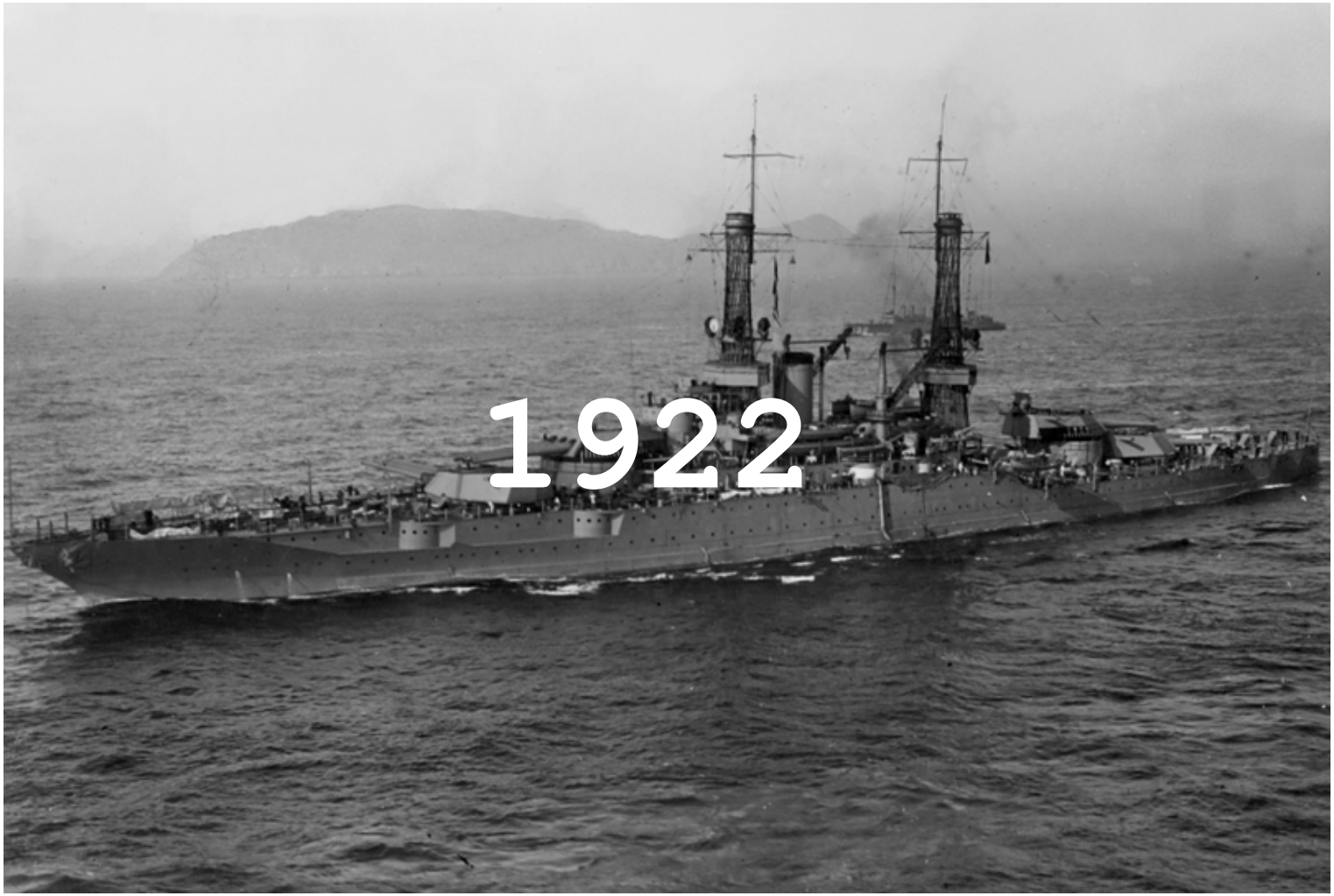
