

# Simulation Results steps

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## 1 Simplest benchmarks results

Table 1: Benchmarks used

Benchmark	# qubits	# gates
4gt11 <sub>82</sub>	5	27
4gt12 <sub>v189</sub>	6	228
4gt4 <sub>v072</sub>	6	258
4mod5 <sub>bdd287</sub>	7	70
4mod5 <sub>v020</sub>	5	20
alu <sub>bdd288</sub>	7	84
alu <sub>v027</sub>	5	36
decod24 <sub>bdd294</sub>	6	73
decod24 <sub>enable126</sub>	6	338
graycode6 <sub>47</sub>	6	5
ham3 <sub>102</sub>	3	20
hwb4 <sub>49</sub>	5	233
mod10 <sub>176</sub>	5	178
mod5adder <sub>127</sub>	6	555
mod5d1 <sub>63</sub>	5	22
mod8 <sub>10177</sub>	6	440
one <sub>twothreev199</sub>	5	132
one <sub>twothreev3101</sub>	5	70
rd32 <sub>v066</sub>	4	34
sf <sub>274</sub>	6	781
sf <sub>276</sub>	6	778
sym6 <sub>145</sub>	7	3888
xor5 <sub>254</sub>	6	7

### 1.1 4gt11<sub>82</sub>

Table 2: Step 1 results after 1000 iterations

Mapper	# qubits	depth	# gates	# SWAPS	p. success	$f$	$V_Q$
No	5	78	84	0	0.96	0.97823066	390
minextendrc	7	226	237	17	0.929	0.92937318	1582
minextend	8	<b>158</b>	<b>228</b>	<b>16</b>	<b>0.947</b>	<b>0.9312172</b>	1264
base	6	177	<b>228</b>	<b>16</b>	0.932	0.906571	1062

### 1.2 4gt12-v1<sub>89</sub>

Table 3: Results after 1000 iterations

Mapper	# qubits	depth	# gates	# SWAPS	p. success	$f$	$V_Q$
no	6	416	658	0	0.768	0.66623522	2496
minextendrc	9	1172	<b>1360</b>	<b>78</b>	0.562	<b>0.44841106</b>	10548
minextend	9	<b>1008</b>	1549	99	<b>0.601</b>	0.40972458	9072
base	6	1069	1423	85	0.517	0.3581228	6414

### 1.3 4gt4-v0<sub>72</sub>

Table 4: Results after 1000 iterations

Mapper	# qubits	depth	# gates	# SWAPS	p. success	$f$	$V_Q$
no	6	442	746	0	0.786	0.68007548	2652
minextendrc	9	1352	1592	94	0.452	<b>0.37749204</b>	12168
minextend	8	<b>963</b>	1736	110	0.498	0.34067243	7704
base	6	1056	<b>1547</b>	<b>89</b>	<b>0.532</b>	0.35703954	6336

### 1.4 4mod5-bdd<sub>287</sub>

Table 5: Results after 1000 iterations

Mapper	# qubits	depth	# gates	# SWAPS	p. success	$f$	$V_Q$
no	7	147	203	0	0.916	0.87474237	1029
minextendrc	9	436	500	33	0.753	0.65935538	3924
minextend	9	<b>332</b>	500	33	<b>0.798</b>	<b>0.69281491</b>	2988
base	7	334	<b>419</b>	<b>24</b>	0.776	0.67942877	2338

### 1.5 4mod5-v0<sub>20</sub>

Table 6: Results after 1000 iterations

Mapper	# qubits	depth	# gates	# SWAPS	p. success	$f$	$V_Q$
no	5	53	61	0	0.985	0.97145968	265
minextendrc	9	139	142	9	0.944	<b>0.9092329</b>	1251
minextend	8	<b>128</b>	160	11	0.938	0.88981602	1024
base	6	133	<b>119</b>	<b>8</b>	<b>0.947</b>	0.89871898	714

### 1.6 alu<sub>bdd288</sub>

Table 7: Results after 1000 iterations

Mapper	# qubits	# gates	# SWAPS	depth	p. success	$f$	$V_Q$
no	7	247	0	165	0.94	0.89851036	1155
minextendrc	8	571	36	495	<b>0.847</b>	<b>0.78096707</b>	3960
minextend	8	616	41	383	0.846	0.73109047	3064
base	7	<b>472</b>	<b>25</b>	<b>360</b>	0.841	0.71637503	2520

