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Signal Processing Lab

Subject- Digital Signal Processing

EXPERIMENT NO. 6

Aim: Implement Impulse Invariant method. Find out H(z) using impulse invariance method at 5Hz sampling frequency from H(s) where H(s) = 1/(s+1) (s+2).

Software Used: Scilab software.

Code:

```
//AIM: Implement Impulse Invariant Method

clc;
clear;
s = %s;
s2 = -2;
s1 = -1;
d1 = (s-s1);
p2 = (s-s2);
if (s1) then  //When pole = -1
   s1 = -1;
   s2 = -2;
   s = s1;
   d2 = (s-s2);
   num1 = 1/d2; //Value of A1
h1 = syslin('c', num1/d1)
end

disp(h1)
disp(num1, 'Value of A1 = ')

if (s2) then  //When pole = -2
   s1 = -1;
   s2 = -2;
   s = s2;
   p1 = (s-s1);
   num2 = 1/p1; //Value of A2
h2 = syslin('c', num2/p2)
end
```

```
disp(h2)
disp(num2, 'Value of A2 = ')

Hs = (h1)+(h2);
disp(Hs, 'Transfer function of analog filter H(s) = ')
//Obtain the Z transform using impulse invariance transformation equation
//1/(s-pk)=1/[1-exp(pk*Ts)*Z^(-1)]
Fs = 5;
Ts = 1/Fs;
disp('sec', Ts, 'Sampling time Ts = ')
Z = poly(0, "Z")
a = num1/(1-exp(s1*(Ts))*Z^(-1));
b = num2/(1-exp(s2*(Ts))*Z^(-1));
disp(a, '1/s+1 = ')
disp(b, '1/s+2 = ')
Hz = (a+b);
disp(Hz, 'The required transfer function for digital IIR Filter H(Z) = ')
```

Output:

```
1/s+1 =


        Z
   ---------------

   -0.8187308 + Z

1/s+2 =


       -Z
   -------------

   -0.67032 + Z

The required transfer function for digital IIR Filter H(Z) =


          0.1484107Z
   ---------------------------
                              2
   0.5488116 - 1.4890508Z + Z

-->
```

Conclusion:

In this experiment we learnt the concept of IIR Filters and various techniques to design them in Scilab. The Impulse Invariant Method is one of the important methods to design Discrete Time IIR Filters from Continuous Time Filters, where the impulse response of continuous time system is sampled to produce the impulse response of discrete time system. Thus we implemented the Impulse Invariant Method at 5 Hz of Sampling Frequency for the given Transfer function of Analog Filter.