Department of Mechatronics Engineering
Rajshahi University of Engineering and Technology

Course No.: **MTE-2206.**

Course Title: **Sensor and Instrumentations Sessional.**

Experiment No: 03

Experiment Name: Verification of sampling theorem and analyze the effect of aliasing

Remarks

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Experiment No:3

Experiment Name: Verification of sampling theorem and analyze the effect of aliasing

Objectives:

1. To know about sampling theorem.
2. To know about the effect of aliasing
3. To know about signal processing for converting continuous analog signal to discrete signal.

Theory:

The sampling theorem specifies the minimum-sampling rate at which a continuous-time signal needs to be uniformly sampled so that the original signal can be completely recovered or reconstructed by these samples alone[1]. The sampling theorem essentially says that a signal has to be sampled at least with twice the frequency of the original signal If a continuous time signal contains no frequency components higher than f Hz, then it can be completely determined by uniform samples taken at a rate f_s Hz where

$f_s \geq 2f$

or, in term of the sampling period,

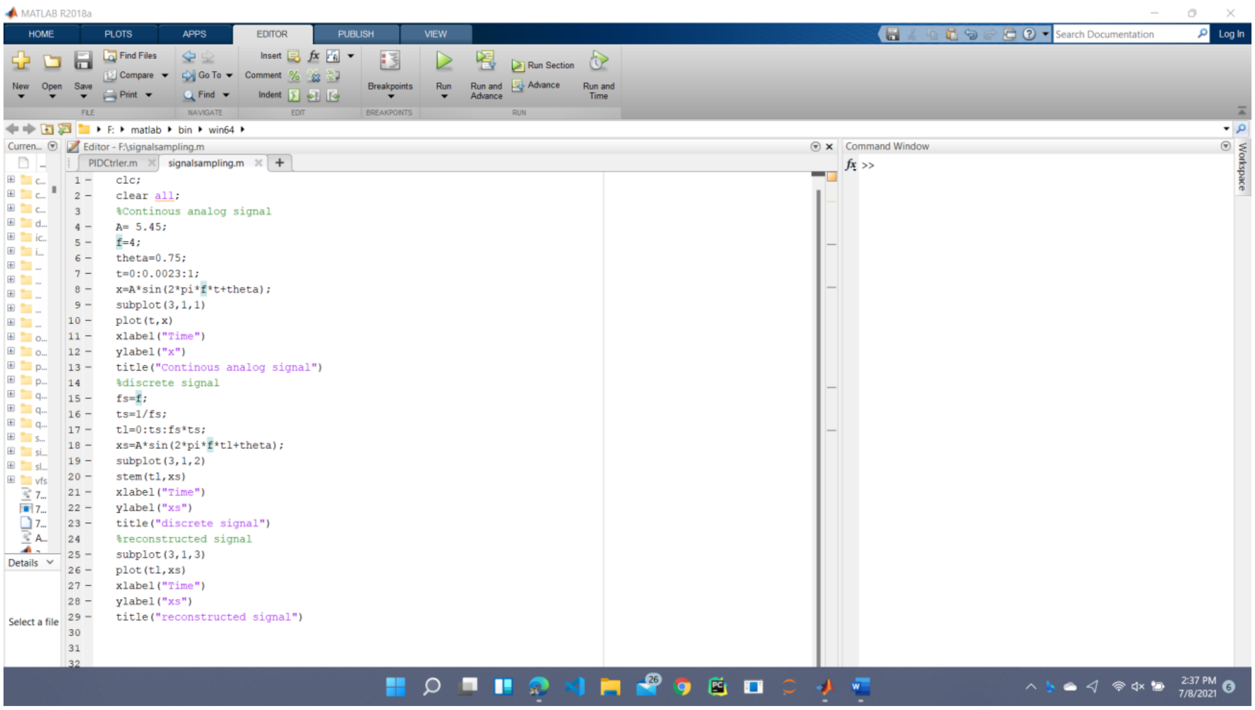
$T \leq 1/f_s$ [2]

Aliasing occurs when a signal is sampled. Aliasing is when a continuous-time frequency appears as a discrete-time frequency with multiple frequencies. The sampling theorem establishes conditions that prevent aliasing so that a continuous-time signal can be uniquely reconstructed from its samples.[3]