### 1.7 alu<sub>v027</sub>

Table 8: Results after 1000 iterations

Mapper	# qubits	# gates	# SWAPS	depth	p. success	$f$	$V_Q$
no	5	107	0	80	0.98	0.96369032	400
minextendrc	9	<b>278</b>	<b>19</b>	248	<b>0.959</b>	<b>0.92602273</b>	2232
minextend	10	296	21	<b>156</b>	0.944	0.89032214	1560
base	6	<b>278</b>	<b>19</b>	214	0.915	0.84492332	1284

### 1.8 decod24<sub>bdd294</sub>

Table 9: Results after 1000 iterations

Mapper	# qubits	# gates	# SWAPS	depth	p. success	$f$	$V_Q$
no	6	207	0	144	0.938	0.91098461	864
minextendrc	9	441	26	407	<b>0.888</b>	<b>0.7749599</b>	3663
minextend	7	468	29	328	0.816	0.73708015	2296
base	6	<b>405</b>	<b>22</b>	<b>300</b>	0.781	0.71803687	1800

### 1.9 **decod24<sub>enable126</sub>**

Table 10: Results after 1000 iterations

Mapper	# qubits	# gates	# SWAPS	depth	p. success	$f$	$V_Q$
no	6	978	0	612	0.894	0.74038417	3672
minextendrc	9	2049	119	1788	<b>0.831</b>	<b>0.57285276</b>	16092
minextend	10	2184	134	<b>1440</b>	0.805	0.50947313	14400
base	6	<b>1959</b>	<b>109</b>	1446	0.74	0.42630108	8676

### 1.10 **graycode6<sub>47</sub>**

Table 11: Results after 1000 iterations

Mapper	# qubits	# gates	# SWAPS	depth	p. success	$f$	$V_Q$
no	6	21	0	32	0.995	0.99332325	192
minextendrc	7	111	10	111	0.991	0.98223938	777
minextend	10	102	9	61	0.987	0.97012132	610
base	6	84	7	82	0.991	0.98075312	492

### 1.11 **ham3<sub>102</sub>**

Table 12: Results after 1000 iterations

Mapper	# qubits	# gates	# SWAPS	depth	p. success	$f$	$V_Q$
no	3	61	0	60	0.987	0.98246387	180
minextendrc	4	115	6	127	0.971	0.95999051	508
minextend	4	115	6	121	0.974	0.96288976	484
base	4	106	5	98	0.973	0.95944625	392

### 1.12 **mod10<sub>176</sub>**

Table 13: Results after 1000 iterations,  $t_1 = t_2 = 3000$

Mapper	# qubits	# gates	# SWAPS	depth	p. success	$f$	$V_Q$
no	5	515	0	327	0.9	0.82976826	1635
minextendrc	7	1199	76	1090	<b>0.758</b>	<b>0.62105388</b>	7630
minextend	10	1127	68	<b>687</b>	0.733	0.60641905	6870
base	6	<b>983</b>	<b>52</b>	734	0.697	0.56115058	4404

Table 14: Results after 1000 iterations,  $t_1 = t_2 = 1000$

Mapper	p. success	$f$
no	0.738	0.59602509
minextendrc	<b>0.453</b>	<b>0.31989048</b>
minextend	0.443	0.31320313
base	0.372	0.27839542

### 1.13 mod5adder<sub>127</sub>

Table 15: Results after 1000 iterations,  $t_1 = t_2 = 3000$

Mapper	# qubits	# gates	# SWAPS	depth	p. success	$f$	$V_Q$
no	6	1583	0	944	0.71	0.45135226	5664
minextendrc	9	3320	193	2878	0.491	<b>0.1922222</b>	25902
minextend	10	3779	244	2667	0.548	0.18165444	26670
base	6	<b>3248</b>	<b>185</b>	<b>2378</b>	<b>0.591</b>	0.18911191	14268

Table 16: Results after 1000 iterations,  $t_1 = t_2 = 1000$

Mapper	p. success	$f$
no	0.528	0.18188697
minextendrc	0.36	<b>0.1484162</b>
minextend	0.399	0.14349585
base	<b>0.465</b>	0.12694018

