

Homework Assignment 5

Instructions to Run

```
python main.py --args
--data_dir: Path to directory containing images
--mask: Include if a mask is available, default mask path will be
data_dir/0.png
--calibrated: Include for calibrated photometric stereo.
--enforce: Include if enforcing integrability.
--visualize: Include to write results to
data_dir/<calibrated/uncalibrated>_stereo
```

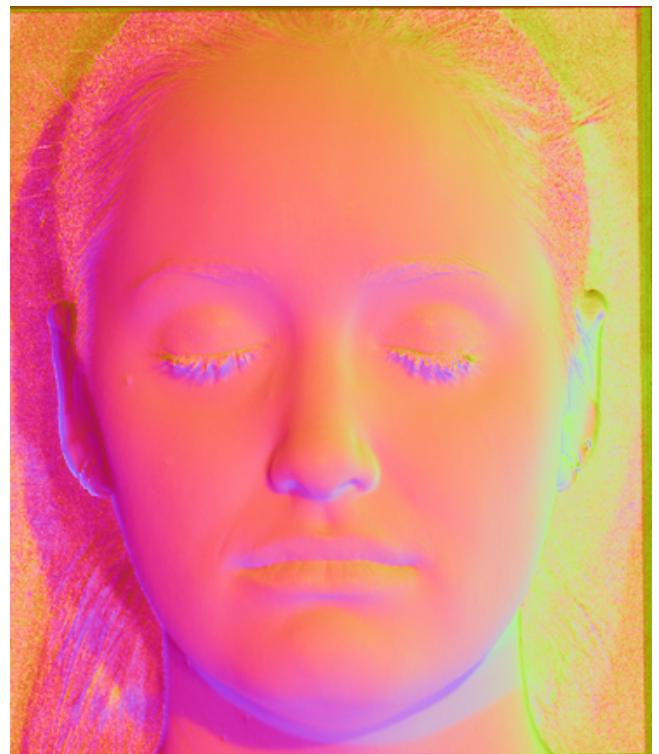
1. Photometric stereo (100 points)

Uncalibrated photometric stereo

Albedo



Normal

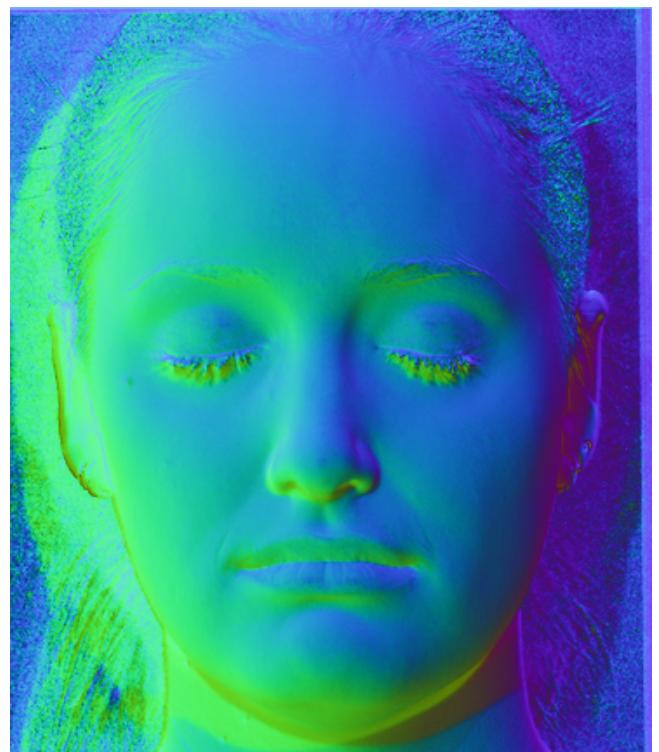


With $Q = [[2, 0.2, 0.4], [0, 1, 0], [0, 0, 1]]$ applied to B_e , the normal and albedo acquired are shown below.

