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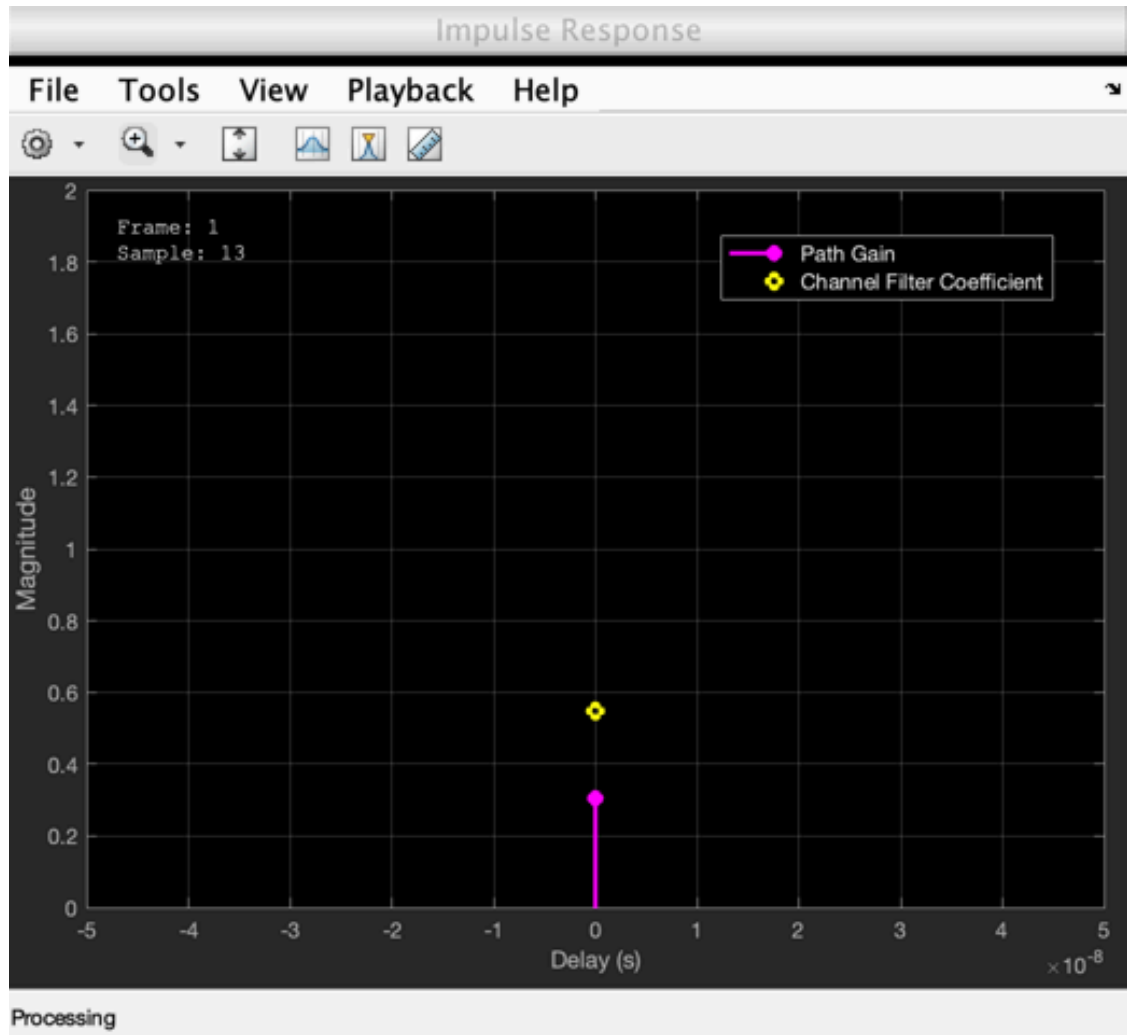
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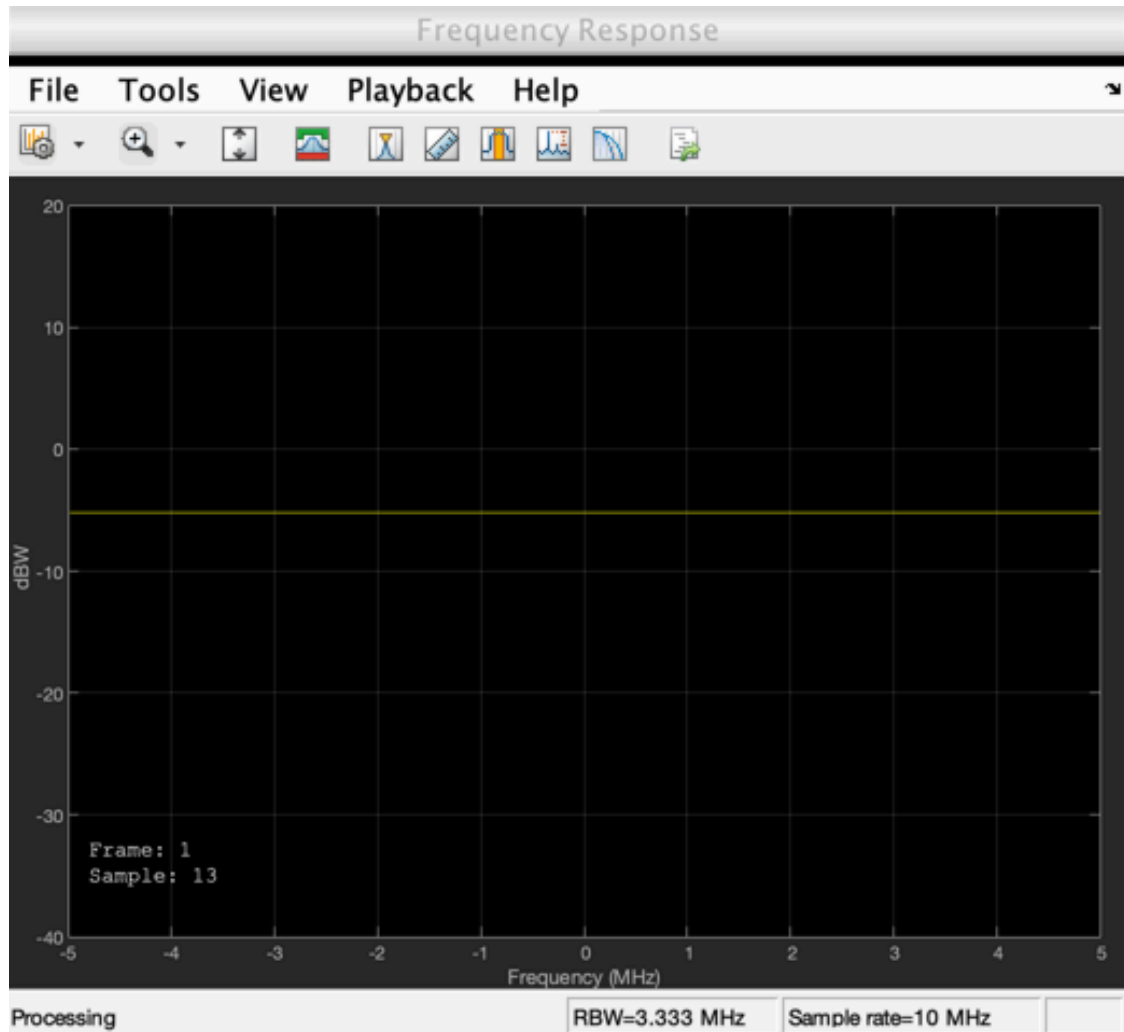
```
pskModulator = comm.PSKModulator(2);      %BPSK modulation
input_signal = randi([0,pskModulator.ModulationOrder-1],16,1);
channelInput = pskModulator(input_signal);
```

Delay [0 0] (single path)

```
rayleigh_channel_sp = comm.RayleighChannel( ...
    'SampleRate',10e6, ...
    'PathDelays',[0 0], ...
    'AveragePathGains',[0 0], ...
