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SIMULATION OF BASIC TEST SIGNALS

Aim

To generate continuous and discrete waveforms for the following :

1. unit impulse signal
2. unit step signal
3. ramp signal
4. sine signal
5. cosine wave
6. bipolar pulse signal
7. unipolar pulse signal
8. triangular signal
9. exponential signal

Theory

A digital signal can be either a deterministic signal that can be predicted with certainity, or a random signal that is unpredictable. Due to ease in signal generation and need for predictability, deterministic signal can be used for system simulation studies. A continuous time signal is defined for all values of time t.

1. Unit impulse signal:
   The simplest signal is the unit impulse signal which is defined as,
   $\delta(t) = \infty; \boldsymbol{t=0}$
   $\boldsymbol{=0; t \neq 0}$

2. Unit step signal:
   A signal that is zero for all negative time values and one for positive time values.It is defined as,
   $u(t) = 1$ for $t \geq 0$
   $= 0$ for $t < 0$

3. Ramp signal:
   A signal that increases linearly with time. This signal is given by,
   $r(n) = n$ for $n \geq 0$
   $= 0$ for $n < 0$

4. Sine signal :
   A continuous periodic signal. It oscillates smoothly between -1 and 1.It is defined as,
   $y(t)=A\sin(2\pi ft)$

5. Cosine wave :
   A continuous periodic signal like the sine wave but phase-shifted by π\2.It is defined as,
   $y(t)=A\cos(2\pi ft)$

6. Bipolar pulse signal :
   A pulse signal that alternates between positive and negative values, usually rectangular in shape. It switches between two constant levels (e.g., -1 and 1) for a defined duration.It is given by,
   $p(t) = A$ for $|t| \leq \tau/2$,
   $= 0$ otherwise

7. Unipolar pulse signal:
   A pulse signal that alternates between zero and a positive value. It remains at zero for a specified duration and then jumps to a positive constant level (e.g., 0 and 1). It is given by,
   $p(t) = A$ for $|t| \leq \tau/2$,
   $= 0$ otherwise (assuming A is positive)

8. Triangular signal :
   A periodic signal that forms a triangle shape, linearly increasing and decreasing with time, typically between a positive and negative peak. It is given by,
   $\Lambda(t) = 1 - |t|$ for $|t| \leq 1$,
   $= 0$ otherwise

9. Exponential signal:
   A signal that increases or decreases exponentially with time. The rate of growth or decay is determined by the constant a . It's general form is,
   $x(n) = a^n$ for all n.

Program

```
clc;

clear all;

close all;

%unit impulse

t=-5:1:5;

y1=[zeros(1,5),ones(1,1),zeros(1,5)];

subplot(3,3,1);

stem(t,y1);
```

```
title('unit impulse');
xlabel('time index');
ylabel('amplitude');
%unit step
y2=[zeros(1,5),ones(1,6)];
subplot(3,3,2);
stem(t,y2);
title('unit step');
xlabel('time index');
ylabel('amplitude');
%ramp
t3=0:1:10;
y3=[t3];
subplot(3,3,3);
stem(t3,y3);
hold on;
plot(t3,y3);
title('ramp');
xlabel('time index');
ylabel('amplitude');
legend("discrete","continuous");
%sine wave
t4=0:0.01:1;
f4=4;
subplot(3,3,4);
stem(t4,sin(2*pi*f4*t4));
hold on;
plot(t4,sin(2*pi*f4*t4));
title('sine wave');
xlabel('time index');
```

```
ylabel('amplitude');
legend("discrete","continuous");
%cosine wave
subplot(3,3,5);
stem(t4,cos(2*pi*f4*t4));
hold on;
plot(t4,cos(2*pi*f4*t4));
title('cosine wave');
xlabel('time index');
ylabel('amplitude');
legend("discrete","continuous");
%squarewave-bipolar
t6=0:0.0001:1;
f6=10;
subplot(3,3,6);
plot(t6,square(2*pi*f6*t6));
title('squarewave-bipolar');
xlabel('time index');
ylabel('amplitude');
%squarewave-unipolar
subplot(3,3,7);
plot(t6,sqrt(square(2*pi*f6*t6)));
title('squarewave-unipolar');
xlabel('time index');
ylabel('amplitude');
%triangular wave
t8=0:0.25:10;
f8=5;
subplot(3,3,8);
stem(t8,sin(2*pi*f8*t8));
```

```
hold on;
plot(t8,sin(2*pi*f8*t8));
title('triangular wave');
xlabel('time index');
ylabel('amplitude');
legend("discrete","continuous");
%exponential signal
t9=0:0.01:100;
y9=exp(t9);
subplot(3,3,9);
stem(t9,y9);
hold on;
plot(t9,y9);
title('exponential signal');
xlabel('time index');
ylabel('amplitude');
legend("discrete","continuous");
```

Result

Generated and verified various waveforms of basic test signal.

Observation