Simulation Results steps

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November 27, 2018

1 First Step

Table 1: Benchmark used

Benchmark	# qubits	# gates	two-qubit gates (%)
$4gt11_{82}$	5	27	67

Table 2: Step 1 results after 100 iterations

Mapper	Init. place	t_1	t_2	meas. err.	p. success	f	V_Q
No	No	3000	3000	0.03	0.99	0.98879	390
minextendrc	No	3000	3000	0.03	0.96	0.9404637	1582
minextendrc	Yes	3000	3000	0.03	0.98	0.9675513	1038
minextend	No	3000	3000	0.03	0.98	0.944128	1264
minextend	Yes	3000	3000	0.03	0.98	0.9585909	834
base	No	3000	3000	0.03	0.97	0.92331	1062
base	Yes	3000	3000	0.03	0.98	0.9568084	780

Table 3: Other mapper statistics

Mapper	Init. place	# qubits	depth	# gates	# SWAPS	Parallelism	# meet. in between
No	No	5	78	84	0	0.0714	0
minextendrc	No	7	226	237	17	0.0464	3
minextendrc	Yes	6	173	174	10	0.0057	2
minextend	No	8	158	228	16	0.3070	1
minextend	Yes	6	139	165	9	0.1576	0
base	No	6	177	228	16	0.2237	
base	Yes	6	130	147	7	0.1156	

$$\text{Parallelism:} \quad 1 - \frac{depth}{\#gates}$$

1.1 Routing comparison

1.1.1 No initial placement

With Resource constraints

```
... the minimally extending path with swaps is: cycleExtend=10
       path from source[1]=[2]
       path from target[2]=[1->5] implying: swap(q1,q5)
... the minimally extending path with swaps is: cycleExtend=9
       path from source[1]=[3]
       path from target[2]=[2->0] implying: swap(q2,q0)
... the minimally extending path with swaps is: cycleExtend=20
       path from source[3]=[4->7->5] implying: swap(q4,q7) swap(q7,q5)
       path from target[3]=[3->0->2] implying: swap(q3,q0) swap(q0,q2)
... the minimally extending path with swaps is: cycleExtend=9
       path from source[1]=[0]
       path from target[2]=[5->2] implying: swap(q5,q2)
... the minimally extending path with swaps is: cycleExtend=12
       path from source[2]=[7->5] implying: swap(q7,q5)
       path from target[2]=[0->2] implying: swap(q0,q2)
... the minimally extending path with swaps is: cycleExtend=9
       path from source[1]=[5]
       path from target[2]=[0->2] implying: swap(q0,q2)
... the minimally extending path with swaps is: cycleExtend=9
       path from source[1]=[5]
       path from target[2]=[0->2] implying: swap(q0,q2)
... the minimally extending path with swaps is: cycleExtend=10
       path from source[1]=[0]
       path from target[2]=[5->2] implying: swap(q5,q2)
... the minimally extending path with swaps is: cycleExtend=13
       path from source[2]=[0->2] implying: swap(q0,q2)
       path from target[2]=[7->5] implying: swap(q7,q5)
... the minimally extending path with swaps is: cycleExtend=10
       path from source[1]=[2]
       path from target[2]=[3->0] implying: swap(q3,q0)
... the minimally extending path with swaps is: cycleExtend=10
       path from source[1]=[2]
       path from target[2]=[3->0] implying: swap(q3,q0)
... the minimally extending path with swaps is: cycleExtend=10
       path from source[1]=[7]
       path from target[2]=[2->5] implying: swap(q2,q5)
```

