Solutions to Homework, Week 10

Assignment 1

Chapter 25

R2: Room resonances have the negative effect of filtering sound. The room strengthens certain resonant frequencies at the expense of others. Because the holes are so bad, you probably don't want to put your home theatre system in the shower (of course there are other practical reasons why not to such as electrocution and water damage).

R15: In the control room of the studio, the mixer needs to hear all the performers/tracks and how they are blended. He or she therefore wants a longer delay time between the direct sound and first reflections in the control room. This used to be done by putting absorbing material in the front of the control room so that sound was "dead" here and you would get more reflections from the back "live" end. A more clever way to make the "dead" and "live" end is to make the room in a geometry such that sounds is reflected away from the dead end and allowed to mix and reflect from the back end. See figure 25.17.

E1: The resonances of a room are given by:

$$f_{l,m,n} = \frac{\mathrm{v}}{2}\sqrt{\left(\frac{l}{L}\right)^2 + \left(\frac{m}{W}\right)^2 + \left(\frac{n}{H}\right)^2}$$

where the dimensions of the room are given by L x W x H, and *l,m,n* are integers.

In this problem the room is 5 m x 10 m x 2.5 m. We want the lowest three frequencies, so we need to compute the first nine since there may be repeat frequencies (degeneracy).

Example:

$$f_{1,0,0} = \frac{343\,m/s}{2}\sqrt{\left(\frac{1}{5\,m}\right)^2 + \left(\frac{0}{10\,m}\right)^2 + \left(\frac{0}{2.5\,m}\right)^2} = 34.3\,Hz$$

$f_{1,0,0} = 34.3$ Hz
$f_{0,1,0} = 17.15$ Hz
$f_{0,0,1} = 68.6$ Hz
$f_{1,1,0} = 38.3$ Hz
$f_{1,0,1} = 76.7$ Hz
$f_{0,1,1} = 70.7$ Hz
$f_{2,0,0} = 68.6$ Hz
$f_{0,2,0} = 34.3$ Hz
$f_{0,0,2} = 137.2$ Hz

So the three lowest modes are 17.15 Hz, 34.3 Hz, and 34.3 Hz