T.C.

ONDOKUZ MAYIS ÜNİVERSİTESİ

MÜHENDİSLİK FAKÜLTESİ

BİLGİSAYAR MÜHENDİSLİĞİ BÖLÜMÜ

Bilgisayar Mühendisliği Özel Konular
Final Projesi

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1_ Alçak geçiren Chebyshev için ayrık zaman z-düzlemine aktarılması

$$S = \frac{w_m}{\tan(\frac{w_m T}{2})} * \frac{1-z^{-1}}{1+z^{-1}}$$

$$T = \frac{1}{f_s}$$

Dönem içi projesinde tasarlanan alçak geçiren Chebyshev filtresi

ϵ = 0,08

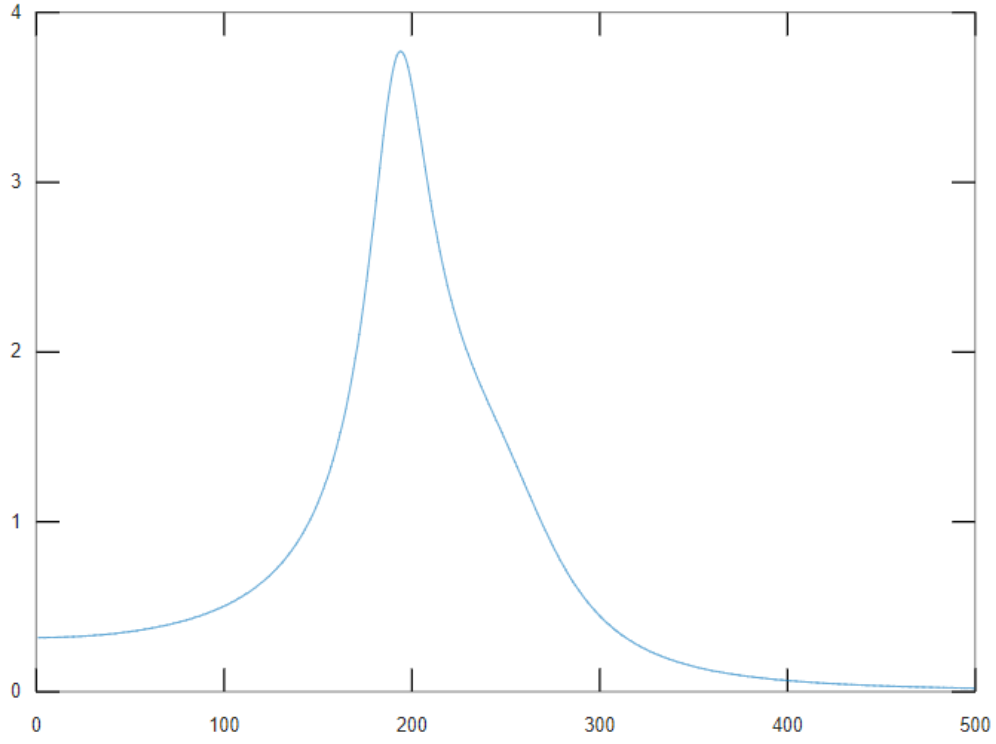
```
octave:1> clear all
e_ripple=0.08;
n=4;
for k=1:n
    D_Re=-sin((2*k-1)*pi/(2*n))*sinh(asinh(1/e_ripple)/n);
    D_Im=i*cos((2*k-1)*pi/(2*n))*cosh(asinh(1/e_ripple)/n);
    s(k)=[(D_Re+D_Im)];
end
for k=1:ceil(n/2)
    if(k==(n-k+1) )
        Hch(k,:)=real([0 1 -s(k)]);
    else
        Hch(k,:)=real(conv([1 -s(k)],[1 -s(n-k+1)]));
    end
end
for l=1:100
    w(l)=2*l/100;
    Nw(l)=1;
    Dw(l)=1;
    for k=1:ceil(n/2)
        Nw(l)=abs(Nw(l)*Hch(k,3) );
        Dw(l)=abs(Dw(l)*(Hch(k,1)*(i*w(l))^2+Hch(k,2)*(i*w(l))+Hch(k,3)));
        Hw(l)=Nw(l)/Dw(l);
    end
end
octave:7> Hch
Hch =

   1.0000   0.6850   1.6545
   1.0000   1.6537   0.9474
```

$$(s^2 + 0.6850s + 1.6545).(s^2 + 1.6537s + 0.9474)$$

```
octave:27> wl = 150;
syms Hn(s) Hdn(s)
Hn(s)=1/1;
for k=1:ceil(n/2)
    if ( k==(n-k+1) )
        Hn(s)=Hn(s)*( Hch(k,3)/(s*Hch(k,2) + Hch(k,3)));
    else
        Hn(s)=Hn(s)*( Hch(k,3)/(s^2* Hch(k,1) + s* Hch(k,2) + Hch(k,3)));
    end
end
Hd(s)=Hn(s/wl);

octave:32> factor(Hd)
ans = (sym)
```

