ISP Cheat Sheet

by alexey192 via cheatography.com/191217/cs/39735/

Periodic signals

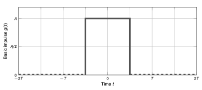
Periodic signals
A signal is periodic with base period T0 > 0 if for all n ∈ N holds that s(t) = s(t + nT0) where • T0 denotes the smallest value such that the definition holds,
• f0 = 1/T0 denotes the base frequency of the signal given in Hz, and • ω0 = 2πf0 is called angular frequency.
Note: The angular frequency may be given in rad/s, where 1 rad =
1/2π Hz

Aperiodic signals

Aperiodic signals

One of the most basic impulses is the rectangle impulse:

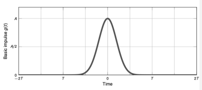
$$\text{rect}(t) = \begin{cases} A & \text{for } -T/2 < t < T/2 \\ A/2 & \text{for } |t| = T/2 \\ 0 & \text{otherwise} \end{cases}$$



- Limited in time
- Jump points at $-T/2$ and $T/2$

Another common impulse is the Gaußian impulse:

$$\text{gauß}(t) = \exp(-\pi(2t/T))$$



- Exists for $-\infty < t < \infty$
- Smooth edges

Dirac δ distribution

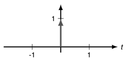
Dirac δ distribution – another aperiodic signal

Dirac δ distribution

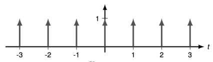
The Dirac delta distribution is defined as the limit value of $\delta(t) = \lim_{\epsilon \to 0} \frac{1}{|\epsilon|\sqrt{\pi}} e^{-(t/\epsilon)^2} = \begin{cases} \infty & t = 0, \\ 0 & \text{otherwise.} \end{cases}$

Properties of the Dirac function

1. Identity: $\int_{-\infty}^{\infty} \delta(t)\,dt = 1$
2. Sampling: $\int_{-\infty}^{\infty} \delta(t)s(t)\,dt = s(0)$
3. Displacement: $\int_{-\infty}^{\infty} \delta(t - t')s(t)\,dt = s(t')$



Visual representation of $\delta(t)$



Dirac comb $\sum_{-\infty}^{\infty} \delta(t - nT)$ (here $T = 1$)

Energy and power of signals

Energy of a signal
The energy E_s of a time-continuous signal the squred magnitude of the signal, i. e.

$$E_s = \int_{-\infty}^{\infty} |s(t)|^2\,dt. \quad (2)$$

For a time-discrete signal $s[n]$, the energy is likewise defined as

$$E_s = \sum_{n=-\infty}^{\infty} |s[n]|^2. \quad (3)$$

A signal with finite energy, i. e., $E_s < \infty$, is called energy signal.

Power of a signal
The power P_s of a time-continuous signal the time avarege of the squared magnitude of the signal, i. e.

$$P_s = \lim_{T \to \infty} \frac{1}{2T} \int_{-T}^{T} |s(t)|^2\,dt < \infty. \quad (4)$$