

Chapter 1

Optimal Control

Minimize $J_{gate} = 1 - \frac{1}{N_0^2} \left| \text{Tr}(U_t^\dagger U(T)) \right|$, with $N_0 = \dim \mathcal{H}$

Procedure: For the chosen control amplitude of every iteration propagate numerically $i\hbar \frac{\partial \eta}{\partial t} = H\eta$ from $t = 0$ to $t = T$. With $\eta(T)$ compute the value of J_{gate} and then with the minimization algorithm choose another amplitude and continue the loop. At the end a convergence test (even a weak one) is needed.

1.1 Optimization of one-qubit NOT gate

$$H(t) = H_c(t) + H_d = \frac{1}{2} [\epsilon(t)\sigma_z + \Delta(t)\sigma_x] + \alpha\sigma_z$$

1.2 Optimization of two-qubit CNOT gate

$$H(t) = H_c(t) + H_d = \frac{1}{2} \sum_{i=1,2} \left[\epsilon^{(i)}(t)\sigma_z^{(i)} + \Delta^{(i)}(t)\sigma_x^{(i)} \right] + E_{cc}(t)\sigma_z^{(1)}\sigma_z^{(2)} + \sum_{i=1,2} \alpha^{(i)}\sigma_z^{(i)}$$