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Filtering

Types

- highpass
- lowpass
- bandpass
- stopband

Implementation

- shaping fourier spectrum and inverse fourier transform
- finite response filters
- infinite response filters

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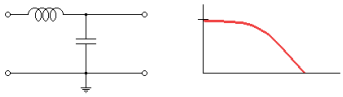
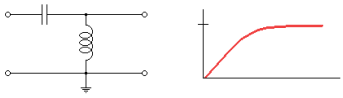
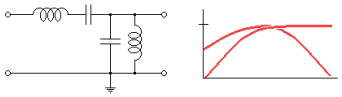
Lowpassfilter:
Passes all components of a signal that are below a frequency limit.



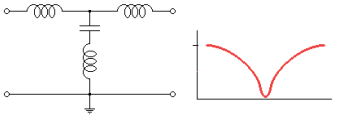
Highpassfilter:
Passes all components of a signal that are above a frequency limit.



Bandpassfilter:
Lets pass all frequency components that are within a frequency range.



Stopbandfilter:
Lets all frequency components pass that are outside a frequency range.



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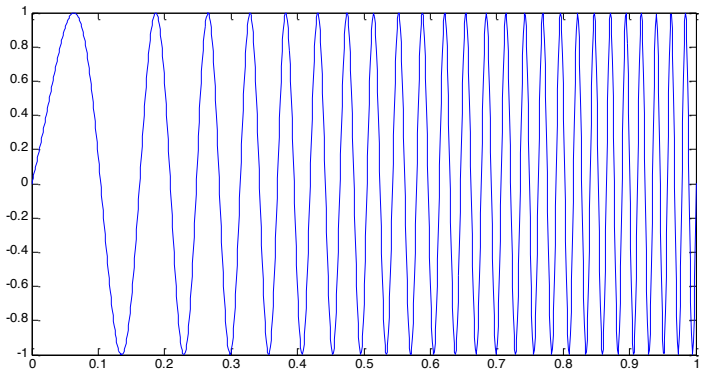

5 Hz **50 Hz**

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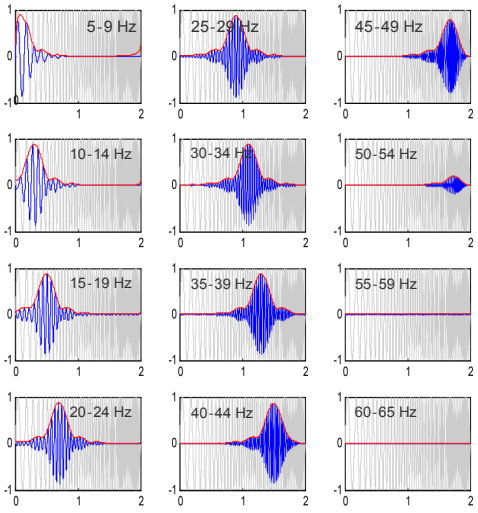

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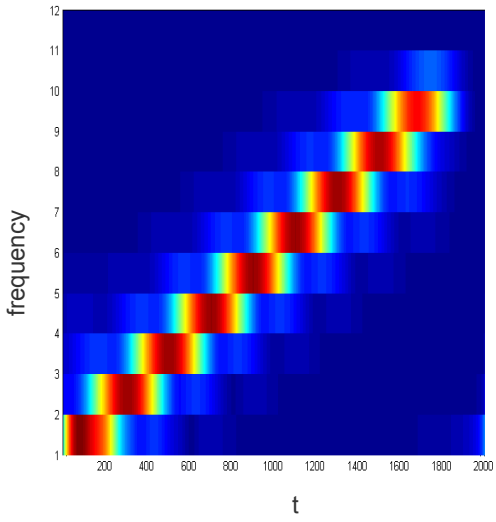

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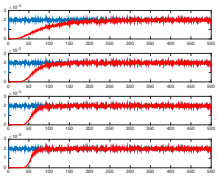
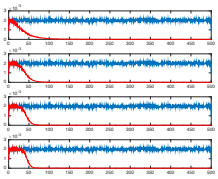
Filtering

Types



highpass



lowpass

```
%% filter
t=0:.001:2;             % time
fs=1./(t(2)-t(1));      %sampling frequency
r=randn(size(t));       % time series

clear a
clear b
n_order=4;
for i=1:n_order
   % highpass
   [b{i},a{i}]=butter(i,100./fs,'high');
end

for i=1:n_order
   % lowpass
   [b{i},a{i}]=butter(i,100./fs);
end
```

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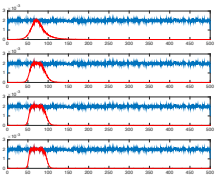
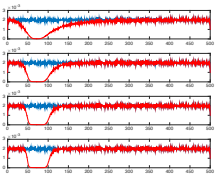
bandpass



stopband



```
%% filter
t=0:.001:2;             % time
fs=1./(t(2)-t(1));      %sampling frequency
r=randn(size(t));       % time series

clear a
clear b
n_order=4;
for i=1:n_order
   % bandpass
   [b{i},a{i}]=butter(i,...
      [100./fs, 200./fs],'bandpass');
end

for i=1:n_order
   % stopband
   [b{i},a{i}]=butter(i,[100./fs, 200./fs],'stop');

end
```

