Experiment No: 02 Date:08-08-2024

Verification of Sampling Theorem

Aim

To verify Sampling Theorem.

Theory

The Sampling Theorem, also known as the Nyquist-Shannon Sampling Theorem, states that a continuous signal can be completely reconstructed from its samples if the sampling frequency is greater than twice the highest frequency present in the signal. This critical frequency is known as the Nyquist rate.

$fs \geq 2 \cdot fmax$

Where:

• fs is the sampling frequency (rate at which the signal is sampled),

• fmax is the highest frequency present in the signal.

Applications:

• Digital audio and video processing

• Communication systems

• Image processing

• Medical imaging

Program

```
clc;
clear all;
close all;
%original signal
t=0:0.01:1;
fm=10;
y=sin(2*pi*fm*t);
```

```
subplot(2,2,1);
stem(t,y);
hold on;
plot(t,y);
title("Original signal");
xlabel("time");
ylabel("amplitude");
%less than nyquist range
fs1=fm;
t1=0:1/fs1:1;
y1=sin(2*pi*fm*t1);
subplot(2,2,2);
stem(t1,y1);
hold on;
plot(t1,y1);
title("Undersampling");
xlabel("time");
ylabel("amplitude");
%equal to nyquist rate
fs2=3*fm;
t2=0:1/fs2:1;
y2=sin(2*pi*fm*t2);
subplot(2,2,3);
stem(t2,y2);
hold on;
plot(t2,y2);
title("Nyquistsampling");
xlabel("time");
ylabel("amplitude");
%greater than nyquist rate
```

```
fs3=10*fm;
t3=0:1/fs3:1;
y3=sin(2*pi*fm*t3);
subplot(2,2,4);
stem(t3,y3);
hold on;
plot(t3,y3);
title("Oversampling");
xlabel("time");
ylabel("amplitude");
```

Result

Verified Sampling Theorem using MATLAB.

Observation