FIR Filter Classifier Type B

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Linear Phase FIR Filter

The Discrete FIR Filter block independently filters each channel of the input signal with the specified digital FIR filter. The block can implement static filters with fixed coefficients, as well as time-varying filters with coefficients that change over time. You can tune the coefficients of a static filter during simulation. This block filters each channel of the input signal independently over time. The Input processing parameter allows you to specify whether the block treats each element of the input as an independent channel (sample-based processing), or each column of the input as an independent channel (frame-based processing). To perform frame-based processing, you must have a DSP System Toolbox™ license. The output dimensions equal those of the input, except when you specify a matrix of filter taps for the Coefficients parameter. When you do so, the output dimensions depend on the number of different sets of filter taps you specify.

Initialization for TYPE A Filter

```
clear all
clc
```

Transfer function in Z domain

This input will be received from the user end.

For Type A Filter

```
num = [ 1 2 2 1];
```

Developer's Mode

```
dmode = 1;
```

Generating Poles for Linear FIR Filter

```
[~,k] = size(num);

den(1) = 1;

for i=2:k

    den(k) = 0;

end


n_roots = roots(num);
d_roots = roots(den);




[number_of_coefficients, ~] = size(d_roots);

number_of_coefficients = number_of_coefficients + 1;
noc = number_of_coefficients;
```

Flags to declare type of system.

```
flag_A = false;
flag_B = false;
flag_C = false;
flag_D = false;
flag_sym = 1;
```

Global Variable Declaration

```
check_sym(1) = 100;

if (rem(noc,2) == 1) %% ODD Coeffs

    flag_A = true;
    flag_C = true;

else    %% Even Coeffs
    flag_B = true;
    flag_D = true;

end
```

Geting Transfer Function h(n)

```
if (flag_A == true)
```

If ODD

```
if (dmode)
    disp('KTB ODD')
end
h = num;

[~,n] = size(h);
N = n;
n = n - 1;
n = n/2;

for i = 1:n
    if (h(i) == h(N+1-i))
        if (dmode)
            disp('KTB SYMM');
        end
        check_sym(i) = 1;
        flag_sym = flag_sym * 1;



    else if (h(i) == (-1 * h(N+1-i)))
            flag_sym = flag_sym * -1;
            check_sym(i) = -1;
            if (dmode)
                disp('KTB ANTI SYMM');
            end

        else
            flag_sym = 0;
            if (dmode)
                disp('KTB Nothing');
            end
        end
    end

end


if (check_sym(1)>0)

    flag_C = false;

else

    flag_A = false;
```

```
        end

    else
```

IF even

```
        if (dmode)
            disp('KTB EVEN')
        end
        h = num;

        [~,n] = size(h);
        N = n;
        n = n/2;



        for i = 1:n
            if (h(i) == h(N+1-i))
                if (dmode)
                    disp('KTB SYMM');
                end
                check_sym(i) = 1;
                flag_sym = flag_sym * 1;

            else

               if (dmode)
                    disp('KTB Reached')
                end
                if (h(i) == (-1 * h(N+1-i)))
                    flag_sym = flag_sym * -1;
                    check_sym(i) = -1;
                    if (dmode)
                        disp('KTB ANTI SYMM');
                    end

                else
                    flag_sym = 0;
                    if (dmode)
                        disp('KTB Nothing');
                    end
                end
            end

        end




        if (check_sym(1)>0)
```

```
        flag_D = false;

    else

        flag_B = false;

    end

KTB EVEN
KTB SYMM
KTB SYMM

end


[~, lc] = size(check_sym);

lfir = 1;

for p = 1:(lc-1)


    if (check_sym(p) ~= check_sym(p+1))
        lfir = lfir *0;

    end

end
```

Final OUTPUT

Answers

```
if (lfir)

    if (flag_A)
        disp('Given Filter classified as type: A')
    end

    if (flag_B)
        disp('Given Filter classified as type: B')
    end
    if (flag_C)
        disp('Given Filter classified as type: C')
    end
    if (flag_D)
        disp('Given Filter classified as type: D')
    end


else

    disp('NOT A LINEAR FINITE IMPULSE RESPONSE FILTER!')
```