### 1.14 mod5d1<sub>63</sub>

Table 17: Results after 1000 iterations,  $t_1 = t_2 = 3000$

Mapper	# qubits	# gates	# SWAPS	depth	p. success	$f$	$V_Q$
no	5	69	0	59	0.989	0.98368741	295
minextendrc	8	<b>195</b>	<b>14</b>	209	0.958	0.93474128	1672
minextend	8	<b>195</b>	<b>14</b>	<b>136</b>	<b>0.969</b>	<b>0.93997349</b>	1088
base	6	<b>195</b>	<b>14</b>	146	0.95	0.91002595	876

Table 18: Results after 1000 iterations,  $t_1 = t_2 = 1000$

Mapper	p. success	$f$
no	0.97	0.95187372
minextendrc	0.901	<b>0.84099717</b>
minextend	<b>0.914</b>	0.83627787
base	0.892	0.7849484

### 1.15 mod8<sub>10177</sub>

Table 19: Results after 1000 iterations,  $t_1 = t_2 = 3000$

Mapper	# qubits	# gates	# SWAPS	depth	p. success	$f$	$V_Q$
no	6	1270	0	794	0.858	0.70131629	4764
minextendrc	10	<b>2674</b>	<b>156</b>	2275	<b>0.52</b>	<b>0.39211003</b>	22750
minextend	10	2827	173	<b>1761</b>	0.411	0.29686116	17610
base	6	2773	167	2006	0.335	0.26106507	12036

Table 20: Results after 1000 iterations,  $t_1 = t_2 = 1000$ 

Mapper	p. success	$f$
no	0.698	0.42021822
minextendrc	0.244	0.19792409
minextend	0.123	0.14638911
base	0.068	0.16412249

**1.16 one<sub>twothreev199</sub>**Table 21: Results after 1000 iterations,  $t_1 = t_2 = 3000$ 

Mapper	# qubits	# gates	# SWAPS	depth	p. success	$f$	$V_Q$
no	5	383	0	256	0.832	0.78653106	1280
minextendrc	7	887	56	839	0.633	0.59855522	5873
minextend	10	869	54	<b>530</b>	<b>0.729</b>	<b>0.62135956</b>	5300
base	6	<b>833</b>	<b>50</b>	609	0.662	0.57083541	3654

Table 22: Results after 1000 iterations,  $t_1 = t_2 = 1000$ 

Mapper	p. success	$f$
no	0.602	0.55524768
minextendrc	0.266	<b>0.38317882</b>
minextend	<b>0.355</b>	0.33820922
base	0.26	0.31493265

**1.17 one<sub>twothreev3101</sub>**Table 23: Results after 1000 iterations,  $t_1 = t_2 = 3000$ 

Mapper	# qubits	# gates	# SWAPS	depth	p. success	$f$	$V_Q$
no	5	203	0	143	0.937	0.88807716	715
minextendrc	8	464	29	440	<b>0.746</b>	0.620299	3520
minextend	8	509	34	<b>302</b>	0.732	0.63161506	2416
base	6	<b>428</b>	<b>25</b>	323	0.742	<b>0.62081173</b>	1938

Table 24: Results after 1000 iterations,  $t_1 = t_2 = 1000$ 

Mapper	p. success	$f$
no	0.809	0.69629912
minextendrc	0.411	0.31374806
minextend	0.391	<b>0.31579028</b>
base	<b>0.42</b>	0.31189591

### 1.18 rd32<sub>v066</sub>

Table 25: Results after 1000 iterations,  $t_1 = t_2 = 3000$

Mapper	# qubits	# gates	# SWAPS	depth	p. success	$f$	$V_Q$
no	4	102	0	83	0.983	0.97241164	332
minextendrc	7	<b>219</b>	<b>13</b>	195	0.947	<b>0.91458844</b>	1365
minextend	7	228	14	<b>142</b>	<b>0.958</b>	0.91079208	994
base	5	<b>219</b>	<b>13</b>	169	0.955	0.90759692	845

Table 26: Results after 1000 iterations,  $t_1 = t_2 = 1000$

Mapper	p. success	$f$
no	0.95	0.9176419
minextendrc	0.88	<b>0.79475368</b>
minextend	<b>0.902</b>	0.77708902
base	0.896	0.77242986

