Lab 7: Filters

Preamble

Other formats

This document is available in HTML (https://cpjobling.github.io/eg-247-textbook/labs/lab07/index) format for online viewing and as PDF (https://cpjobling.github.io/eg-247-textbook/labs/lab07/lab07.pdf) for printing.

Acknowledgements

This lab is based on Filter Design Using Matlab Demo by David Dorran (http://dadorran.wordpress.com/2013/10/18/filter-design-using-matlab-demo/).

There is a YouTube video (http://www.youtube.com/watch?v=vfH5r4cKukg&list=PLJ8LTUMGG9U4vAGind2_Bh4TUfgg1y0F4&feature=share&index=2) that illustrates what we are going to be using.

Not Assessed

This lab is optional, but you may find it useful preparation for the Project.

Preparation

Download the example filter design script filters.m (https://github.com/cpjobling/eg-247-textbook/blob/master/portfolio/lab07/filters.m) from this repository. Save it to your folder for `lab07`.

Open the script as a LiveScript and execute the embedded code step-by step and read and understand the commentary.

Lab Exercise 15: Interactive Filter Design

MATLAB provides a filter design tool with a graphical user interface called `fdatool`.

We want you to use this tool to design and test a low-pass, band-pass and high-pass Butterworth filter with sampling frequency equal to 44.1 kHz. The filter should implement the first, second and third stage in a three-stage graphic equalizer with a low pass filter with a cut-off frequency of 31.5 Hz, a pass-band filter for the middle filter (f_1 to f_2) of about one octave and centre-frequency fc equal to 63 hz and a high-pass filter with pass-frequency of 125 Hz.

The aim of this exercise is to determine the order of the Butterworth filters to be used in your design and the Q factor needed (where $Q = f_c / (f_2 - f_1)$) for the pass-band filters required to implement the mid-range of your 10-stage graphic equalizer.

The centre pass-band filter should be designed so that f2 & f1 satisfies $fc = (f_1 f_2)^{1/2}$. Your goal is to find the Δf value for this filter that achieves a flat frequency response when it is combined with equal weight to the low-pass and high-pass filters.