

22.058, Principles of Medical Imaging
Fall 2002
Homework #1

1. Define the instrument response function (IRF) and the point spread function (PSF), and explain their relation to the image resolution? Why is it convenient to assume that the PSF is spatially invariant?
2. What is meant by stating that edges in an image correspond to high spatial frequencies?
3. Describe a pin-hole camera as prototype imaging system (show both figures and equations), include the effects of
 - Magnification,
 - Finite sized pin-hole,
 - Finite thickness of the pin-hole material (including leakage through this),
 - Oblique angle effect of detector,
 - Oblique angle effect of pin-hole spot size,
 - Detector resolution (assume a 2D array detector like the CCD).
4. Define the following in terms of the pin-hole camera and suggest a means of measuring them:
 - Resolution (what limits it and how),
 - Sensitivity,
 - Contrast,
 - Contrast to noise ratio,
 - Distortions (sources and what are the effects).
5. Given the above non-idealities, suggest a linear model that captures most of the physics and defend it. Experimentally how would you explore if your model was adequate?
6. Write a program that simulates the action of a true pin-hole camera in 1 dimension.