AGH

Lab Assignments #5

What to do?

- Design lowpass IIR filters using Matlab's IIR filter design toolbox
- Plot results (label axis and titles)
- Report all observations and example plots in your report

Analog filter design

Analog IIR Filter design

Copy and complete missing lines in Matlab scripts from pages 2 & 3.
Run scripts and plot results.

- Set filter order to 3
  - Study and compare amplitude responses of the designed filters
  - Study and compare phase responses of the designed filters
- Set filter order to 7
  - Study and compare amplitude responses of the designed filters
  - Study and compare phase responses of the designed filters
- Comment the results
  - What change you can see in amplitude responses with increasing filter order?
  - What change you can see in phase responses with increasing filter order?
- Replace the *elliptic filter with Bessel filter* using command besself(n,fo) plot it at separate figure and compare the results of its amplitude and phase response with other filters..

IMPORTANT:
Report all your observations in your report, they are very important!

Analog filter design cnt

```
%
%   Design a nth-order analog Butterworth lowpass filter
%   with a cutoff frequency of fo Hz.
%   Multiply by 2pi to convert the frequency to radians per second.
%   Compute the frequency response of the filter at 4096 points.
%
%%
clear
% Set filter order and cut-off frequency
n = 3;  % Filter order 3 or 7
fo = 10e4; % Limit freq in Hz

% Design a nth-order analog Butterworth lowpass filter with a cutoff frequency fo
[zb,pb,kb] = butter(n,2*pi*fo,'s');
% Compute its frequency response
[bb,ab] = zp2tf(zb,pb,kb);
[hb,wb] = freqs(bb,ab,4096);

% Design a nth-order Chebyshev Type I filter with the same edge frequency
% and 3 dB of passband ripple.
[z1,p1,k1] = cheby1(n,3,2*pi*fo,'s');
% Compute its frequency response

% Design a nth-order Chebyshev Type II filter with the same edge frequency
% and 30 dB of stopband attenuation. Compute its frequency response.
[z2,p2,k2] = cheby2(n,30,2*pi*fo,'s');
% Compute its frequency response.

% Design a nth-order elliptic filter with the same edge frequency, 3 dB of passband ripple,
% and 30 dB of stopband attenuation. Compute its frequency response.
[ze,pe,ke] = ellip(n,3,30,2*pi*fo,'s');
% Compute its frequency response.
```

Analog filter design cnt

```
%   Plot the attenuation in decibels vs relative frequency f/fo.
%   Compare responses of the filters and comment differences.

figure(1)
wo = 2*pi*fo;
plot(wb/wo,mag2db(abs(hb)))
% Plot attenuation of other filters
axis([0 2 -80 5])
grid
title('Filter gain')
xlabel('Relative frequency f/fo')
ylabel('Attenuation (dB)')
legend('butter','cheby1','cheby2','ellip')

figure(2)
plot(wb/wo,unwrap(angle(hb)/pi))
hold on

% Plot phase responses of other filters
hold off
axis([0 2 -1.1 1.1])
grid
title('Filter phase')
xlabel('Relative frequency f/fo')
ylabel('Phase in radians')
legend('butter','cheby1','cheby2','ellip')
```

Analog filter design cnt

Example plots for n=5