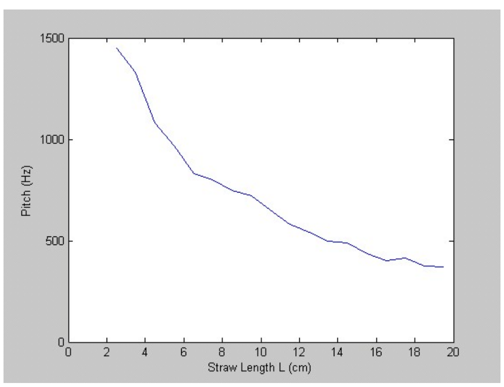
Friday - last lecture

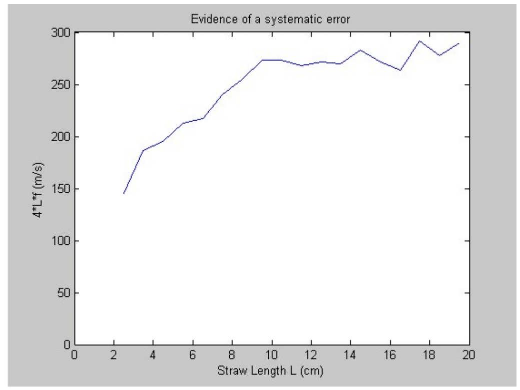
Name________________

Pitch of a straw used as a double reed instrument (as a function of the straw length).

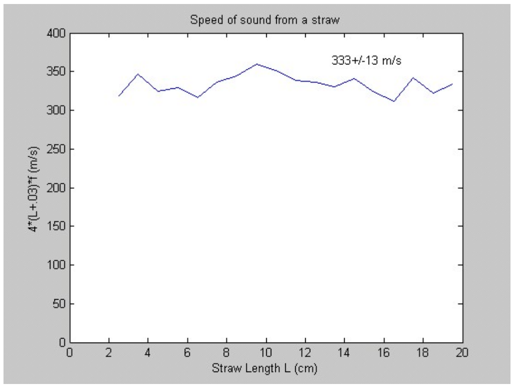
f (KHz)	L(m)
1.4500	0.0250
1.3333	0.0350
1.0833	0.0450
0.9667	0.0550
0.8333	0.0650
0.8000	0.0750
0.7500	0.0850
0.7200	0.0950
0.6500	0.1050
0.5833	0.1150
0.5429	0.1250
0.5000	0.1350
0.4875	0.1450
0.4375	0.1550
0.4000	0.1650
0.4167	0.1750
0.3750	0.1850
0.3714	0.1950



According to the simplest theory, we would expect a straight line if we plot the length of the straw times the frequency of the fundamental note. This is because a pipe that is closed at one end is supposed to have one quarter wavelength in the pipe and frequency times wavelength should be the speed of sound. The plot above shows that this is not quite right. The speed of sound should not depend on the length of the straw. Something is systematically wrong.



If we assume that the acoustic length of the straw (the length of the region where standing waves occur) may not be the same as the physical length (the distance you would measure with a ruler), then we can obtain a straight line. It is also true that the exact end of the tube on the double reed side is not obvious either. When we allow for an effective tube length we once again plot the data but instead we calculate (length + extra bit) times frequency, instead of length times frequency. For a specific choice of extra length we do get a straight line. Not only that, but the value on the y-axis should be the speed of sound and it is. This plot is shown below. The length correction can be calculated and is found that the acoustic length of a tube is longer than its physical length by $\delta=0.61*\boldsymbol{a}$ where $\boldsymbol{a}$ is the radius of the tube.



Equal Tempered Scale

0.7420	1.4840	-
0.7004	1.4007	-
0.6610	1.3221	
0.6239	1.2479	-
0.5889	1.1779	
0.5559	1.1117	-
0.5247	1.0493	
0.4952	0.9905	-
0.4674	0.9349	-
0.4412	0.8824	
0.4164	0.8329	-
0.3931	0.7861	
0.3710	0.7420	-