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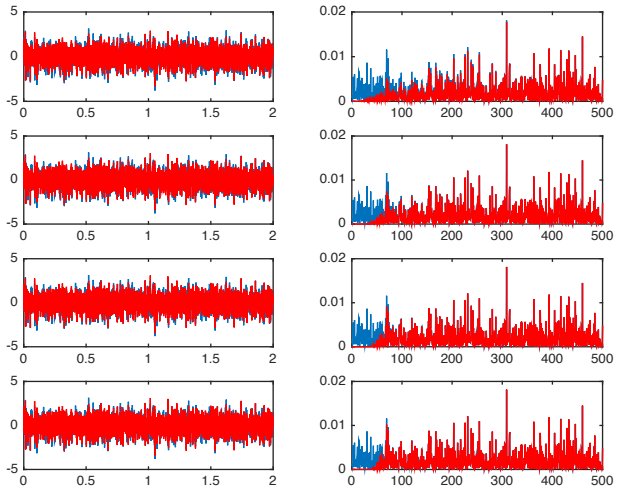
Types
- highpass



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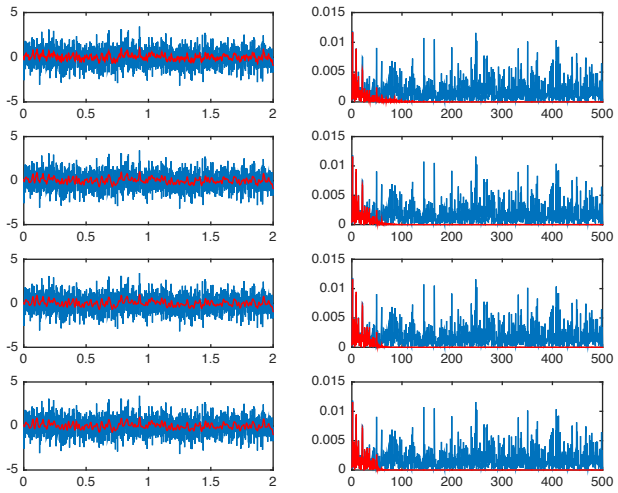
Filtering

Types
- lowpass



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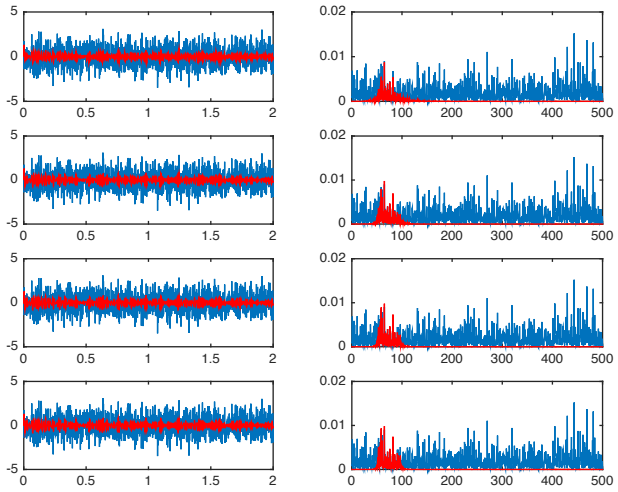
Filtering

Types
- bandpass



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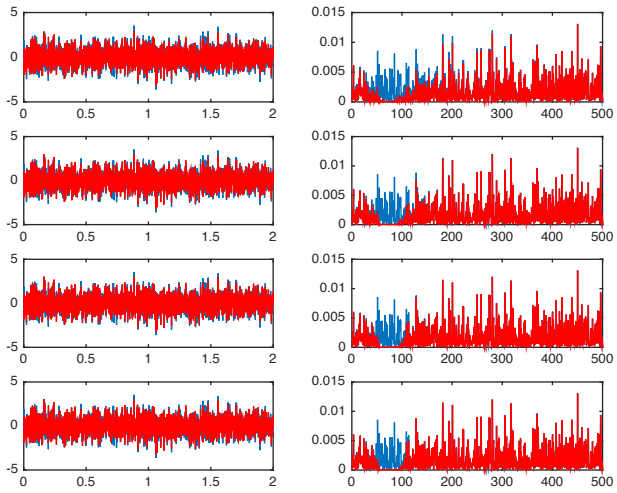
Filtering

