

2021 IEEE International Conference on Quantum Computing and Engineering (QCE 2021)

**Virtual Conference
17 – 22 October 2021**



IEEE Catalog Number: CFP21W18-POD
ISBN: 978-1-6654-1692-4

**Copyright © 2021 by the Institute of Electrical and Electronics Engineers, Inc.
All Rights Reserved**

Copyright and Reprint Permissions: Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limit of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923.

For other copying, reprint or republication permission, write to IEEE Copyrights Manager, IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854. All rights reserved.

***** *This is a print representation of what appears in the IEEE Digital Library. Some format issues inherent in the e-media version may also appear in this print version.***

IEEE Catalog Number:	CFP21W18-POD
ISBN (Print-On-Demand):	978-1-6654-1692-4
ISBN (Online):	978-1-6654-1691-7

Additional Copies of This Publication Are Available From:

Curran Associates, Inc
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: (845) 758-0400
Fax: (845) 758-2633
E-mail: curran@proceedings.com
Web: www.proceedings.com

CURRAN ASSOCIATES INC.
proceedings
.com

2021 IEEE International Conference on Quantum Computing and Engineering (QCE)

QCE 2021

Table of Contents

Message from the Chairs	xv
Organizing Committee	xviii
Program Committee	xx
Workshops Committee	xxiv
Tutorials Committee	xxv
Panels Committee	xxvi
Posters Committee	xxvii
Birds-of-a-Feather Committee	xxviii
Steering Committee	xxix
Keynote Presentation Abstracts	xxx
Workshop Abstracts	xli
Tutorial Abstracts	lxv
Panel Abstracts	lxxiv
Sponsors	ciii

Quantum Algorithms and Applications

Normalized Gradient Descent for Variational Quantum Algorithms	1
<i>Yudai Suzuki (Keio University, Japan), Hiroshi Yano (Keio University, Japan), Rudy Raymond (IBM Quantum, IBM Japan, Japan; Keio University, Japan), and Naoki Yamamoto (Keio University, Japan; Quantum Computing Center, Keio University, Japan)</i>	
Parameters Fixing Strategy for Quantum Approximate Optimization Algorithm	10
<i>Xinwei Lee (University of Tsukuba, Japan), Yoshiyuki Saito (University of Aizu, Japan), Dongsheng Cai (University of Tsukuba, Japan), and Nobuyoshi Asai (University of Aizu, Japan)</i>	
Quantum-Inspired Algorithm for Vehicle Sharing Problem	17
<i>Whei Yeap Suen (Singapore Management University, Singapore), Chun Yat Lau (Singapore Management University, Singapore), and Hoong Chuin Lau (Singapore Management University, Singapore)</i>	

Decision Diagrams for Quantum Measurements with Shallow Circuits	24
<i>Stefan Hillmich (Johannes Kepler University Linz, Austria), Charles Hadfield (IBM Quantum, IBM T.J. Watson Research Center, Yorktown Heights, NY), Rudy Raymond (IBM Quantum, IBM Japan, Japan; Keio University, Japan), Antonio Mezzacapo (IBM Quantum, IBM T.J. Watson Research Center, Yorktown Heights, NY), and Robert Wille (Johannes Kepler University Linz, Austria; Software Competence Center Hagenberg GmbH (SCCH), Austria)</i>	
Multi-car Paint Shop Optimization with Quantum Annealing	35
<i>Sheir Yarkoni (Volkswagen Data:Lab, Germany; LIACS, Leiden University, The Netherlands), Alex Alekseyenko (Volkswagen Group of America, USA), Michael Streif (Volkswagen Data:Lab, Germany; University Erlangen-Nürnberg, Germany), David Von Dollen (Volkswagen Group of America, USA; LIACS, Leiden University, The Netherlands), Florian Neukart (Volkswagen Data:Lab, Germany; LIACS, Leiden University, The Netherlands), and Thomas Bäck (LIACS, Leiden University, The Netherlands)</i>	
The Effect of Noise on the Performance of Variational Algorithms for Quantum Chemistry	42
<i>Waheeda Saib (IBM Quantum, IBM Research-Africa, South Africa), Petros Wallden (University of Edinburgh, Scotland), and Ismail Akhalwaya (IBM Research-Africa, University of the Witwatersrand, South Africa)</i>	
A Simple Method for Sampling Random Clifford Operators	54
<i>Ewout van den Berg (IBM Quantum, IBM T.J. Watson Research Center, USA)</i>	
PT-Enhanced Bayesian Parameter Estimation	60
<i>Yaroslav Balytskyi (UCCS BioFrontiers Center, University of Colorado, USA), Manohar Raavi (University of Colorado, USA), and Sang-Yoon Chang (University of Colorado, USA)</i>	
QuGAN: A Quantum State Fidelity Based Generative Adversarial Network	71
<i>Samuel A. Stein (Pacific Northwest National Laboratory; Fordham University), Betis Baheri (Kent State University), Daniel Chen (Case Western Reserve University), Ying Mao (Fordham University), Qiang Guan (Kent State University), Ang Li (Pacific Northwest National Laboratory), Bo Fang (Pacific Northwest National Laboratory), and Shuai Xu (Case Western Reserve University)</i>	
Modified Layerwise Learning for Data Re-Uploading Classifier in High-Energy Physics Event Classification	82
<i>Eraraya Ricardo Muten (Institut Teknologi Bandung, Indonesia), Togan Tlimakhov Yusuf (Ankara University, Turkey), and Andrei Voicu Tomut (Babeş-Bolyai University, România)</i>	
Quantum Image Representation on Clusters	89
<i>Arijit Mandal (Visvesvaraya National Institute of Technology, India), Shreya Banerjee (Indian Institute of Science Education and Research Kolkata, India), and Prasanta K. Panigrahi (Indian Institute of Science Education and Research Kolkata, India)</i>	

