REPORT

Zajęcia: Analog and digital electronic circuits
Teacher: prof. dr hab. Vasyl Martsenyuk

Lab 8
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Topic: "FIR filtering"
Variant 2

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1. Problem statement: The objective is to investigate FIR filtering technique for different parameters of filtering

2. Input data:

M = 2

$b_0 = 1$

$b_1 = 1$

$b_2 = 2$

3. Commands used (or GUI):

a) source code

Bode plot definition

```
def bode_plot(b, N=2**10, fig=None):  # we use this here for FIRs only
    if fig is None:
        fig = plt.figure()

    a = np.zeros(len(b))  # some scipy packages need len(a)==len(b)
    a[0] = 1

    z, p, gain = signal.tf2zpk(b, a)
    W, Hd = signal.freqz(b, a, N, whole=True)

    print('number of poles:', len(p), '\npole(s) at:', p,
          '\nnumber of zeros:', len(z), '\nzero(s) at:', z)

    gs = fig.add_gridspec(2, 2)
    # magnitude
    ax1 = fig.add_subplot(gs[0, 0])
    ax1.plot(W/np.pi, np.abs(Hd), "C0",
             label=r'$|H(\Omega)|$)',
             linewidth=2)
    ax1.set_xlim(0, 2)
    ax1.set_xticks(np.arange(0, 9)/4)
    ax1.set_xlabel(r'$\Omega \,/\, \pi$', color='k')
```

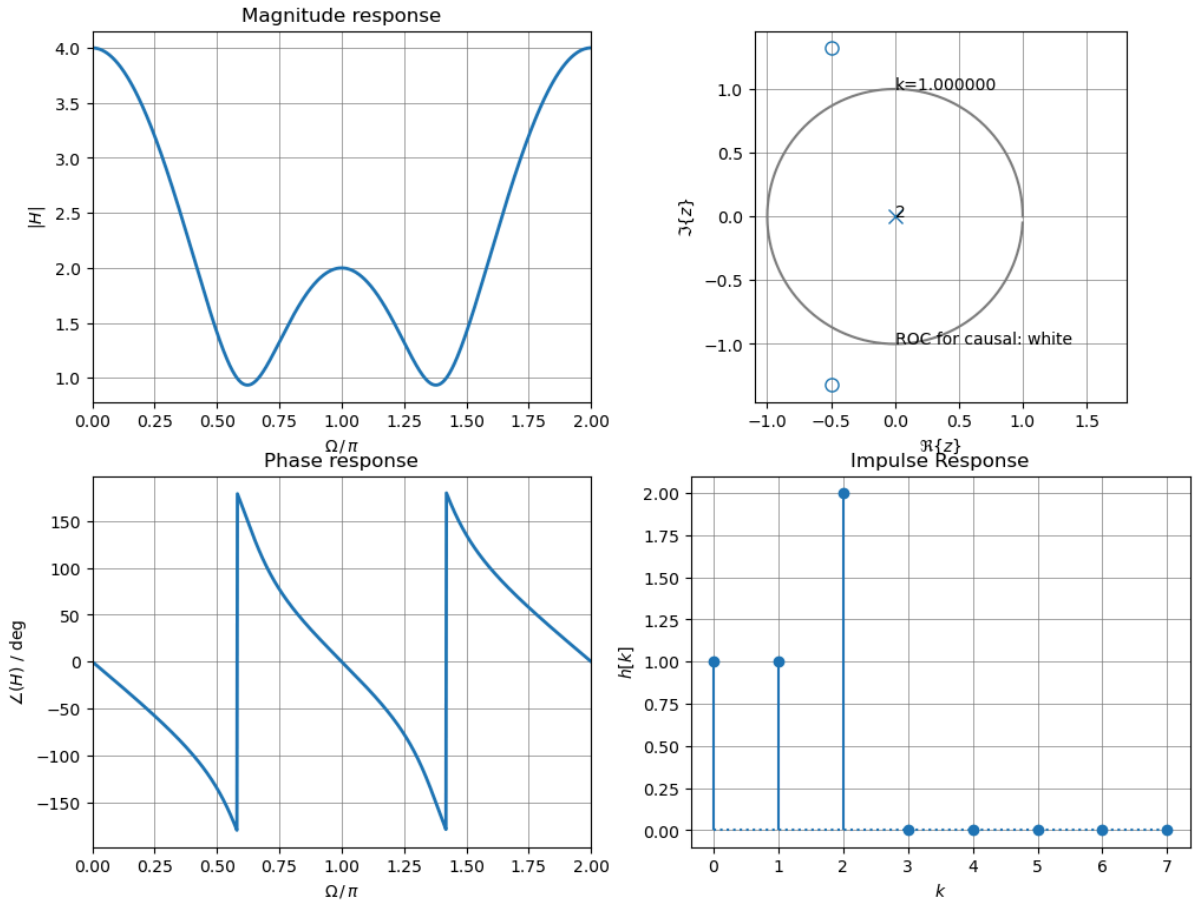
```
ax1.set_ylabel(r'$|H|$', color='k')
ax1.set_title("Magnitude response", color='k')
ax1.grid(True, which="both", axis="both",
        linestyle="-", linewidth=0.5, color='C7')

# phase
ax2 = fig.add_subplot(gs[1, 0])
ax2.plot(W/np.pi, (np.angle(Hd)*180/np.pi), "C0",
        label=r'$\mathrm{angle}(H(r'\omega))$',
        linewidth=2)
ax2.set_xlim(0, 2)
ax2.set_xticks(np.arange(0, 9)/4)
ax2.set_xlabel(r'$\Omega \,/\, \pi$', color='k')
ax2.set_ylabel(r'$\angle(H)$ / deg', color='k')
ax2.set_title("Phase response", color='k')
ax2.grid(True, which="both", axis="both",
        linestyle="-", linewidth=0.5, color='C7')

# zplane
ax3 = fig.add_subplot(gs[0, 1])
zplane_plot(ax3, z, p, gain)

# impulse response
N = 2**3  # here specially chosen for the examples below
k = np.arange(N)
x = np.zeros(N)
x[0] = 1  # create a Dirac
h = signal.lfilter(b, a, x)
ax4 = fig.add_subplot(gs[1, 1])
ax4.stem(k, h, linefmt='C0', markerfmt='C0o',
        basefmt='C0:', use_line_collection=True)
ax4.set_xlabel(r'$k$')
ax4.set_ylabel(r'$h[k]$')
ax4.set_title('Impulse Response')
ax4.grid(True, which="both", axis="both", linestyle="-",
        linewidth=0.5, color='C7')
```

Plotting result for given input parameters

b = [1, 1, 2] # linear phase FIR Type I, the zero in between counts as coeff
bode_plot(b, fig=plt.figure(figsize=figsize))

https://github.com/wm64167/AADEC

4. Outcomes:



5. Conclusions:

In this FIR filtering lab, we investigated the impact of different filter parameters on the filter's response. By analyzing the magnitude response, poles, phase response, and impulse response for filters with parameters determined by our variants, we gained knowledge of the filter's behavior. This allows us to select appropriate FIR filters for specific signal processing applications.