    'Visualization','Impulse and frequency responses');

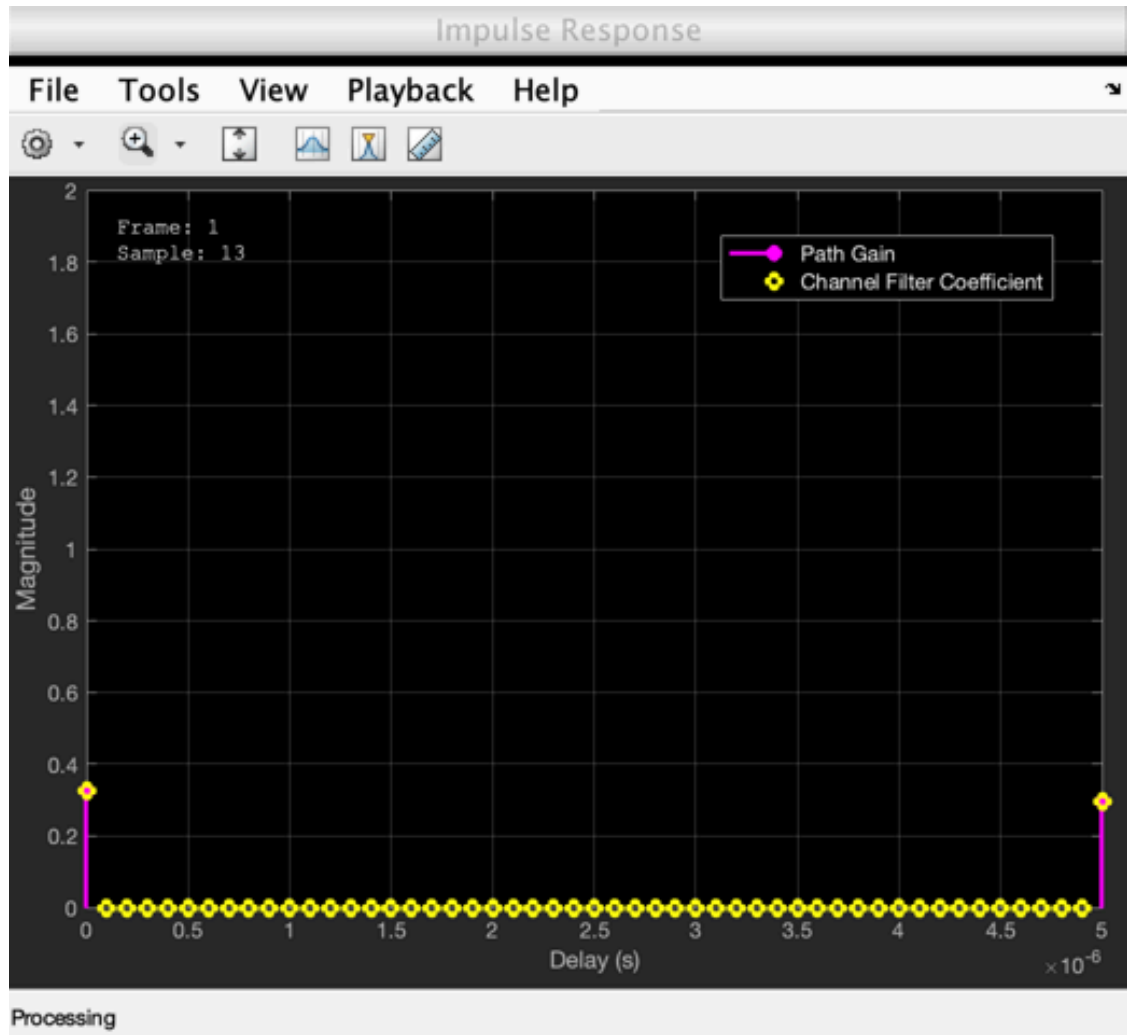
rc_single = rayleigh_channel_sp(channelInput);
```

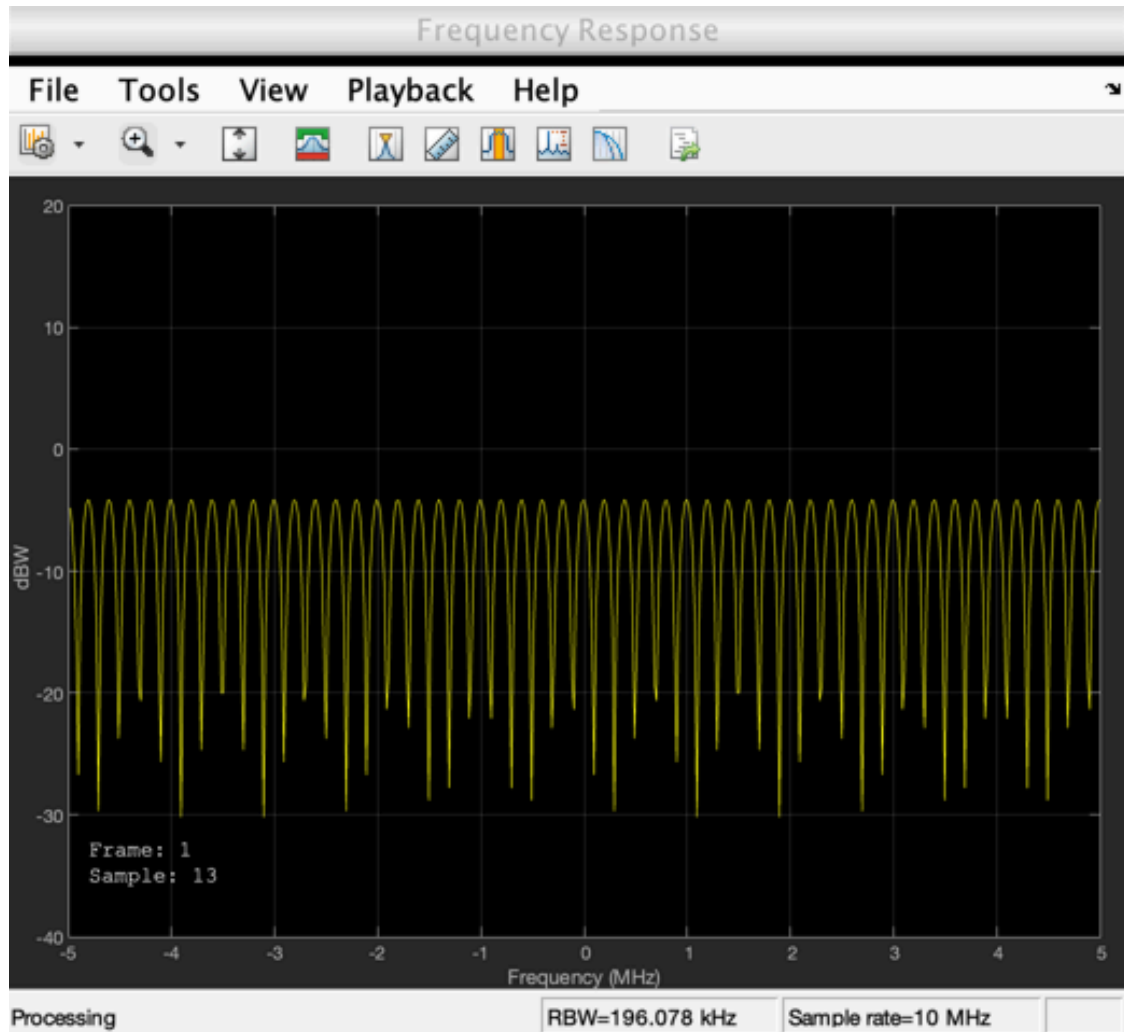




Delay [0 5e-6]

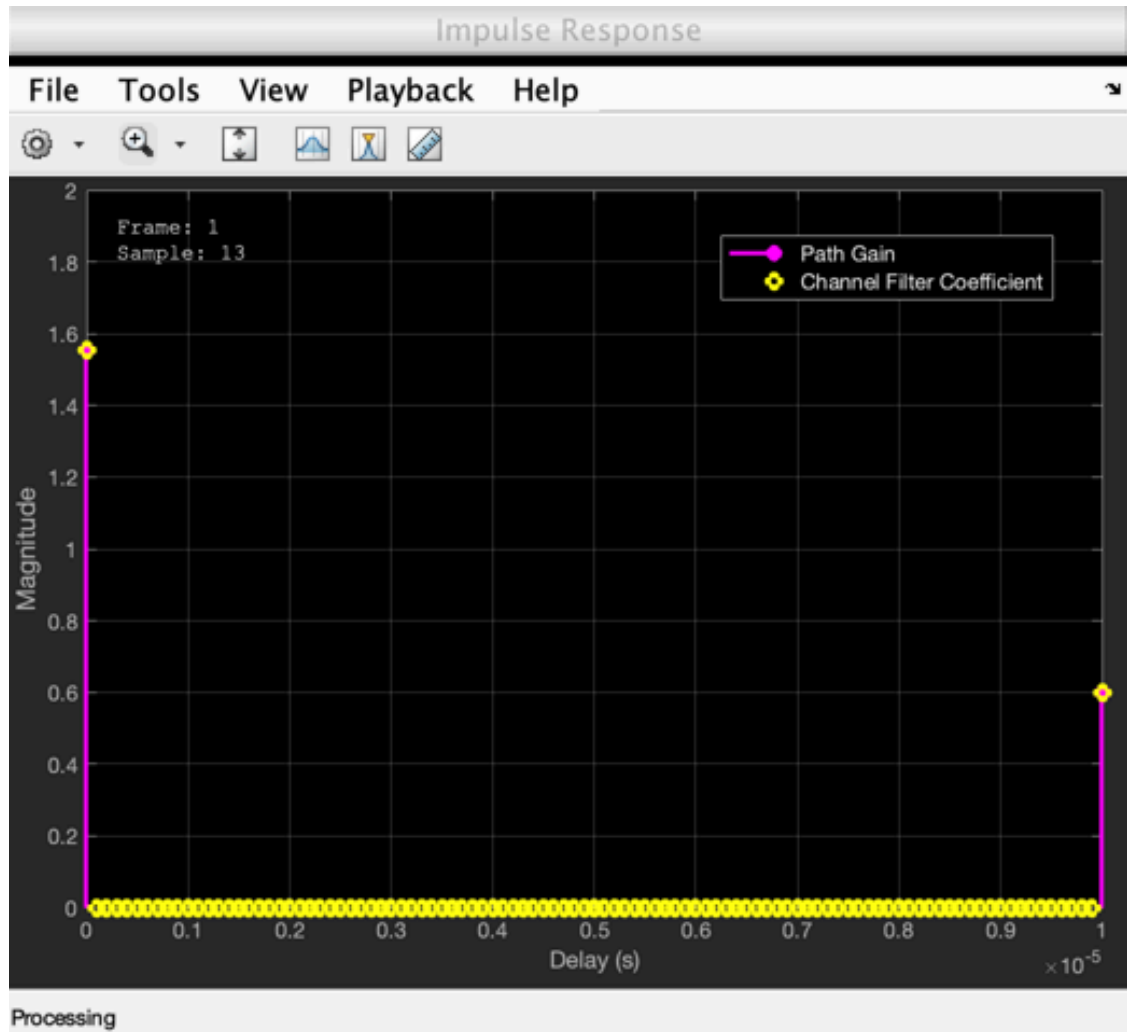
```
rayleigh_channel1 = comm.RayleighChannel( ...  
    'SampleRate',10e6, ...  
    'PathDelays',[0 5e-6], ...  
    'AveragePathGains',[0 -3], ...  
    'Visualization','Impulse and frequency responses');  
  
rc_5 = rayleigh_channel1(channelInput);
```

