转发: 61 DAC: Notification of your submitted work (Submission ID 1199)

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主题: 61 DAC: Notification of your submitted work (Submission ID 1199)

Congratulations! On behalf of the DAC Technical Program Committee, we are pleased to inform you that your manuscript "Image Computation for Quantum Transition Systems" was selected to present a poster at one of the **Work-in-Progress (WIP) poster sessions** at the 61th DAC, June 23-27 in San Francisco, CA.
By **Wednesday, March 13**, you must log into the submission portal and confirm your agreement with the terms of acceptance. This includes: at least one (1) author of your poster will register for the event and attend in-person to present the poster; a unique full conference registration will be associated with each accepted poster by the registration deadline (April 10).
To confirm or decline your acceptance:

- Log into Softconf
- Choose "Your Current Submissions" and then select your paper
- You'll see an option to revise your WIP confirmation. Select this option, then accept or decline to present.
- If you do not complete your confirmation by March 13 the DAC office will take this as a sign that you do not wish to participate in the 2024 DAC Work-in-Progress session and your submission will be deleted from the DAC submission system.

**PLEASE NOTE: A WIP poster presentation at DAC is not considered a publication and no paper will be published. WIP authors can submit their work to other conferences and journals without violating any pre-publication issues or common code of ethics.
Registration Requirement
Registration for 61 DAC will open on March 20. You will receive an email prior to that date with instructions on how to register as an author. If you need assistance with a Visa letter prior to that date, please submit a visa request form at https://www.compusystems.com/servlet/ar?evt_uid=2171&site=INQ.
At least one author of your paper must register by **April 10** in order to have your final paper accepted and to be included in the conference. Please note that each paper must have a unique associated registration. If you are the author on more than one paper, a co-author must register for any additional papers, even if you will present them.
Regards,
David Pan, 61th DAC Technical Program Committee Chair
Chia-Lin Yang, 61th DAC Technical Program Committee Co-Chair
https://softconf.com/dac24/research/
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DAC 2024 Reviews for Submission #1199
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Title: Image Computation for Quantum Transition Systems
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Authors: Xin Hong, Dingchao Gao, Shenggang Ying, Sanjiang Li and Mingsheng Ying

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REVIEWER #1
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Reviewer's Scores

Clarity / Writing Style (1-5): 3
Originality / Innovativeness (1-5): 4
Impact of Ideas and/or Results (1-5): 3
OVERALL RECOMMENDATION (1-5): 3

Summarize shortly the contributions of the paper in your own words.

The authors introduce a method for model checking quantum systems based on efficient image computation algorithms. They demonstrate the scalability of their technique on a set of well-known benchmarks.

Strengths

+ ...The paper is in an area of interest to the community.
+ ...The authors cleverly leverage techniques known for classical computing and develop an analogous method for quantum computing.

Weaknesses

- ...This paper was a heavy read, but perhaps cannot be helped due to the concepts being introduced.

Main Discussion of Paper

The authors have developed a method for model checking quantum systems based on efficient image computation algorithms. Their technique uses tensor networks to represent the quantum circuits and tensor decision diagrams to create the efficient image computation algorithm. They have developed a scalable technique leveraging concepts used in classical computing. They go on to demonstrate the scalability of their technique on a set of well-known benchmarks and show that their contraction partition algorithm greatly improves the image computation for quantum systems.

I found this paper difficult to read, but this was due I believe to my not being familiar with the classical technique that they leveraged in their work. The work seems well-conceived and the carried out.

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REVIEWER #2
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Reviewer's Scores

Clarity / Writing Style (1-5): 5
Originality / Innovativeness (1-5): 3
Impact of Ideas and/or Results (1-5): 3
OVERALL RECOMMENDATION (1-5): 3

Summarize shortly the contributions of the paper in your own words.

The paper presents an efficient quantum extension of a classical model checking technique called image computation. The proposed approach uses Tensor Decision Diagram networks to represent the quantum circuit under evaluation in a compact form. Lastly, a pair of partition-based image computation methods are proposed which dramatically improve the baseline efficiency of performing quantum image computation.

Strengths

+The paper is well written.
+Results show that the proposed method scales well for many quantum circuits, notably QFT.

