SUQA: Simulator for Universal Quantum Algorithms

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1 Notes on the implementation

1.1 time factor for the phase estimation

We assume all physical energies to lie in a certain range $E \in [0, E_{max}]$

Moreover, we define the time factor (variable $\bar{t}$) as the factor in front of 2π used for the phase estimation process:

$$t = 2\pi\bar{t}$$

Given an eigenstate v of the Hamiltonian, for which $e^{iHt}v = e^{iEt}v \equiv e^{2\pi i(E\bar{t})}$, the phase estimation process reads the value $\bar{E} \equiv E\bar{t}$, which is therefore measured in the range $[0, 1]$, while the energy measured in the energy register, since is encoded as an integer $\widetilde{E} \in [0, L_E - 1]$, where $L_E = 2^n e$ is the number of energy levels and ne is the number of qubits used for representing energies, is related to the energy $\bar{E}$ by a rescaling:

$$\bar{E} = \widetilde{E}/L_E.$$

This value is, in turn, related to the true energy of the system by the following relation:

$$E = \frac{\widetilde{E}}{\bar{t}L_E}. \tag{1}$$

Since $\bar{E}$ bust be less than 1 in order to not overlap measures of distinct energy values, we must take

$$\bar{t} < \frac{1}{E_{max}}.$$

N.B.: all the measures used in the code (i.e., for the acceptance computation) must be rescaled to the physical value using the relation 1.