Without Resource constraints

```
... the minimally extending path with swaps is: cycleExtend=10
       path from source[1]=[2]
       path from target[2]=[1->5] implying: swap(q1,q5)
... the minimally extending path with swaps is: cycleExtend=0
       path from source[2]=[3->0] implying: swap(q3,q0)
       path from target[1]=[2]
... the minimally extending path with swaps is: cycleExtend=9
       path from source[3]=[4->1->5] implying: swap(q4,q1) swap(q1,q5)
       path from target[2]=[0->2] implying: swap(q0,q2)
... the minimally extending path with swaps is: cycleExtend=0
       path from source[3]=[3->6->8] implying: swap(q3,q6) swap(q6,q8)
       path from target[1]=[5]
... the minimally extending path with swaps is: cycleExtend=10
       path from source[1]=[1]
       path from target[2]=[8->5] implying: swap(q8,q5)
... the minimally extending path with swaps is: cycleExtend=10
       path from source[1]=[1]
       path from target[2]=[8->5] implying: swap(q8,q5)
... the minimally extending path with swaps is: cycleExtend=10
       path from source[1]=[1]
       path from target[2]=[8->5] implying: swap(q8,q5)
... the minimally extending path with swaps is: cycleExtend=10
       path from source[1]=[8]
       path from target[2]=[1->5] implying: swap(q1,q5)
... the minimally extending path with swaps is: cycleExtend=0
       path from source[1]=[8]
       path from target[2]=[2->6] implying: swap(q2,q6)
... the minimally extending path with swaps is: cycleExtend=8
       path from source[1]=[8]
       path from target[3]=[0->2->5] implying: swap(q0,q2) swap(q2,q5)
... the minimally extending path with swaps is: cycleExtend=4
       path from source[1]=[8]
       path from target[2]=[2->6] implying: swap(q2,q6)
... the minimally extending path with swaps is: cycleExtend=2
       path from source[2]=[1->5] implying: swap(q1,q5)
       path from target[1]=[8]
```

1.1.2 With initial placement

With Resource constraints

```
... Virt2Real(v->r) ... result Virt2Real map of InitialPlace before adding unused virtual qubits and unused locations : (0->10) (1->4) (2->1) (3->5) (4->7) (5->2147483647) (6->2147483647) (7->2147483647) (8->2147483647) (9->2147483647) (10->2147483647) (11->2147483647) (12->2147483647) (13->2147483647) (14->2147483647) (15->2147483647) (16->2147483647)
... Virt2Real(v->r) ... final result Virt2Real map of InitialPlace: (0->10) (1->4) (2->1) (3->5) (4->7) (5->0) (6->2) (7->3) (8->6) (9->8) (10->9) (11->11) (12->12) (13->13) (14->14) (15->15) (16->16)
... the minimally extending path with swaps is: cycleExtend=10
        path from source[1]=[4]
        path from target[2]=[10->7] implying: swap(q10,q7)
... the minimally extending path with swaps is: cycleExtend=10
        path from source[1]=[4]
        path from target[2]=[10->7] implying: swap(q10,q7)
... the minimally extending path with swaps is: cycleExtend=10
        path from source[1]=[4]
        path from target[2]=[10->7] implying: swap(q10,q7)
... the minimally extending path with swaps is: cycleExtend=10
        path from source[1]=[10]
        path from target[2]=[4->7] implying: swap(q4,q7)
... the minimally extending path with swaps is: cycleExtend=10
        path from source[1]=[10]
        path from target[2]=[5->8] implying: swap(q5,q8)
... the minimally extending path with swaps is: cycleExtend=10
        path from source[2]=[10->8] implying: swap(q10,q8)
        path from target[2]=[1->5] implying: swap(q1,q5)
... the minimally extending path with swaps is: cycleExtend=10
        path from source[1]=[8]
        path from target[2]=[7->5] implying: swap(q7,q5)
... the minimally extending path with swaps is: cycleExtend=12
        path from source[2]=[4->1] implying: swap(q4,q1)
        path from target[2]=[8->5] implying: swap(q8,q5)
```

