Supplement to Chapter 4 of *The Science of Digital Media* – Digital Audio Representation

Worksheet – Digital Audio > Computing the Frequency of an Aliased Wave[1]

Exercise 1

Refer to the aliasing algorithm in Chapter 4. This algorithm can be written in MATLAB as a single function y = f(x) where the input value x is the actual frequency of a sound wave and the output y is the observed frequency. The function contains a constant that gives the Nyquist frequency for a fixed sampling rate. Write and plot this function in MATLAB for a fixed sampling rate of 3000 Hz. There's more than one way to do this (of course).

Hints:

If the function is written correctly, it can handle all four cases of the algorithm. Look at the four cases and think about how you can get certain terms to fall out or become negative appropriately for each case, depending on the values of INT and REM. (There's more than one way to do this, of course.)

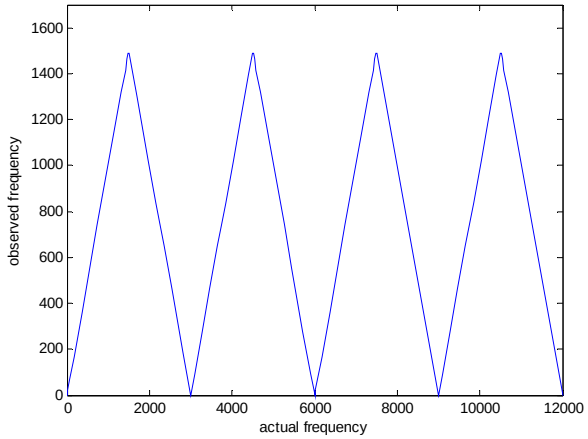
Remember for your first function that the constant is not the sampling rate but the Nyquist frequency associated with the sampling rate.
To drop the remainder when dividing x by y, use *floor(x/y)*.
mod(x,2) = 0 if *x* is even and 1 if *x* is odd. You can use the result of this *mod* function as a multiplier in the function.
You can define a function inline with *inline('function')*. Replace *function* with your own function.
You can plot your inline function with *fplot(inline('function'))*.

Function:

Draw the graph of the function on an attached sheet, or attach a printout of the graph you plot for the function. Mark the areas of the function where Cases 1, 2, 3, and 4 of the algorithm appear.

Using your function, give observed frequencies for an actual frequency of
1200 Hz
2100 Hz
6300 Hz
11500 Hz
Verify these values by looking at the graph. Tell which case each of these examples falls into.

[1]This material is based on work supported by the National Science Foundation under Grant No. DUE-0340969. This worksheet was written by Dr. Jennifer Burg (burg@wfu.edu).



Exercise 2

Now consider the function where the input value is the sampling rate and the output value is the observed frequency. This function has as a constant the actual frequency of the sound wave under consideration. Write and plot this function in MATLAB for a fixed actual frequency of 1000 Hz.

Function:

Draw the graph of the function on an attached sheet, or attach a printout of the graph you plot for the function. Mark a sampling rate of 700 Hz on the x-axis and the corresponding point on the y-axis.

Execute the function for an input value of 800, and verify that the output value is the point you marked on your graph.