Speech Signal Preprocessing

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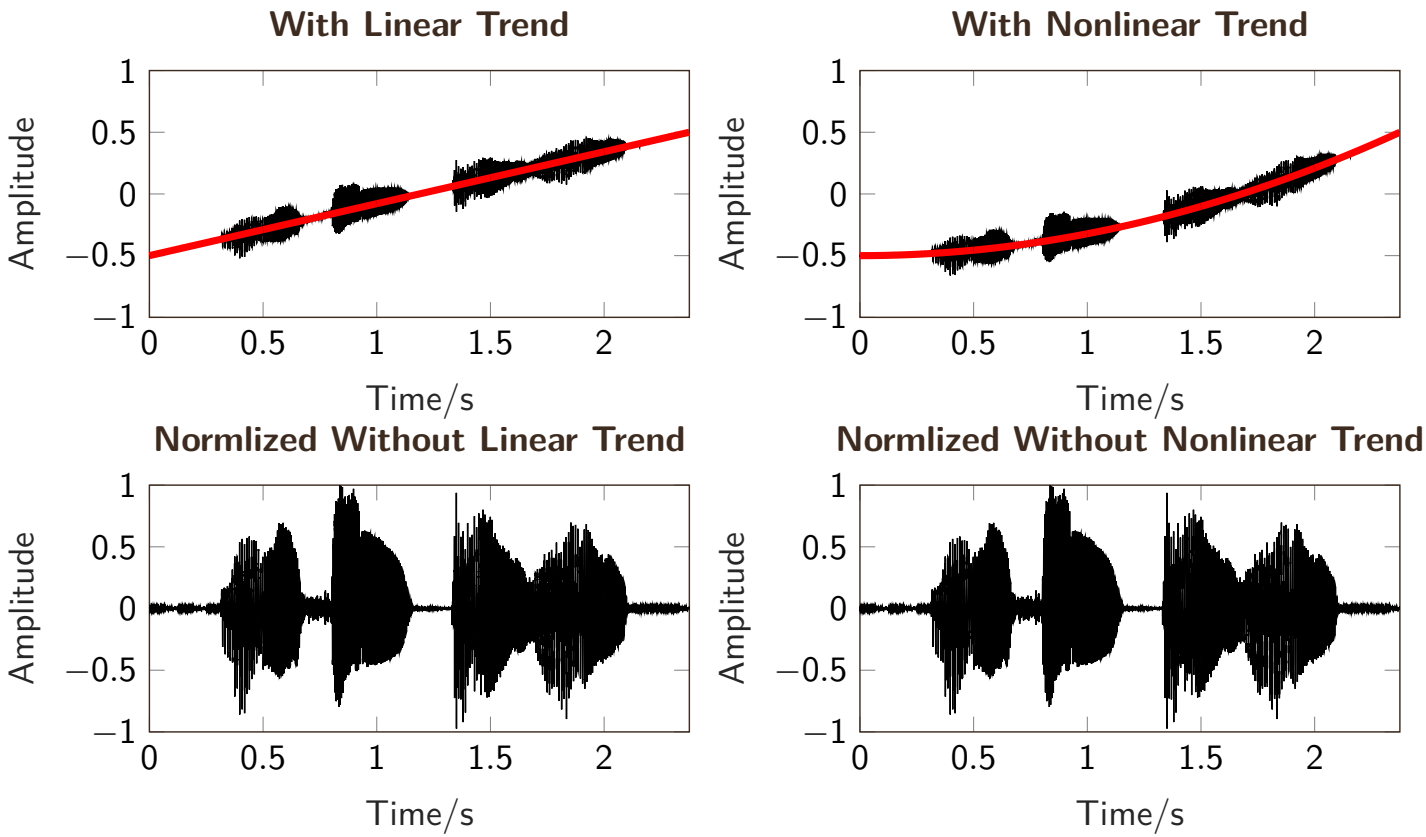
Speech Signal Detrend

```
y = detrend(x);
% Bulit-in function in MATLAB
% Remove linear trend
% x: Signal with linear trend
% y: Signal without linear trend
```

```
function [y,xtrend] = detrendN(x, fs, m)
% Remove linear and nonlinear trend
% fs: Sample rate
% m: Highest fitting order
x = x(:);
N = length(x);
t = (0:N-1)'/fs; % Solve time sequence
a = polyfit(t, x, m); % Returns coefficients ...
    for a polynomial x(t) of degree m
xtrend = polyval(a, t); % Returns polynomial ...
    of coefficients a evaluated at t
y = x - xtrend;
end
```


With Linear Trend
With Nonlinear Trend
Normlized Without Linear Trend
Normlized Without Nonlinear Trend
Amplitude
Time/s
1
0.5
0
−0.5
−1
0
0.5
1
1.5
2

Digital Filters Parameters

- W_p: Passband cutoff frequency, $0<W_p<1$
- W_s: Stopband cutoff frequency, $0<W_s<1$
- R_p: Passband ripple factor
- R_s: Stopband ripple factor

