Why analysis?

Disclaimer: images are stolen from the internet, no ownership claimed, educational use only

(1) **Physics** [all types of engineering]

(i) *classical mechanics*, ex. Newton's 2nd law:

$$F = m\frac{d^2x}{dt^2}$$

(ii) *classical electromagnetism*,

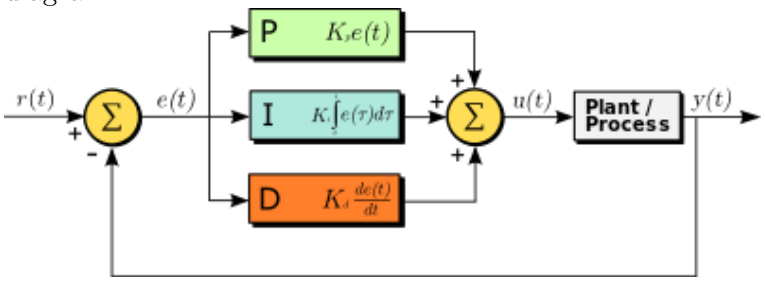
$$\oiint_{\partial\Omega} E \cdot dS = 4\pi \iiint_{\Omega} \rho dV$$

(iii) *quantum mechanics* : functional analysis (Hilbert spaces : Cauchy convergence),...

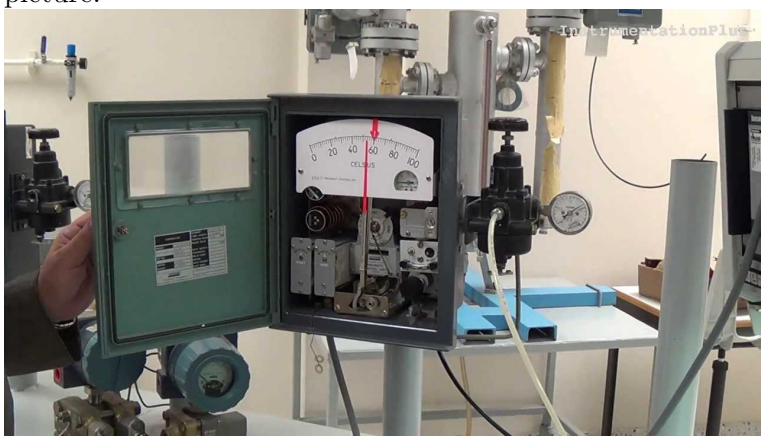
(iv) *etc.*

(2) **control theory** [electrical & mechanical engineering], ex. proportional-integral-derivative controller,

- diagram:



- picture:

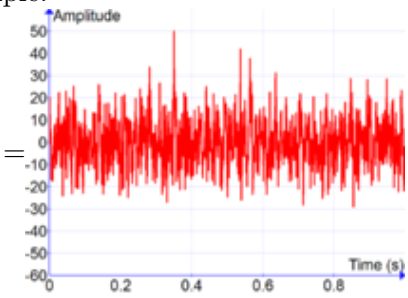


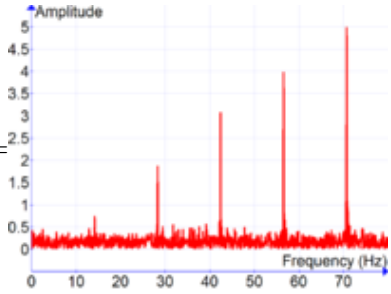
(3) **signal processing** [informatics, communications systems], Fourier transforms:

$$\text{phase function: } \hat{f}(\xi) = \int_{-\infty}^{\infty} f(x) e^{-2\pi i x \xi} dx$$

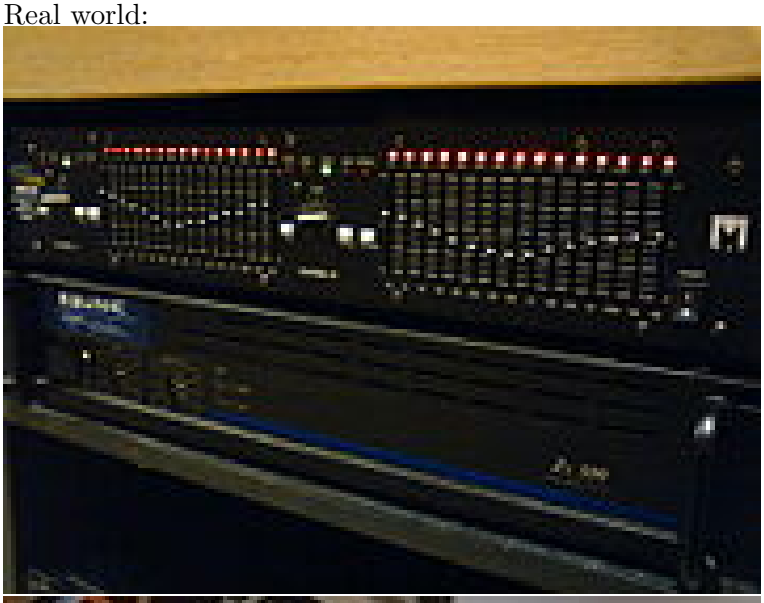
$$f(x) = \int_{-\infty}^{\infty} \hat{f}(\xi) e^{2\pi i x \xi} d\xi = \int_{-\infty}^{\infty} \hat{f}(\xi) \left(\cos(2\pi i x \xi) + i \sin(2\pi i x \xi)\right) d\xi$$

Example:

$f(x) =$ 

$\longrightarrow$ $\hat{f}(\xi) =$ 

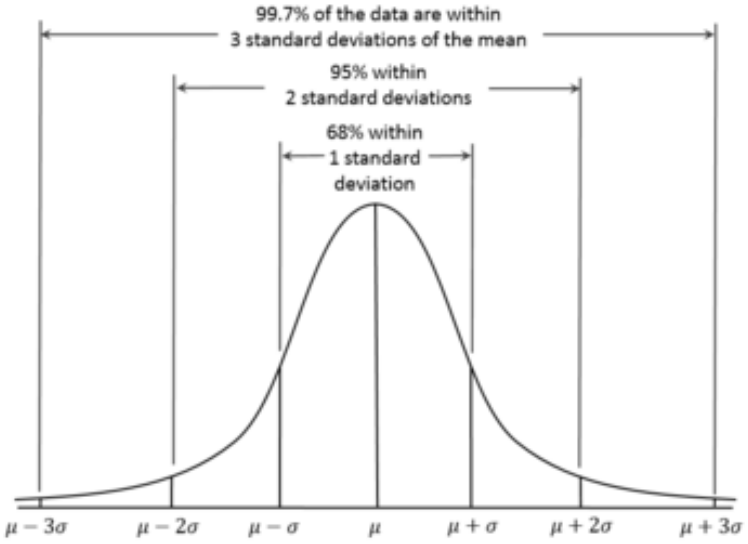
Real world:



(4) **statistics, probability theory** [all types of engineering]

Example: Central Limit theorem: if X_i are independent random variables with the same distribution, with expected value μ and variance σ^2, then

$$\sum_{i=1}^{n} \frac{X_i - \mu}{\sqrt{n}\sigma} \rightarrow \text{Gauss distribution}$$



(5) etc.