### 1.19 sf<sub>274</sub>

Table 27: Results after 1000 iterations,  $t_1 = t_2 = 3000$

Mapper	# qubits	# gates	# SWAPS	depth	p. success	$f$	$V_Q$
no	6	2227	0	1359	0.484	0.34974095	8154
minextendrc	7	5116	321	4515	0.0	<b>0.16778098</b>	31605
minextend	10	5071	316	<b>3007</b>	<b>0.097</b>	0.14752778	30070
base	6	<b>4450</b>	<b>247</b>	3289	0.088	0.15461728	19734

Table 28: Results after 1000 iterations,  $t_1 = t_2 = 1000$

Mapper	p. success	$f$
no	0.108	0.16219308
minextendrc	<b>0.002</b>	<b>0.19857107</b>
minextend	0.0	0.1458942
base	0.0	0.14493197

### 1.20 sf<sub>276</sub>

Table 29: Results after 1000 iterations,  $t_1 = t_2 = 3000$

Mapper	# qubits	# gates	# SWAPS	depth	p. success	$f$	$V_Q$
no	6	2224	0	1360	0.472	0.30846996	8160
minextendrc	9	4852	292	4103	0.0	<b>0.16746873</b>	36927
minextend	10	4807	287	<b>2747</b>	<b>0.092</b>	0.14342305	27470
base	6	<b>4447</b>	<b>247</b>	3280	0.089	0.13928494	19680

Table 30: Results after 1000 iterations,  $t_1 = t_2 = 1000$ 

Mapper	p. success	$f$
no	0.034	0.15718296
minextendrc	0.0	<b>0.22111901</b>
minextend	0.0	0.15992956
base	0.0	0.14842314

## 1.21 sym6<sub>145</sub>

Table 31: Results after 1000 iterations,  $t_1 = t_2 = 3000$ 

Mapper	# qubits	# gates	# SWAPS	depth	p. success	$f$	$V_Q$
no	7	11185	0	6759	0.506	0.15429107	47313
minextendrc	8	24658	1497	20984	0.513	<b>0.22079977</b>	167872
minextend	10	25756	1619	<b>14156</b>	<b>0.546</b>	0.12489321	141560
base	7	<b>21679</b>	<b>1166</b>	15613	0.531	0.12176519	109291

Table 32: Results after 1000 iterations,  $t_1 = t_2 = 1000$ 

Mapper	p. success	$f$
no	0.513	0.1407412
minextendrc	0.518	<b>0.24438143</b>
minextend	<b>0.543</b>	0.1533595
base	0.53	0.14274046

## 1.22 xor5<sub>254</sub>

Table 33: Results after 1000 iterations,  $t_1 = t_2 = 3000$ 

Mapper	# qubits	# gates	# SWAPS	depth	p. success	$f$	$V_Q$
no	6	23	0	36	0.995	0.99375935	216
minextendrc	7	68	5	75	0.984	0.9736118	525
minextend	7	68	5	58	0.958	0.94092446	406
base	6	104	9	92	0.942	0.91559086	552

Table 34: Results after 1000 iterations,  $t_1 = t_2 = 3000$ 

Mapper	p. success	$f$
no	0.984	0.97720823
minextendrc	<b>0.952</b>	<b>0.91998206</b>
minextend	0.896	0.84674549
base	0.837	0.77312906

## 2 Correlation and Plots

Pearson correlation formula:

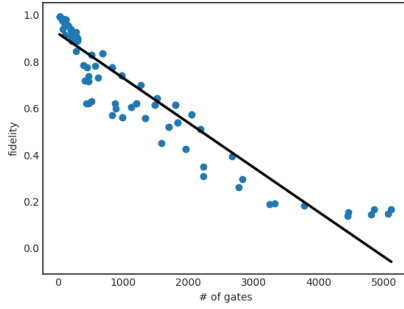


$$\rho_{X,Y} = \frac{\text{cov}(X,Y)}{\sigma_X \sigma_Y}$$

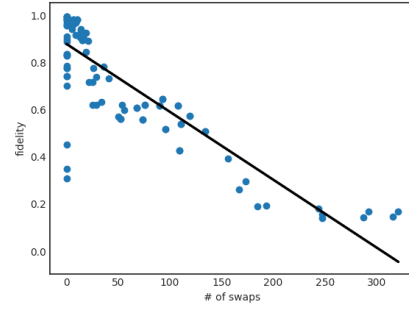
## 2.1 $t_1 = 3000$

Table 35: Pearson correlation coefficient for decoherence time of  $t_1 = 3000$  and measurement error of 0.005