$$\frac{1766535441879375000 \cdot \pi}{\left(45064 \cdot s^{2} + 1473825 \cdot \pi \cdot s + 533988750 \cdot \pi\right) \cdot \left(155193 \cdot s^{2} + 12253600 \cdot \pi \cdot s + 3308188500\right)}$$

```
octave:9> clear all
for k = 1:500
    s(k) = k;
    Nw(k) = 1766535441879375000 * pi;
    % Initialize the imaginary unit 'i'
    i = 1i;
    Dw(k) = (45064 * (i * s(k))^2 + 1473825 * (i * s(k)) + 533988750 * pi) * (155193 * (i * s(k))^2 + 12253600 * (i * s(k)) +
3308188500 * pi);
    H(k) = Nw(k) / Dw(k);
end
Ha = abs(H);
plot(s, Ha)
```



Ayrık Zaman Düzlemi

Wm=150 T=1/110

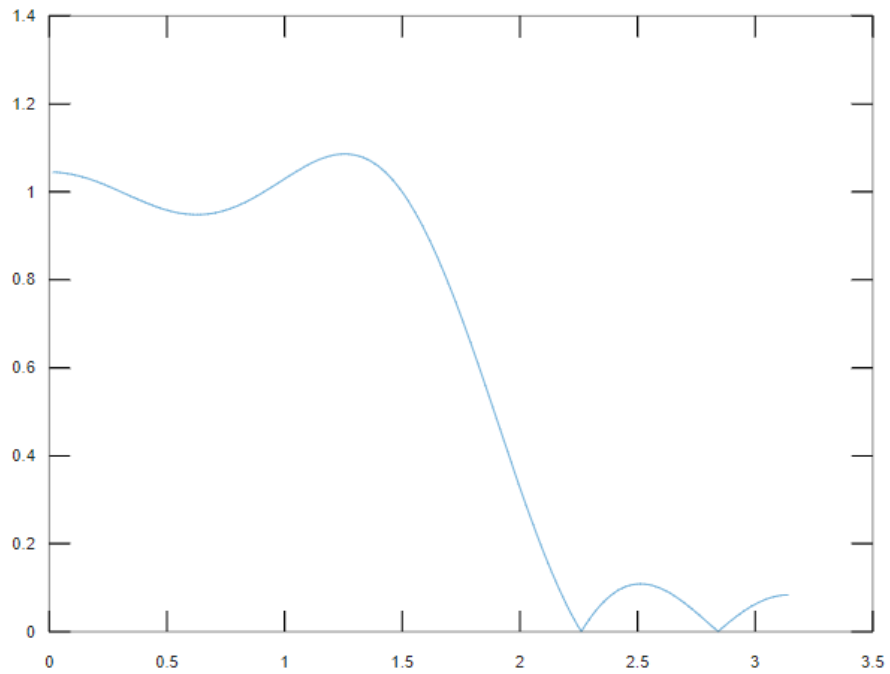
```
octave:99> wl = 150;
syms Hn(s) Hdn(s)
Hn(s)=1/1;
for k=1:ceil(n/2)
    if ( k==(n-k+1) )
        Hn(s)=Hn(s)*( Hch(k,3)/(s*Hch(k,2) + Hch(k,3)));
    else
        Hn(s)=Hn(s)*( Hch(k,3)/(s^2* Hch(k,1) + s* Hch(k,2) + Hch(k,3)));
    end
end
Hd(s)=Hn(s/wl);
factor(Hd)

%S=150/tan(150*(1/110)/2) %=115.58
syms Ha(z) D(z)
D(z)=126.04*(z-1)/(z+1);
Ha(z)=Hd(D(z));
factor(Ha)
error: 'n' undefined near line 1, column 14
error: can't perform indexed assignment for function handle type
error: factor: Q must be a real non-negative integer
error: called from
    factor at line 71 column 5
ans = (sym)

  3151·(z - 1)
  ------------
   25·(z + 1)
```

