# Time Domain

## 1 Definition

$$\begin{aligned} f_s &= \text{sampling rate} \\ \lambda &= \text{wavelength} \\ T &= \text{period} \\ \omega &= \text{angular frequency} \end{aligned}$$

## 2 Wavelength $\lambda$

$$\lambda = \frac{c}{f}$$

## 3 Period $T$

$$T = 1\,ms = 1000\,Hz$$

## 4 Angular Frequency $\omega$

$$\begin{aligned} \omega &= 2\pi f \\ &= \frac{2\pi}{T} \end{aligned}$$

$$\begin{aligned} \omega_0 &= 2\pi T \\ &= \pi \frac{f_0}{fs} \end{aligned}$$

## 5 Unit Pulse & Unit Step

unit pulse:

$$\delta(n) = \begin{cases} 1, & \text{if } n = 0 \\ 0 & \text{otherwise} \end{cases}$$

unit step:

$$u(n) = \begin{cases} 1, & \text{if } n \geq 0 \\ 0 & \text{otherwise} \end{cases}$$

## 6 Harmonic Signals

$$n = [1 : t \cdot f_s]$$

$$\begin{aligned} x[n] &= sin(\omega_0 n + \varphi) \\ &= sin(2\pi f_0 T + \varphi) \\ &= sin(2\pi \frac{f_0}{fs} n + \varphi) \end{aligned}$$

$$\begin{aligned} x[n] &= e^{-i\omega_0 n} \\ &= cos(\omega_0 n) + i\, sin(\omega_0 n) \end{aligned}$$

# Frequency Domain

## 1 Definition

$$\begin{aligned} f_s &= \text{sampling rate} \\ \lambda &= \text{wavelength} \\ T &= \text{period} \\ \omega &= \text{angular frequency} \end{aligned}$$

# LTI Systems

$$y[n] = T\{\, x[n]\,\}$$

*Linear time-invariant systems* (LTI systems) are a class of systems used in signals and systems that are both linear and time-invariant. Linear systems are systems whose outputs for a linear combination of inputs are the same as a linear combination of individual responses to those inputs. Time-invariant systems are systems where the output does not depend on when an input was applied. These properties make LTI systems easier to represent and understand.

1. memory freedom
2. causality
3. stability (BIBO)

# Other