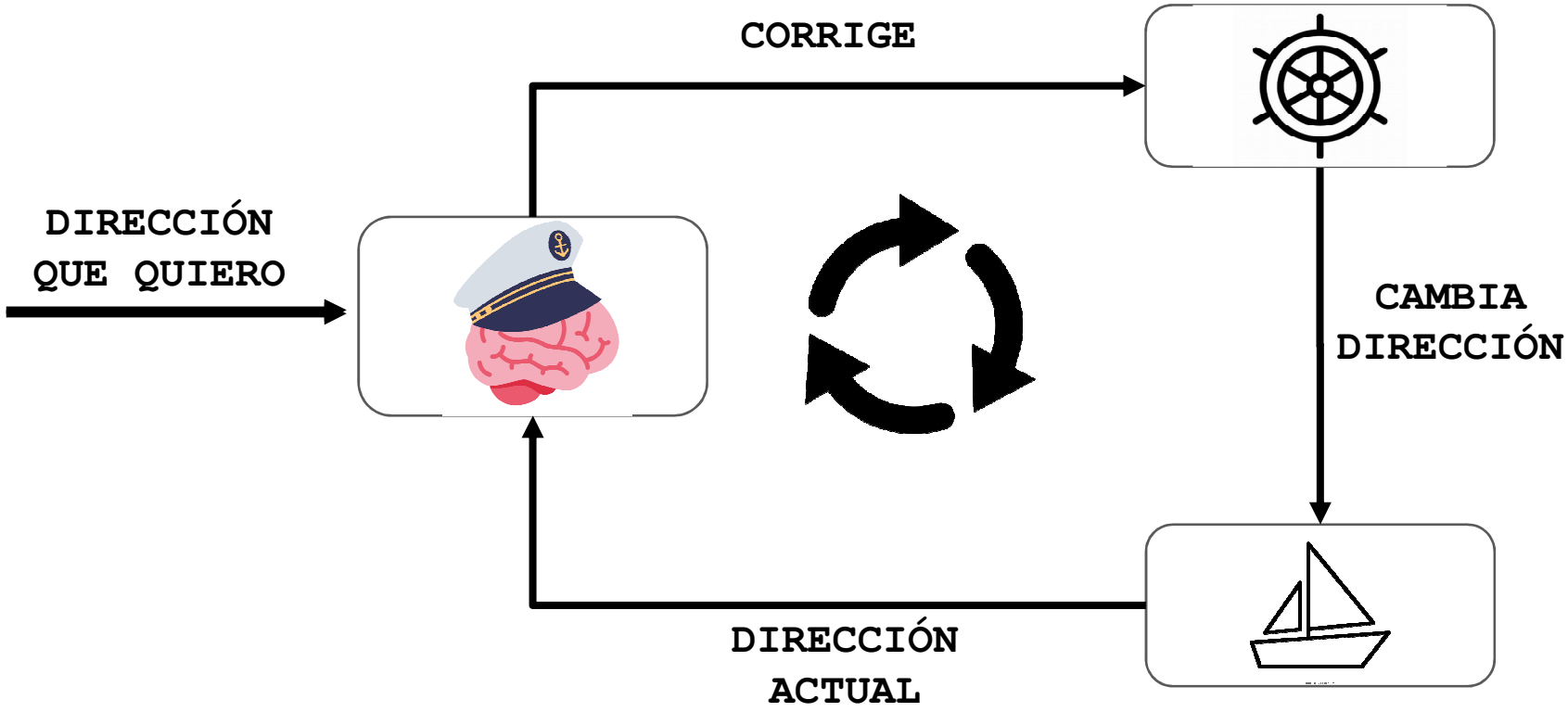