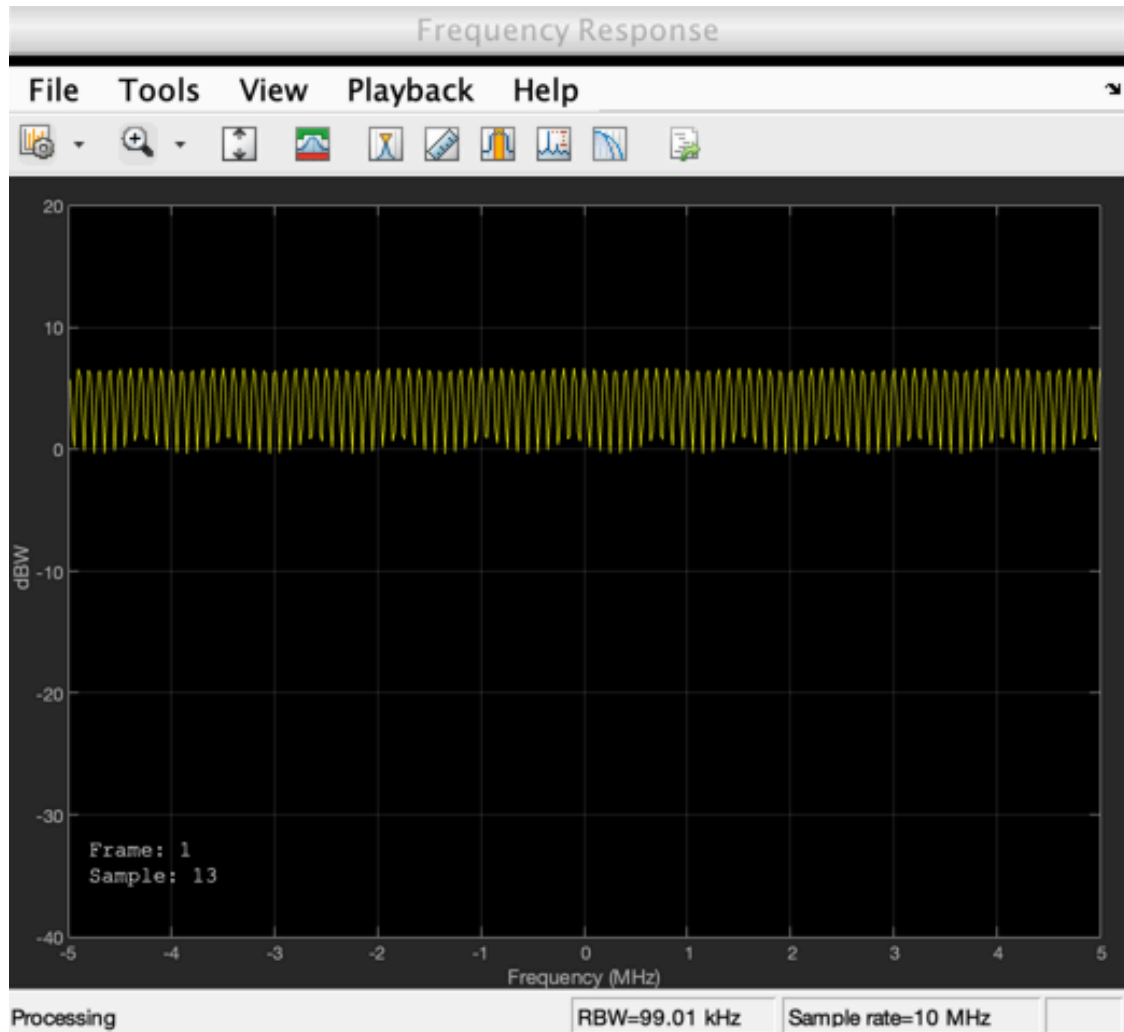




Delay [0 10e-6]

```
rayleigh_channel_2 = comm.RayleighChannel( ...  
    'SampleRate',10e6, ...  
    'PathDelays',[0 10e-6], ...  
    'AveragePathGains',[0 -3], ...  
    'Visualization','Impulse and frequency responses');  
  
rc_10 = rayleigh_channel_2(channelInput);
```





Time domain

```
fc = 10e6; %f_c = 10 MHz
t = 0:1:15;

rc_5_t = zeros(1,length(rc_5));
for i = 1:length(rc_5)
    in_phase = real(rc_5(i));
    quad = imag(rc_5(i));
    carrier = in_phase*cos(2*pi*fc*t(i)) - quad*sin(2*pi*fc*t(i));

