Diagnostic Ultrasound Imaging: Inside Out by T. L. Szabo
Solutions for Problem Set 6 for Chapter 7

1. Engineer A was asked to design a 128 element 7.5 MHz linear array
(a) He decided that as a cost-savings measure he would make the element to element spacing to be 200 microns. Find the angular location of the first order grating lobes.
(b) In order to add a Doppler capability to the array, the beams are to be steered. How far in angle can a beam be steered before encountering the first grating lobe?
(c) The engineer said he had a clever idea: by modifying the width of the element he could place nulls at the first order grating lobe locations. Was he right? Is it possible?

2. Given a particle velocity waveform on the aperture of the form of a Gaussian,
$$v_n(t) = \exp(-at^2)\cos\omega_c t ,$$
(a) Write a time domain expression for pressure waveform at an angle of 45 degrees for a line aperture of length L_x .
(b) Write a time domain expression for pressure waveform on axis for a line aperture of length L_x . You may find Table A1 helpful for derivative evaluation.

3. For the velocity waveform of problem 2, write an expression for the pressure waveform at the focal point of 65 element linear array with elements of width w.