Linear SOA Equations

$$\left\{\begin{array}{l}\dfrac{\partial N}{\partial t}=\dfrac{I}{qV}-\dfrac{N}{\tau_c}-\dfrac{g(N)}{\hbar\omega_0}\left|A\right|^2 \\ g(N)=\Gamma a(N-N_0)\end{array}\right\} \Rightarrow \frac{\partial g}{\partial t}=\frac{g-g_0}{\tau_c}-g\frac{\left|A\right|^2}{E_{sat}} \qquad (1)$$

$$E_{sat}=\hbar\omega_0\delta/a \qquad (2)$$

$$\delta=wd/\Gamma \qquad (3)$$

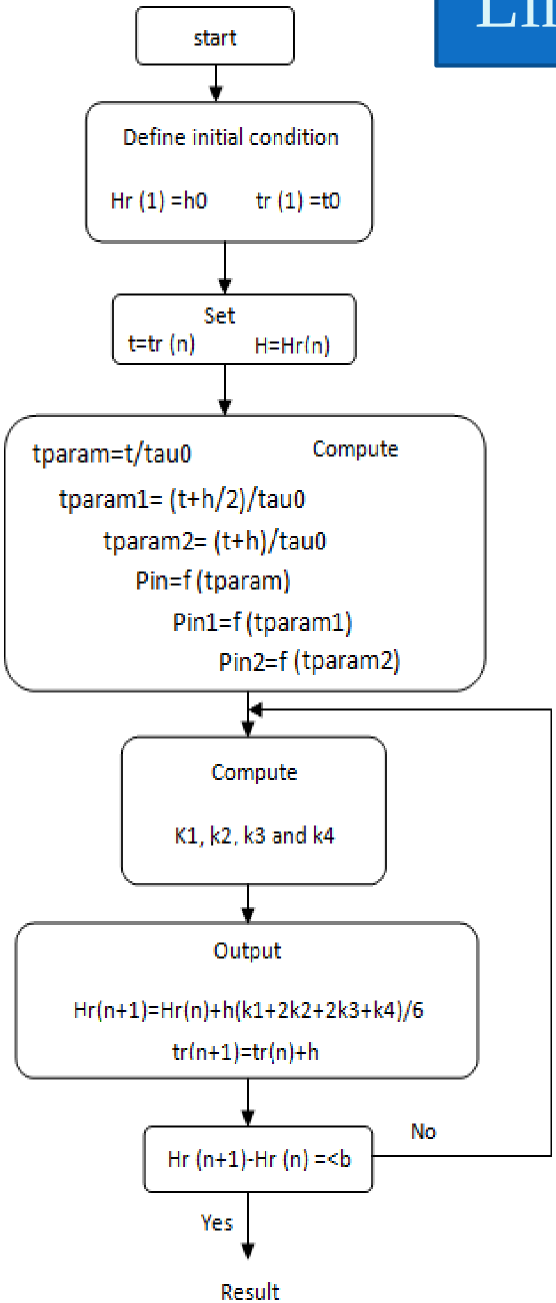
$$I_0=qVN_0/\tau_c \qquad (4)$$

$$g_0=\Gamma aN_0(I/I_0-1) \qquad (5)$$

$$A=\sqrt{P}\exp(i\varphi) \qquad (6)$$

$$\left\{\begin{array}{ll}\dfrac{\partial P}{\partial z}=(g-\alpha_{\text{int}})P & (7) \\ \dfrac{\partial \varphi}{\partial z}=-\dfrac{1}{2}\alpha g & (8) \\ \dfrac{\partial g}{\partial t}=\dfrac{g_0-g}{\tau_c}-\dfrac{gP}{E_{sat}} \text{ and } h(\tau)=\displaystyle\int_0^L g(z,\tau)dz \Rightarrow \dfrac{\partial h}{\partial t}=\dfrac{g_0L-h}{\tau_c}-\dfrac{P_{in}(\tau)}{E_{sat}}\left[\exp(h)-1\right] & (9)\end{array}\right\}$$

Linear SOA Flowchart by Rung-Kutta 4-order



$$A_{in}(\tau) = \frac{E_{in}}{\tau_0\sqrt{\pi}} \exp\left(-\frac{\tau^2}{\tau_0^{\,2}}\right)$$

$$\tau_p \approx 1.665\tau_0$$

$$A_{in}(\tau) = \frac{E_{in}}{2\tau_0} \sec h^2\left(-\frac{\tau}{\tau_0}\right)$$

$$\tau_p \approx 1.7627\tau_0$$

$$k_1 = \frac{h_0 - h}{\tau_c} - \frac{P_{in}}{E_{sat}}\left[\exp(h) - 1\right]$$

$$k_2 = \frac{h_0 - (H + 0.5hk_1)}{\tau_c} - \frac{P_{in,1}}{E_{sat}}\left[\exp(H + 0.5hk_1) - 1\right]$$

$$k_3 = \frac{h_0 - (H + 0.5hk_2)}{\tau_c} - \frac{P_{in,1}}{E_{sat}}\left[\exp(H + 0.5hk_2) - 1\right]$$

$$k_4 = \frac{h_0 - (H + hk_3)}{\tau_c} - \frac{P_{in,2}}{E_{sat}}\left[\exp(H + hk_3) - 1\right]$$