

# Preemphasis Digital Filter

## 1. Preemphasis Digital Filter

- Preemphasis Digital Filter is used to reduce differences in power of different components of the signal and it is defined like

$$y(n) = x(n) - a \cdot x(n-1) \quad (1.1)$$

where:  $x(n)$  – value of input signal at discrete time step  $n$ ,  
 $y(n)$  – value of output signal at discrete time step  $n$   
 $a$  – constant  $a = 0.95$ .

- For example let us define following signal whose first component has much greater power than the second one:

$$x(t) = \sin(\omega t) + 0.1 \sin(10\omega t)$$

- After using preemphasis filter, differences in amplitudes of components are dramatically decreased, as shown on following figure:

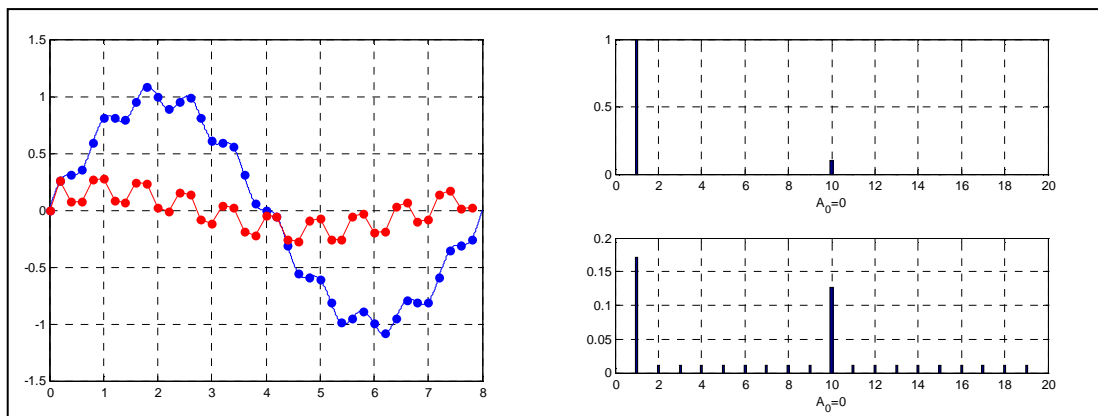


Figure 1.1.  $x(t) = \sin(\omega t) + 0.1 \sin(10\omega t)$ ,  $y(t) = x(t) - 0.95x(t - T_s)$

- Formula (1.1) can be implemented in MATLAB as follows:

$$y = [x \ 0] - 0.95 * [0 \ x];$$

## 1.1. MATLAB Scripts

### 1.1.1. Figure 1.1.

```
%CONTINUOUS SIGNAL.T = 4;
T      = 8;
f      = 1/T;          %Signal frequency is number of periods per second.
w      = 2*pi*f;
step   = 0.001;
t_cont = (0:step:T);  %Time in seconds. Show 2 periods of signal.
y_cont = sin(w*t_cont)+0.1*sin(10*w*t_cont);
figure(1); hold off; plot(t_cont, y_cont); grid on;

%DESCRETE SIGNAL.
Ts     = 1/5;        %Sampling period is number of seconds between two samples.
t_desc = t_cont(1:Ts/step:length(t_cont)-1); %Take samples at this times.
y_desc = y_cont(1:Ts/step:length(y_cont)-1); %Discrete signal containing only samples of continuous
signal.
figure(1); hold on; plot(t_desc, y_desc, '.', 'MarkerSize',20);

%DFS.
[a0,ak,bk]= DFT_Get_a0akbk_FromSamples(y_desc);
[A0,Ak]   = DFT_Get_A0Ak_From_a0akbk(a0,ak,bk);
figure(2); subplot(2,1,1); bar(Ak,0.1); xlabel(strcat('A_0=', num2str(a0))); grid;

%FILTERED DESCRETE SIGNAL.
y_filtered = y_desc-0.9*[0 y_desc(1:length(y_desc)-1)];
figure(1); plot(t_desc, y_filtered, '-r.', 'MarkerSize',20); grid on;

%DFS.
[a0,ak,bk]= DFT_Get_a0akbk_FromSamples(y_filtered);
[A0,Ak]   = DFT_Get_A0Ak_From_a0akbk(a0,ak,bk);
figure(2); subplot(2,1,2); bar(Ak,0.1); xlabel(strcat('A_0=', num2str(a0))); grid;
```