FIR filtrenin katsayıları ve genlik-frekans eğrileri

$$\left(\omega - H(z)\right) z \rightarrow e^{j\omega T}$$

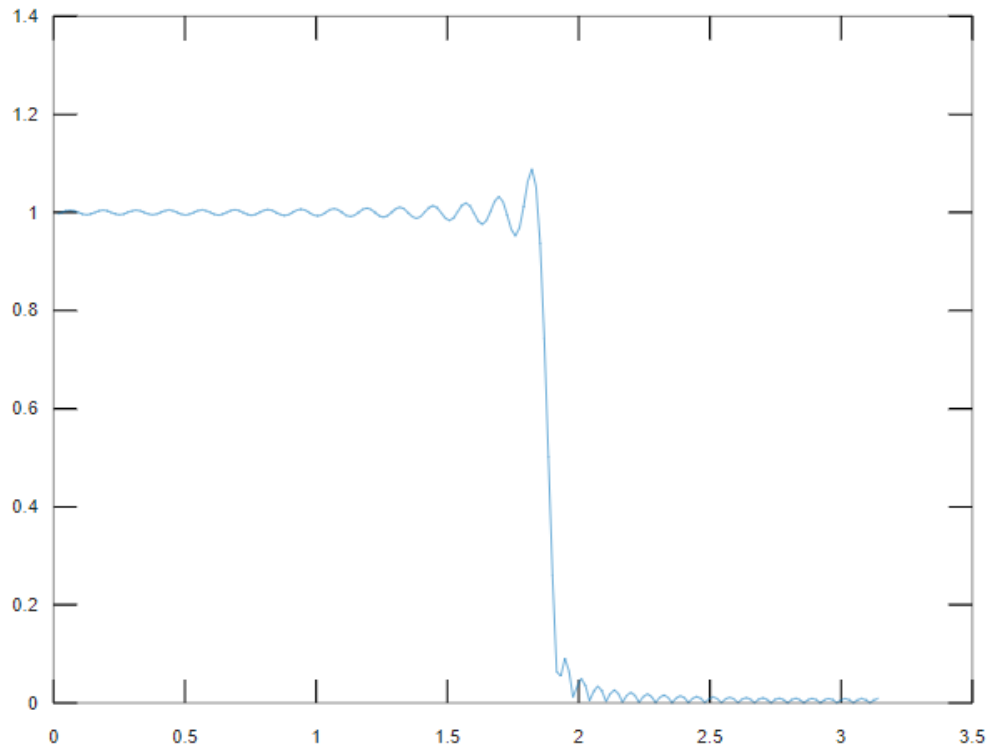
- 10 örnek

```
octave:72> clear all
w=0;
Hw=0;
Hs=0;
hd=0;
Whann=0; Wbarhan=0; Wham=0;
N=10;
%N=100;
wc=0.6*pi;
for k=1:N
    hd(k)=(wc/pi)*sin(wc*(k-N/2))/(wc*(k-N/2));
    if(wc*(k-N/2))==0
        hd(k)=(wc/pi);
    end
end
,
for j=1:200
    w(j)=pi*j/200;
    for k=1:N
    Hs(k)=exp(-i*k*w(j))*hd(k);
    end
    Hw(j)=abs(sum(Hs));
end
plot(w,Hw);
```



- 100 örnek

```
octave:61> clear all
w=0;
Hw=0;
Hs=0;
hd=0;
Whann=0; Wbarhan=0; Wham=0;
N=100;
%N=100;
wc=0.6*pi;
for k=1:N
    hd(k)=(wc/pi)*sin(wc*(k-N/2))/(wc*(k-N/2));
    if(wc*(k-N/2))==0
        hd(k)=(wc/pi);
    end
end
,
for j=1:200
    w(j)=pi*j/200;
    for k=1:N
    Hs(k)=exp(-i*k*w(j))*hd(k);
    end
    Hw(j)=abs(sum(Hs));
end
plot(w,Hw);
```



4- FIR filtrenin pencereleme fonksiyonları ile çarpılması

Hann Window

$$w[n] = \frac{1}{2}\left[1 - \cos\left(\frac{2\pi n}{N-1}\right)\right]$$

Bartlett-Hanning Window

$$w[n] = 0.62 - 0.48\left|\frac{n}{N-1} - 0.5\right| + 0.38\cos\left(2\pi\left(\frac{n}{N-1} - 0.5\right)\right)$$

