$$G(s) = \frac{1}{(s+1)^3}$$

PID

1) $PID(s) = K_p + K_i/s + \underbrace{K_d \cdot s}$

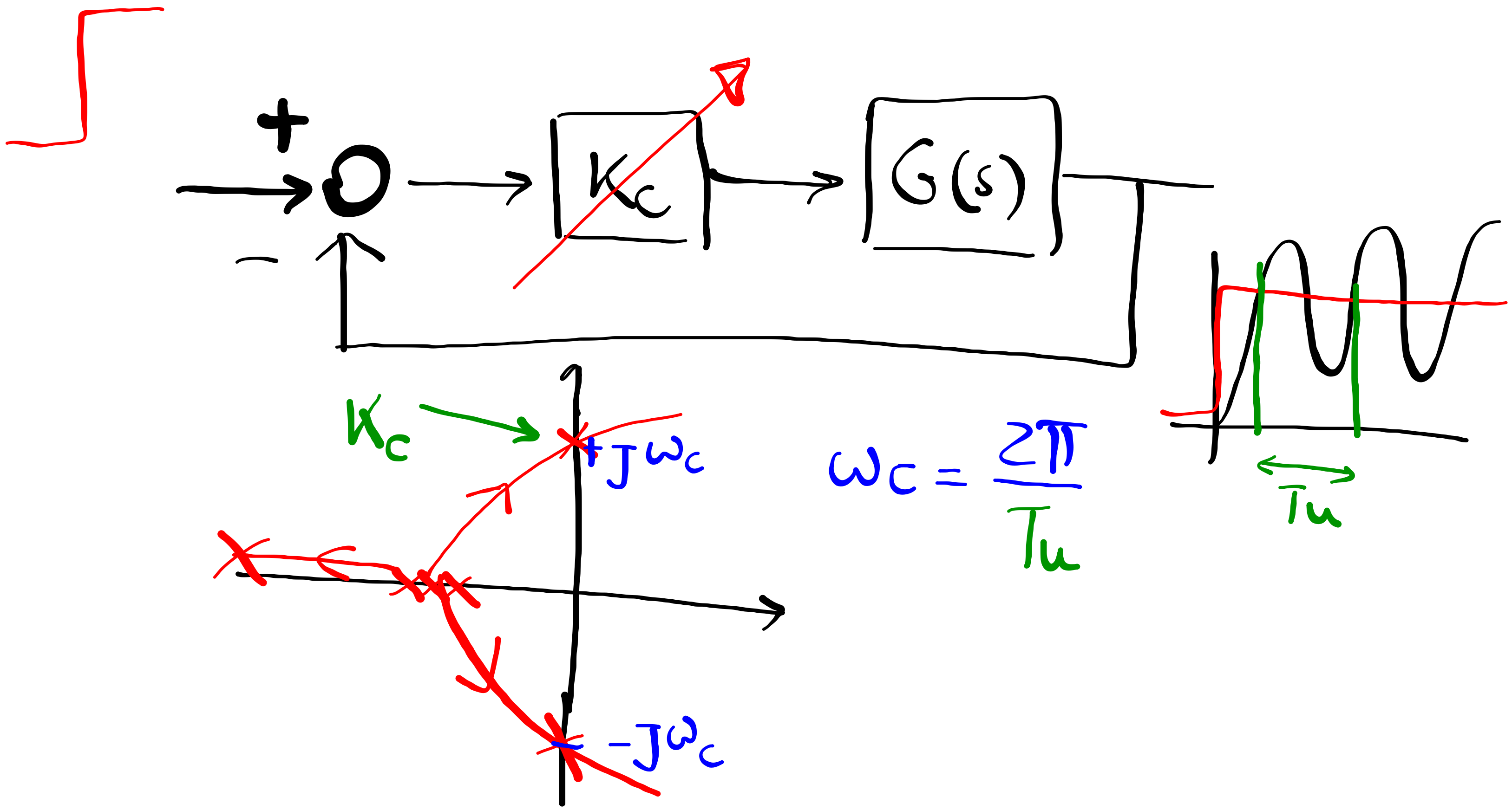
I

2) $PID(s) = K_p + K_i/s + \boxed{\dfrac{K_d \cdot s}{1 + \dfrac{K_d \cdot s}{N}}}$

$N \in [10 \div 100]$ $\quad K_d \cdot s \leftarrow$ $N \to \infty$

# Ziegler - Nichols

$$
\begin{cases}
K_p = 0.6 \cdot K_c \\
K_i = 2\, K_p / T_u \\
K_d = K_p \cdot T_u / 8
\end{cases}
$$




$$\omega_c = \frac{2\pi}{T_u}$$

# $\boxed{\text{Vantaggi del PID}}$

- Riduce o elimina l'errore a regime (I) $1/s$
- Riduce la sovraelongazione (D)

# PID Discreto

**PID Continuo**

$$K_p + K_i \cdot \frac{1}{s} + \frac{K_d s}{1 + K_d \cdot s / N}$$

EA EI

**PID discreto**

$$s = \frac{z-1}{T} \qquad s = \frac{1 - z^{-1}}{T}$$