BENG280A, Principles of Biomedical Imaging 11/22/05
Fall Quarter 2005

HOMEWORK #7
Due Thursday 12/1/05

Readings:
Chapters 10 and 11.

Problem 1
You have been asked to design an ultrasound system for imaging of the heart. The system must be capable of acquiring 30 frames a second at a maximum depth of 20 cm.

a) Determine how many lines per frame can be acquired. Assume that the speed of sound is 1500 m/s.
b) Determine the highest frequency that can be used in order that the waves not be attenuated by more than 99%. Assume an attenuation of 1dB/cm/MHz.
c) Determine the size of the detector such that the entire field of view will be in the near field. Use the frequency derived in part b.
d) Determine the depth resolution, assuming that the temporal pulse duration is equal to 3 cycles of the acoustic wave.

Problem 2
Consider a transducer of dimensions LxL operating at a frequency of 5 MHz.

a) Determine the size L of the transducer such that the far field region begins at 30 cm.
b) Sketch the 2D far field pattern as a function of z.
c) Consider two point reflectors at (d/2,0,z) and (-d/2,0,z). If the resolution is defined as the effective width of the field pattern, determine the minimum distance *d* between the two points such that the two points can still be resolved. In other words, the distance should be equal to the effective width of the field pattern.
d) Now assume that an acoustic lens has been added to the transducer to focus the beam at a focal depth of 15 cm. What is the minimum separation of points that can be resolved at the focal depth?