Hamming Window

$$w[n] = 0.54 - 0.46\left(1 - \cos\left(\frac{2\pi n}{N-1}\right)\right)$$

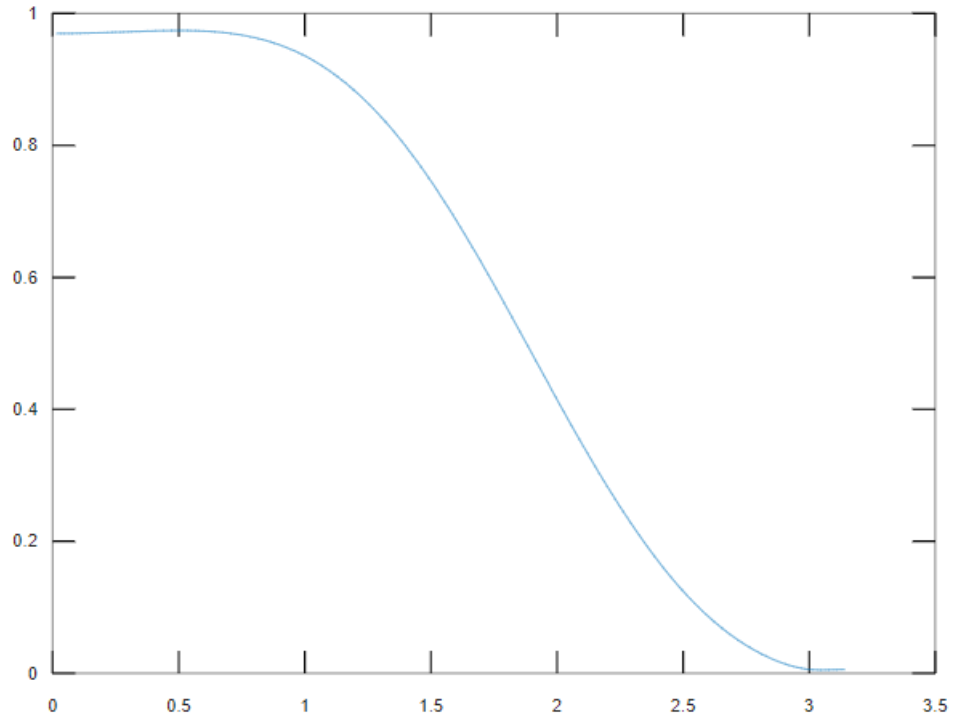
Blackman Window

$$w[n] = 0.42 - 0.5\cos\left(\frac{2\pi n}{N-1}\right) + 0.08\cos\left(\frac{4\pi n}{N-1}\right)$$

Hann

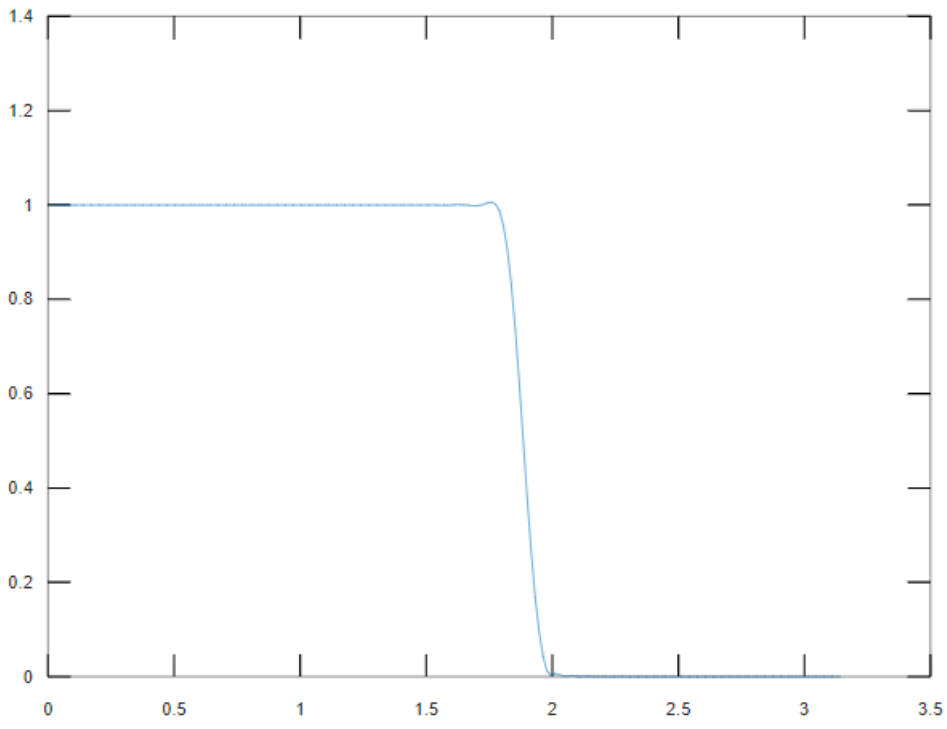
- 10 örnek

```
octave:83> clear all
w=0;
Hw=0;
Hs=0;
hd=0;
Whann=0; Wbarhan=0; Wham=0;
N=10;
%N=100;
wc=0.6*pi;
for k=1:N
    hd(k)=(wc/pi)*sin(wc*(k-N/2))/(wc*(k-N/2));
    if(wc*(k-N/2))==0
        hd(k)=(wc/pi);
    end
end

for k=1:N
    n=k-1;
        Whann(k)=0.5*(1-cos(2*pi*(n/(N-1)) ));
    Wbarhan(k)=0.62-0.48*abs(n/(N-1)-0.5)+0.38*cos(2*pi*(n/(N-1)-0.5));
        Wham(k)=0.54-0.46*(cos(2*pi*(n/(N-1))));
        Wblac(k)=0.42-0.5*(cos(2*pi*(n/(N-1))))+0.08*(cos(4*pi*(n/(N-1))));
end
hd=hd.*Whann;


for j=1:200
    w(j)=pi*j/200;
    for k=1:N
    Hs(k)=exp(-i*k*w(j))*hd(k);
    end
    Hw(j)=abs(sum(Hs));
end
plot(w,Hw);
```



