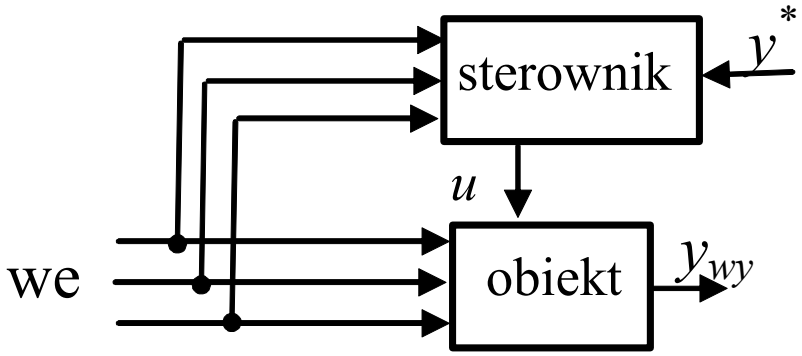
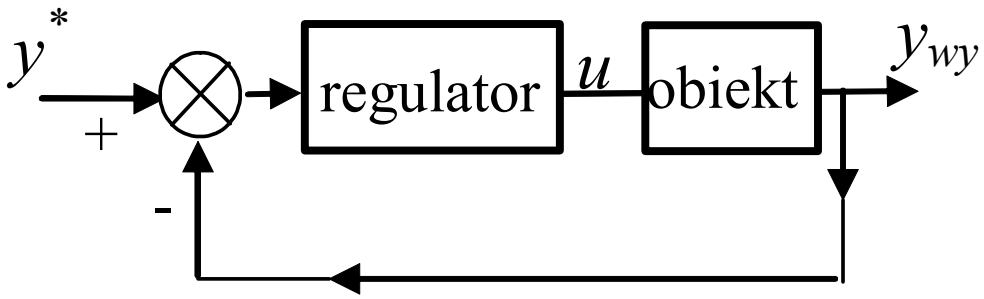
Podstawowe typy układów sterowania

Sterowanie w

układzie otwartym	układzie zamkniętym (regulacja)