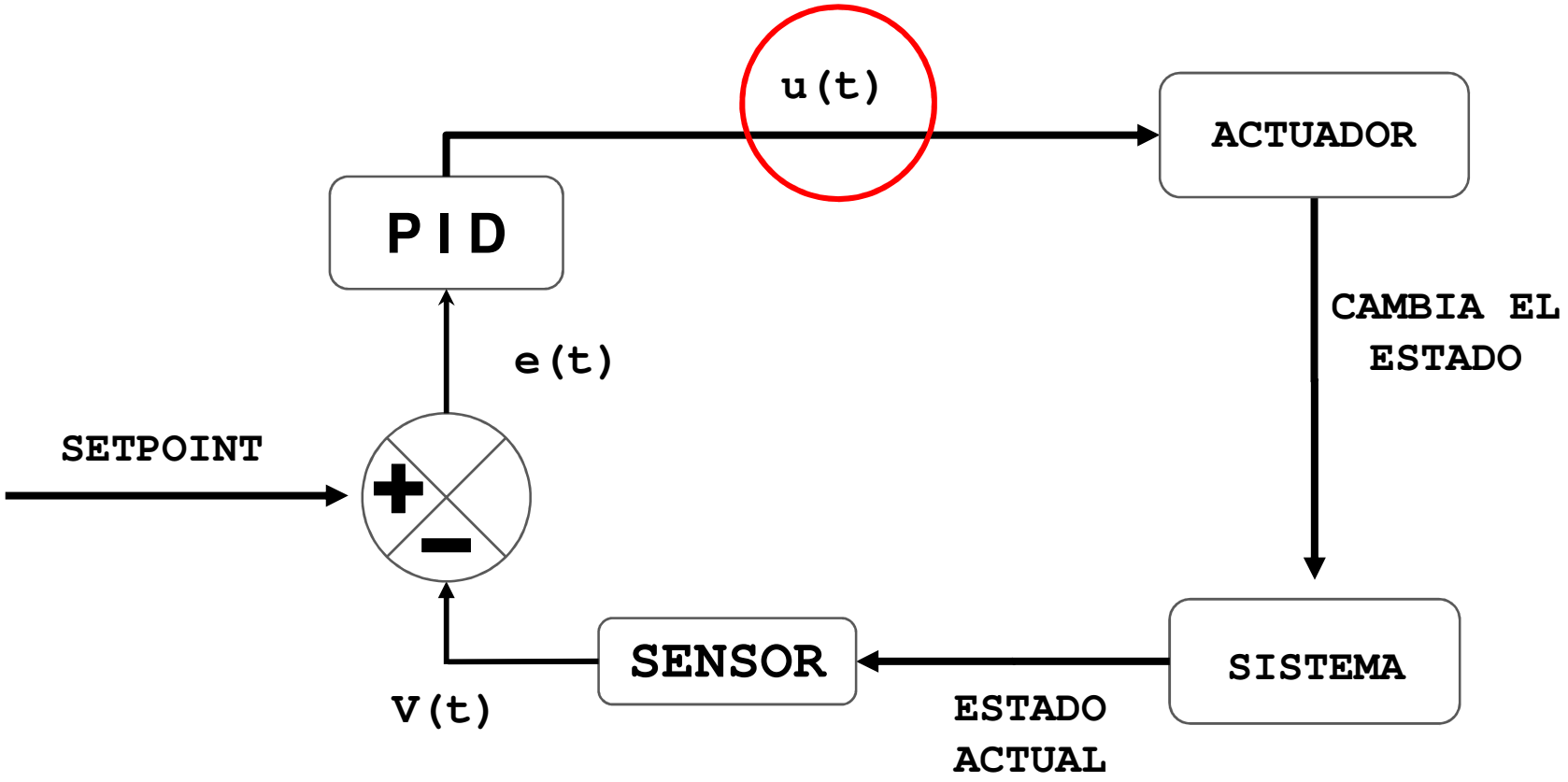