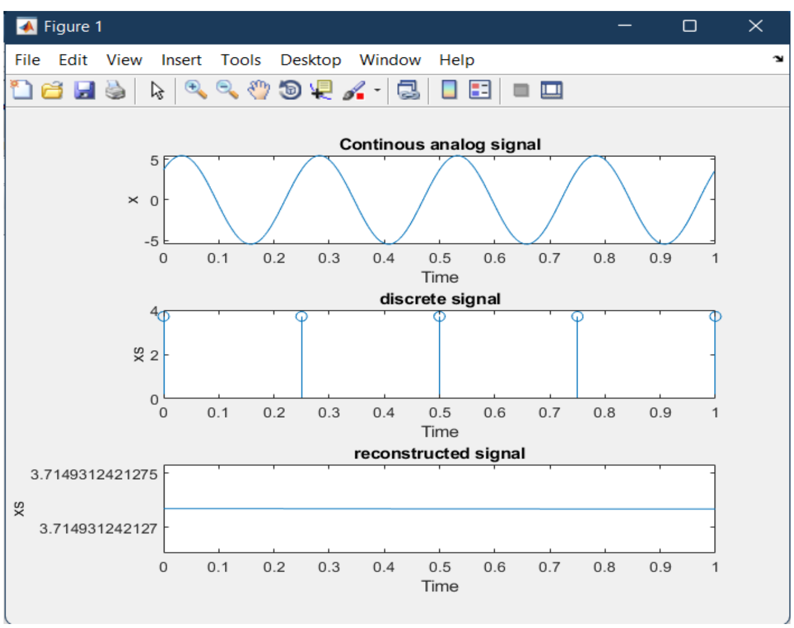
Reconstruction is another term which means conversion of discrete time signal into continuous time signal.[4]

Code and output when sample frequency is equal to continuous signal frequency:

Code:

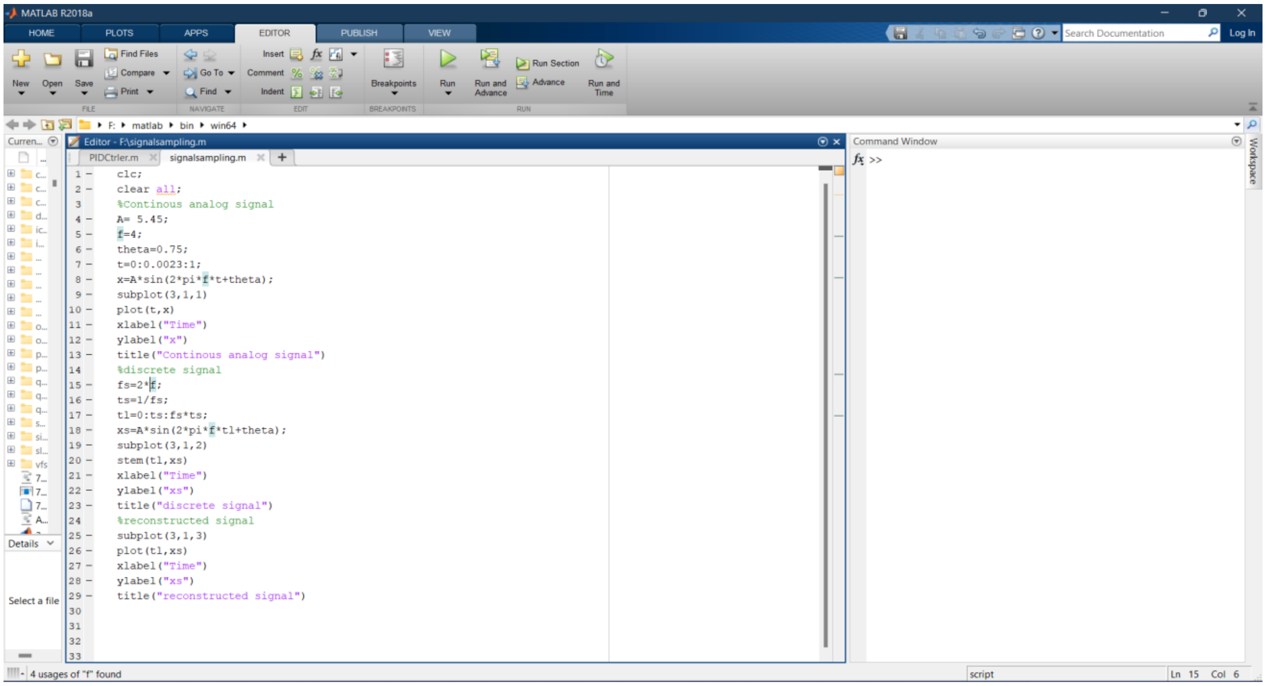


Output:

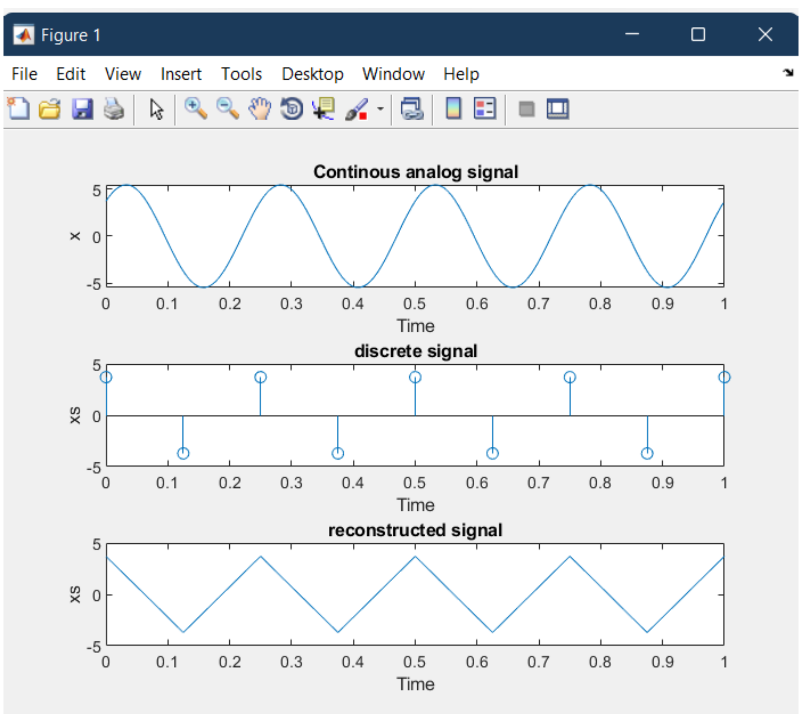


Code and output when sample frequency is twice of continuous signal frequency:

Code:

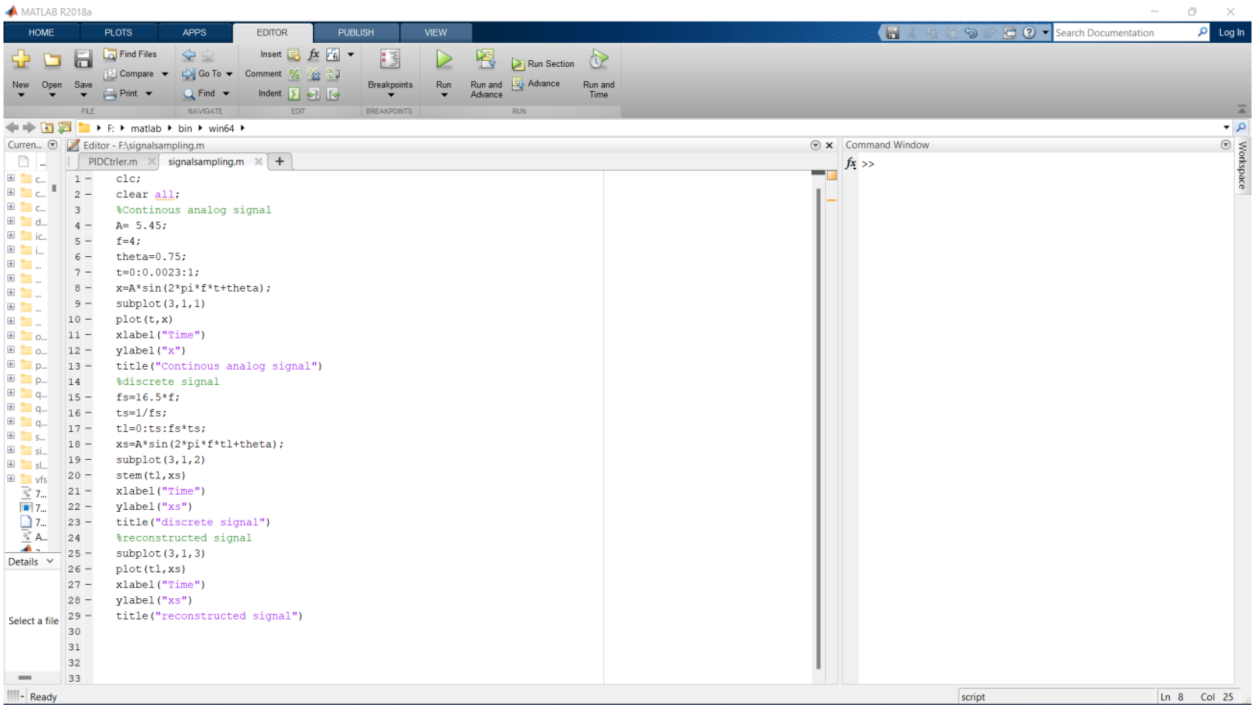


Output:

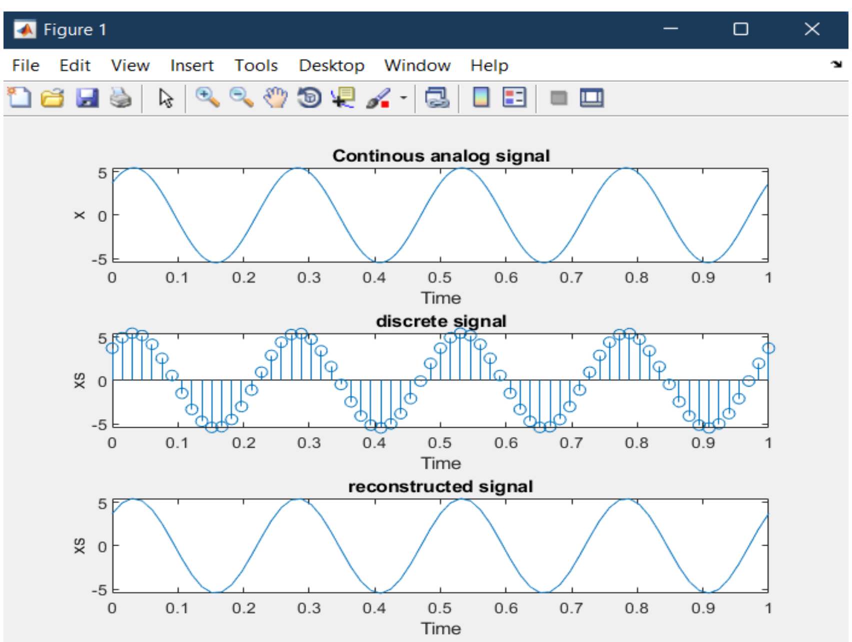


Code and output when sample frequency is more than twice of continuous signal frequency:

Code:



Output:



Discussion:

We can see from the outputs that number of discrete value is less when sample frequency is same as continuous signal frequency . Number of discrete values have increased When sample frequency is twice of continuous signal frequency. When sample frequency is more than twice of continuous signal frequency, discrete values have increased more than before and the reconstructed signal is almost same as the continuous signal. Thus it was proved that the experiment was completed rightly.

Conclusion:

From this experiment we can learn about sampling theorem and aliasing effect on sampling. We can get a good idea on signal processing and can learn about discrete and reconstructed signals by sampling.

References:

1. 1.Wikimedia Foundation. (2021, March 23). *Nyquist–Shannon sampling theorem*. Wikipedia. https://en.wikipedia.org/wiki/Nyquist%E2%80%93Shannon_sampling_theorem

2. Lai, E. (n.d.). *Sampling Theorem*. Sampling Theorem - an overview | ScienceDirect Topics. https://www.sciencedirect.com/topics/computer-science/sampling-theorem.

3.Creative, 3200. (2019, February 8). *Aliasing and the Sampling Theorem Simplified*. ALLSIGNALPROCESSING.COM. https://allsignalprocessing.com/lessons/aliasing-and-the-sampling-theorem-simplified/.

4. Namrata. (2011, January 13). *sampling and reconstruction*. Electrical and Computer Engineering. http://www.ece.iastate.edu/.