

CT.2306 : Signal & Systems II

Report

Processing motion signals from a PTZ camera



Philéas CURTIL, Thomas MAFILLE, Rémy MAILLARD

January 7th, 2024



Made with LaTeX

Contents

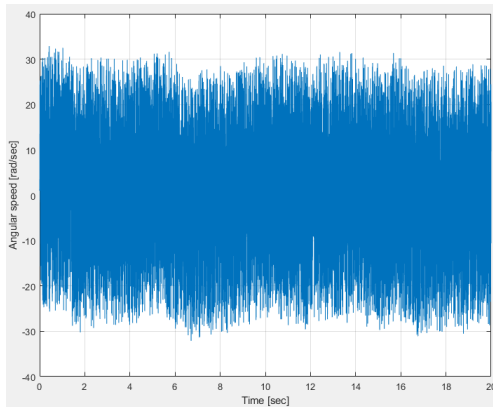
1	Data visualization	2
2	Analog filtering	3
3	Sampling	5
4	Angular position and acceleration	6
5	Digital filtering	7

1 Data visualization

- 1) When we load *data-proj.mat*, we can see that there are two vectors in the file :

Name	Size
<code>omega</code>	1x20001
<code>t</code>	1x20001

- 2) Plot of the angular speed *omega* as a function of time.



To obtain this graph :

```
figure(1)
plot(t, omega)
grid on
hold on
xlabel('Time [sec]')
ylabel('Angular speed [rad/sec]')
)
```

Figure 1: Angular speed as a function of time

It is not possible to use the signal as it is now, mostly because there is too much information (too noisy) or the window is too large. This signal is continuous (analog). Electronic control devices requires digital signals.

2 Analog filtering

- 3) The sampling period T_{e1} can be calculated with :

```
Te1=t(2)-t(1)
```

```
>>Te1 =
```

```
1.0000e-03
```

- 4) Plot of the amplitude spectrum of $\omega(t)$, with the use of the workshop 5 :

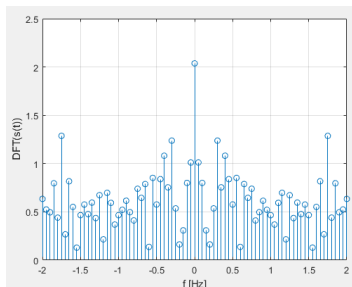


Figure 2: DFT plot of $\omega(t)$

To obtain this graph :

```
% Plot of the DFT of omega(t)
Te2= 0.05;
Fe2=1/Te2;
Tf=t(end);
N=Tf/Te2 ;

f1=-Fe2*(N/2-1)/N:Fe2/N:0;
f2=Fe2/N:Fe2/N:(N/2)*Fe2/N;
f = [f2,f1];
S= zeros(N,1);
for m=1:N
    for k=1:N
        S(m)=S(m)+omega(k)*exp(-1i
            *2*pi*m*k/N);

    end
end

figure(2)
stem(f,abs(S)/N)
grid on
hold on
xlim([-2 2])
xlabel('f [Hz]')
ylabel('DFT(\omega (t))')
```

- 5) $F_{max} = 2Hz$

- 6) The cutoff frequency is $f_c = 2Hz$.
On Matlab :

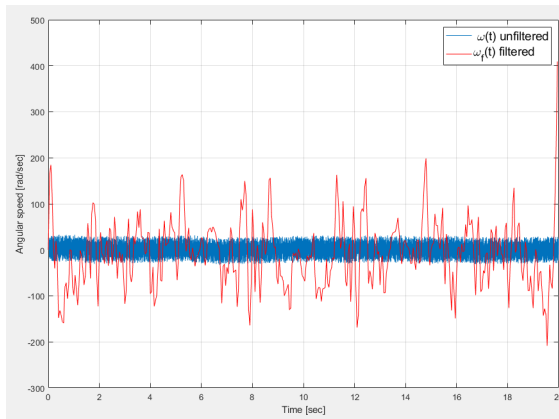


Figure 3: $\omega(t)$ filtered and unfiltered ($\omega_f(t)$)

To obtain this graph :

```
% filter design
t1=0:Te2:t(end)-Te2;
fc1=2;
H1=tf(1,[1/(2*pi*fc1) 1]);
Sf=lsim(H1,S,t1);

% plot of filtered signal
figure(1);
plot(t1,Sf,'r')
grid on
legend(' \omega(t) unfiltered','
\omega_{f}(t) filtered','
FontSize',14)
```

« « « < HEAD On Simulink :

- 7) A

===== On Simulink :

- 8) Plot of the amplitude spectrum of $\omega_f(t)$, with the use of the workshop 5 :

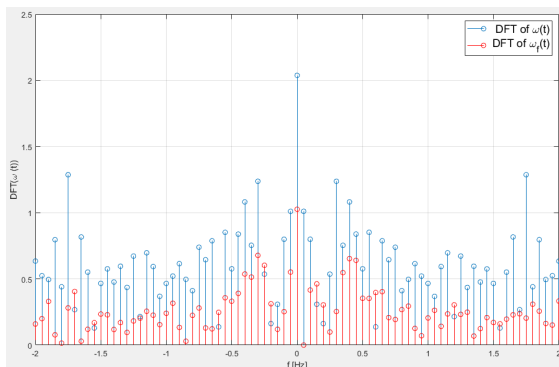


Figure 4: DFT plot of $\omega(t)$ and $\omega_f(t)$

To obtain this graph :

```
figure(2)
stem(f,abs(Sf)/N,'r')
grid on
xlim([-2 2])
legend(' DFT of \omega(t)','DFT
of \omega_{f}(t)','FontSize'
,14)
```

» » » > a9ce1a7192a51e4b47ce38b7133c53abc16fa617

3 Sampling

8) A

9) A

10) A

11) A

12) A

4 Angular position and acceleration

13) A

14) A

5 Digital filtering

16) A

17) A