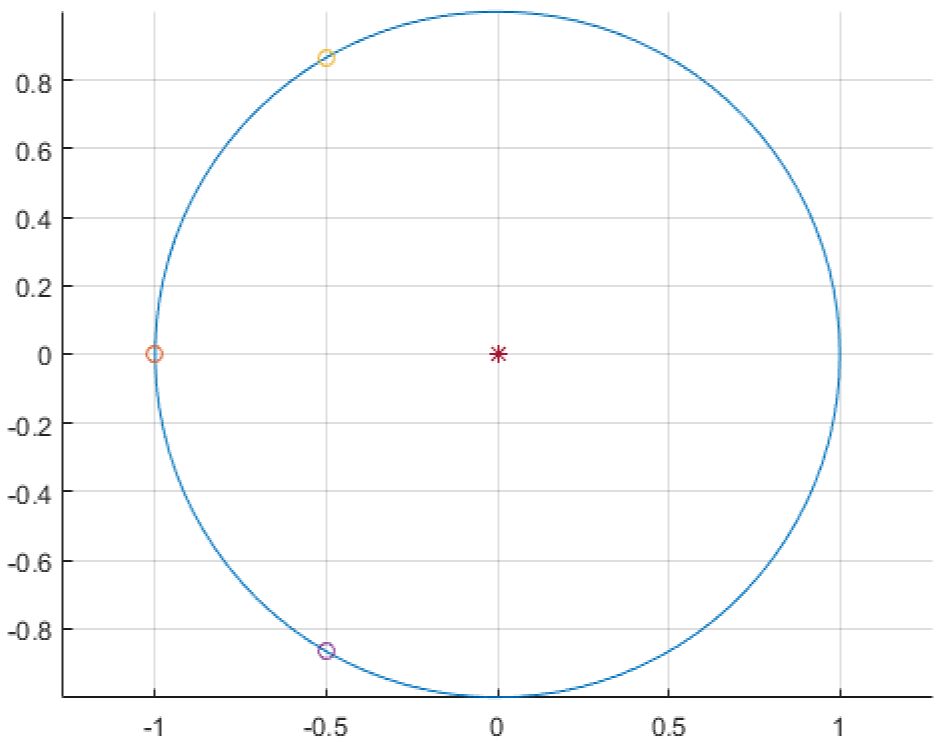
```
end
```

Given Filter classified as type: B

Graph Plot in Z domain

```
figure();
r = 1;
xc = 0;
yc = 0;
grid on
hold on
theta = linspace(0,2*pi);
x = r*cos(theta) + xc;
y = r*sin(theta) + yc;
plot(x,y)

[l1, ~] = size(n_roots);

[l2, ~] = size(d_roots);

for i=1:l1

    plot(real(n_roots(i)),imag(n_roots(i)),'o');

end



for i=1:l2

    plot(real(d_roots(i)),imag(d_roots(i)),'*');

end

axis equal

equity = 0;

equity_num = 0;
equity_den = 0;

%syms z;

w = 1:180;

x = cos((w*pi)/180) + i*sin((w*pi)/180);

z  = x;
```

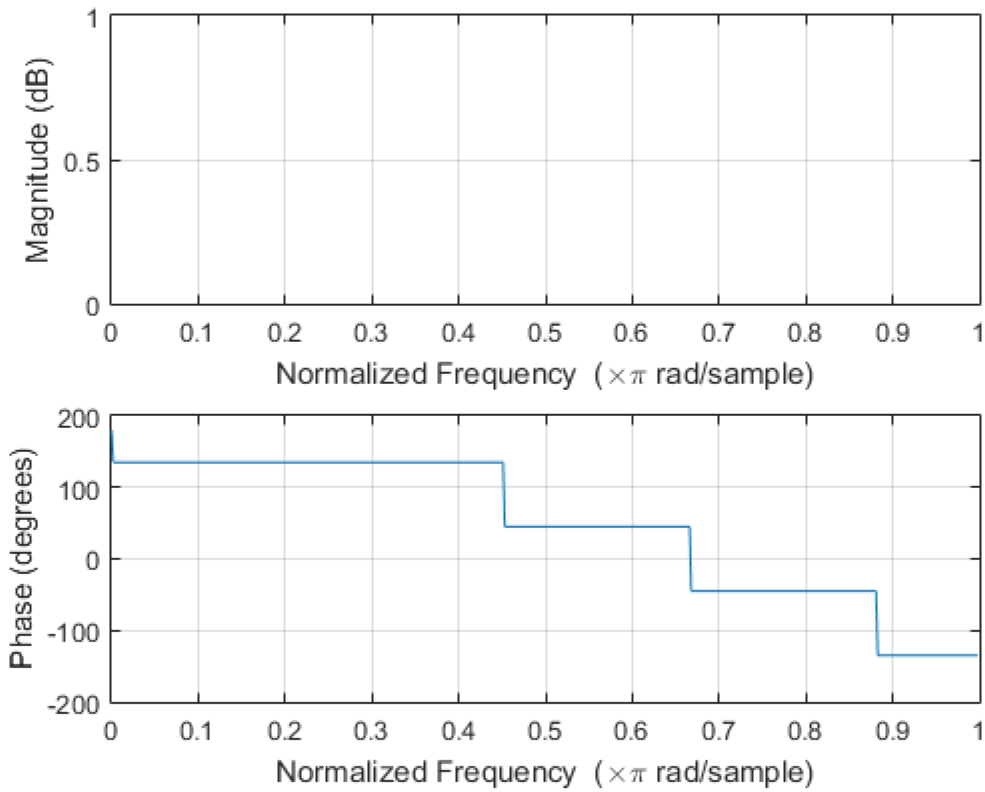
```
for k = 1:(l1)
    %disp('KTB');
    equity_num = equity_num + z.^k * num(l1 - k + 1);

end

equity_num = equity_num + num(l1+1);


for m = 1:(l2)

    equity_den = equity_den + z.^m * den(l2 - m + 1);

end


equity_den = equity_den + den(l2+1);


equity = equity_num / equity_den;
```