- znany „przepis” na sterowanie
- stabilne
- niedokładne

- sterowanie jest wypracowywane
- stabilne/niestabilne
- dokładne

Feedforward Control

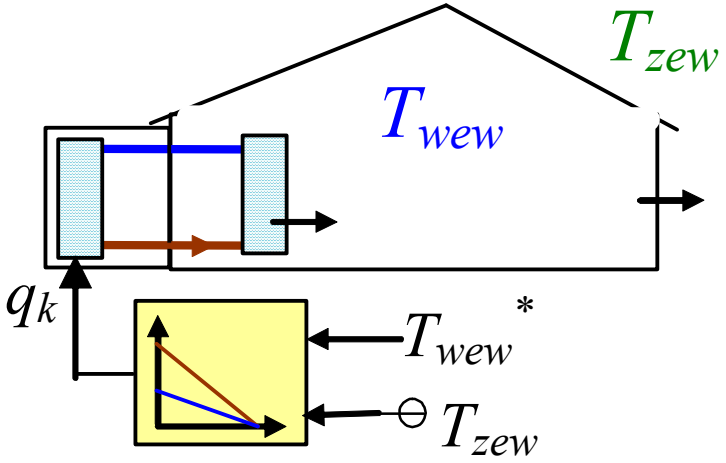
Feedback Control

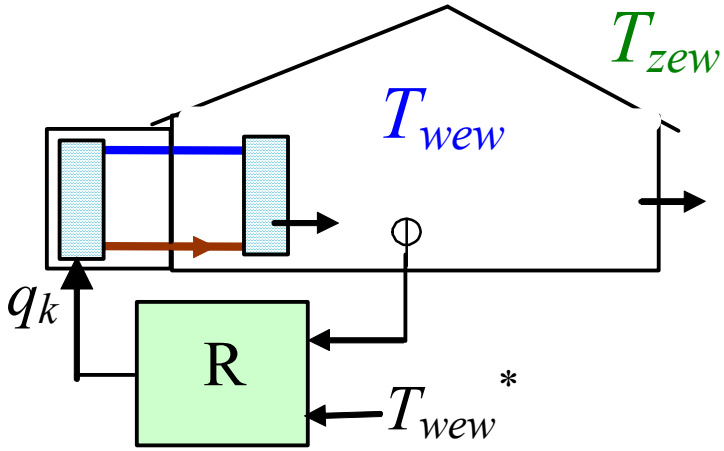
Process Control

Podstawowe typy układów sterowania - przykład

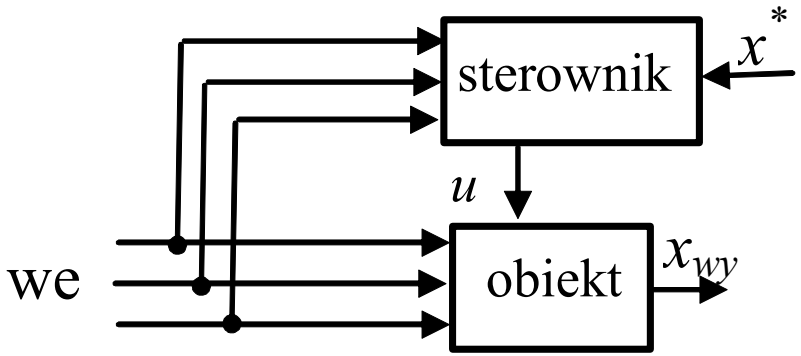
Sterowanie w

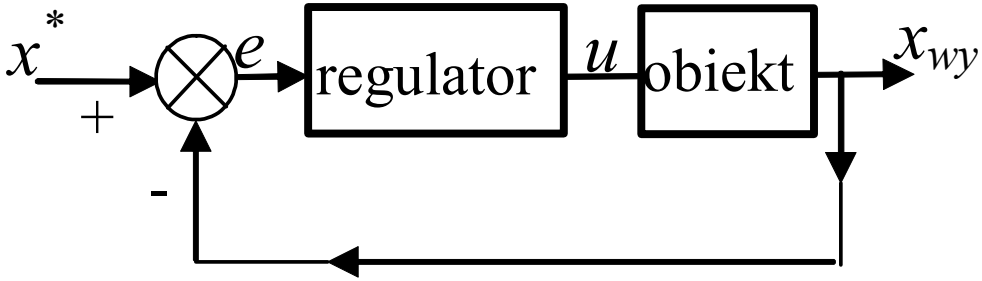
układzie otwartym	układzie zamkniętym (regulacja)

