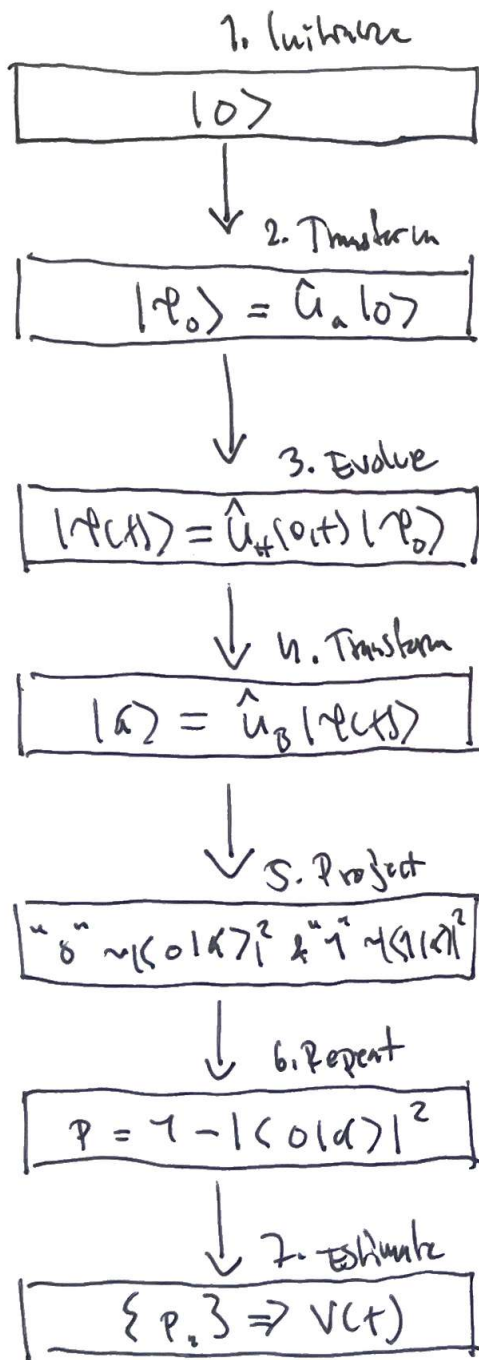


The sensing protocol



① The quantum sensor is initialized into a known basis state.

② The quantum sensor is transformed into the desired initial sensing state $|\psi_0\rangle = \hat{U}_a|0\rangle$.

③ The quantum sensor evolves under the Hamiltonian $\hat{H}$ for time t . At the end of the sensing period:

$$|\psi\rangle = \hat{U}_H(0,t)|\psi_0\rangle = c_0|\psi_0\rangle + c_1|\psi_1\rangle$$

where $\hat{U}_H(0,t)$ is the propagator of $\hat{H}$, $|\psi_1\rangle$ is the state orthogonal to $|\psi_0\rangle$.

④ The quantum sensor is transformed into a superposition of observable readouts: $|\alpha\rangle = \hat{U}_b|\psi(t)\rangle = c'_0|0\rangle + c'_1|1\rangle$.

⑤ The final state of the quantum sensor is read out. The readout is

assumed to be projective, a Bernoulli process that yields "0" with probability $1-p'$ and "1" with probability p' where $p' = |c'_1|^2$ or $p = 1 - |c_0|^2$ i.e. prop to transition probability of qubit changing its state during t .

⑥

Steps 1-5 represent a single measurement cycle. But this needs to be repeated and averaged over a large nr. of cycles N to estimate p . The repetition can be done sequentially on the same system or in parallel by averaging over an ensemble of N identical systems. (Non-interacting of course?)

⑦ In many situations we need to record a set of values for p , not only one as in step 6. The transition probability p is measured as a function of time t or a parameter of H_C , and the desired signal V is inferred from the data record $\{p_i\}$ by a suitable procedure.