    rc_5_t(i) = carrier;
end

rc_single_t = zeros(1,length(rc_single));
for i = 1:length(rc_single)
    in_phase = real(rc_single(i));
    quad = imag(rc_single(i));
```

```

        carrier = in_phase*cos(2*pi*fc*t(i)) - quad*sin(2*pi*fc*t(i));

        rc_single_t(i) = carrier;
    end

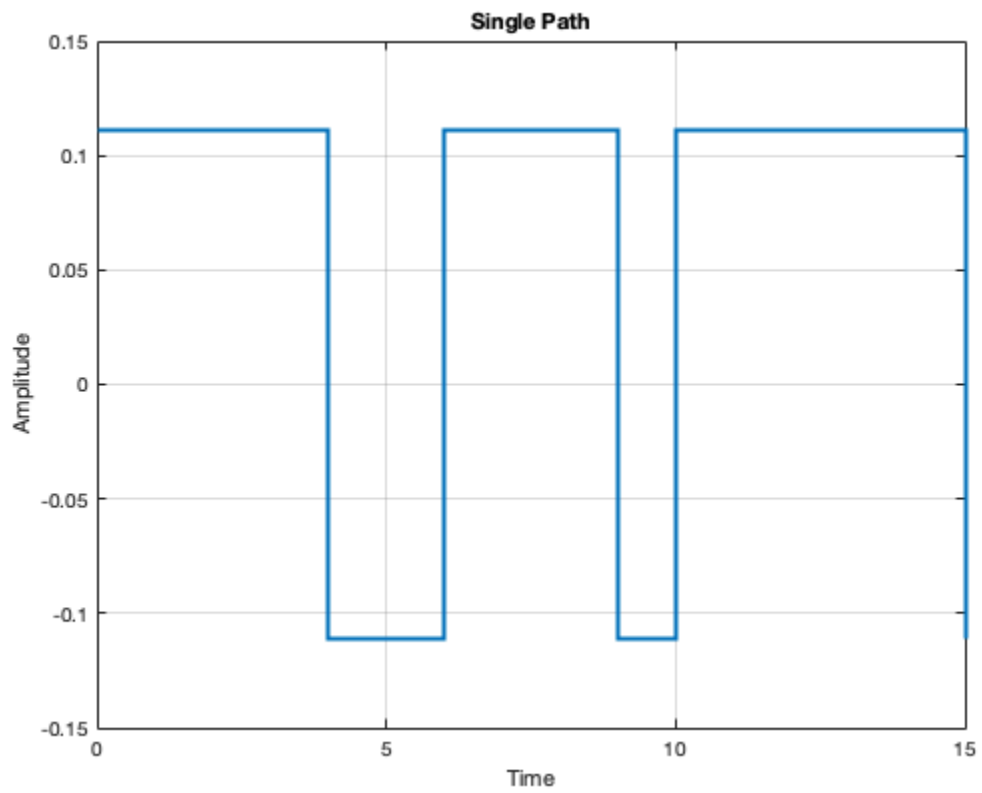
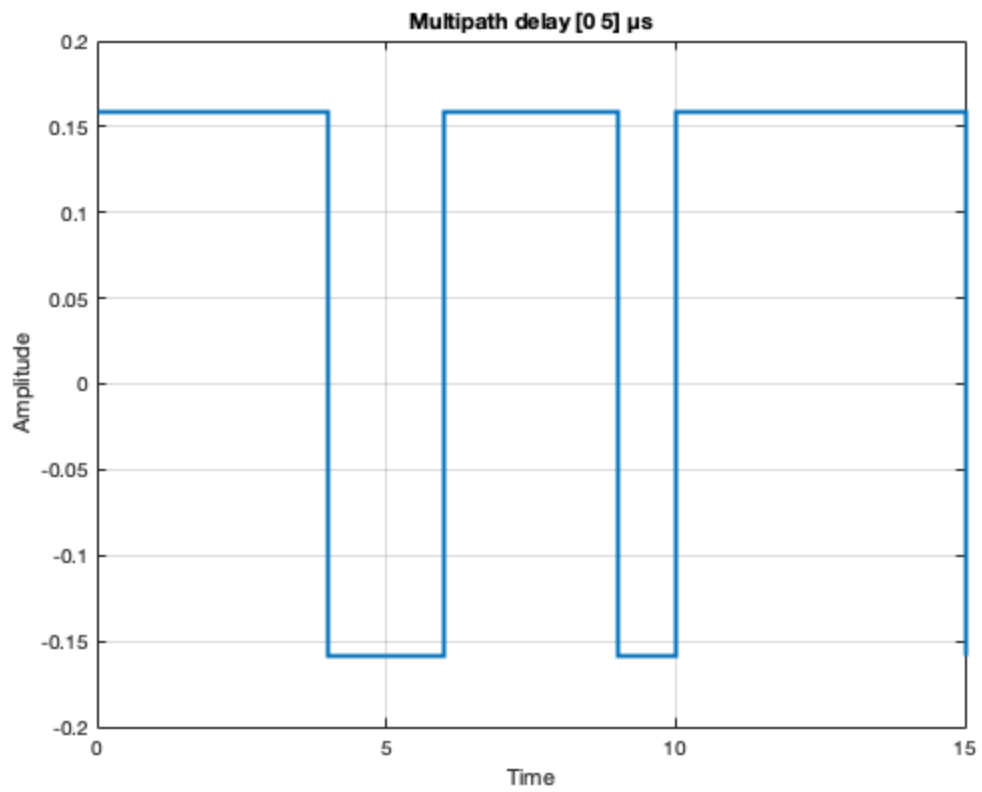
    rc_10_t = zeros(1,length(rc_10));
    for i = 1:length(rc_10)
        in_phase = real(rc_10(i));
        quad = imag(rc_10(i));