Optimizing Parameterized Quantum Circuits with Free-Axis Selection	100
Hiroshi C. Watanabe (<i>Keio University, Japan; JST PRESTO, Japan</i>), Rudy Raymond (<i>IBM Quantum, IBM Japan, Japan; Keio University, Japan</i>), Yu-Ya Ohnishi (<i>Materials Informatics Initiative, RD Technology & Digital Transformation Center, JSR Corporation, Japan; Keio University, Japan</i>), Eriko Kaminishi (<i>Keio University, Japan; JST PRESTO, Japan</i>), and Michihiko Sugawara (<i>Keio University, Japan</i>)	
Simpler (Classical) and Faster (Quantum) Algorithms for Gibbs Partition Functions	112
Srinivasan Arunachalam (<i>IBM Quantum, IBM T.J. Watson Research Center, Yorktown Heights, USA</i>), Vojtech Havlicek (<i>IBM Quantum, IBM T.J. Watson Research Center, Yorktown Heights, USA</i>), Giacomo Nannicini (<i>IBM Quantum, IBM T.J. Watson Research Center, Yorktown Heights, USA</i>), Kristan Temme (<i>IBM Quantum, IBM T.J. Watson Research Center, Yorktown Heights, USA</i>), and Paweł Wocjan (<i>IBM Quantum, IBM T.J. Watson Research Center, Yorktown Heights, USA</i>)	
Photonic Quantum Policy Learning in OpenAI Gym	123
Dániel Nagy (<i>Wigner Research Centre for Physics and Ericsson Research, Hungary</i>), Zsolt Tábi (<i>Ericsson Hungary and Eötvös Loránd University, Hungary</i>), Péter Hága (<i>Ericsson Research, Hungary</i>), Zsófia Kallus (<i>Ericsson Research, Hungary</i>), and Zoltán Zimborás (<i>Wigner Research Centre for Physics and MTA-BME Lendület QIT Research Group, Hungary</i>)	
Towards a Quantum Modeling Approach to Reactive Agents	130
Abder Koukam (<i>Univ. Bourgogne Franche-Comté, UTBM, France</i>), Abdeljalil Abbas-Turki (<i>Univ. Bourgogne Franche-Comté, UTBM, France</i>), Vincent Hilaire (<i>Univ. Bourgogne Franche-Comté, UTBM, France</i>), and Yassine Ruichek (<i>Univ. Bourgogne Franche-Comté, UTBM, France</i>)	
Threshold-Based Quantum Optimization	137
John Golden (<i>Los Alamos National Laboratory, USA</i>), Andreas Bärtschi (<i>Los Alamos National Laboratory, USA</i>), Daniel O’Malley (<i>Los Alamos National Laboratory, USA</i>), and Stephan Eidenbenz (<i>Los Alamos National Laboratory, USA</i>)	
A Quantum-Inspired Classical Solver for Boolean k-Satisfiability Problems	148
S. Andrew Lanham (<i>Applied Research Laboratories, The University of Texas at Austin, USA</i>) and Brian R. La Cour (<i>Applied Research Laboratories, The University of Texas at Austin, USA</i>)	
Numerical Simulations of Noisy Variational Quantum Eigensolver Ansatz Circuits	155
Meenambika Gowrishankar (<i>Quantum Computing Institute, Oak Ridge National Laboratory, Oak Ridge, Tennessee, United States of America</i>), Jeremiah Wright (<i>Quantum Computing Institute, Oak Ridge National Laboratory, Oak Ridge, Tennessee, United States of America</i>), Daniel Claudino (<i>Quantum Computing Institute, Oak Ridge National Laboratory, Oak Ridge, Tennessee, United States of America</i>), Thien Nguyen (<i>Quantum Computing Institute, Oak Ridge National Laboratory, Oak Ridge, Tennessee, United States of America</i>), Alexander McCaskey (<i>Quantum Computing Institute, Oak Ridge National Laboratory, Oak Ridge, Tennessee, United States of America</i>), and Travis Humble (<i>Quantum Computing Institute, Oak Ridge National Laboratory, Oak Ridge, Tennessee, United States of America</i>)	