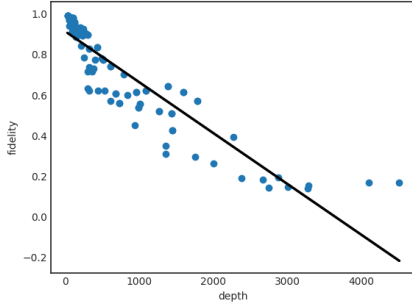
	# of Gates	# of SWAPs	Depth	$V_Q$
$\rho_{f,Y}$	-0.9360	-0.8614	-0.9091	-0.9360
$\rho_{p_s,Y}$	-0.9257	-0.8700	-0.9060	-0.9257



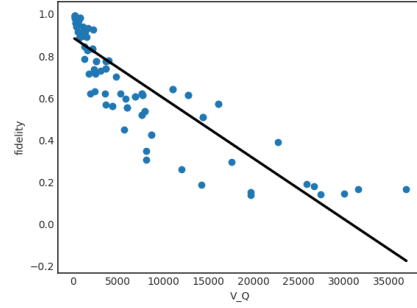
(a) Number of gates



(b) Number of SWAPs

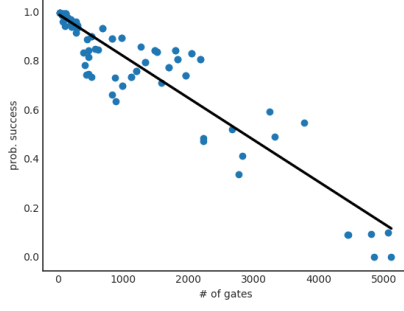


(c) Depth

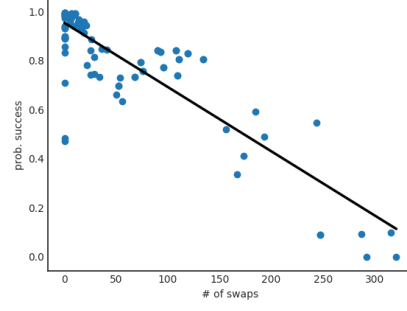


(d) Quantum Volume

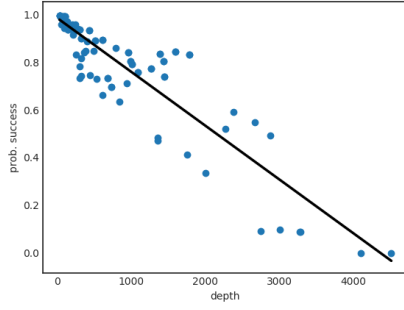
Figure 1: Plotting fidelity against number of gates, swaps, depth and Quantum Volume



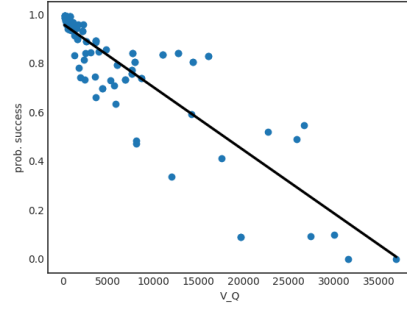
(a) Number of gates



(b) Number of SWAPs



(c) Depth



(d) Quantum Volume

Figure 2: Plotting probability of success against number of gates, swaps, depth and Quantum Volume

### 2.1.1 Two-qubit gates

$$\rho_{f',Y} = 0.5784$$

## 2.2 $t_1 = 1000$

Table 36: Pearson correlation coefficient for decoherence time of  $t_1 = 1000$  and measurement error of 0.005

	# of Gates	# of SWAPs	Depth	$V_Q$
$\rho_{f,Y}$	-0.7637	-0.6658	-0.7354	-0.7637
$\rho_{p_s,Y}$	-0.8341	-0.7484	-0.8076	-0.8341