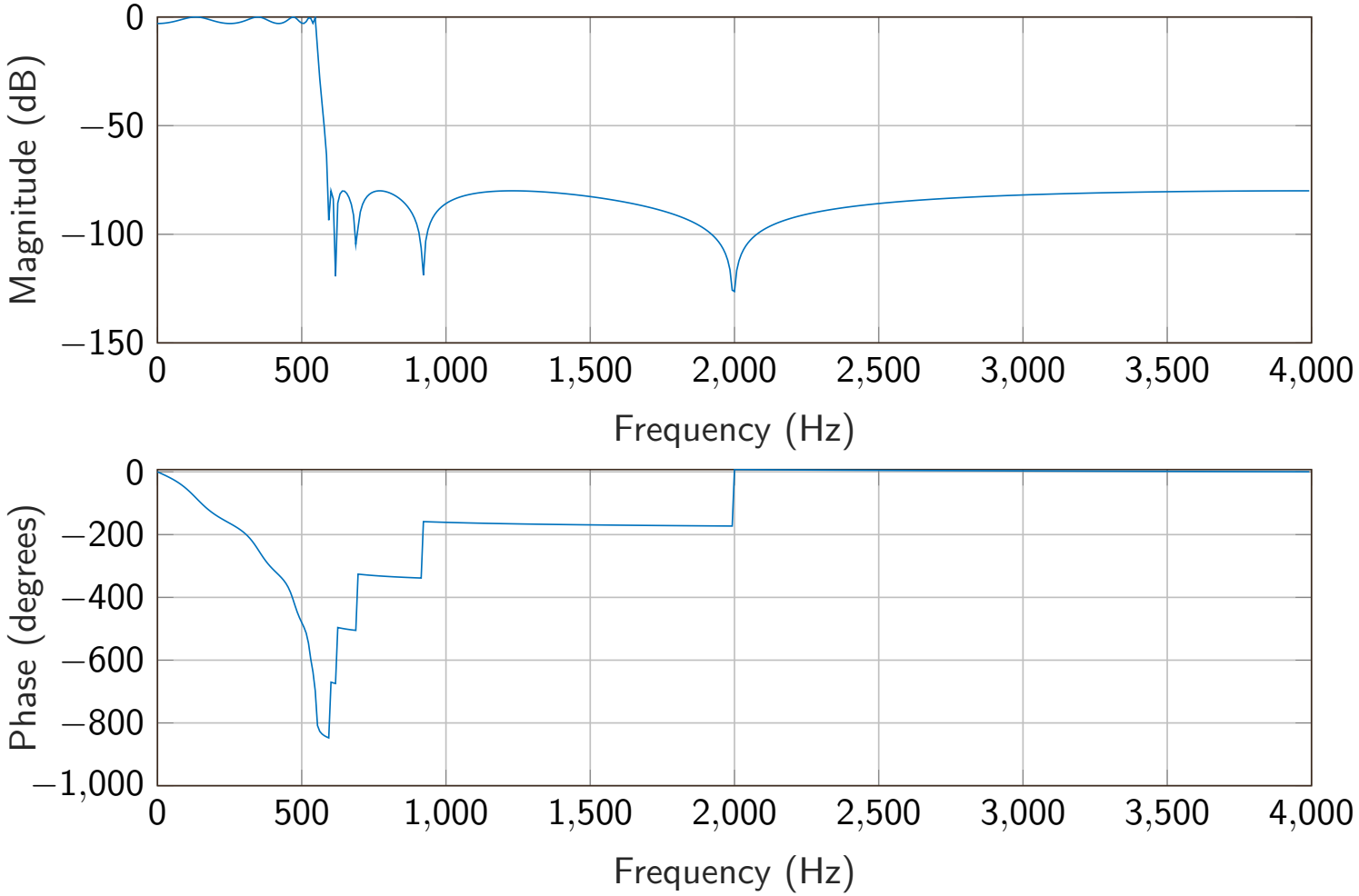
Digital Filters Calculating

- Butterworth: [n, Wn] = buttord(Wp, Ws, Rp, Rs); [m, Wn] = butter(n, Wn, 'ftype')
- Chebyshev Type I: [n, Wn] = cheb1ord(Wp, Ws, Rp, Rs); [n, Wn] = chebv1(n, Rp, Wn, 'ftype')
- Chebyshev Type I: [n, Wn] = cheb2ord(Wp, Ws, Rp, Rs); [n, Wn] = chebv2(n, Rp, Wn, 'ftype')
- Chebyshev Type I: [n, Wn] = ellipord(Wp, Ws, Rp, Rs); [n, Wn] = ellip(n, Rp, Wn, 'ftype')

MATALB Code Example

```
% Elliptic filter design
clc
clear all
fs=8000;
wp=550*2/fs;
ws=500*2/fs;
rp=3;
rs=80;
Nn=512; % Number of evaluation points
[n,wn]=ellipord(wp,ws,rp,rs);
[b,a]=ellip(n,rp,rs,wn);
freqz(b,a,Nn,fs);
```

MATALB Plot Example



Pre-emphasising

Enhancing component and SNR in high frequency when transmission

```
y = filter([1,-0.95],1,x);
```

Pre-emphasising Removal

```
y = filter(1,[1,-0.95],x);
```

Pre-emphasising Example