- 100 örnek

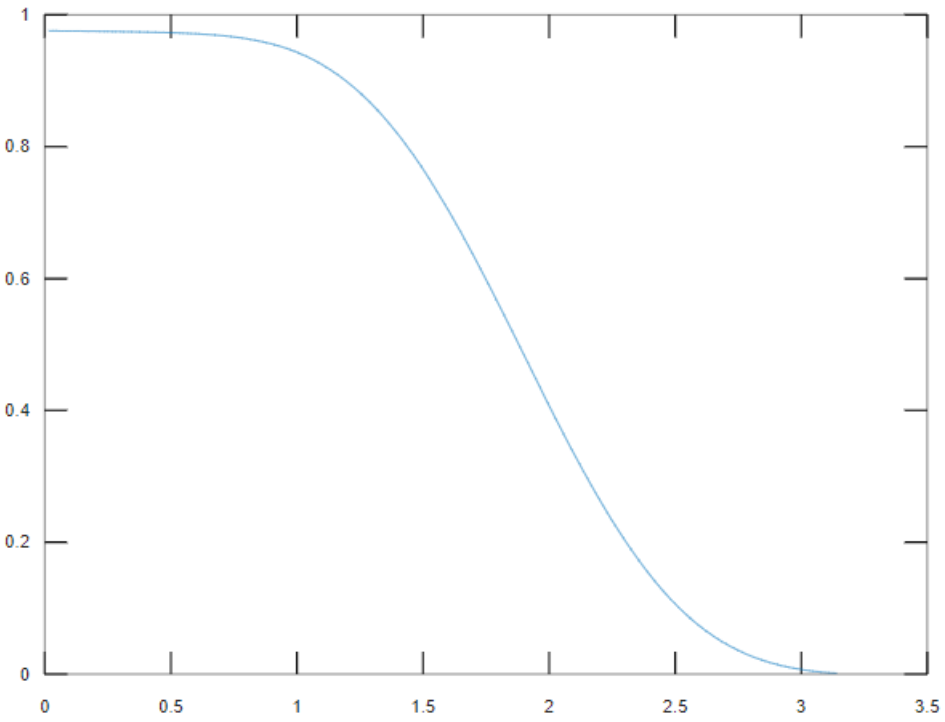
```
octave:96> clear all
w=0;
Hw=0;
Hs=0;
hd=0;
Whann=0; Wbarhan=0; Wham=0;
N=100;
%N=100;
wc=0.6*pi;
for k=1:N
    hd(k)=(wc/pi)*sin(wc*(k-N/2))/(wc*(k-N/2));
    if(wc*(k-N/2))==0
        hd(k)=(wc/pi);
    end
end

for k=1:N
    n=k-1;
        Whann(k)=0.5*(1-cos(2*pi*(n/(N-1)) ));
    Wbarhan(k)=0.62-0.48*abs(n/(N-1)-0.5)+0.38*cos(2*pi*(n/(N-1)-0.5));
        Wham(k)=0.54-0.46*(cos(2*pi*(n/(N-1))));
        Wblac(k)=0.42-0.5*(cos(2*pi*(n/(N-1))))+0.08*(cos(4*pi*(n/(N-1))));
end
hd=hd.*Whann;


for j=1:200
    w(j)=pi*j/200;
    for k=1:N
    Hs(k)=exp(-i*k*w(j))*hd(k);
    end
    Hw(j)=abs(sum(Hs));
end
plot(w,Hw);
```



