

Exercise 2.1 (Sampling)

Consider the following input signal:

$$x(t) = \sin(2\pi * 30 * t) + \cos(2\pi * 20 * t) + \sin(2\pi * 10 * t) + 2$$

The signal needs to be sampled and converted into a digital sequence.

1. Determine the minimum frequency at which the signal can be sampled and subsequently fully reconstructed.
2. Use Matlab to display the continuous signal $x(t)$, and the impulse sampled signal $x(n)$.
3. Do FFT of both $x(t)$ and $x(n)$, compare their spectrum.

(hint: continuous signal can be approximated as sampling with very high frequency)

4. Determine the spectrum of $x(t)$ if it is sampled using pulse sampling (Let the pulse width τ be $T/2$).

Exercise 2.2 (Reconstruction)

Consider the following signal:

$$x(t) = \sin\left(\frac{2\pi}{10}t\right)$$

It lasts for 20s. Let's do a sampling of 1 Hz. Then you will have a discrete sequence $x(n)$. Now you are asked to reconstruct it to an analog signal.

1. Determine the spectrum of the signal after a zero-order hold circuit.
2. Show the ZOH signal
3. Show the reconstructed analog signal by sinc() reconstruction filter.
4. What is the amplitude of the reconstructed signal at exact time stamp 2.5s?