

## ECE 425 – Image Science and Engineering Spring Semester 2000

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April 17, 2000

### Homework 6 Due in-class Tuesday April 25, 2000

This is an exercise in simulation of an optical imaging system with a CCD Focal Plane Array (FPA) detector. It will integrate several things you have learned in this class and is good practice for doing simulations in your take-home final exam. Use tclSADIE to do the simulation.

**This homework must be turned in during class on April 25, or before. Late homeworks will not be accepted.** A solution to this homework will be handed out in Tuesday's class after you have turned in your homeworks.

Given:

- The camera has f/numbers of 2, 2.4, 3.5, 4, 5.6, 8, 11, 16 and 22 available. It's focal length is 80mm and the optics are diffraction-limited.
- The FPA contains 128x128 detectors, each 10x10 $\mu$ m. It requires at least  $3 \times 10^{-5}$  W-cm<sup>-2</sup> to successfully record the image and saturates above  $3 \times 10^{-3}$  W-cm<sup>-2</sup>.
- Two test files are provided, **face.256** and **star.256**. Both are 256x256 with a Digital Number (DN) range of [0,255], which represents a radiance range of  $1.6 \times 10^{-3}$  to  $6.6 \times 10^{-3}$  (W-sr<sup>-1</sup>-cm<sup>-2</sup>) in the simulation. Think of these files as "objects" that are imaged by the system. The object distance from the camera lens is -2m.
- The optical part of the simulation is to be done at twice the sample rate of the FPA. The sample rate is then reduced by detector spatial integration at the FPA.

Your tasks:

1. Simulate the images produced by the camera, i.e. the 128x128 digital images of **face.256** and **star.256**, for at least one feasible f-number setting. Include 8-bit quantization in the final image.
2. Simulate the image produced by the camera if it is 3mm out-of-focus. Compare the quality of this image (using tclSADIE tools) with that of the in-focus image.