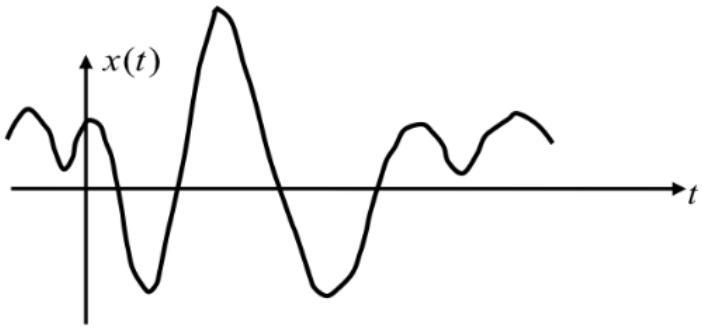
SEGNALI

Un SEGNALE è una quantità fisica che VARIA nel TEMPO e porta le informazioni

$$x(t), \quad -\infty < t < +\infty$$



Esempio di segnale continuo nel tempo

CLASSIFICAZIONE

Un segnale può essere espresso da una FUNZIONE $f(x)$ REALE o COMPLESSA : $x(t) = x_R(t) + j\,x_I(t)$

SEGNALE COMPLESSO : coppia di due segnali reali, che sono un segnale reale $x_R(t)$ e un SEGNALE IMMAGINARIO $x_I(t)$

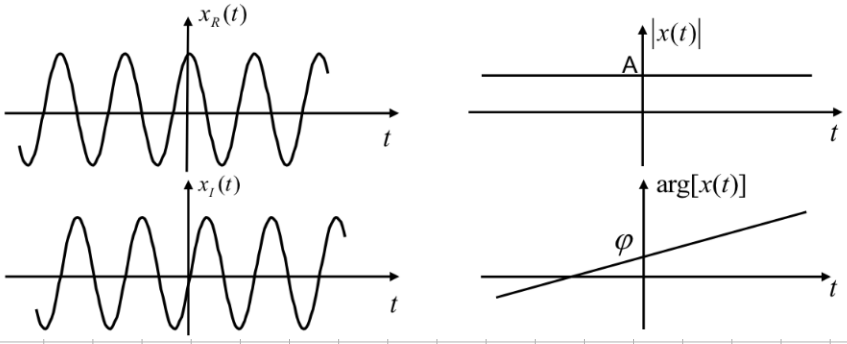
$$x(t) = |x(t)| \cdot e^{j \cdot \arg(x(t))}$$

$$|x(t)| = \sqrt{x_R^2(t) + x_I^2(t)}$$

$$\arg(x(t)) = \arctan\left(\frac{x_I(t)}{x_R(t)}\right)$$

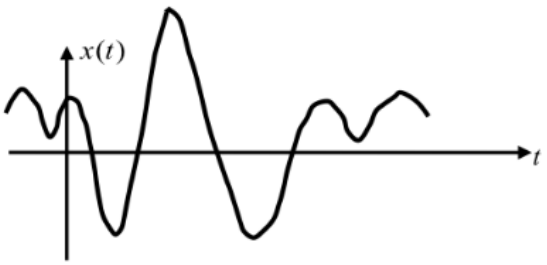
ESPONENZIALE COMPLESSO

$$x(t) = A e^{j(2\pi f_0 t + \varphi)} = A\cos(2\pi f_0 t + \varphi) + j\,A\sin(2\pi f_0 t + \varphi)$$



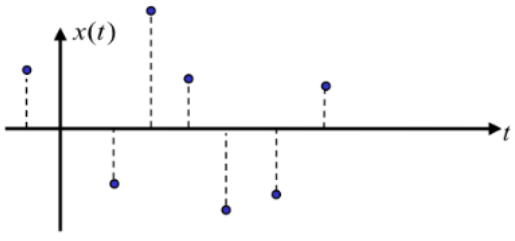
SEGNALE CONTINUO

Analogic signal



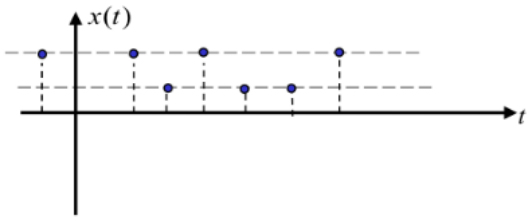
The signal is a continuous function (real or complex) of a continuous vaariable

