

VERIFICTION OF SAMPLING THEOREM

Aim

To perform and verify undersampling, nyquist sampling and oversampling.

Theory

The sampling theorem, also known as the Nyquist-Shannon theorem, states that a continuous-time signal can be completely reconstructed from its samples if it is sampled at a rate greater than twice its highest frequency component, known as the Nyquist rate. Mathematically, if the maximum frequency of the signal is f_{max} , the sampling frequency f_s must satisfy $f_s \geq 2f_{max}$ to avoid loss of information and prevent aliasing.

Applications of the Sampling Theorem:

1. Digital audio processing (e.g., CDs, MP3s)
2. Digital communication systems
3. Medical imaging (e.g., MRI, CT scans)
4. Video compression (e.g., MPEG, HDTV)
5. Radar and sonar systems

Program

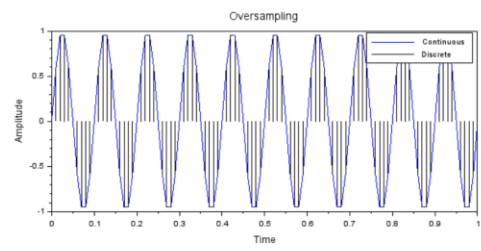
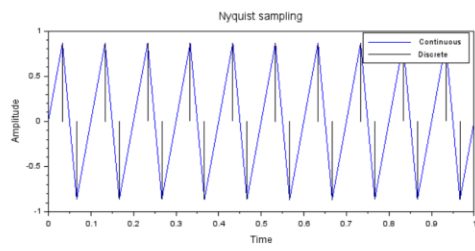
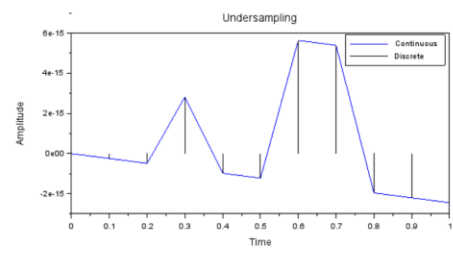
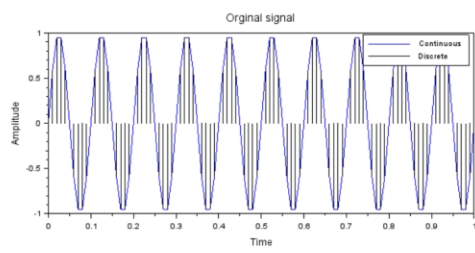
```
//verification of sampling theorem  
clc;  
clear ;  
close;  
clf;  
//original signal  
t=0:0.01:1;  
fm=10;
```

```

y=sin(2*%pi*fm*t);
subplot(2,2,1);
plot(t,y);
plot2d3(t,y);
xlabel("Time");
ylabel("Amplitude");
title("Original signal");
legend("Continuous","Discrete");
//less than nyquist rate
fs1=fm;
t1=0:1/fs1:1;
y1=sin(2*%pi*fm*t1);
subplot(2,2,2);
plot(t1,y1);
plot2d3(t1,y1);
xlabel("Time");
ylabel("Amplitude");
title("Undersampling");
legend("Continuous","Discrete");
//equal to nyquist rate
fs2=3*fm;
t2=0:1/fs2:1;
y2=sin(2*%pi*fm*t2);
subplot(2,2,3);
plot(t2,y2);
plot2d3(t2,y2);
xlabel("Time");
ylabel("Amplitude");
title("Nyquist sampling");

```

OUTPUT



```
legend("Continuous","Discrete");  
//greater than nyquist rate  
fs3=10*fm;  
t3=0:1/fs3:1;  
y3=sin(2*%pi*fm*t3);  
subplot(2,2,4);  
plot(t3,y3);  
plot2d3(t3,y3);  
xlabel("Time");  
ylabel("Amplitude");  
title("Oversampling");  
legend("Continuous","Discrete");
```

Result

Performed and verified undersampling, nyquist sampling and oversampling.