Quantum Optimization Heuristics with an Application to Knapsack Problems	160
<i>Wim van Dam (QC Ware, UC Santa Barbara), Karim Eldefrawy (SRI International), Nicholas Genise (SRI International), and Natalie Parham (University of Waterloo, QC Ware)</i>	
Transferability of Optimal QAOA Parameters between Random Graphs	171
<i>Alexey Galda (University of Chicago, USA), Xiaoyuan Liu (University of Delaware, USA), Danylo Lykov (Computational Science Division, Argonne National Laboratory, USA), Yuri Alexeev (Computational Science Division, Argonne National Laboratory, USA), and Ilya Safro (University of Delaware, USA)</i>	
Adapting Quantum Approximation Optimization Algorithm (QAOA) for Unit Commitment	181
<i>Samantha Koretsky (University of Chicago), Pranav Gokhale (Super.tech), Jonathan Baker (University of Chicago), Joshua Viszlai (University of Chicago), Honghao Zheng (Commonwealth Edison), Niroj Gurung (Commonwealth Edison), Ryan Burg (Commonwealth Edison), Esa Aleksi Paaso (Commonwealth Edison), Amin Khodaei (University of Denver), Rozhin Eskandarpour (Resilient Entanglement), and Frederic T. Chong (University of Chicago, Super.tech)</i>	

Quantum Computing and Systems

Sampling Strategy Optimization for Randomized Benchmarking	188
<i>Toshinari Itoko (IBM Quantum, IBM Research - Tokyo, Japan) and Rudy Raymond (IBM Quantum, IBM Research - Tokyo, Japan)</i>	
Hybrid Schrödinger-Feynman Simulation of Quantum Circuits With Decision Diagrams	199
<i>Lukas Burgholzer (Johannes Kepler University Linz, Austria), Hartwig Bauer (Johannes Kepler University Linz, Austria), and Robert Wille (Johannes Kepler University Linz, Austria; Software Competence Center Hagenberg GmbH (SCCH), Austria)</i>	
Sampling on NISQ Devices: "Who's the Fairest One of All?"	207
<i>Elijah Pelofske (CCS-3 Information Sciences, Los Alamos National Laboratory, USA), John Golden (CCS-3 Information Sciences, Los Alamos National Laboratory, USA), Andreas Bärtschi (CCS-3 Information Sciences, Los Alamos National Laboratory, USA), Daniel O'Malley (EES-16 Earth Sciences, Los Alamos National Laboratory, USA), and Stephan Eidenbenz (CCS-3 Information Sciences, Los Alamos National Laboratory, USA)</i>	
A Simple Heuristic for Expressing a Truth Table as a Quadratic Pseudo-Boolean Function	218
<i>Scott Pakin (Computer, Computational, and Statistical Sciences Division, Los Alamos National Laboratory, New Mexico)</i>	
Resource Optimal Executable Quantum Circuit Generation Using Approximate Computing	225
<i>Smaran Adarsh (Delft University of Technology, The Netherlands) and Matthias Möller (Delft University of Technology, The Netherlands)</i>	
QFAST: Conflating Search and Numerical Optimization for Scalable Quantum Circuit Synthesis....	232
<i>Ed Younis (Lawrence Berkeley National Laboratory), Koushik Sen (University of California, Berkeley, CA), Katherine Yelick (University of California, Berkeley, CA), and Costin Iancu (Lawrence Berkeley National Laboratory)</i>	