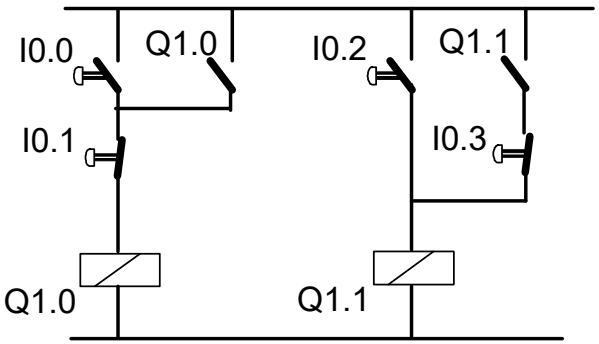


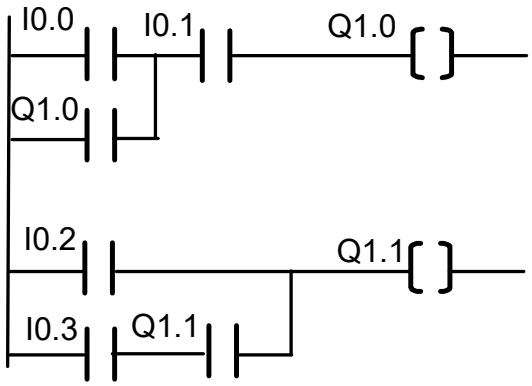


Sterowanie logiczne, binarne, ciągłe, dyskretne



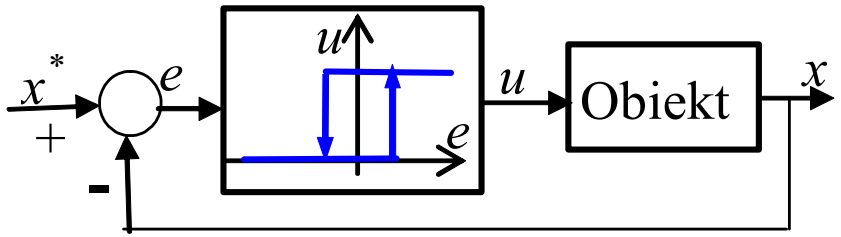




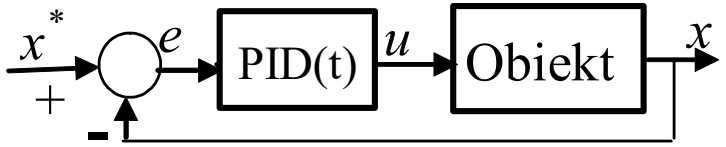


- sterowanie logiczne (sekwencyjne)
- PLC - Programmable Logic Controller

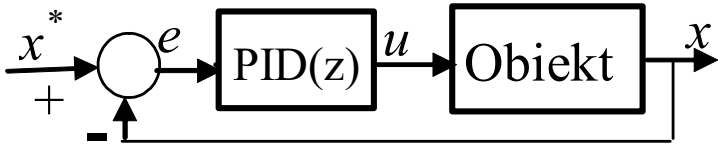
- regulatory przekaźnikowe (binarne)



- regulatory ciągłe



- regulatory dyskretne

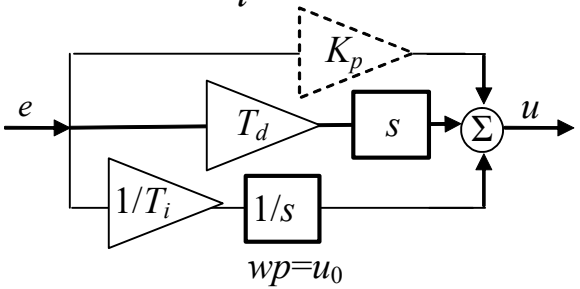


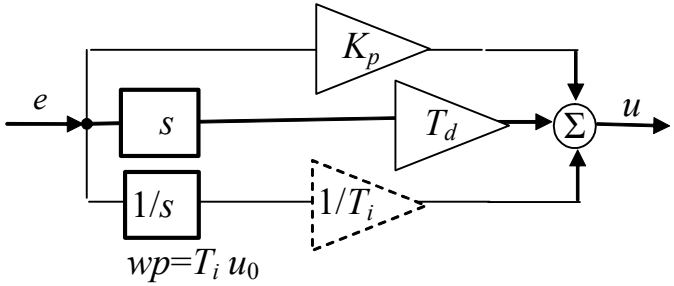
regulacja klasyczna

Regulator ciągły: Struktura PID i sposób realizacji

PID-IND (INDependent algorithm)

