

## Homework #5

Special Topics in Signals & Systems: Biomedical Imaging  
ECEn 682R, Section 3

**Due:** Thursday 10/15/2009 by midnight in the box outside Dr. Bangerter's office.

**Homework help sessions:** I will be holding a homework help session (in addition to my regularly scheduled office hours) for each homework assignment. For Homework #5, the help session will be Tuesday 10/13 from 5-6pm in 490 CB. If you need help and cannot make the help session, please see me during office hours or contact me to arrange an alternate time.

### Problems:

1. In mammographic examinations, the breast is compressed between two plates, effectively reducing the thickness of the breast in the direction of x-ray propagation. This is mostly a distortion of the breast; the tissues themselves are not actually compressed to a higher density.
  - a. Is the geometric unsharpness increased or decreased by compression?
  - b. What effect would you expect compression to have on the image contrast, and why?
  - c. Is the required x-ray dose for a given image SNR higher or lower with compression? Explain your reasoning.
  
2. Derive Equation 5.12 in the book. Show all work, and provide a diagram with the various variables (angles and distances) labeled. Specifically, show derivations for each of the following components building to Equation 5.12:
  - a. Inverse square law intensity drop-off;
  - b. Obliquity drop-off;
  - c. Path length drop-off.

### From Prince & Links:

5.1

5.2

5.6 (Note: Use Equation 5.12 for intensity variations in the image. You can assume that  $\theta$  is small, such that  $\mu L / \cos(\theta) \approx \mu L$ ) ← (Just the first term in a Taylor series expansion of  $\cos(\theta)$ ... ☺)

5.8

5.23