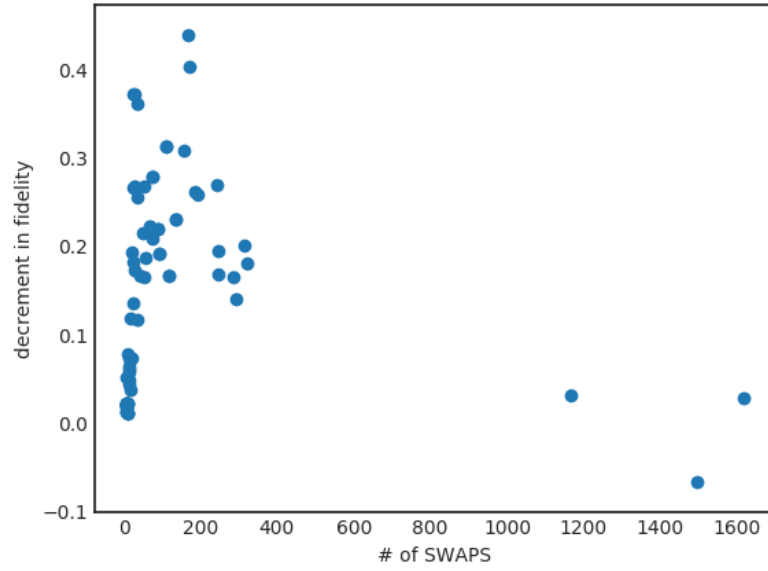
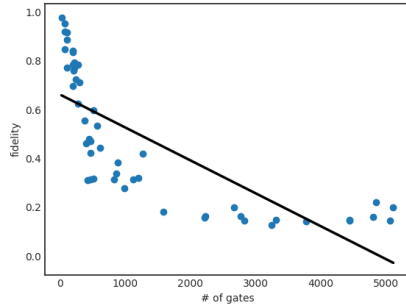
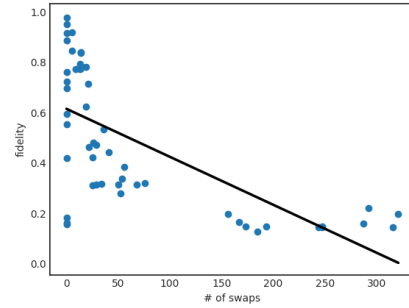


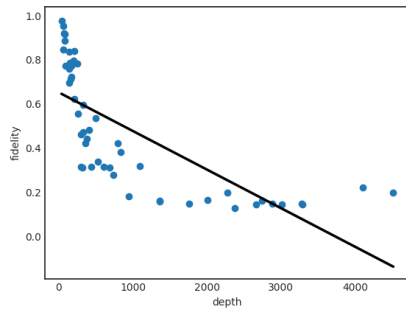
Figure 3: Number of swaps and fidelity difference relationship's



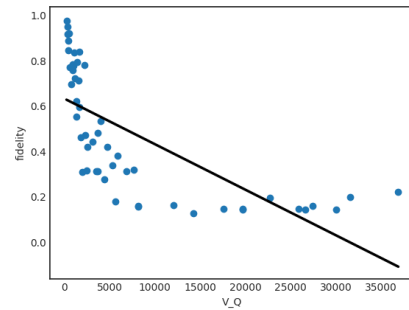
(a) Number of gates



(b) Number of SWAPs

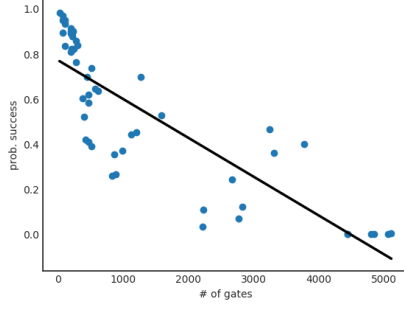


(c) Depth

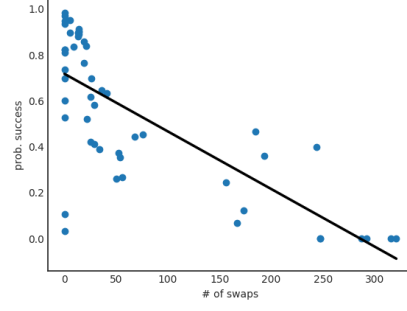


(d) Quantum Volume

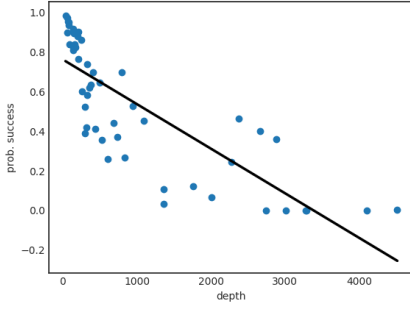
Figure 4: Plotting fidelity against number of gates, swaps, depth and Quantum Volume