1922


CORRIGE
DIRECCIÓN
QUE QUIERO
CAMBIA
DIRECCIÓN
DIRECCIÓN
ACTUAL

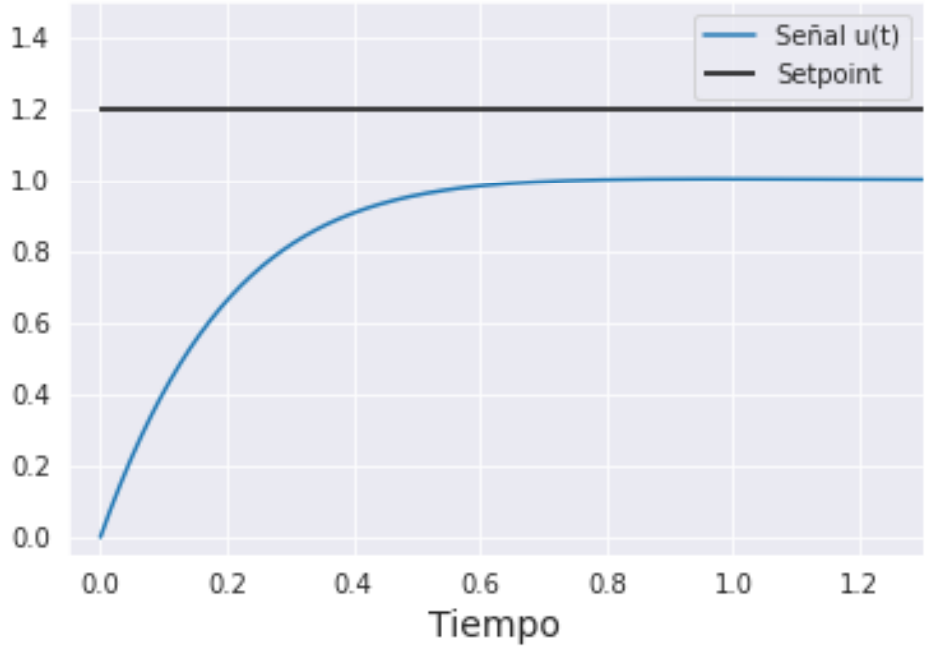

u(t)
ACTUADOR
PID
CAMBIA EL
ESTADO
e(t)
SETPOINT
+
-
SENSOR
SISTEMA
V(t)
ESTADO
ACTUAL

**P** **I** **D**

$$k_p e(t) \quad \boxplus \quad k_i \int e(t)dt \quad \boxplus \quad k_d \frac{\mathrm{d}e(t))}{\mathrm{d}t}$$