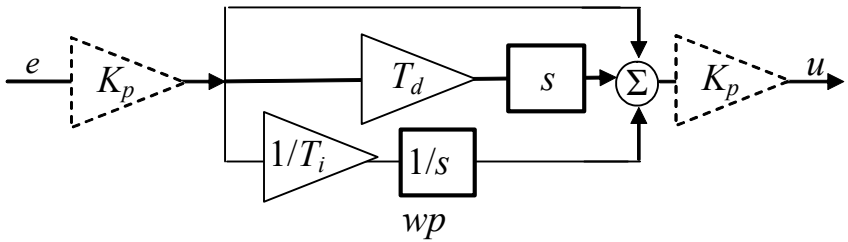
$$R = K_p + \frac{1}{T_i s} + T_d s$$



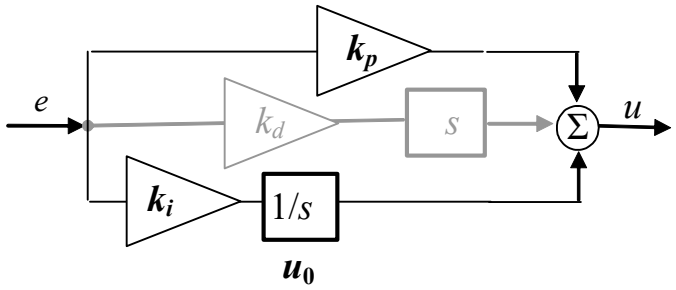


PID-ISA (Ideal Standard Algorithm)

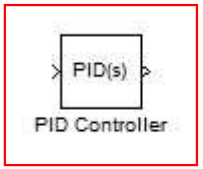
$$R = K_p\left(1 + \frac{1}{T_i s} + T_d s\right)$$

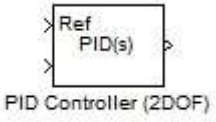


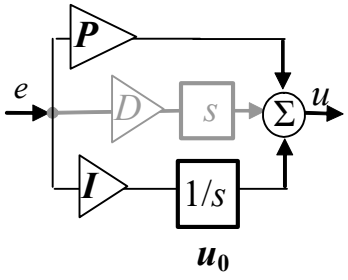
Realizacja PID - wybór



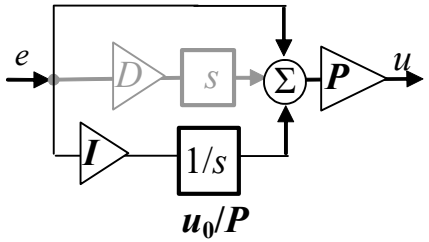
Simulink







PID Paralell

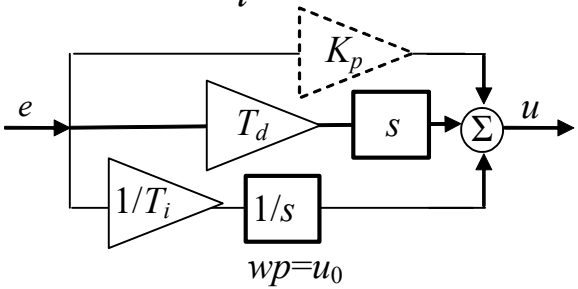


PID Ideal

Regulator ciągły: Struktura PID w teorii

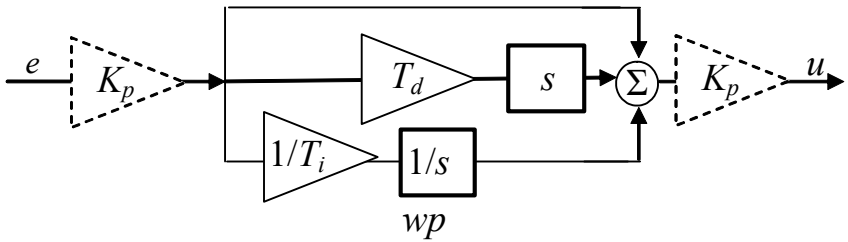
PID-IND (INDependent algorithm)

$$R = K_p + \frac{1}{T_i s} + T_d s$$



PID-ISA (Ideal Standard Algorithm)

$$R = K_p\left(1 + \frac{1}{T_i s} + T_d s\right)$$



PID-kaskadowy (interacting)

PID kaskadowy (interacting):

$$K_p \frac{T_i s + 1}{T_i s}(T_d s + 1) = K_p\left(\frac{1}{T_d s} + 1\right)(T_d s + 1)$$