Hamming

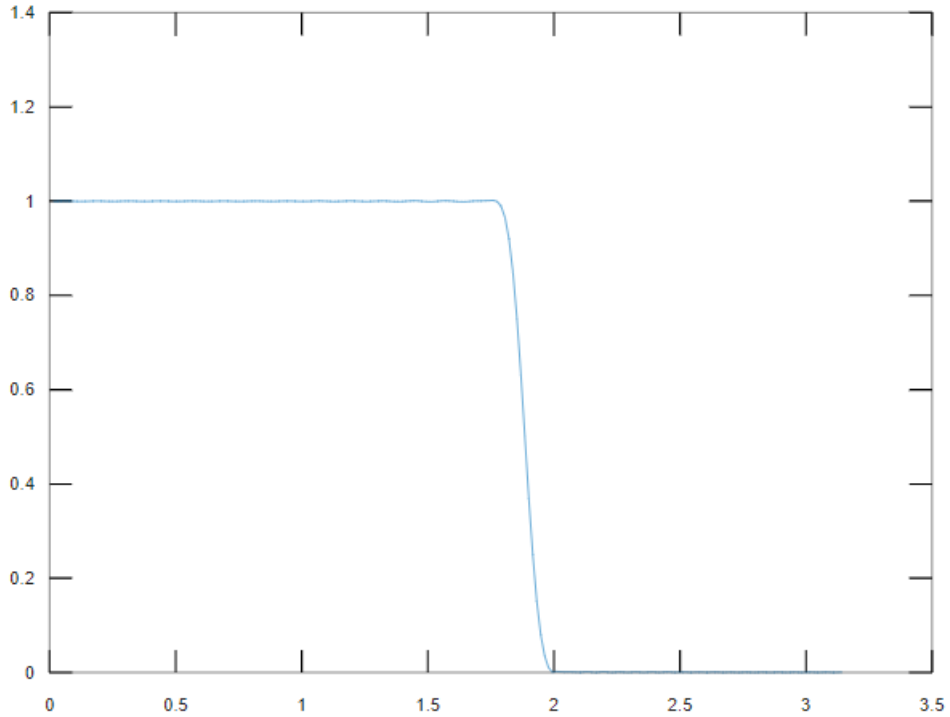
- 10 örnek

```
octave:109> clear all
w=0;
Hw=0;
Hs=0;
hd=0;
Whann=0; Wbarhan=0; Wham=0;
N=10;
%N=100;
wc=0.6*pi;
for k=1:N
    hd(k)=(wc/pi)*sin(wc*(k-N/2))/(wc*(k-N/2));
    if(wc*(k-N/2))==0
        hd(k)=(wc/pi);
    end
end

for k=1:N
    n=k-1;
        Whann(k)=0.5*(1-cos(2*pi*(n/(N-1)) ));
    Wbarhan(k)=0.62-0.48*abs(n/(N-1)-0.5)+0.38*cos(2*pi*(n/(N-1)-0.5));
        Wham(k)=0.54-0.46*(cos(2*pi*(n/(N-1))));
        Wblac(k)=0.42-0.5*(cos(2*pi*(n/(N-1))))+0.08*(cos(4*pi*(n/(N-1))));
end
hd=hd.*Wham;


for j=1:200
    w(j)=pi*j/200;
    for k=1:N
    Hs(k)=exp(-i*k*w(j))*hd(k);
    end
    Hw(j)=abs(sum(Hs));
end
plot(w,Hw);
```



- 100 örnek

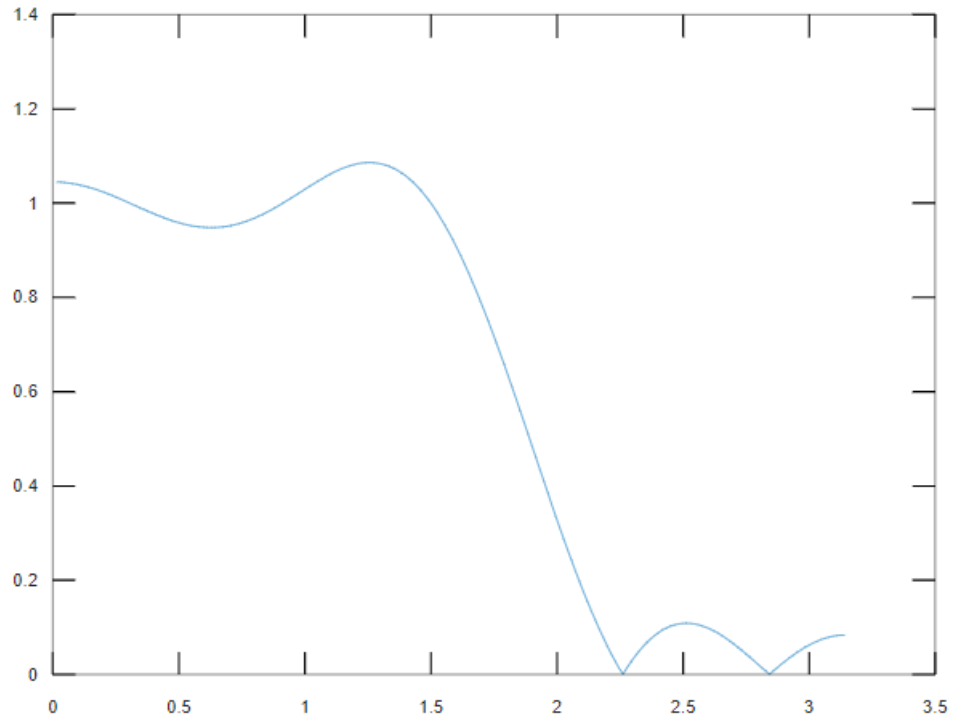
```
octave:122> clear all
w=0;
Hw=0;
Hs=0;
hd=0;
Whann=0; Wbarhan=0; Wham=0;
N=100;
%N=100;
wc=0.6*pi;
for k=1:N
    hd(k)=(wc/pi)*sin(wc*(k-N/2))/(wc*(k-N/2));
    if(wc*(k-N/2))==0
        hd(k)=(wc/pi);
    end
end

for k=1:N
    n=k-1;
        Whann(k)=0.5*(1-cos(2*pi*(n/(N-1)) ));
    Wbarhan(k)=0.62-0.48*abs(n/(N-1)-0.5)+0.38*cos(2*pi*(n/(N-1)-0.5));
        Wham(k)=0.54-0.46*(cos(2*pi*(n/(N-1))));
        Wblac(k)=0.42-0.5*(cos(2*pi*(n/(N-1))))+0.08*(cos(4*pi*(n/(N-1))));
end
hd=hd.*Wham;


for j=1:200
    w(j)=pi*j/200;
    for k=1:N
    Hs(k)=exp(-i*k*w(j))*hd(k);
    end
    Hw(j)=abs(sum(Hs));
end
plot(w,Hw);
```