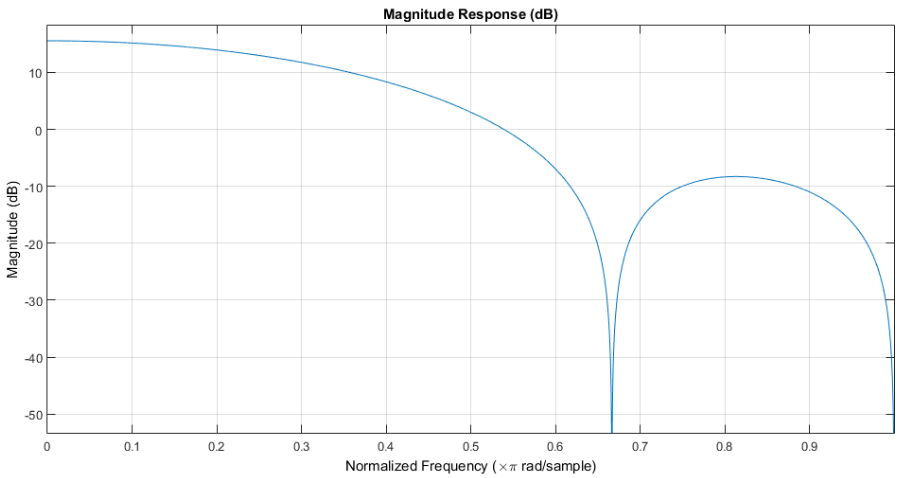


Reuired Responses

```
figure();
freqz(n_roots,d_roots);
figure();
```

```
fvtool(num);
```


Magnitude (dB)
Normalized Frequency (×π rad/sample)
Phase (degrees)
Normalized Frequency (×π rad/sample)



Function Termination

```
disp ('Function Termination');
% end
```

Function Termination

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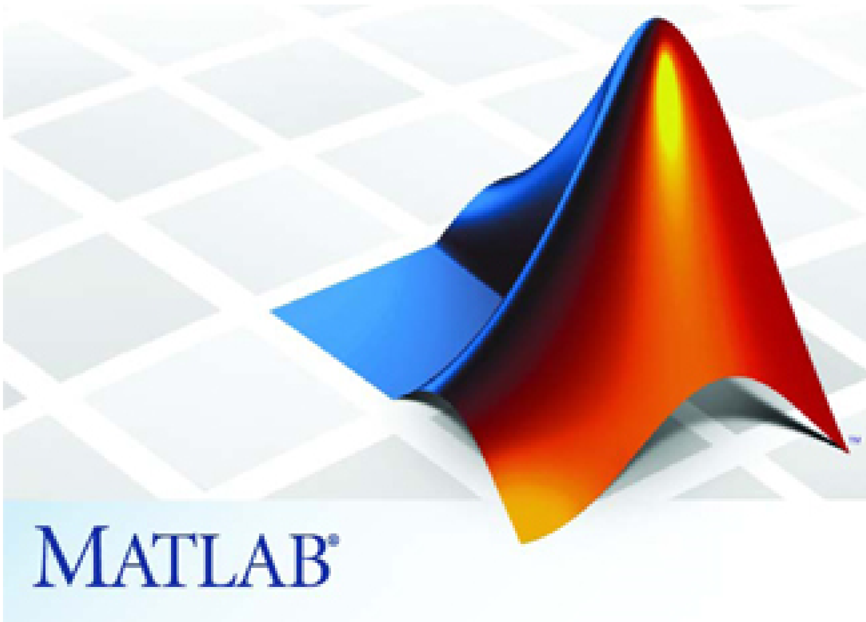
MATLAB Lab experiment of FIR Filter Classifier.



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