Sampled signal



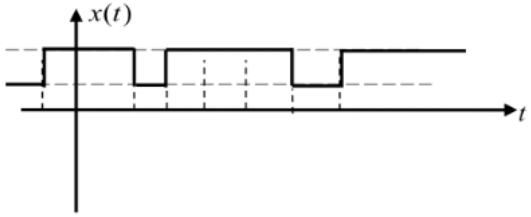
The signal is represented by a continuous function but the t-variable can have only discrete values

Digital signal



t is a discrete variable and it can have only discrete values

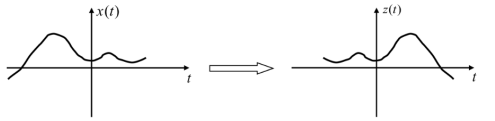
Discrete signal



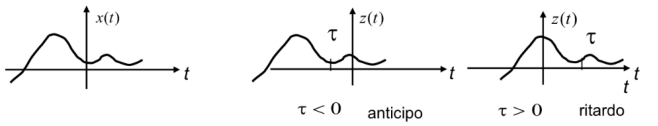
t is a continuous variable but it can have only discrete values

OPERAZIONI TRA SEGNALI

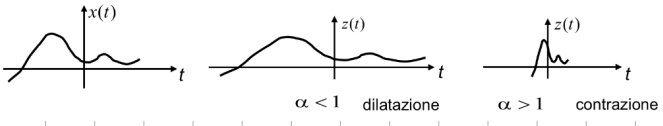
- SOMMA, PRODOTTO: $z(t) = x(t) + y(t)$, $z(t) = x(t) \cdot y(t)$
- PRODOTTO CON COSTANTE: $z(t) = c \cdot x(t)$ ⇒ AMPLIFICATION
- RIBALTAMENTO (FLIPPING): $z(t) = x(-t)$ (SIMMETRICO SU Y)



- TRASLAZIONE: $z(t) = x(t - \tau)$

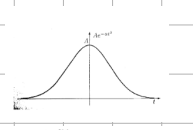


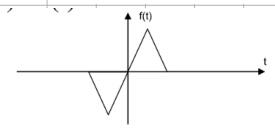
- AXIS WARPING (DILATAZIONE/CONTRAZIONE): $z(t) = x(\alpha t)$, $\alpha > 0$



SIMMETRIA

- Dato un SEGNALE REALE (o SEQUENZA)
  - SIMMETRIA PARI $f(t) = f(-t)$
  - SIMMETRIA DISPARI $f(-t) = -f(t)$





- Dato un SEGNALE COMPLESSO:
  - SIMMETRIA HERMITIANA:
    - parte reale e MODULO: SIMMETRIA PARI
    - parte immaginaria e FASE: ⇒ DISPARI

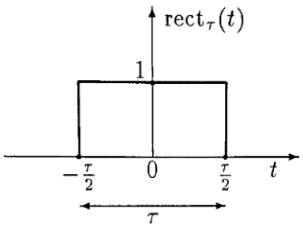
ESEMPI:

- $x(t) = \text{rect}\left(\frac{t}{3}\right)$
- $x(t) = 2\,\text{rect}\left(\frac{t}{3}\right)$
- $x(t) = \text{tri}(2t - 3)$
- $x(t) = \text{rect}\left(t + \frac{1}{2}\right) \cdot 3\,\text{tri}\left(\frac{t}{2}\right)$
- $x(t) = \text{rect}\left(\frac{t}{2} - 4\right) + \text{tri}(t + 2)$

Example of signals

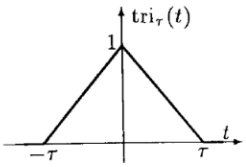
- Rettangolo

$$x(t) = rect(t) = \begin{cases} 1 \; if \; |t| \leq \frac{\tau}{2} \\ \frac{1}{2} \; if \; |t| = \frac{\tau}{2} \\ 0 \; otherwise \end{cases}$$



- triangolo

$$x(t) = tri(t) = \begin{cases} \frac{t}{\tau} + 1 \; if \; t \in [-\tau, 0] \\ -\frac{t}{\tau} + 1 \; if \; t \in [0, \tau] \\ 0 \; otherwise \end{cases}$$



- Gradino unitario

$$x(t) = u_{-1}(t) = \begin{cases} 1 \; if \; t \geq 0 \\ 0 \; otherwise \end{cases}$$