Weaknesses

-No comparison is provided between the proposed image computation method(s) and other quantum model checking methods.
-Relative lack of discussion of the effects of partition parameters.
-Discussion of results is limited to one short paragraph regarding Table 1 and two sentences regarding Table 2

Main Discussion of Paper

The paper is well written and provides detailed background information and explanation of the basic components of the proposed method. Additionally, the results demonstrate that, while the basic and addition partition quantum image computation methods perform poorly, the contraction partition method provides significant improvements in runtime and memory usage. However, no discussion or results are provided which compare the utility or performance of the proposed quantum image computation method with other quantum model checking methods.

Relatively little discussion is provided for the parameters of either partition method, such as how (or if) good values for the parameters are expected to be different for different circuits. Also notable is the lack of discussion regarding the fact that exceptionally small values of the contraction partition parameters (which amount to simply considering all qubits and/or multi-qubit gates separately) perform very well.

Lastly, although the paper is well written, the proposed method seems to be a relatively natural extension of existing methods in classical model checking and quantum computing, and thus not particularly innovative. Additionally, the paper has not convincingly demonstrated the importance of this work as compared with other quantum model checking methods, and thus may not be particularly impactful.

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REVIEWER #3
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Reviewer's Scores

Clarity / Writing Style (1-5): 4
Originality / Innovativeness (1-5): 3
Impact of Ideas and/or Results (1-5): 2
OVERALL RECOMMENDATION (1-5): 3

Summarize shortly the contributions of the paper in your own words.

This paper proposes two tensor network partition-based approaches for the image computation of a quantum transition system. The image computation is used for model checking of a quantum circuit.

Strengths
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1. Clear explanation of concepts and provide useful examples.
2. Strong numerical evidence on reducing computation time and memory compared to baseline.

Weaknesses
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1. Lack of evaluation on dynamic and noisy circuits.
2. Not clear how the paper checks correctness of image computation.
3. Lack concrete introduction of the usage of image computation in model checking
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Main Discussion of Paper

The paper proposed two tensor network partition-based algorithms for image computation of quantum transition systems. The proposed methods (especially the contraction partition) show improvements over the baseline method. In terms of scaling, it is very promising as it can handle problem sizes up to 500 qubits. However, one primary concern of the work needs to be clarified.

How this work ensures the correctness of image computation needs to be clarified. It is great to see reductions both in computation time and memory. The authors should have at least a fidelity/error measure to quantify the quality of image computation. After all, we want to check model equivalence between a large-size quantum circuit and classical computation of various input states through subspace projectors.

On the other hand, the authors consider dynamic and noisy quantum circuits to be transition systems. The methods proposed should also be applied to those two types of circuits. Such evaluations are lacking in the current study. Are there any fundamental difficulties? Noisy quantum circuits require density matrix simulation and are much more expansive than state-vector simulation.

In the end, it is worthy to introduce more how does the image computation is used in the model checking of a quantum circuit.

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Reviewer's Scores
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           Clarity / Writing Style (1-5): 4
      Originality / Innovativeness (1-5): 3
    Impact of Ideas and/or Results (1-5): 4
            OVERALL RECOMMENDATION (1-5): 3
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Summarize shortly the contributions of the paper in your own words.

The paper provides efficient image computation algorithms for quantum transition system for quantum system model checking. The approach taken by the paper represent quantum circuits as tensor networks and design algorithms by leveraging the properties of tensor networks and tensor decision diagrams.

Strengths

+ A range of quantum circuits has been covered for evaluation.
+ For each circuit, qubit number is also tuned for evaluation.
+ Significant improvement shown in run time and number of nodes.

Weaknesses

- The impact of parameters for contraction partition is discussed but the reason is not clear.
- The correctness of the proposed image computation algorithm is not validated.
- There is no comparison with other quantum model checking methods.

Main Discussion of Paper

This paper describes an approach for using image computation algorithms for quantum system model checking. A wide range of quantum algorithms has been considered, which is good, and for each circuit, the qubit number was tuned for evaluation. The authors show significant runtime improvement using their technique. However, the correctness of this method has not been validated. And, the impact of the parameters for the contraction partition is not clear. Lastly, there isn't a comparison with other model checking techniques.

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