Bartlett-Hanning

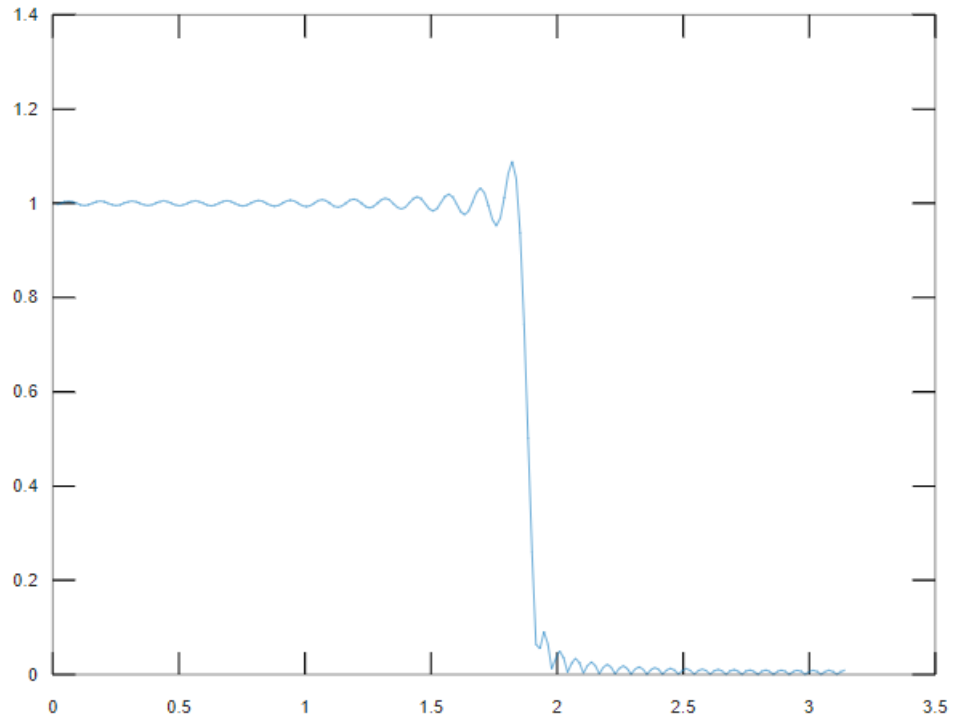
- 10 örnek

```
octave:135> clear all
w=0;
Hw=0;
Hs=0;
hd=0;
Whann=0; Wbarhan=0; Wham=0;
N=10;
%N=100;
wc=0.6*pi;
for k=1:N
    hd(k)=(wc/pi)*sin(wc*(k-N/2))/(wc*(k-N/2));
    if(wc*(k-N/2))==0
        hd(k)=(wc/pi);
    end
end

for k=1:N
    n=k-1;
        Whann(k)=0.5*(1-cos(2*pi*(n/(N-1)) ));
    Wbarhan(k)=0.62-0.48*abs(n/(N-1)-0.5)+0.38*cos(2*pi*(n/(N-1)-0.5));
        Wham(k)=0.54-0.46*(cos(2*pi*(n/(N-1))));
        Wblac(k)=0.42-0.5*(cos(2*pi*(n/(N-1))))+0.08*(cos(4*pi*(n/(N-1))));
end
hd=hd.*Wbarnan;


for j=1:200
    w(j)=pi*j/200;
    for k=1:N
    Hs(k)=exp(-i*k*w(j))*hd(k);
    end
    Hw(j)=abs(sum(Hs));
end
plot(w,Hw);
```



