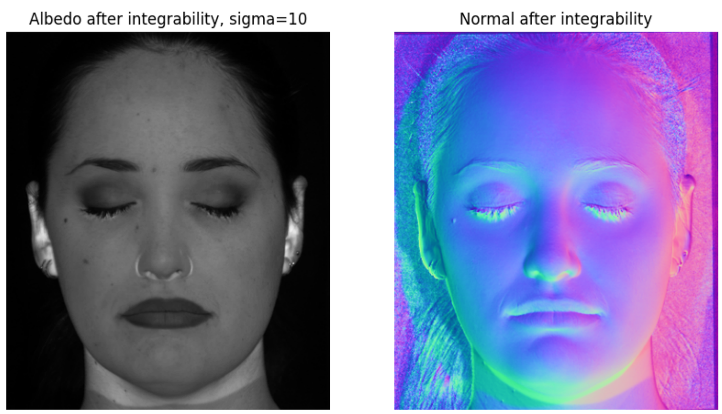
1.1 Uncalibrated photometric stereo

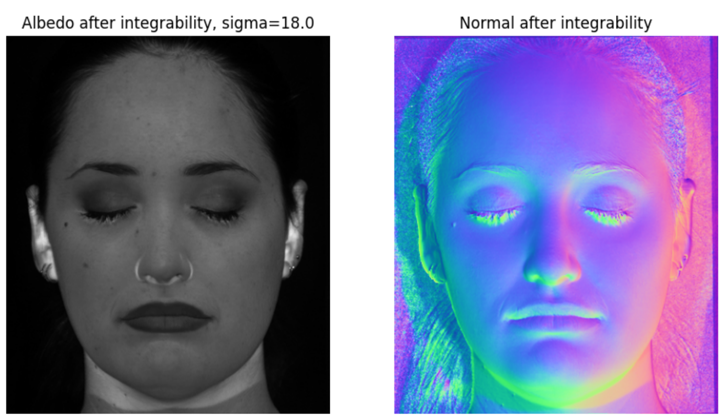
Non-diagonal invertible matrix Q:
Q = [[4, -5, -2], [5, -6, -2], [-8, 9, 3]]



1.2 Enforcing integrability







I notice that the range of values in albedo (hence contrast in normalized albedo) varies by vairation in σ, but normal doesn't change. I end up using a $\sigma = 6.0$ and $\epsilon = 1e - 12$.

1.3 Normal integration

Figure 1: These are uncalibrated case depth and 3D surfaces. GBR for all till now: $\mu = 0, v = 0, \lambda = -1$.

Varying GBR:

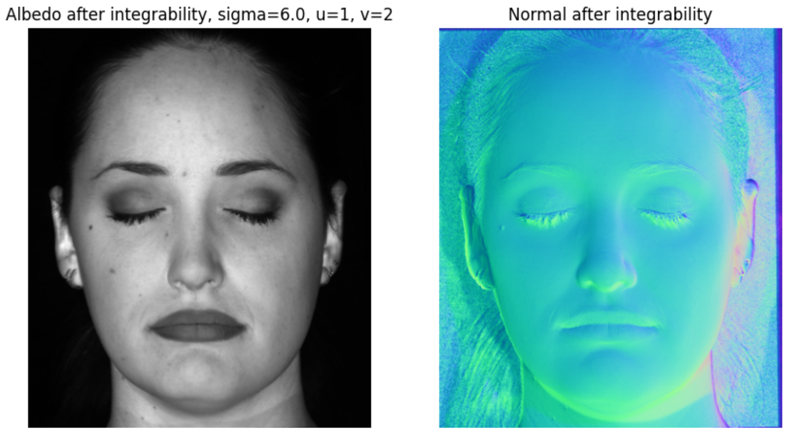


Figure 2: These are uncalibrated case depth and 3D surfaces. GBR for all till now: $\mu = 1, v = 2, \lambda = -1$.

1.4 Calibrated photometric stereo

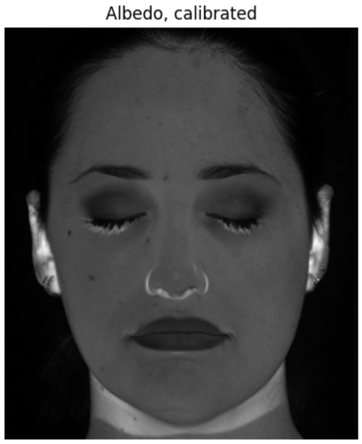


Figure 3: These are calibrated case depth and 3D surfaces. GBR for all till now: $\mu = 0, v = 0, \lambda = -1$.

Calibrated versus uncalibrated. The face shape in the calibrated case is a lot clearer (notice the face features like eyelashes, nose and lips), even the face boundary is a lot clearer, the uncalibrated case has lower contrast. The uncalibrated process involves taking a blur and computing gradients which becomes noisy for computing normal directions and hence gives less accurate normal, depth and shapes. The albedo however can be matched with appropriate choice of σ.

Issues faced - even though I could perfectly produce the normal as in Figure 1 and Figure 3, and followed all the steps for getting normalized depth maps from the normal field, the normals seem to have a black area at the top left corner which I could not resolve.