

Ruslan Shaydulin

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GitHub: <https://github.com/rsln-s>

Google Scholar: <https://scholar.google.com/citations?user=PxOuGGcAAAAJ>

Profile

PhD candidate in computer science, expecting to graduate in August 2020. My research focusses around the intersection between (hyper)graph problems, optimization, machine learning, quantum and high-performance computing. I have extensive experience designing and implementing hybrid quantum-classical algorithms, with particular interest in variational and decomposition-based approaches (including multilevel).

Peer-reviewed Publications

Ruslan Shaydulin, Caleb Thomas, Paige Rodeghero. Making Quantum Computing Open: Lessons from Open-Source Projects. In *Proceedings of First International Workshop on Quantum Software Engineering (Q-SE 2020)* (co-located with ICSE 2020) (to appear). Preprint: [arXiv:1902.00991](https://arxiv.org/abs/1902.00991)

Sami Khairy, Ruslan Shaydulin, Lukasz Cincio, Yuri Alexeev, Prasanna Balaprakash. Learning to Optimize Variational Quantum Circuits to Solve Combinatorial Problems. In *Proceedings of Thirty-Fourth AAAI Conference on Artificial Intelligence (AAAI-20)* (to appear), 2020. **Acceptance rate: 20.6%**

Sami Khairy, Ruslan Shaydulin, Lukasz Cincio, Yuri Alexeev, Prasanna Balaprakash. Reinforcement-Learning-Based Variational Quantum Circuits Optimization for Combinatorial Problems. In *Proceedings of the Machine Learning and the Physical Sciences workshop at Conference on Neural Information Processing Systems (NeurIPS 2019)*, 2019. ([link](#)) Preprint: [arXiv:1911.04574](https://arxiv.org/abs/1911.04574)

Ruslan Shaydulin, Yuri Alexeev. Evaluating Quantum Approximate Optimization Algorithm: A Case Study. In *Proceedings of the 2nd International Workshop on Quantum Computing for Sustainable Computing (QCSC 2019)* (in conjunction with 10th International Green and Sustainable Computing Conference (IGSC 2019)), 2019 DOI: [10.1109/IGSC48788.2019.8957201](https://doi.org/10.1109/IGSC48788.2019.8957201)

Sami Khairy, Ruslan Shaydulin, Lukasz Cincio, Yuri Alexeev, Prasanna Balaprakash. Reinforcement Learning for Quantum Approximate Optimization. *Research Poster, Supercomputing '19*, 2019 ([available in Proceedings](#))

Ruslan Shaydulin, Ilya Saфро, and Jeffrey Larson. Multistart Methods for Quantum Approximate Optimization. In *Proceedings of 2019 IEEE High Performance Extreme Computing Conference (HPEC)*, 2019 **Best Student Paper** (of ~50 student papers). DOI: [10.1109/HPEC.2019.8916288](https://doi.org/10.1109/HPEC.2019.8916288)

Ruslan Shaydulin, Hayato Ushijima-Mwesigwa, Christian F.A. Negre, Ilya Saфро, Susan M Mniszewski, and Yuri Alexeev. A Hybrid Approach for Solving Optimization Problems on Small Quantum Computers. *Computer*, 52(6):18-26, 2019. **Cover Feature**. DOI: [10.1109/MC.2019.2908942](https://doi.org/10.1109/MC.2019.2908942)

Ruslan Shaydulin, Hayato Ushijima-Mwesigwa, Ilya Saфро, Susan Mniszewski, and Yuri Alexeev. Network Community Detection on Small Quantum Computers. *Advanced Quantum Technologies*, 2(9):1900029, 2019. DOI: [10.1002/qute.201900029](https://doi.org/10.1002/qute.201900029)

Ruslan Shaydulin, Hayato Ushijima-Mwesigwa, Ilya Saфро, Susan Mniszewski, and Yuri Alexeev. Community Detection Across Emerging Quantum Architectures. In *Proceedings of the 3rd International Workshop on Post Moore's Era Supercomputing* (in conjunction with Supercomputing '18), 12-14, 2018. Preprint [arXiv:1810.07765](https://arxiv.org/abs/1810.07765)

Ruslan Shaydulin and Ilya Safro. Aggregative Coarsening for Multilevel Hypergraph Partitioning. *In Proceedings of 17th International Symposium on Experimental Algorithms (SEA 2018)*, 103:2:1-2:15, 2018.

