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Application of GWO-PID to Totem Pole Power Factor Corrector

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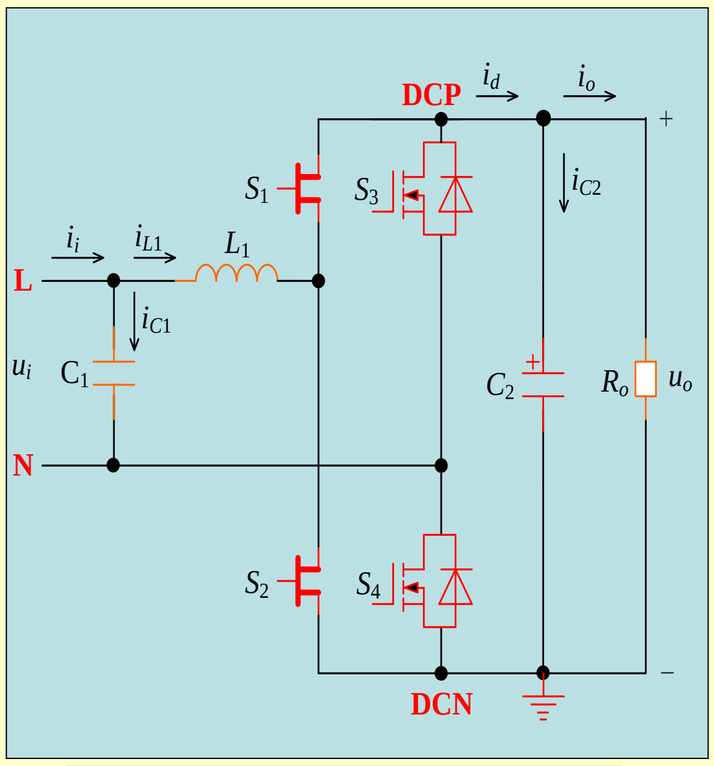
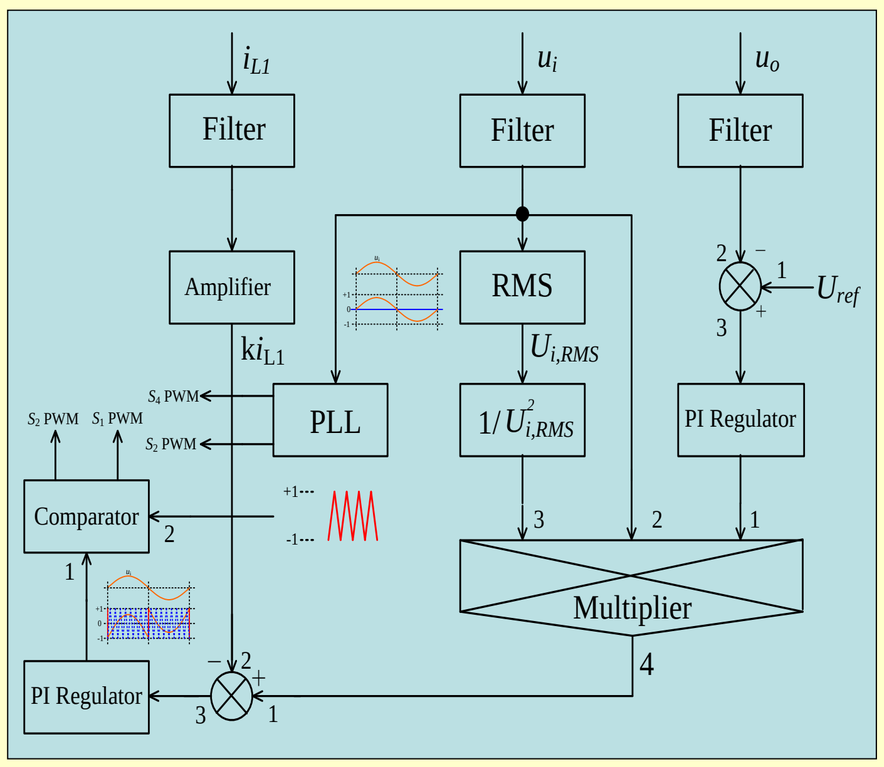
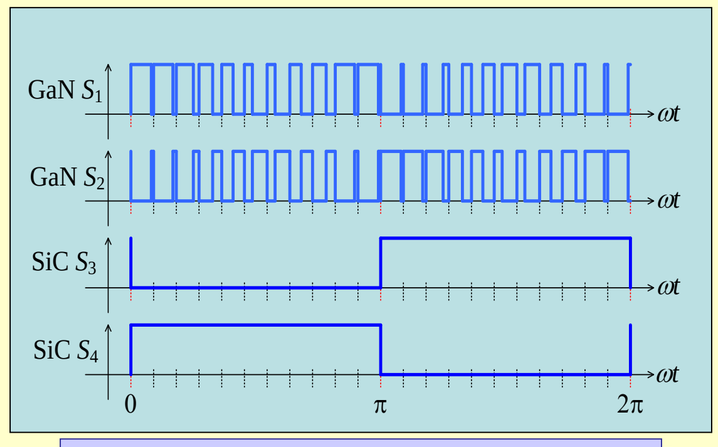