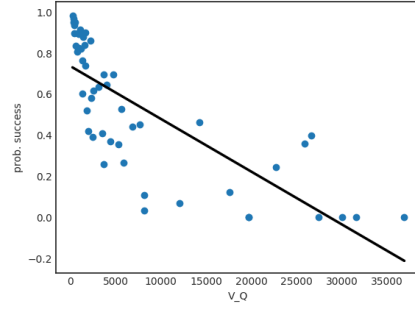
(a) Number of gates



(b) Number of SWAPs



(c) Depth



(d) Quantum Volume

Figure 5: Plotting probability of success against number of gates, swaps, depth and Quantum Volume

### 2.2.1 Two-qubit gates

$$\rho_{f',Y} = -0.639791579133524$$

## 2.3 No measurement error and $t_1 = 3000$

Table 37: Pearson correlation coefficient for decoherence time of  $t_1 = 3000$  and probability 0 for the measurement

	# of Gates	# of SWAPs	Depth	$V_Q$
$\rho_{f,Y}$	-0.9246	-0.8482	-0.9012	-0.9246
$\rho_{p_s,Y}$	-0.9495	-0.8972	-0.9334	-0.9495

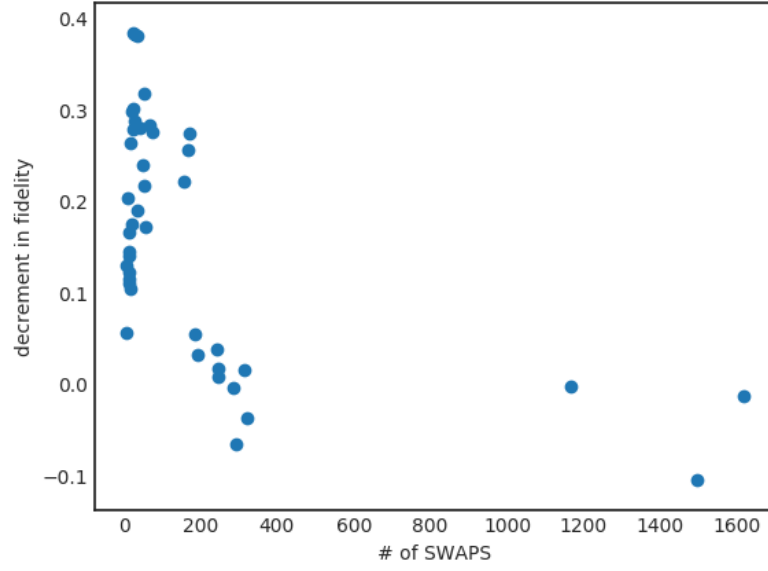
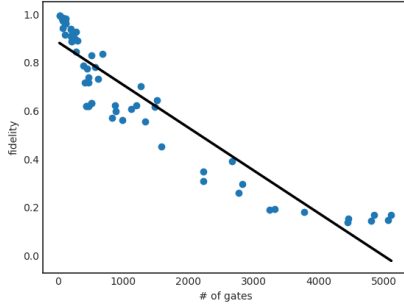
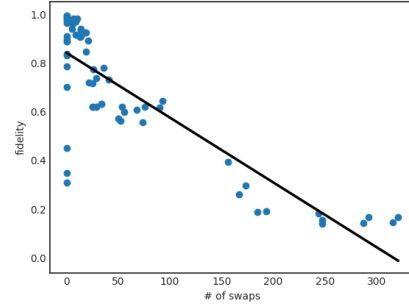


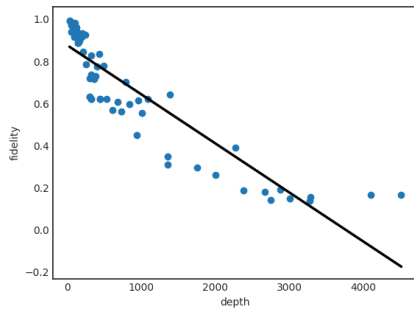
Figure 6: Number of swaps and fidelity difference relationship's



