CSE 252A: Introduction

Lecturer: David Kriegman

Scribed by Owen Jow on September 27, 2018

1 A Process for Understanding Shading

1. Construct a physics-based mathematical model for a particular domain.
2. Prove properties of the model to better understand it.
3. Under the assumption that the model is correct, develop algorithms to solve problems.
4. Implement and evaluate the algorithms.
5. Question any assumptions about the model, and start again from step 1.

For example, we can (1) assume a model for reflectance, then (2) prove some of its geometric properties, then (3) develop and (4) implement algorithms for relighting and photometric stereo, and finally (5) question the validity of our reflectance model for certain materials.

* ***Relighting****: the creation of synthetic images with different lighting conditions.*

* ***Photometric stereo****: 3D reconstruction given images of the same view under different lighting.*

2 Related Fields

There are many, many related fields, and vision pops up in pretty much every application space because we can conceivably have imagery of almost anything and desire to understand it better. Some examples of related fields are optics and signal processing.

Probably the two most related fields are *machine vision* and *image processing*. About ten years ago, *machine vision* referred more to industrial automation; nowadays it is pretty much the same thing as computer vision. *Image processing* refers to the notion of taking an image as input, producing a new image as output, and doing some kind of processing such as compression or information extraction in the middle.

3 Course Overview

The course contains a mixture of classical and modern computer vision topics. There are four main segments.

1. **The physics of imaging.** Image formation, including camera and lighting models. A realistic image isn't just an arbitrary matrix of numbers – it originated as a result of some light, some camera, etc. This unit will include topics such as lighting and photometry.

2. **Early vision.** Low-level V1-esque processing. Filtering, edge detection, segmentation.
3. **Reconstruction.** Going from 2D to 3D. We'll cover methods such as photometric stereo, stereopsis (reconstruction based on two images), and structure from motion (reconstruction based on many images).
4. **Recognition.** Identifying something seen before. Dominated by deep learning in recent times (as with most computer vision problems). Challenging because it's not exact memorization – a lot of things can happen to something you want to recognize. It could appear in a setting of clutter or occlusion, or grow a beard.