        carrier = in_phase*cos(2*pi*fc*t(i)) - quad*sin(2*pi*fc*t(i));

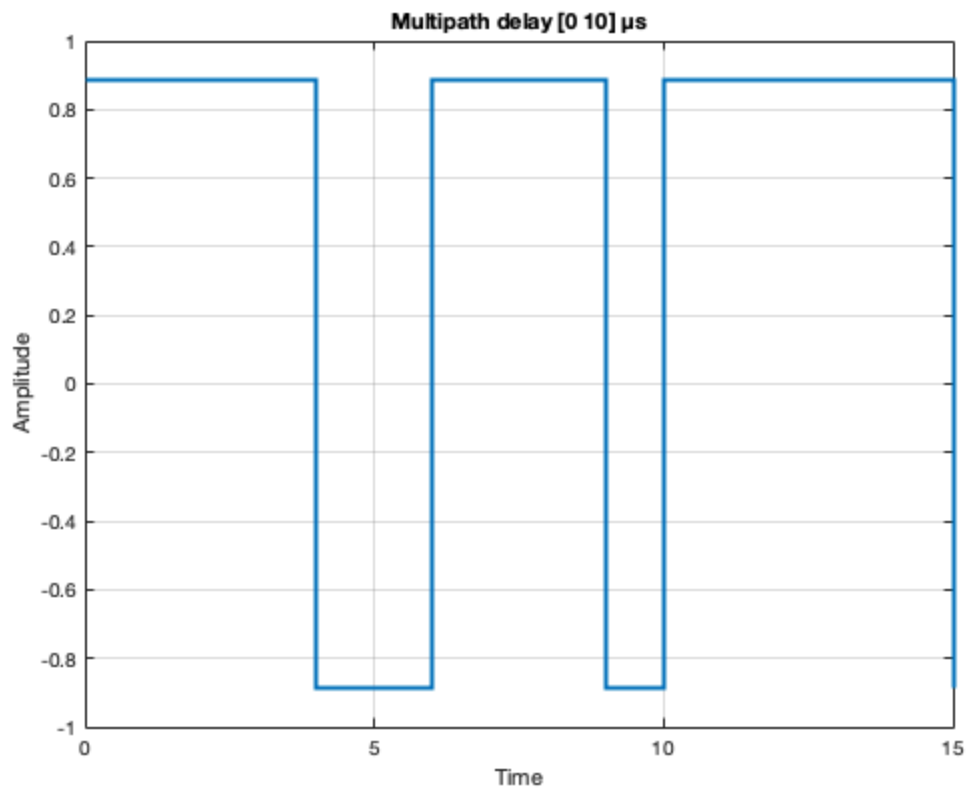
        rc_10_t(i) = carrier;
    end

    figure;
    stairs(t,rc_5_t, 'linewidth',2);
    hold on;
    grid on;
    title("Multipath delay [0 5]  $\mu$ s");
    xlabel('Time'); ylabel('Amplitude');

    figure;
    stairs(t,rc_single_t, 'linewidth',2);
    hold on;
    grid on;
    title("Single Path");
    xlabel('Time'); ylabel('Amplitude');

    figure;
    stairs(t,rc_10_t, 'linewidth',2);
    hold on;
    grid on;
    title("Multipath delay [0 10]  $\mu$ s");
    xlabel('Time'); ylabel('Amplitude');
```



Observations:

i) It is evident from the plots that the maximum attenuation observed is when the time delay is maximum, i.e., $[0\ 10]\ \mu\text{s}$ case. Whereas for single path channel, the attenuation observed is the least. ii) In the impulse response plots, the impulses are observed at the time instants where there is delay. Hence, for single path, the impulse is obtained at $t=0$. But for multipath with delay $= [0\ 5]\ \mu\text{s}$, the impulses can be seen at $t = 0$ and $5\ \mu\text{s}$. iii) In frequency response plots, the dips in the power is largest for $[0\ 10]\ \mu\text{s}$ case. Whereas, for the single path channel, the power is constant throughout.

References:

%Rayleigh simulator: <https://in.mathworks.com/help/comm/ref/comm.rayleighch>
%annel-system-object.html

%Modulation and demodulation: <https://in.mathworks.com/help/comm/ref/comm.pskmodulator-system-object.html>

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