- 100 örnek

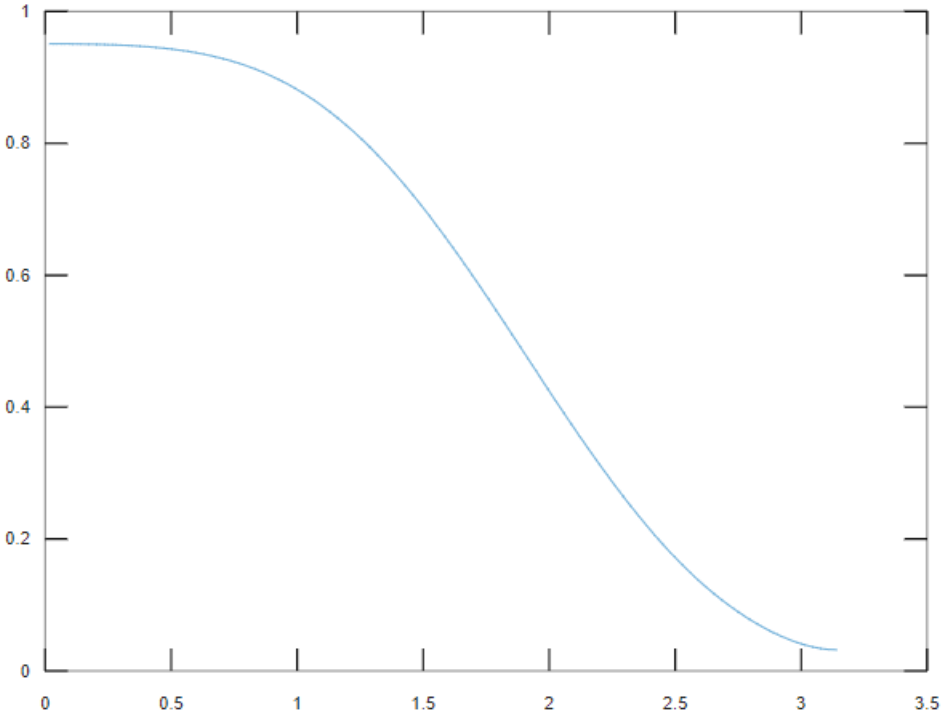
```
octave:148> clear all
w=0;
Hw=0;
Hs=0;
hd=0;
Whann=0; Wbarhan=0; Wham=0;
N=100;
%N=100;
wc=0.6*pi;
for k=1:N
    hd(k)=(wc/pi)*sin(wc*(k-N/2))/(wc*(k-N/2));
    if(wc*(k-N/2))==0
        hd(k)=(wc/pi);
    end
end

for k=1:N
    n=k-1;
        Whann(k)=0.5*(1-cos(2*pi*(n/(N-1)) ));
    Wbarhan(k)=0.62-0.48*abs(n/(N-1)-0.5)+0.38*cos(2*pi*(n/(N-1)-0.5));
        Wham(k)=0.54-0.46*(cos(2*pi*(n/(N-1))));
        Wblac(k)=0.42-0.5*(cos(2*pi*(n/(N-1))))+0.08*(cos(4*pi*(n/(N-1))));
end
hd=hd.*Wbarnan;


for j=1:200
    w(j)=pi*j/200;
    for k=1:N
    Hs(k)=exp(-i*k*w(j))*hd(k);
    end
    Hw(j)=abs(sum(Hs));
end
plot(w,Hw);
```



Blackman

- 10 örnek

```
octave:161> clear all
w=0;
Hw=0;
Hs=0;
hd=0;
Whann=0; Wbarhan=0; Wham=0;
N=10;
%N=100;
wc=0.6*pi;
for k=1:N
    hd(k)=(wc/pi)*sin(wc*(k-N/2))/(wc*(k-N/2));
    if(wc*(k-N/2))==0
        hd(k)=(wc/pi);
    end
end

for k=1:N
    n=k-1;
        Whann(k)=0.5*(1-cos(2*pi*(n/(N-1)) ));
    Wbarhan(k)=0.62-0.48*abs(n/(N-1)-0.5)+0.38*cos(2*pi*(n/(N-1)-0.5));
        Wham(k)=0.54-0.46*(cos(2*pi*(n/(N-1))));
        Wblac(k)=0.42-0.5*(cos(2*pi*(n/(N-1))))+0.08*(cos(4*pi*(n/(N-1))));
end
hd=hd.*Wblac;


for j=1:200
    w(j)=pi*j/200;
    for k=1:N
    Hs(k)=exp(-i*k*w(j))*hd(k);
    end
    Hw(j)=abs(sum(Hs));
end
plot(w,Hw);
```



- 100 örnek

```
octave:174> clear all
w=0;
Hw=0;
Hs=0;
hd=0;
Whann=0; Wbarhan=0; Wham=0;
N=100;
%N=100;
wc=0.6*pi;
for k=1:N
    hd(k)=(wc/pi)*sin(wc*(k-N/2))/(wc*(k-N/2));
    if(wc*(k-N/2))==0
        hd(k)=(wc/pi);
    end
end

for k=1:N
    n=k-1;
        Whann(k)=0.5*(1-cos(2*pi*(n/(N-1)) ));
    Wbarhan(k)=0.62-0.48*abs(n/(N-1)-0.5)+0.38*cos(2*pi*(n/(N-1)-0.5));
        Wham(k)=0.54-0.46*(cos(2*pi*(n/(N-1))));
        Wblac(k)=0.42-0.5*(cos(2*pi*(n/(N-1))))+0.08*(cos(4*pi*(n/(N-1))));
end
hd=hd.*Wblac;


for j=1:200
    w(j)=pi*j/200;
    for k=1:N
    Hs(k)=exp(-i*k*w(j))*hd(k);
    end
    Hw(j)=abs(sum(Hs));
end
plot(w,Hw);
```