DOI: [10.4230/LIPIcs.SEA.2018.2](https://doi.org/10.4230/LIPIcs.SEA.2018.2)

Ruslan Shaydulin, Jie Chen, and Ilya Safro. Relaxation-Based Coarsening for Multilevel Hypergraph Partitioning. *Multiscale Modeling & Simulation*, 17(1):482-506, 2019. DOI: [10.1137/17M1152735](https://doi.org/10.1137/17M1152735)

Online Preprints and In-Submission Works

Hayato Ushijima-Mwesigwa, **Ruslan Shaydulin**, Christian F. A. Negre, Susan Mniszewski, Yuri Alexeev, Ilya Safro. Multilevel Combinatorial Optimization Across Quantum Architectures. *In submission*. Preprint: [arXiv:1910.09985](https://arxiv.org/abs/1910.09985)

Zirou Qiu, **Ruslan Shaydulin**, Xiaoyuan Liu, Yuri Alexeev, Christopher S. Henry, Ilya Safro. ELRUNA: Elimination Rule-based Network Alignment. *In submission*. Preprint: [arXiv:1911.05486](https://arxiv.org/abs/1911.05486)

Justin Sybrandt, **Ruslan Shaydulin**, Ilya Safro. Hypergraph Partitioning With Embeddings. *In submission*. Preprint: [arXiv:1909.04016](https://arxiv.org/abs/1909.04016)

Ruslan Shaydulin, Justin Sybrandt. To Agile, or not to Agile: A Comparison of Software Development Methodologies. Preprint: [arXiv:1704.07469](https://arxiv.org/abs/1704.07469)

Education

Clemson University, SC

PhD candidate in Computer Science, advisor: Ilya Safro

Master of Science in Computer Science en route to PhD

Research in algorithms, high performance computing, big data analysis and quantum computing

Relevant coursework: Design & Analysis of Algorithms, Data Mining, Distributed & Cluster Computing, Parallel Architecture, Network Science

Summer 2020 (expected)

Fall 2019

Moscow Institute of Physics and Technology

Department of Control and Applied Math,

Bachelor of Science in Applied Mathematics and Physics

Minor: Computer Science and Data Analysis

Summer 2016

Work Experience

Intern, Quantum Artificial Intelligence Lab (QuAIL)

Spring 2020

NASA Ames Research Center (KBR)

- Developed novel analysis connecting the symmetries in problem instance structure to the performance of Quantum Approximate Optimization Algorithm under the supervision of Salvatore Mandra
- Performed extensive numerical simulations using HPC resources

Research Aide, Argonne National Laboratory

Summer 2018, 2019

- Developed quantum-accelerated frameworks for network community detection and graph partitioning under the supervision of Yuri Alexeev
- Co-authored 6 papers on quantum optimization and machine learning (5 first author)
- Contributed to multiple proposals

Research Intern, Parallels LABs

Winter 2014 - Summer 2016

- Improved stability and security of SmartMail macOS email client by isolating potentially unstable parts as separate services
 - Added features to UI of iQuickMark iOS app
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Contributed Talks and Posters

Information Science and Technology Institute Seminar *Los Alamos National Laboratory*

Nov 26, 2019

Gave talk "Practical Optimization on Near-term Quantum Computers"

Supercomputing '19 *Denver, CO*

Nov 17-22, 2019

Gave talk "Hybrid Quantum-Classical Algorithms for Graph Problems: Forging a Path to Near-Term Applications" at the [Clemson booth](#) and at the [SC Theater](#)

Quantum Computing Seminar *Oak Ridge National Laboratory*

Nov 4, 2019

Gave talk "Practical Optimization on Near-term Quantum Computers"

International Green and Sustainable Computing Conference (IGSC 2019) *Alexandria, VA*

