Key Literature

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1 Key Literature

The focus of the literature review will be on the following articles, roughly in order of importance.

1.1 Progress key

'*' means 'have read'
'@' means 'have understood'
'!' means 'have taken notes'
'#' means 'read next'.
'-' means 'reading'
'.' means 'understanding'
'?' means 'taking notes'

1.2 Multi-Qubit Gate Synthesis

[1]*@?
[2]*.?
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[4]*@?
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1.3 Single Qubit Gate Synthesis

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1.4 Other

[15]*.?
[16]

2 Discussion points

For each synthesis scheme consider the following (and compare schemes to one another):

- Resource cost
  - Number of elementary gates used
  - Number of expensive/T gates (resource states) used
- Applicability
  - Is the scheme universal or for unitaries generated by a non-universal gate set?
  - Does the scheme yield optimal circuits or circuits that use fewer resources than a certain function of the number of qubits?
  - Is it exact or approximate? If approximate how is the precision characterized i.e. as a function of number of gates used?
  - Is the scheme applicable to multi-qubit circuits or only single qubit circuits?
- Efficiency
  - Is the algorithm for generating the circuit efficient in time and/or space requirements?
  - How fast does the algorithm execute asymptotically?

3 Additional Literature

[17]*! [18]*! [19]- [20]- [21] [22] [23] [24] [25]

References

[1] Earl T Campbell and Mark Howard. Unified framework for magic state distillation and multiqubit gate synthesis with reduced resource cost. *Phys. Rev. A*, 95(022316), 2017.

[2] Matthew Amy and Michele Mosca. T-count optimization and reed-muller codes. *arXiv*, arXiv:1601.07363v1 [quant-ph], 2016.

[3] Vadym Kliuchnikov. Synthesis of unitaries with clifford+t circuits. *arXiv*, arXiv:1306.3200v1 [quant-ph], 2013.

[4] David Gosset, Vadym Kliuchnikov, Michele Mosca, and Vincent Russo. An algorithm for the t-count. *arXiv*, arXiv:1308.4134v1 [quant-ph], 2013.

[5] Matthew Amy, Dmitri Maslov, and Michele Mosca. Polynomial-time t-depth optimization of clifford+t circuits via matroid partitioning. *arXiv*, arXiv:1303.2042v2 [quant-ph], 2013.

[6] Matthew Amy, Dmitri Maslov, Michele Mosca, and Martin Roetteler. A meet-in-the-middle algorithm for fast synthesis of depth-optimal quantum circuits. *arXiv*, arXiv:1206.0758v3 [quant-ph], 2013.

[7] Earl T Campbell and Mark Howard. Unifying gate synthesis and magic state distillation. *Phys. Rev. Lett.*, 118(060501), 2017.

[8] Brett Giles and Peter Selinger. Exact synthesis of multiqubit clifford+ t circuits. *Phys. Rev. A*, 87(032332), 2013.

[9] Peter Selinger. Quantum circuits of t-depth one. *Phys. Rev. A*, 87(042302), 2013.

[10] Alex Bocharov, Martin Roetteler, and Krysta M Svore. Efficient synthesis of universal repeat-until-success quantum circuits. *Phys. Rev. Lett*, 114(080502), 2015.

[11] Vadym Kliuchnikov, Dmitri Maslov, and Michele Mosca. Practical approximation of single-qubit unitaries by single-qubit quantum clifford and t circuits. *arXiv*, arXiv:1212.6964v2 [quant-ph], 2014.

[12] Vadym Kliuchnikov, Dmitri Maslov, and Michele Mosca. Fast and effcient exact synthesis of single qubit unitaries generated by clifford and t gates. *arXiv*, arXiv:1206.5236v4 [quant-ph], 2013.

[13] Vadym Kliuchnikov, Dmitri Maslov, and Michele Mosca. Asymptotically optimal approximation of single qubit unitaries by clifford and t circuits using a constant number of ancillary qubits. *arXiv*, arXiv:1212.0822v2 [quant-ph], 2012.

[14] Neil J Ross and Peter Selinger. Optimal ancilla-free clifford+t approximation of z-rotations. *arXiv*, arXiv:1403.2975v3 [quant-ph], 2016.

[15] Richard A. Low. Learning and testing algorithms for the clifford group. *Phys. Rev. A*, 80(052314), 2009.

[16] Ashley Montanaro and Tobias J. Osborne. Quantum boolean functions. *arXiv*, arXiv:0810.2435v5 [quant-ph], 2010.

[17] Abraham Lempel. Matrix factorization over gf(2) and trace-orthogonal bases of gf(2^n). *SIAM J. Comput.*, 4(2), 1975.

[18] Irving S Reed. A class of multiple-error-correcting codes and the decoding scheme. *Transactions of the IRE Professional Group on Information Theory*, 4(4):38–49, 1954.

[19] Earl T Campbell. Shorter gate sequences for quantum computing by mixing unitaries. *arXiv*, arXiv:1612.02689v2 [quant-ph], 2017.

[20] Mark Howard and Earl Campbell. Application of a resource theory for magic states to fault-tolerant quantum computing. *arXiv*, arXiv:1609.07488v2 [quant-ph], 2017.

[21] Nabila Abdessaied, Mathias Soeken, and Rolf Drechsler. Quantum circuit optimization by hadamard gate reduction, 2014.

[22] Nabila Abdessaied, , Matthew Amy, Mathias Soeken, and Rolf Drechsler. Technology mapping of reversible circuits to clifford+t quantum circuits, 2016.

[23] Nabila Abdessaied, Matthew Amy, Rolf Drechsler, and Mathias Soeken. Complexity of reversible circuits and their quantum implementations. *Theoretical Computer Science*, 618:85–106, 2016.

[24] Dmitri Maslov. Optimal and asymptotically optimal nct reversible circuits by the gate types. *arXiv*, arXiv:1602.02627v4 [quant-ph], XXXX.

[25] Cody Jones. Low-overhead constructions for the fault-tolerant toffoli gate. *Phys. Rev. A*, 87(022328), 2013.