$$u(t) = k_p e(t) + k_i \int e(t)dt + k_d \frac{\mathrm{d}e(t))}{\mathrm{d}t}$$

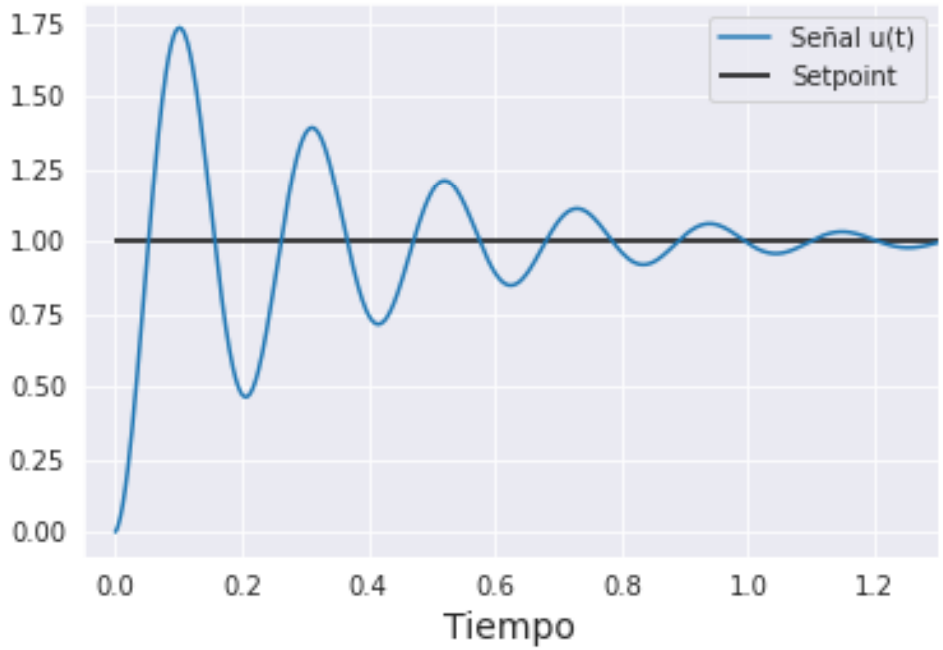
$$k_p e(t)$$


Señal u(t)
Setpoint
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Tiempo

$$k_p e(t)$$

$$+$$

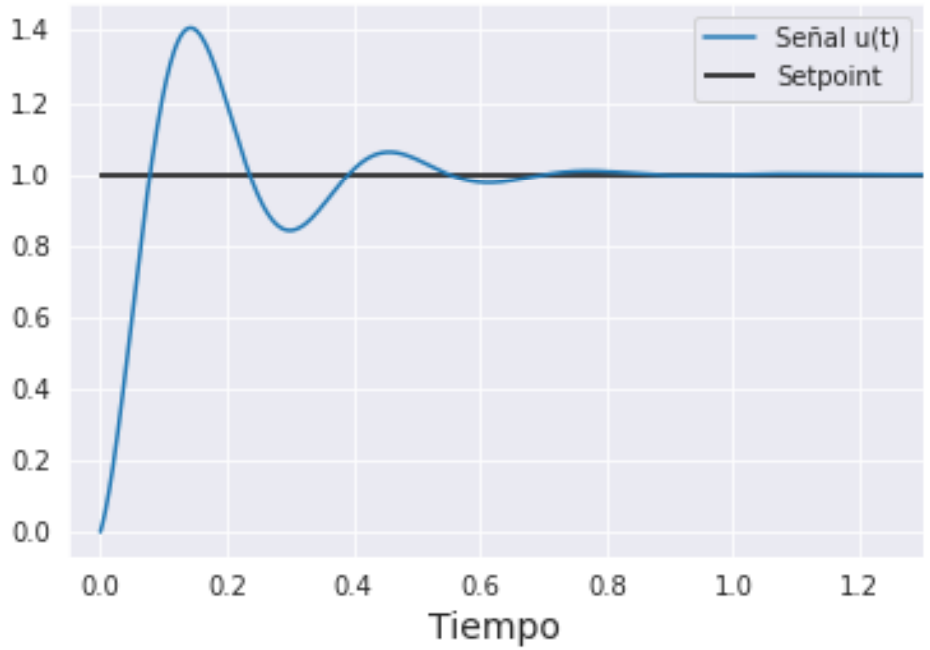
$$k_i \int e(t)dt$$



$$k_p e(t)$$

$$+$$

$$k_d \frac{\mathrm{d}e(t))}{\mathrm{d}t}$$



$$u(t) = k_p e(t) + k_i \int e(t)dt + k_d \frac{\mathrm{d}e(t))}{\mathrm{d}t}$$

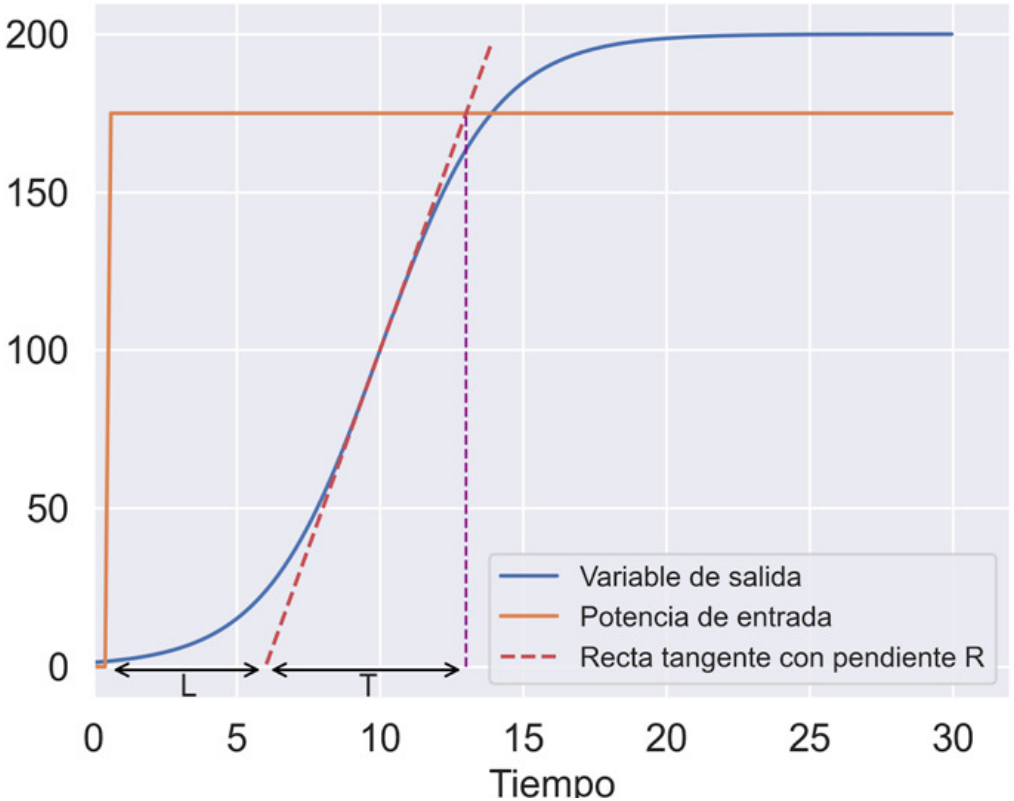
# Métodos de Sintonización

**Prueba y error**

**Ziegler – Nichols**

- Lazo Abierto