Without Resource constraints

```
... Virt2Real(v->r) ... result Virt2Real map of InitialPlace before adding unused virtual qubits and unused locations : (0->10) (1->4) (2->1) (3->5) (4->7) (5->2147483647) (6->2147483647) (7->2147483647) (8->2147483647) (9->2147483647) (10->2147483647) (11->2147483647) (12->2147483647) (13->2147483647) (14->2147483647) (15->2147483647) (16->2147483647)
... Virt2Real(v->r) ... final result Virt2Real map of InitialPlace: (0->10) (1->4) (2->1) (3->5) (4->7) (5->0) (6->2) (7->3) (8->6) (9->8) (10->9) (11->11) (12->12) (13->13) (14->14) (15->15) (16->16)
... the minimally extending path with swaps is: cycleExtend=10
        path from source[1]=[4]
        path from target[2]=[10->7] implying: swap(q10,q7)
... the minimally extending path with swaps is: cycleExtend=10
        path from source[1]=[4]
        path from target[2]=[10->7] implying: swap(q10,q7)
... the minimally extending path with swaps is: cycleExtend=10
        path from source[1]=[4]
        path from target[2]=[10->7] implying: swap(q10,q7)
... the minimally extending path with swaps is: cycleExtend=10
        path from source[1]=[10]
        path from target[2]=[4->7] implying: swap(q4,q7)
... the minimally extending path with swaps is: cycleExtend=0
        path from source[1]=[10]
        path from target[2]=[5->8] implying: swap(q5,q8)
... the minimally extending path with swaps is: cycleExtend=8
        path from source[1]=[10]
        path from target[3]=[1->5->7] implying: swap(q1,q5) swap(q5,q7)
... the minimally extending path with swaps is: cycleExtend=4
        path from source[1]=[10]
        path from target[2]=[5->8] implying: swap(q5,q8)
... the minimally extending path with swaps is: cycleExtend=2
        path from source[2]=[4->7] implying: swap(q4,q7)
        path from target[1]=[10]
```

Table 4: Step 1 results after 1000 iterations

Mapper	Init. place	t_1	t_2	meas. err.	p. success	f	V_Q
No	No	3000	3000	0.03	0.96	0.97823066	390
minextendrc	No	3000	3000	0.03	0.929	0.92937318	1582
minextendrc	Yes	3000	3000	0.03	0.939	0.94685216	1038
minextend	No	3000	3000	0.03	0.947	0.9312172	1264
minextend	Yes	3000	3000	0.03	0.949	0.94748374	834
base	No	3000	3000	0.03	0.932	0.906571	1062
base	Yes	3000	3000	0.03	0.9509	0.9459456	780

2 1000 iterations

3 10000 iterations

Table 5: Step 1 results after 10000 iterations

Mapper	Init. place	t_1	t_2	meas. err.	p. success	f	V_Q
No	No	3000	3000	0.03	0.961	0.980342528	390
minextendrc	No	3000	3000	0.03	0.9372	0.937136544	1582
minextendrc	Yes	3000	3000	0.03	0.9435	0.951650597	1038
minextend	No	3000	3000	0.03	0.9519	0.93665818	1264
minextend	Yes	3000	3000	0.03	0.9556	0.954629151	834
base	no	3000	3000	0.03	0.9417	0.9156453	1062
base	yes	3000	3000	0.03	0.953	0.95037428	780

3.1 Conclusions

3.1.1 Probability of success

Mapper	Init. place	100 it.	1000 it.	10000 it.	Diff 100-1000	Diff 1000-10000
No	No	0.99	0.96	0.961	-0.0300	0.0010
minextendrc	No	0.96	0.929	0.9372	-0.0310	0.0082
minextendrc	Yes	0.98	0.939	0.9435	-0.0410	0.0045
minextend	No	0.98	0.947	0.9519	-0.0330	0.0049
minextend	Yes	0.98	0.949	0.9556	-0.0310	0.0066
base	No	0.97	0.932	0.9417	-0.0380	0.0097
base	Yes	0.98	0.9509	0.953	-0.0291	0.0021

Iterations comparison	Mean diff
100-1000	-0.0333
1000-10000	0.0053

3.1.2 Fidelity

Mapper	Init. place	100 it.	1000 it.	10000 it.	Diff 100-1000	Diff 1000-10000
No	No	0.98879	0.97823066	0.980342528	-0.0106	0.0021
minextendrc	No	0.9404637	0.92937318	0.937136544	-0.0111	0.0078
minextendrc	Yes	0.9675513	0.94685216	0.951650597	-0.0207	0.0048
minextend	No	0.944128	0.9312172	0.93665818	-0.0129	0.0054
minextend	Yes	0.9585909	0.94748374	0.954629151	-0.0111	0.0071
base	No	0.92331	0.906571	0.9156453	-0.0167	0.0091
base	Yes	0.9568084	0.9459456	0.95037428	-0.0109	0.0044

Iterations comparison	Mean diff
100-1000	-0.0134
1000-10000	0.0058

4 Simplest benchmarks results