Contents

Diffence Equation using Convolution

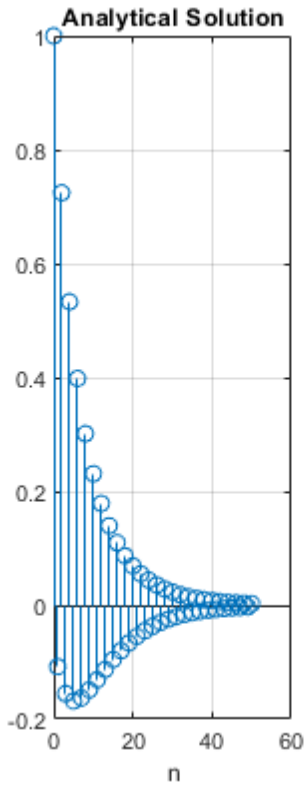
```
clc;
close all;
clear all;
```

Given Signals

```
% define global timesteps to use throughout
n = 0:50;

x = (0.8).^n;  % original signal
h = (-0.9).^n;  %filter
```

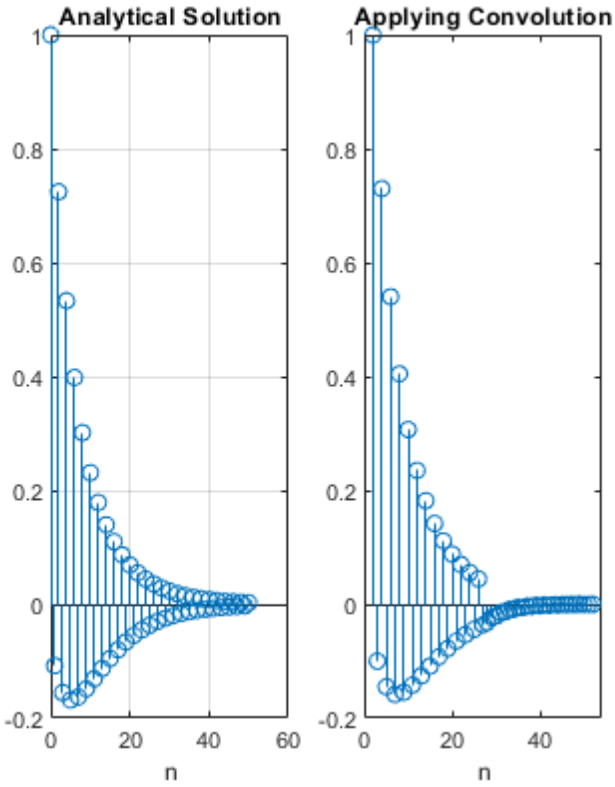
Analytical solution of Y

```
% define empty array to store
Y = [];

for k=0:50

    sum = 0;

    for i=0:k
        % coeff will be 0.8/-0.9 i.e 0.88
        sum = sum + (-0.88)^i;
    end

    % add last term
    Y(i+1) = ((-0.9)^k) * sum;
end

% plot the result using 3 col plot
subplot(1, 3, 1);
stem(n, Y);
grid on;
xlabel("n");
title("Analytical Solution");
```