Types
- stopband



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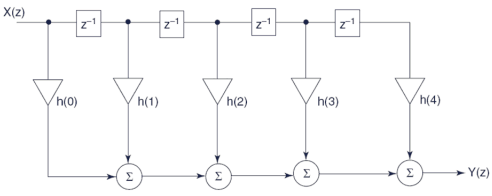
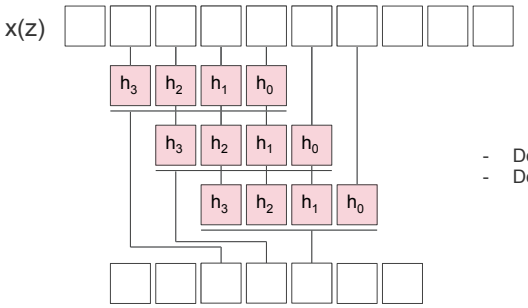
Filtering

Finite Response Filter (FIR)





- Design smoothing filter
- Design highpass filter

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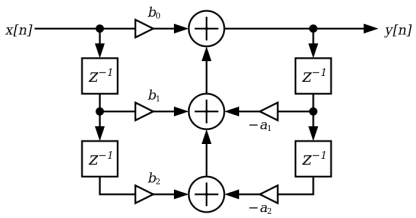
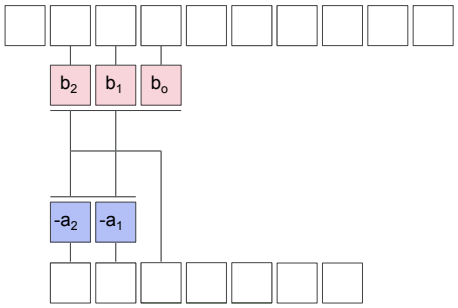
Filtering

Infinite Response Filter (IIR)



x(z)



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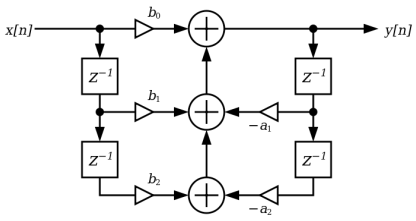
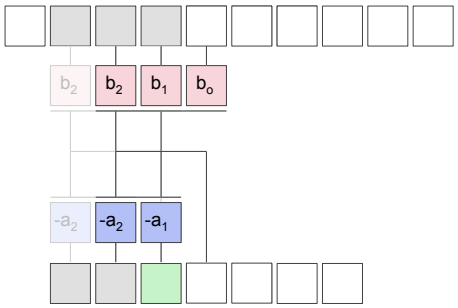
Infinite Response Filter (IIR)



x(z)



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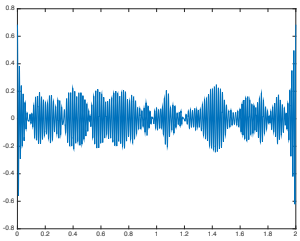

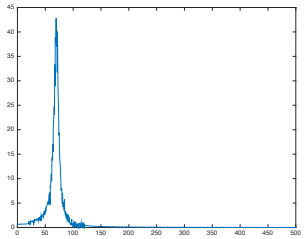

```
t=[0:0.001:2]
f=[20:0.5:120]
a=1./((f-mean(f)).^2+25);

s=zeros(size(t));
i=0;
for b=a
        i=i+1;
        s=s+b*cos(2*pi*f(i)*t+randn);
end
figure
plot(t,s)

u=fft(s)
figure
plot([0:round(size(t,2)/2)-1]*.5,...
        abs(u(1:round(size(t,2)/2))));
```

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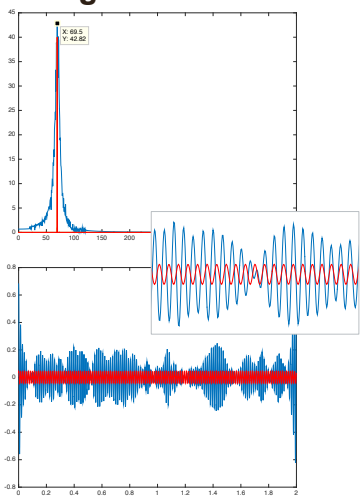

```
figure
plot([0:round(size(t,2)/2)-1]*.5,…
      abs(u(1:round(size(t,2)/2))));
hold on
t_fun=zeros(1,2001)
t_fun(140)=1
t_fun(end-140+2)=1
plot([0:round(size(t,2)/2)-1]*.5,...
      40*abs(t_fun(1:round(size(t,2)/2))));

figure
plot(t,s)
hold on;plot(t,real(ifft((t_fun.*u))),'r')
```

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Filtering

Command: *ft_preprocessing, ft_redefinetrials*

Filtering is best done on continuous data

Task:
- Read data of subject 04_Inhibition_20150507_14.ds
- Filter the data between .5 Hz and 40 Hz
- Use redefine trials in a second step to find conditions d2/d3 max single
- Store the selected data

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Artifacts

Command: *ft_rejectvisual*

Filtering is best done on continuous data

Task:
- Use the previously preprocessed data of subject 04_Inhibition_20150507_14.ds
- Apply artifact rejection
- (www.fieldtriptoolbox.org/tutorial/visual_artifact_rejection)
- Save data