16-385 Computer Vision, Fall 2020

Take-home Quiz 7

Due Date: Monday November 2, 2020 23:59

Question 1

In 1941, Marcel Minnaert introduced one of the first analytic expressions for a non-Lambertian BRDF. His motivation was to allow a better interpretation of observations of the brightness of the moon. Minnaert's BRDF model has two parameters, ρ and k, with the latter (k) taking a value between 0 and 2. Using $\boldsymbol{n}$ to represent a unit-length surface normal vector, the Minnaert BRDF model can be written:

$$f(\boldsymbol{\omega_i}, \boldsymbol{\omega_o}) = \rho \left((\boldsymbol{n}^\top \boldsymbol{\omega_i})(\boldsymbol{n}^\top \boldsymbol{\omega_o}) \right)^{k-1}.$$

1. Prove that the Lambertian BRDF model is a special case of the Minnaert BRDF model.
2. As shown on the left in the figure below, a full moon that is high in the sky is perceived as being a flat disk instead of a round ball, because its edges do not darken like those of a Lambertian sphere that is rendered with frontal view and light directions (shown right). What value(s) of $k \in [0, 2]$ would predict this moon-like behavior? Explain your answer in words, supported by any necessary equations or diagrams.

Instructions

1. **Integrity and collaboration:** Students are encouraged to work in groups but each student must submit their own work. If you work as a group, include the names of

your collaborators in your write up. Plagiarism is strongly prohibited and may lead to failure of this course.

2. **Questions:** If you have any questions, please look at Piazza first. Other students may have encountered the same problem, and it may be solved already. If not, post your question on the discussion board. Teaching staff will respond as soon as possible.

3. **Write-up:** Your write-up should be typeset in LaTeXand should consist of your answers to the theory questions. Please note that we **do not** accept handwritten scans for your write-up in quizzes.

4. **Submission:** Your submission for this take-home quiz should be a PDF file, `<andrew-id.pdf>`, with your write-up. **Please do not submit ZIP files.**