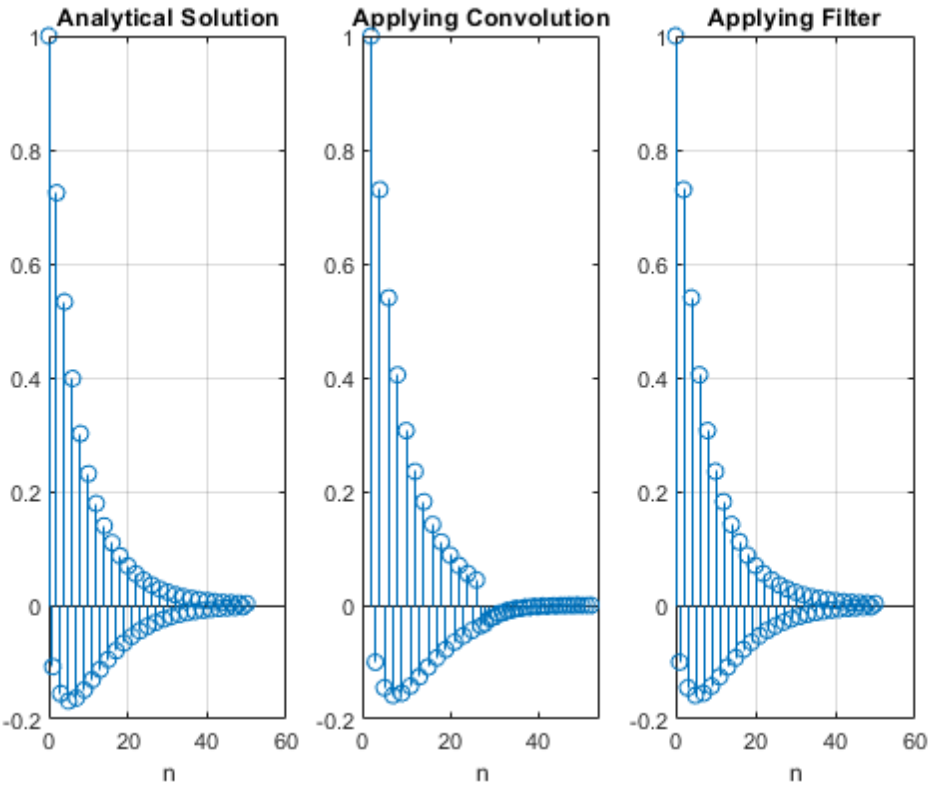
Using own Functions to calculate Convolution

```
% take 26 length slices as said
n1 = 1:26;
n2 = 1:26;

x_mini = x(1:26);
h_mini = h(1:26);

%defining the convolution length
max_length = length(x_mini)+length(h_mini)-1;

% padding our signals
[x_mini, h_mini] = pad(x_mini, h_mini);

%performing the folding operation on signal h to produce h(-n)
[h_mini, n2]= fold(h_mini, n2);

%the add function used here calls the multiply function within itself
result = zeros(1,max_length);

for i=1:max_length
    result(i)=add(x_mini, h_mini,i);
end

% flip the timestamps of h
n2 = -fliplr(n2);

% new timestamp
n_new = min(n1)+ min(n2): max(n1)+max(n2);

%plot convolved signal
subplot(1, 3, 2);
stem(n_new, result);
xlabel("n");
title("Applying Convolution");
xlim([n_new(1)-2 n_new(length(n_new))+2]);
```



Using Filter function

```
% use filter inbuilt
% coeff: a=[1, 0.9], b=[1]

Y_filter = filter([1], [1, 0.9], x);
subplot(1, 3, 3);
stem(n, Y_filter);
grid on;
xlabel("n");
title("Applying Filter");
```



Helper functions

```
% function to fold
function [h,n2] = fold(h,n2)
    h=fliplr(h);n2=-1.*fliplr(n2);
end
% function to pad
function [padded_x,padded_h] = pad(x_signal,h_signal)
    l1 = length(x_signal);
    l2 = length(h_signal);
    convolved_length = l2+l2-1;

    %declare empty matrix for padded sequence
    padded_x = zeros(1,convolved_length);
    padded_h = zeros(1,convolved_length);

    padded_x(1:l1)=x_signal;
    padded_h(1:l2)=h_signal;
end
% function to multiply
function [y]=multiply(x,h,n,k)
    y=0;
    l_h= length(h);
    y=x(k)*h(l_h-n+k);
end
% function to add
function [y,n]=add(xk,hk,n)
    y=0;
    for i=1:n
        y=y+multiply(xk,hk,n,i);
    end

end
```

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