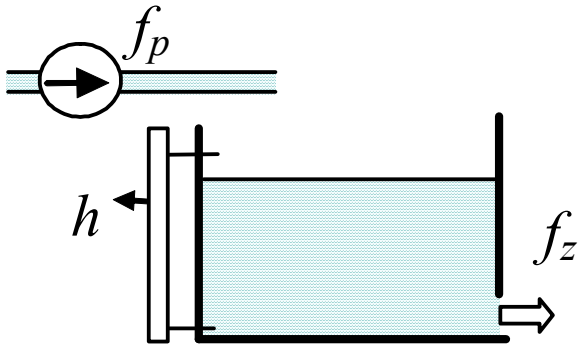
PID ISA (non-interacting):

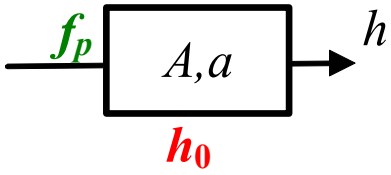
$$K_p\left(1 + \frac{1}{T_i s} + T_d s\right)$$

PI: $K_p \frac{T_i s + 1}{T_i s} = K_p\left(\frac{1}{T_d s} + 1\right)$

PI: $K_p\left(1 + \frac{1}{T_i s}\right)$

Układ regulacji ciągłej PID – wartości początkowe

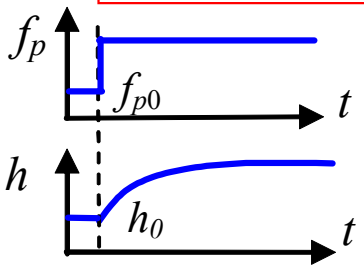


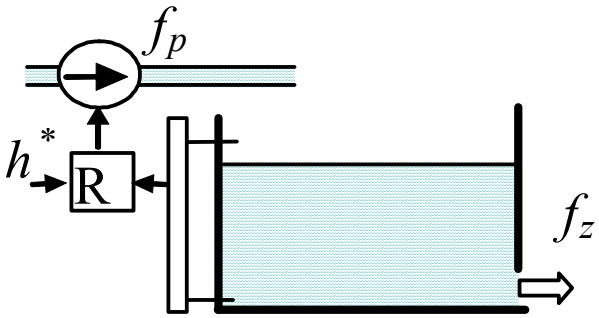


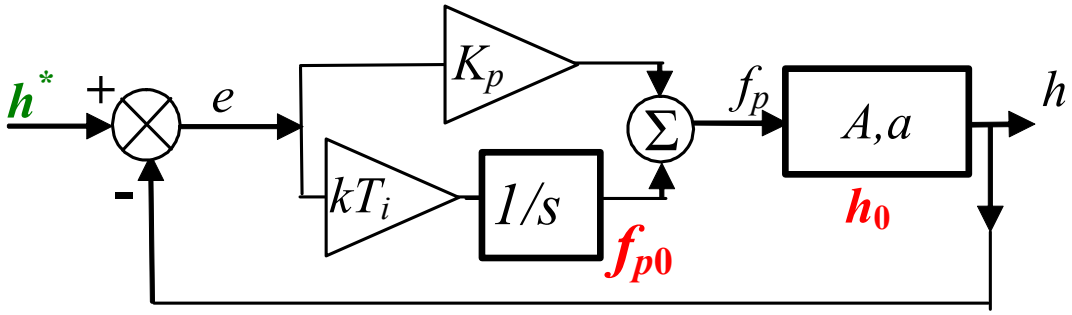
$$A\dot{h}(t) = f_p(t) - ah(t)$$

$$0 = f_{p0} - ah_0$$

$$h_0 = f_{p0} / a$$







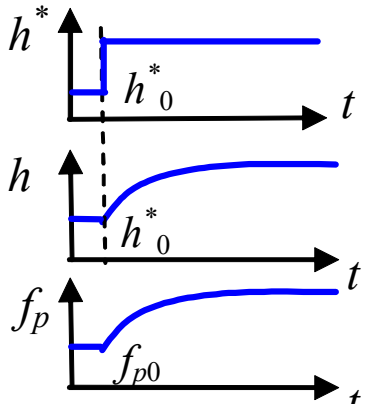
$$A\dot{h}(t) = f_p(t) - ah(t)$$

