Exercise Class 4

Exercise 1

Consider a state $|\psi\rangle$. Knowing that $P_0(|\psi\rangle) = 0.8, P_1(|\psi\rangle) = 0.3, P_0(H|\psi\rangle) = 0.6$, $P_1(H|\psi\rangle) = 0.4, P_0\left(HS^\dagger|\psi\rangle\right) = 0.7, P_1\left(HS^\dagger|\psi\rangle\right) = 0.3$, estimate the angles θ, ϕ localizing the state on the Bloch sphere.

Exercise 2

Derive the pulse schedule to operate $\hat{O} = \hat{X}\hat{H}$ for a spin-qubit quantum computing system equipped with the following primitives:

- $R_z(\theta)$ by free Larmor precession induced by a static field $B_z = 0.5\ T$
- $R_x(\theta)$ by ESR induced by a resonant oscillating field $B_x = 2.7\ mT$ with constant phase

Exercise 3

Consider the operator in Exercise 2. Derive the pulse schedule to operate $\hat{O}$ in a spin-qubit quantum computing system equipped with:

- Calibrated $R_x\left(\frac{\pi}{2}\right)$ pulses realized by ESR with $\Omega = 18.896\ MHz$, $\omega = 7\ GHz$
- Virtual-Z gates with arbitrary phase angle θ