- Lazo Cerrado

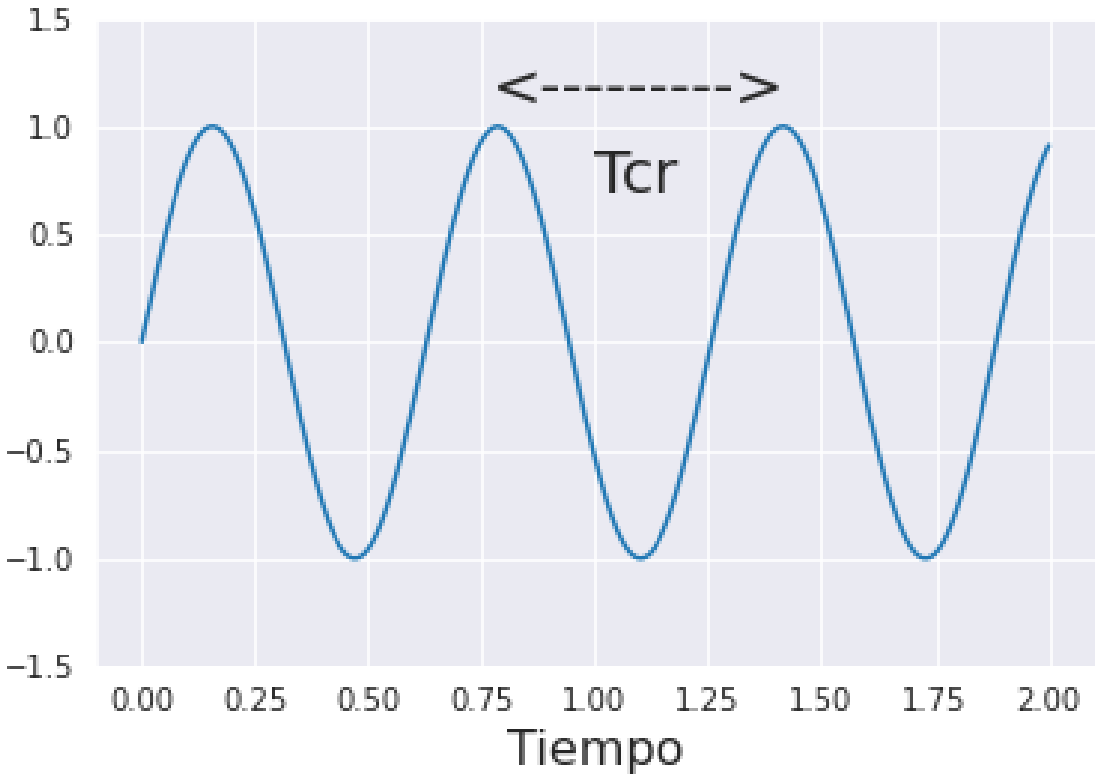
# Ziegler-Nichols a lazo abierto




| Tipo de controlador | Kp | Ti | Td |
|---|---|---|---|
| P | 1/RL | 0 | 0 |
| PI | 0.9/RL | 3L | 0 |
| PID | 1.2/RL | 2L | 0.5L |

- Se mide respuesta a pulso
- Se obtienen L, R
- Se calcula Kp, Ki, Kd
- Ki=Kp/Ti, Kd=Td*Kp

# Ziegler-Nichols a lazo cerrado




| Tipo de controlador | Kp | Ti | Td |
|---|---|---|---|
| P | 0.5 Kcr | 0 | 0 |
| PI | 0.45 Kcr | Tcr/1.2 | 0 |
| PID | 0.6 Kcr | Tcr/2 | Tcr/8 |