$$f_p(t) = K_p e(t) + k_{Ti} \int e(t)$$

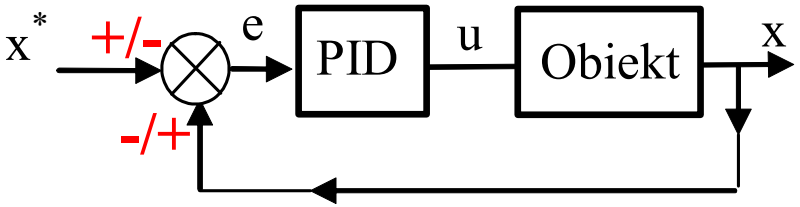
$$e = 0 \rightarrow h_0 = h_0^*$$

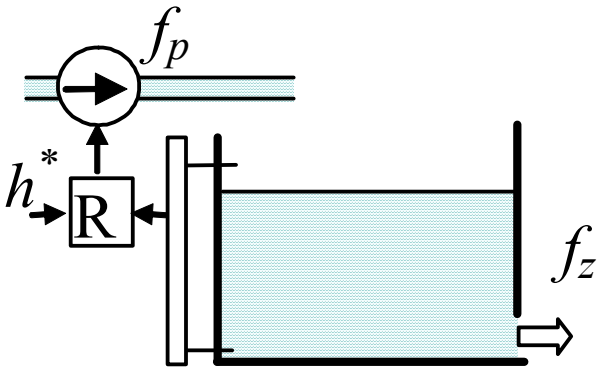
$$0 = f_{p0} - ah_0^*$$

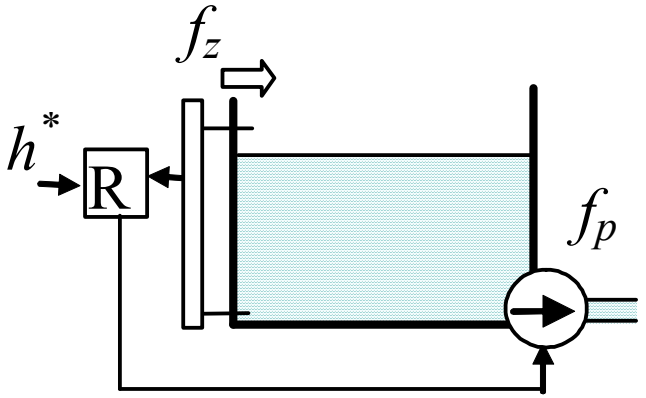
$$f_{p0} = ah_0^*$$

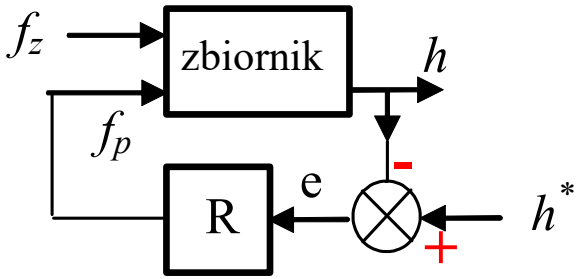


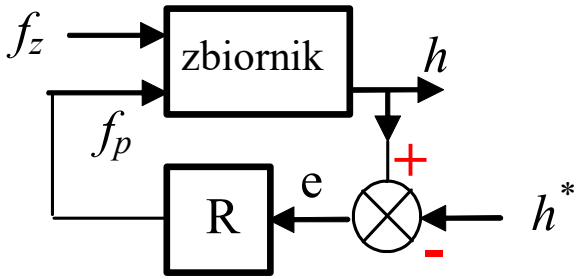
Układ regulacji ciągłej PID - znak











$h^* > h$ (poziom za niski)

zwiększ f_p ← → *zmniejsz* f_p

$e=h^*-h$ → sterowanie $K_p e + \frac{1}{T_i}\int e$ ← $e=h-h^*$

Układ regulacji ciągłej PID – przykłady

Jakie znaki w węźle sumacyjnym? Jakie warunki początkowe w regulatorze?