

CS543/ECE549 Assignment 4

Your Name: <name>

Your NetId: <netid>

Part 1 Shape from Shading:

A: Estimate the albedo and surface normals

- 1) Insert the albedo image of your test image here:
- 2) What implementation choices did you make? How did it affect the quality and speed of your solution?
- 3) What are some artifacts and/or limitations of your implementation, and what are possible reasons for them?
- 4) Display the surface normal estimation images below:

B: Compute Height Map

- 5) For every subject, display the surface height map by integration. Select one subject, list height map images computed using different integration method and from different views; for other subjects, only from different views, using the method that you think performs best. When inserting results images into your report, you should resize/compress them appropriately to keep the file size manageable -- but make sure that the correctness and quality of your output can be clearly and easily judged.
- 6) Which integration method produces the best result and why?
- 7) Compare the average execution time (only on your selected subject, “average” here means you should repeat the execution for several times to reduce random error) with each integration method, and analyze the cause of what you’ve observed:

Integration method	Execution time
row	
column	
average	
random	

C: Violation of the assumptions

- 8) Discuss how the Yale Face data violate the assumptions of the shape-from-shading method covered in the slides.
- 9) Choose one subject and attempt to select a subset of all viewpoints that better match the assumptions of the method. Show your results for that subset.
- 10) Discuss whether you were able to get any improvement over a reconstruction computed from all the viewpoints.

Part 1: Extra Credit (optional)

Clearly mark every item you're submitting for extra credit. Don't forget to include discussion of what you did, results, and any references. Refer to the assignment for suggested outputs.

Part 2 Single-View Geometry:

1. Estimate the three major vanishing points.
 - a. Plot the VPs and the lines used to estimate them on the image plane using the provided code.
 - b. Specify the VP pixel coordinates. Discuss how you estimated them.
 - c. Plot the ground horizon line and specify its parameters in the form $a * x + b * y + c = 0$. Normalize the parameters so that: $a^2 + b^2 = 1$.
2. Using the fact that the vanishing directions are orthogonal, solve for the focal length and optical center (principal point) of the camera. Show all your work.

3. Compute the rotation matrix for the camera.
4. Estimate the following heights and show all the lines and measurements used to perform the calculation. As a reference measurement, assume that the person in the picture is 5ft 6in tall.
 - a. The left side of the ECE building.
 - b. The right side of the ECE building.
 - c. The lamp posts.
5. Recompute the answers in a-c above assuming that the person is 6ft tall.

Part 2 Extra Credit (optional)

Clearly mark every item you're submitting for extra credit. Don't forget to include discussion of what you did, results, and any references. Refer to the assignment for suggested outputs.