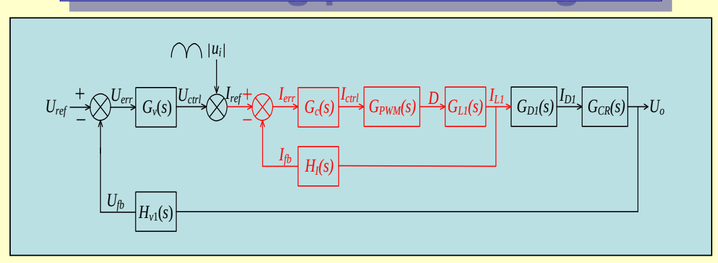
Power circuit of TP-PFC



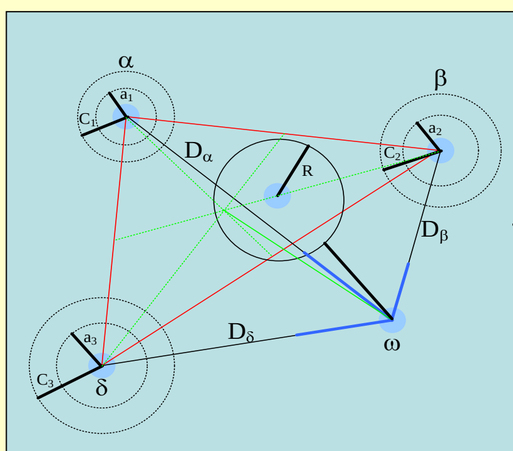
Control structure of TP-PFC



Driving pulse timing



Double closed-loop control



$$\begin{cases} \vec{D}_\alpha = \left|\vec{C}_1 \cdot \vec{X}_\alpha(t) - \vec{X}(t)\right| \\ \vec{D}_\beta = \left|\vec{C}_2 \cdot \vec{X}_\beta(t) - \vec{X}(t)\right| \\ \vec{D}_\delta = \left|\vec{C}_3 \cdot \vec{X}_\delta(t) - \vec{X}(t)\right| \end{cases} \quad \begin{cases} \vec{X}_1 = \vec{X}_\alpha(t) - \vec{A}_1 \cdot \vec{D}_\alpha \\ \vec{X}_2 = \vec{X}_\beta(t) - \vec{A}_2 \cdot \vec{D}_\beta \\ \vec{X}_3 = \vec{X}_\delta(t) - \vec{A}_3 \cdot \vec{D}_\delta \end{cases}$$

$$\vec{X}(n+1) = [\vec{X}_1(t) + \vec{X}_2(t) + \vec{X}_3(t)]/3$$

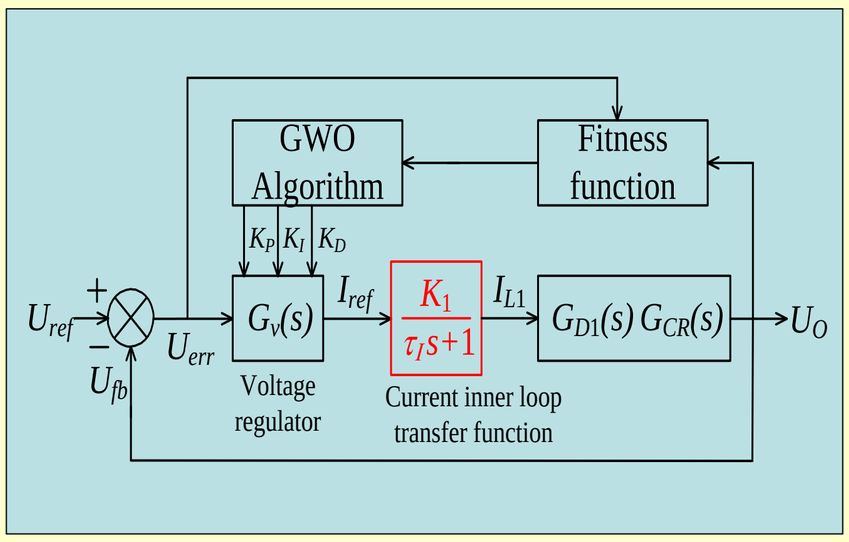
Mathematical modeling of the surrounding behavior

