Update on Amplifying Noise in Optimized VQE Circuit (5)

August 11, 2020

Readout Errors

- Read out errors are given by probabilities like
  - P(0|1) = 0.35 i.e. the probability that a qubit measured as ‘0’ when it should be measured as ‘1’

Readout Error

Classical readout errors are specified by a list of assignment probabilities vectors $P(A|B)$:

- A is the ***recorded*** classical bit value
- B is the ***true*** bit value returned from the measurement

Data From London Device

Readout Errors are a big deal!

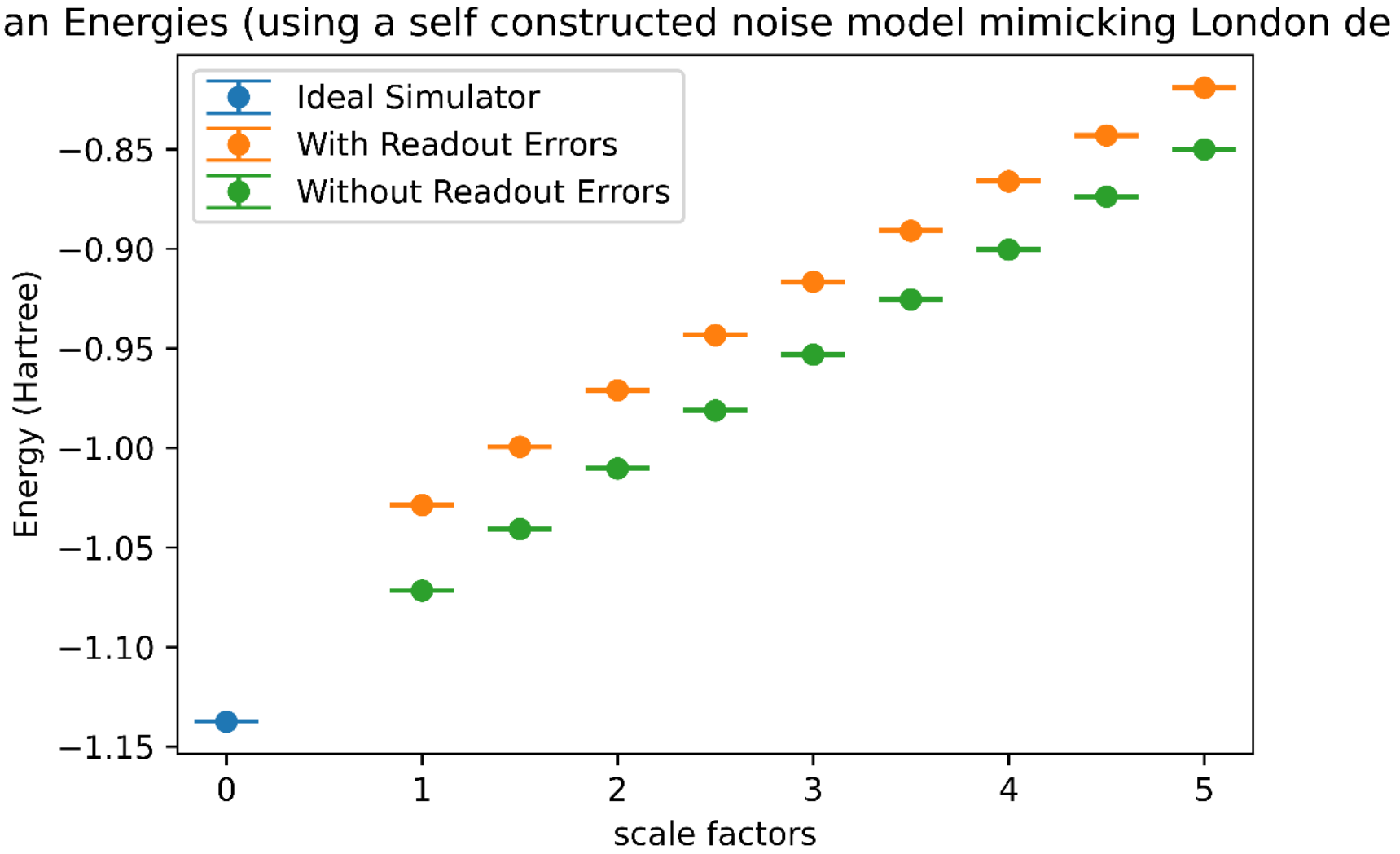
In the table below, the term ‘readout’ error is slightly different

- Readout Error: Let’s say a particular qubit has a readout error rate of 0.05. If you make 100 measurements, then 5 of them will be faulty!

Qubit	T1 (Âµs)	T2 (Âµs)	Frequency	Readout error	Single-qubit U2 error rate	CNOT error rate
Q0	53.70296	73.43838	5.253997	2.00E-02	3.66E-04	cx0_1: 7.230e-3
Q1	40.5309	71.17946	5.048845	3.50E-02	3.70E-04	cx1_0: 7.230e-3, cx1_2: 9.894e-3, cx1_3: 1.498e-2
Q2	69.59602	26.70285	5.230339	1.43E-01	4.71E-04	cx2_1: 9.894e-3
Q3	64.53714	78.41965	5.201325	3.00E-02	3.50E-04	cx3_1: 1.498e-2, cx3_4: 2.201e-2
Q4	89.05166	19.48939	5.065943	2.50E-02	4.50E-04	cx4_3: 2.201e-2

Results

- Note: Errors are amplified here by tuning probabilities directly, something you can't do on a real device



What to do next?

- In the results (2nd plot), look how the green points will definitely give you an extrapolated energy closer to the exact energy than the orange points
- Clearly then, readout errors make a difference!
- Now, amplification of read out errors can be done both on the simulator and actual quantum computer (Will try that out tomorrow)