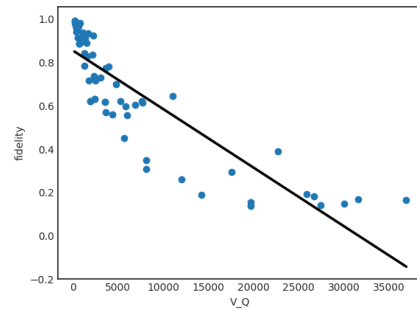
(a) Number of gates



(b) Number of SWAPs

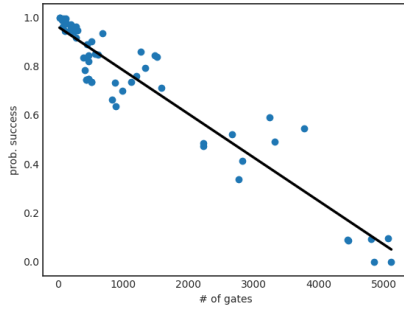


(c) Depth

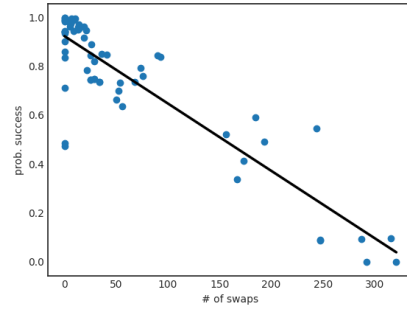


(d) Quantum Volume

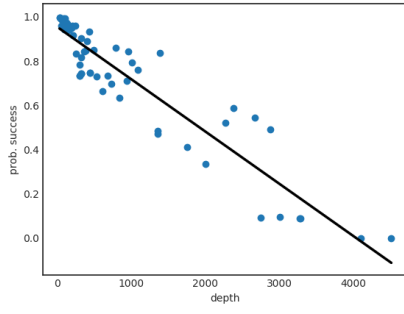
Figure 7: Plotting fidelity against number of gates, swaps, depth and Quantum Volume



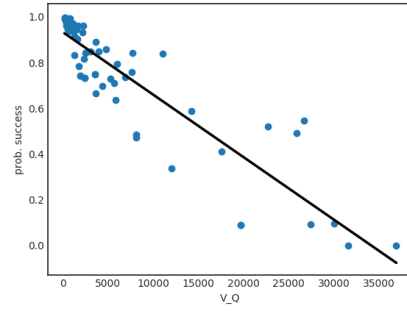
(a) Number of gates



(b) Number of SWAPs



(c) Depth



(d) Quantum Volume

Figure 8: Plotting probability of success against number of gates, swaps, depth and Quantum Volume

### 2.3.1 Two-qubit gates

$$\rho_{f',Y} = 0.4445$$

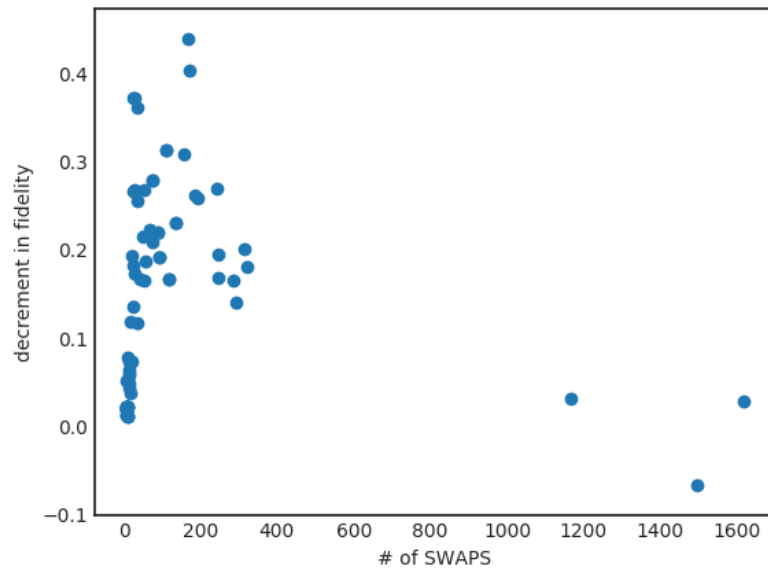


Figure 9: Number of swaps and fidelity difference relationship's