$$J_2 = K_1 \int_0^\infty t \cdot (u_o - U_{o,ref})^2 dt$$

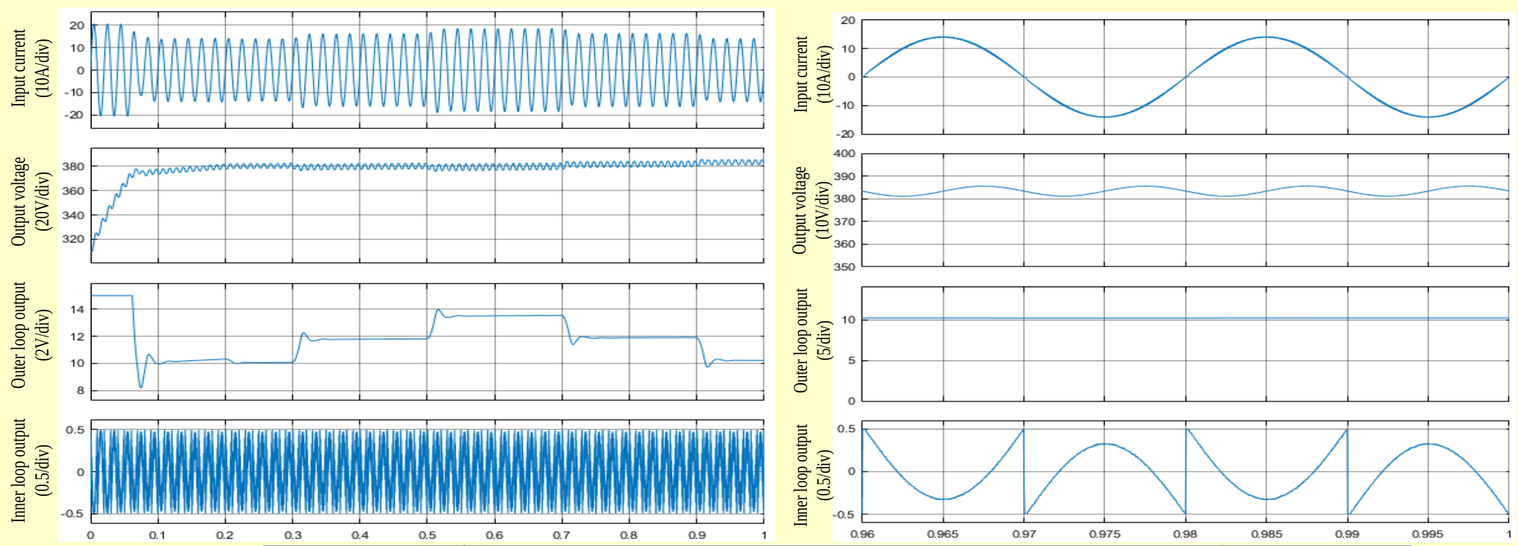
$$J_4 = \frac{1}{2} C_o u_o^2 + \frac{u_o^2}{R_o}$$

$$\frac{dJ_4}{dt} = \frac{2 + R_o C_o}{R_o} u_o \frac{du_o}{dt} < A_1$$

constraints of input current



GWO-PID control structure



GWO-PID based TP-PFC Simulink simulation

An improved uniform distribution is used to improve the gray wolf algorithm in order to initialize the population. GWO-PID control structure of TP-PFC is designed using the optimization index reflecting the change of electrolytic capacitor energy storage and the constraint condition to prevent the input current amplitude from exceeding the limit. It is applied to the PID parameter optimization of TP-PFC control system and verified by simulation. The results show that GWO-PID based TP-PFC has very good control effect and avoids falling into local optimization. The output voltage response speed is faster, without overshoot in the start-up, and with resistance to load variation.