Albedo

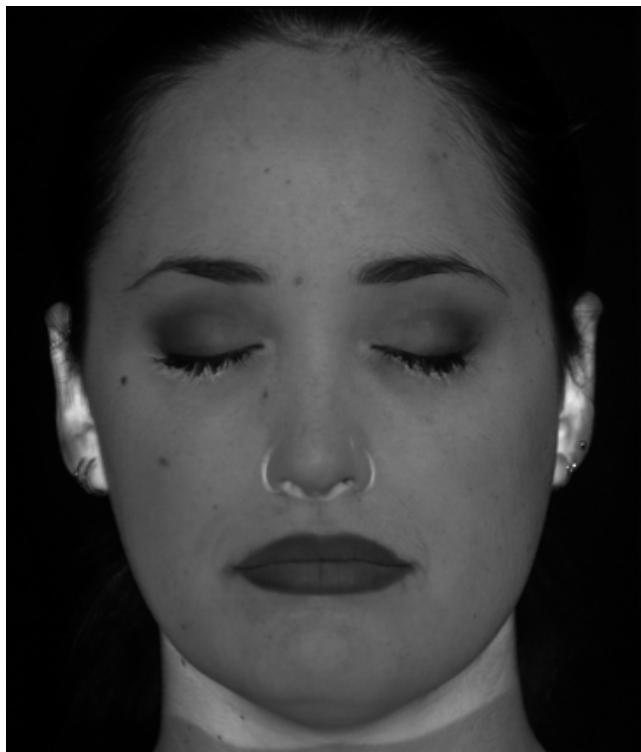


Normal

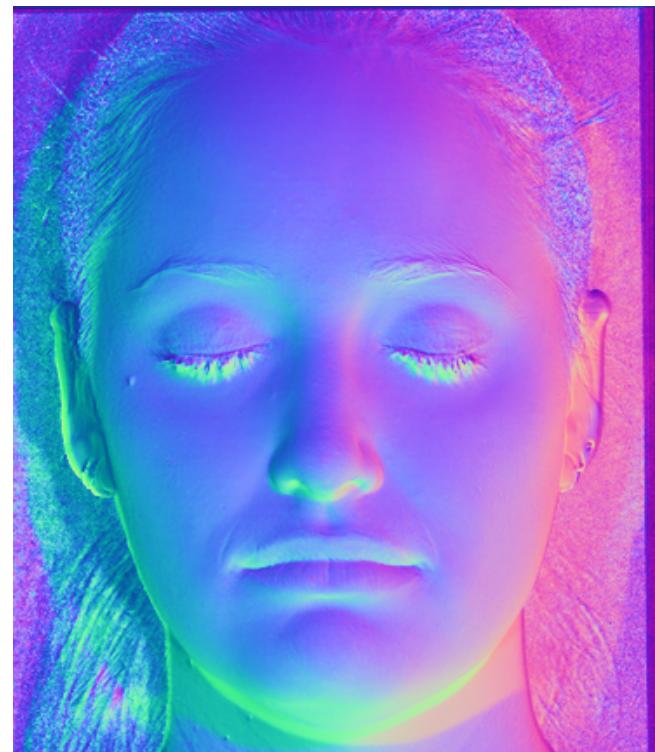


Enforcing integrability

Albedo



Normal



Normal integration

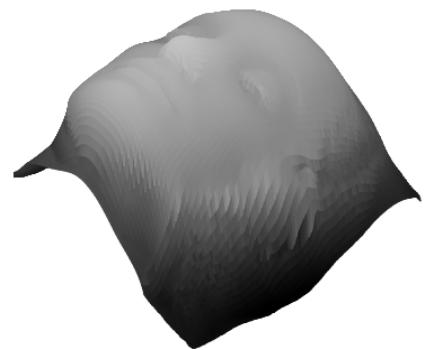
Depth



Surface View 1



Surface View 2



For the GBR matrix, I experimented with values in the following ranges with step sizes of 0.1:

μ	ν	λ
[0, 5]	[0, 5]	[0.1, 5]

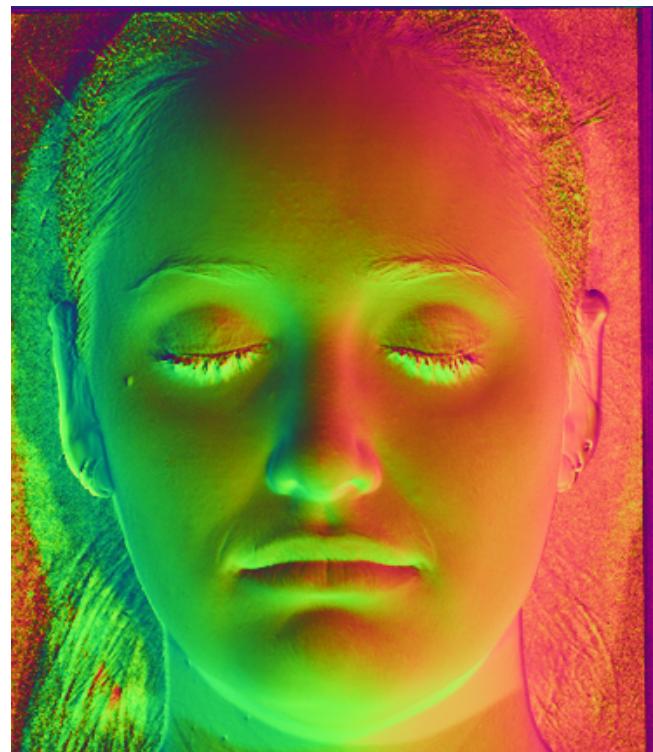
However, no GBR matrix yielded noticeably better/different results than the one shown above.