Oct 22, 2019

Presented poster "Reinforcement Learning for Quantum Approximate Optimization"

Chicago Quantum Exchange Meeting *University of Chicago*

June 12, 2019

Presented poster "Practical Quantum Approximate Optimization"

SIAM Conference on Computational Science and Engineering (CSE19) *Spokane, WA*

Feb 25-28, 2019

Presented poster "[Quantum Local Search for Graph Community Detection](#)"

Quantum Computing Tutorial *Argonne National Laboratory*

Dec 10-11, 2018

Gave talk "[QAOA Algorithm Introduction](#)"

Supercomputing '18 *Dallas, TX*

Nov 11-16, 2018

Gave talk "Community Detection Across Emerging Quantum Architectures" at Clemson booth

Quantum Computing Workshop *Argonne National Laboratory*

Jul 25-27, 2018

Presented preliminary results on "[Machine Learning on Near-Term Quantum Computers](#)"

32nd Clemson Mini-Conference on Discrete Mathematics and Algorithms *Clemson University*

Nov 4, 2017

Presented poster "Relaxation-Based Coarsening for Multilevel Hypergraph Partitioning"

58th Scientific Conference *Moscow Institute of Physics and Technology*

Nov 23-28, 2015

Gave talk "IPC (Inter-Process Communication) in OS X"

Leadership and Service

Requested Reviewer (peer review)

- [Quantum](#) journal
- IEEE Transactions on Computers

Supercomputing '19 *Denver, CO*

Nov 17-22, 2019

Student volunteer, run tutorials, technical program session and Birds-of-Feather

SIAM Conference on Parallel Processing for Scientific Computing (PP20) *Seattle, WA*

Feb 12-15, 2020

Led and co-organized a minitutorial "[Combinatorial Optimization on Quantum Computers](#)"

SIAM Conference on Parallel Processing for Scientific Computing (PP20) *Seattle, WA*

Feb 12-15, 2020

Co-organized a minisymposium "Recent Advances and Trends in Hybrid Quantum-Classical Algorithms"

Quantum Computing Tutorial *Argonne National Laboratory*

May 14, 2019

Led and co-organized a [hands-on tutorial for Qiskit, a framework for quantum computing](#)

Mathematics Teacher, Summer School *Kostroma, Russia*

Summer 2014

School administrator, organized extracurricular activities.

Teaching

Network Science CPSC 8480 *Clemson University*

Fall 2018, 2019

Teaching Assistant responsible for grading and answering students' questions during office hours

Design and Analysis of Algorithms CPSC 8400 *Clemson University*

Spring 2019

Teaching Assistant responsible for grading and answering students' questions during office hours

Algorithms and Data Structures CPSC 2120 *Clemson University*

Spring 2019

Teaching Assistant responsible for running the lab section, grading and answering students' questions during office hours

Mathematics Teacher, Summer School *Kostroma, Russia*

Summer 2014

Created and taught a course on basics of graph theory, combinatorics and number theory to middle and high school students.

Languages and Technologies

C, Python

Prior experience: C++, MATLAB, Objective-C, Swift, Bash, IBM QISKit, Rigetti PyQuil

Limited prior experience: R, SQL, yacc, bison, AWS, Google Cloud Engine

Technologies and tools: Git, Xcode for iOS/OSX UI/Backend, TCP/IP, UNIX/Linux, MPI

Honors and Awards

- International Green and Sustainable Computing Conference (IGSC 2019) student travel award, *recipient*
- Best Student Paper at IEEE HPEC 2019 (of ~50 student papers), *recipient*
- IBM Teach-the-Qiskit-Teacher training program, *selected to represent Argonne National Laboratory*
- Upsilon Pi Epsilon CS Honor Society, *member*
- Supercomputing '19 Student Volunteer Travel award, *recipient*
- SIAM CSE '19 Broader Engagement Travel award, *recipient*
- Clemson CCIT Supercomputing '17, '18 and '19 travel award, *recipient*
- Clemson Graduate Travel Grant, Spring '19, *recipient*

- Moscow Institute of Physics and technology Abramov scholarship - Top 300 students in the university, based on high academic achievement, *recipient*