Not required to be submitted
(self-study)

AV314 - Programming Assignment 5

Design of filters for undoing the effects of baseband channels.

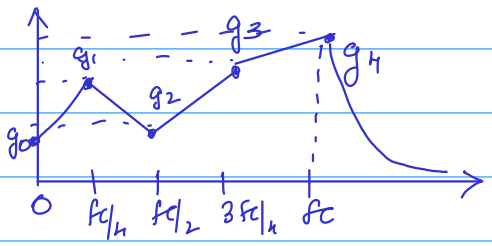
In this self study assignment you will experiment with undoing the effects of various baseband channels using equalising filters.

Please download the file progassgn5.tar.gz from the web page for use with this assignment. See below for a description of the files that you should use -

a) plotspectrum.m — plots the magnitude spectrum of a signal (within 10 kHz) for five frequencies. Use this to check out the spectrum of the signals which you get below.

b) channelsimulator.m - function implementation

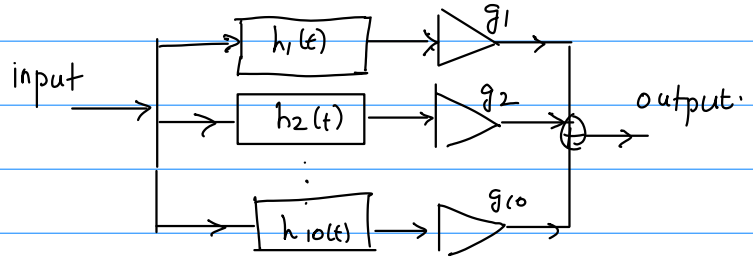
This function returns a channel impulse response $h(t)$ (sampled of course) that represents a low pass filter. The function takes as input the following parameters - the cutoff freq f_c, and the gain values $(g_0, g_1, g_2, g_3, g_4)$ at 0, $f_c/4$, $f_c/2$, $3f_c/4$ and f_c. The freq response that you would get will look approximately like



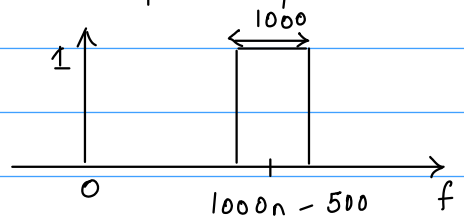
- make sure that $f_c \in [5, 10]$ kHz.

So you can use this function to approximate any channel that you want to model. (within the restriction that $f_c \in [5, 10]$ kHz).

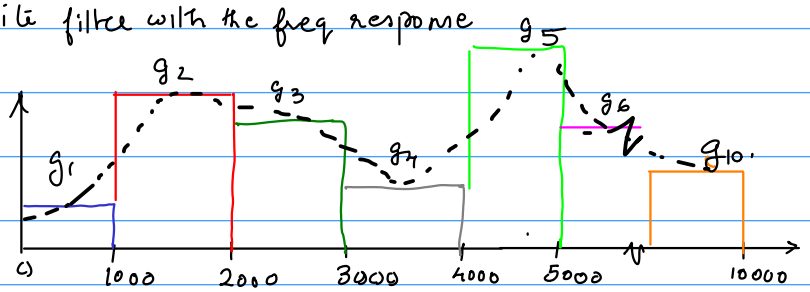
c) receiver function - implements the equalizer filter for any channel with cutoff frequency ≤ 10 kHz. The function returns the impulse response of a composite filter obtained as the parallel connection of many (10) bandpass filters as shown.



The nth block has ideally the impulse response $h_n(t)$ with the corresponding spectrum $|H_n(f)|$ as shown



For a particular choice of $(g_1 \cdots g_{10})$ the parallel combination of all these filters can be seen as a composite filter with the freq response



Self study tasks (also discuss with instructor if you have doubts)

1) Make a baseband channel of your choice - choose inputs $g_0, g_1 \cdots g_4$ and the channel simulator to obtain an impulse response
2) use plotspectrum to plot the freq response of the channel.
3) Design a filter response that will undo the effect of the channel.
4) use receiver function to obtain an inverse filter impulse response that approximates the filter design in (3). You need to choose the gains $(g_1 \cdots g_{10})$
5) use plotspectrum to see the response of the inverse filter
6) Check whether you are able to undo the channel / invert the channel. How will you do this?
7) Tune $(g_1 \cdots g_{10})$ until you are satisfied.

see example.m to see a possible sequence of the above steps.