Calibrated photometric stereo

Albedo



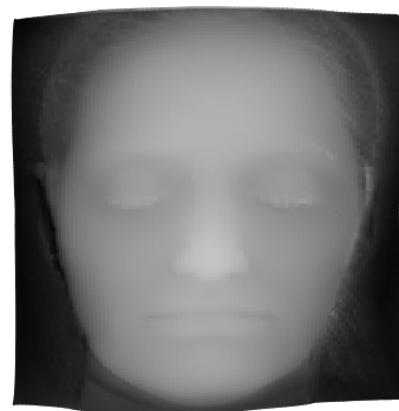
Normal



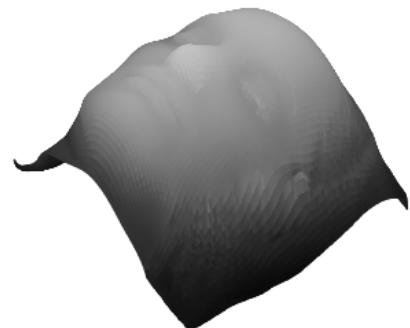
Depth



Surface View 1



Surface View 2



Compared to the uncalibrated case, calibrated photometric stereo seem to better capture the symmetry of depth on the face. At least visually, in the calibrated case, it looks like the depth values on the left half of the face could be reflected over the vertical-axis and give the same result. In the uncalibrated case, this symmetry is not captured as well. Besides that, the only difference is in the normal maps as there is no ambiguity that needs to be resolved in the calibrated case.

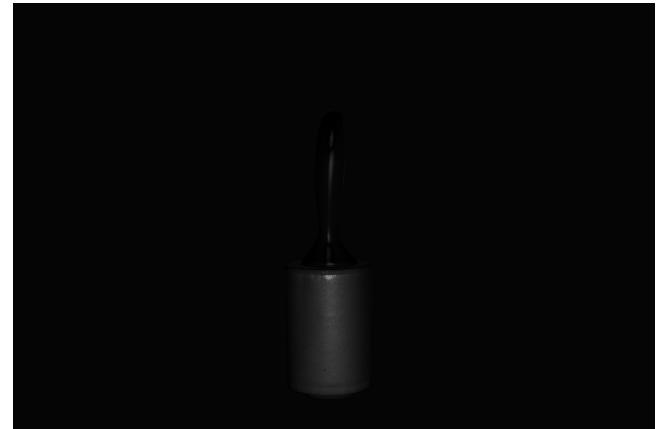
2. Capture and reconstruct your own shapes (100 points)

Object 1: Lint Roller

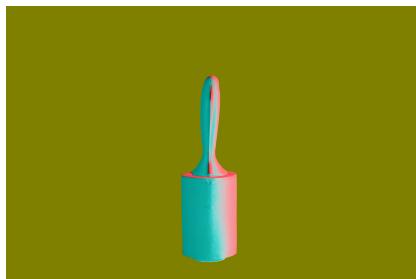
Example Image



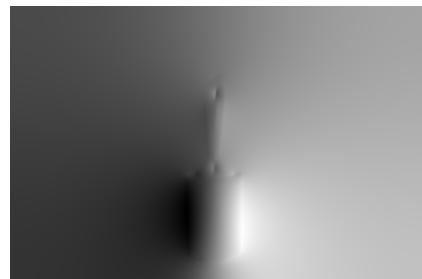
Albedo



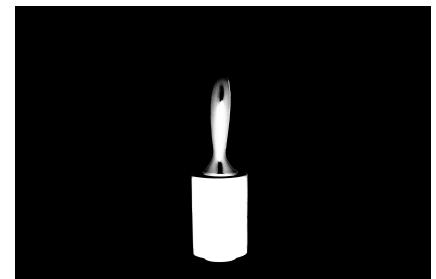
Normal



Depth



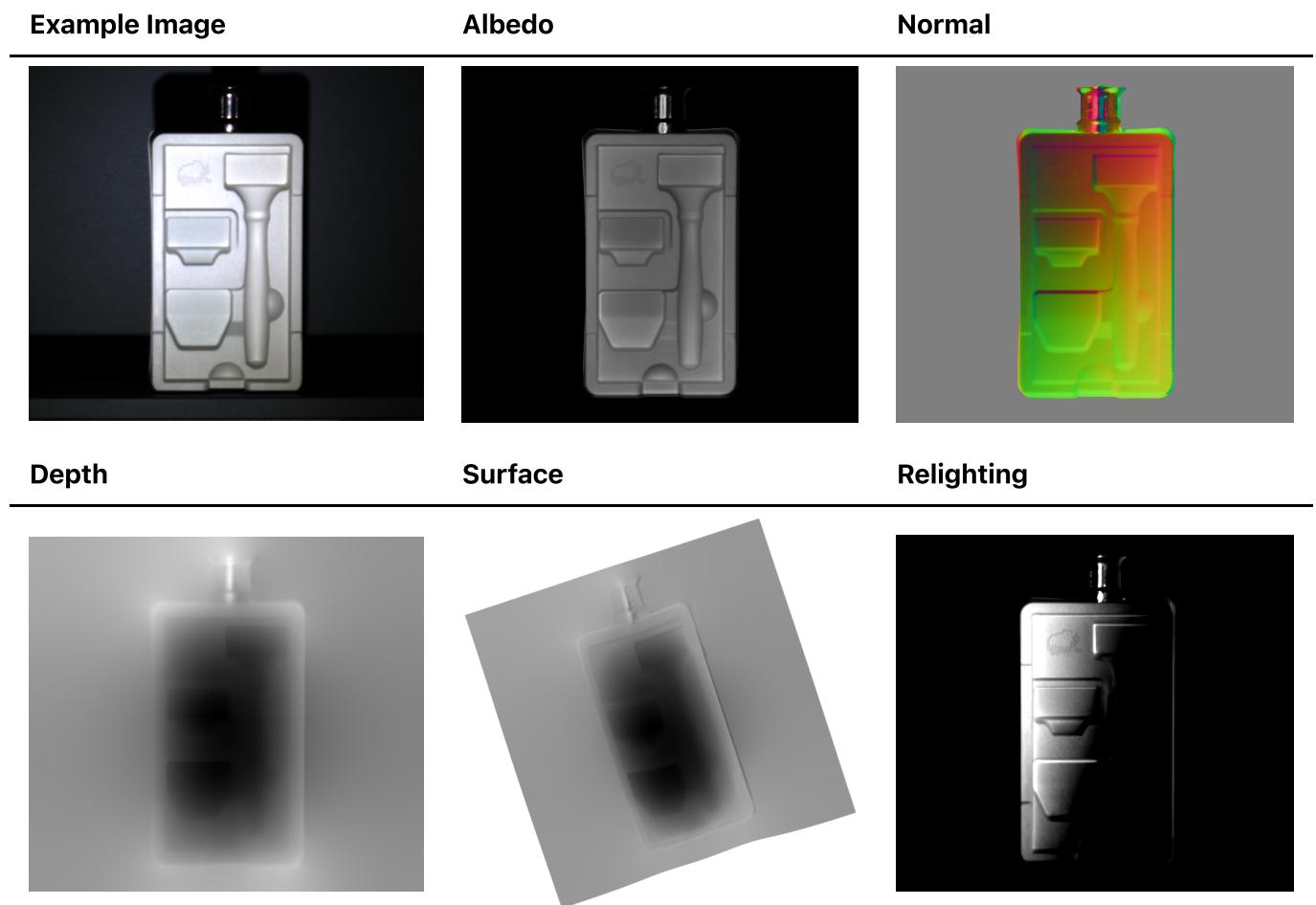
Relighting



The surface for the lint roller was too large to render and capture images of but the albedo, normal, and depth map look pretty good so the surface should be correct as well. I really tried to downsample and process the images as much as possible to be able to capture the surface but it simply wouldn't work as well on downsampled/cropped images.

Object 2: Shiny cologne cap stacked on top of plastic razor package.

As expected, the normals along the shiny/glossy cap are noisy and inconsistent. Unexpectedly, however, the concavities of the razor package are captured very well.



I did try to capture objects that more glaringly violate the assumptions of photometric stereo, however, this process was quite hit or miss and would work well for some objects and poorly for others (this is why I am submitting late 😞). I can provide more examples of images I took and their corresponding normals/albedo/depth map if needed.