A Quantum Computing Programming Language for Transparent Experiment Descriptions	244
<i>Virginia Frey (University of Waterloo, Canada; Institute for Quantum Computing, University of Waterloo, Canada), Richard Rademacher (University of Waterloo, Canada; Institute for Quantum Computing, University of Waterloo, Canada), Elijah Durso-Sabina (University of Waterloo, Canada; Institute for Quantum Computing, University of Waterloo, Canada), Noah Greenberg (University of Waterloo, Canada; Institute for Quantum Computing, University of Waterloo, Canada), Nikolay Videnov (University of Waterloo, Canada; Institute for Quantum Computing, University of Waterloo, Canada), Matthew L. Day (University of Waterloo, Canada; Institute for Quantum Computing, University of Waterloo, Canada), Rajibul Islam (University of Waterloo, Canada; Institute for Quantum Computing, University of Waterloo, Canada), and Crystal Senko (University of Waterloo, Canada; Institute for Quantum Computing, University of Waterloo, Canada)</i>	
A MLIR Dialect for Quantum Assembly Languages	255
<i>Alexander McCaskey (Computer Science and Mathematics Division, Oak Ridge National Laboratory, USA; Quantum Science Center, Oak Ridge National Laboratory, USA) and Thien Nguyen (Computer Science and Mathematics Division, Oak Ridge National Laboratory, USA; Quantum Science Center, Oak Ridge National Laboratory, USA)</i>	
Quantum Annealing Stencils with Applications to Fuel Loading of a Nuclear Reactor	265
<i>Joseph Fustero (North Carolina State University), Scott Palmtag (North Carolina State University), and Frank Mueller (North Carolina State University)</i>	
Quantum Fan-out: Circuit Optimizations and Technology Modeling	276
<i>Pranav Gokhale (Super.tech), Samantha Koretsky (University of Chicago), Shilin Huang (Duke University), Swarnadeep Majumder (Duke University), Andrew Drucker (University of Chicago), Kenneth R. Brown (Duke University), and Frederic T. Chong (University of Chicago; Super.tech)</i>	
Error Mitigation for Deep Quantum Optimization Circuits by Leveraging Problem Symmetries	291
<i>Ruslan Shaydulin (Argonne National Laboratory, USA) and Alexey Galda (University of Chicago, USA; Argonne National Laboratory, USA)</i>	
Adaptive job and Resource Management for the Growing Quantum Cloud	301
<i>Gokul Subramanian Ravi (University of Chicago), Kaitlin N. Smith (University of Chicago), Prakash Murali (Princeton University), and Frederic T. Chong (University of Chicago)</i>	

Quantum Networking and Communications

A Quantum Walk Control Plane for Distributed Quantum Computing in Quantum Networks	313
<i>Matheus Guedes de Andrade (University of Massachusetts Amherst), Wenhan Dai (University of Massachusetts Amherst; Quantum Photonics Laboratory, Massachusetts Institute of Technology), Saikat Guha (University of Arizona), and Don Towsley (University of Massachusetts Amherst)</i>	

Distributing Graph States Across Quantum Networks	324
<i>Alex Fischer (University of Massachusetts, Amherst) and Don Towsley (University of Massachusetts, Amherst)</i>	
Distance-Independent Entanglement Generation in a Quantum Network using Space-Time Multiplexed Greenberger-Horne-Zeilinger (GHZ) Measurements	334
<i>Ashlesha Patil (University of Arizona, USA), Joshua I. Jacobson (University of Arizona, USA), Emily Van Milligen (University of Arizona, USA), Don Towsley (University of Massachusetts, USA), and Saikat Guha (University of Arizona, USA)</i>	
Password Authentication Schemes on a Quantum Computer	346
<i>Sherry Wang (University of Ottawa, Canada), Carlisle Adams (University of Ottawa, Canada), and Anne Broadbent (University of Ottawa, Canada)</i>	
Performance Analysis of the Quantum Safe Multivariate Polynomial Public Key Algorithm	351
<i>Randy Kuang (Quantropi Inc, Canada) and Michel Barbeau (Carleton University, Canada)</i>	
Pseudo Quantum Random Number Generator with Quantum Permutation Pad	359
<i>Randy Kuang (Quantropi Inc., Canada), Dafu Lou (Quantropi Inc., Canada), Alex He (Quantropi Inc., Canada), Chris McKenzie (Quantropi Inc., Canada), and Michael Redding (Quantropi Inc., Canada)</i>	
The Quantum Internet: a Communication Engineering Perspective	365
<i>Marcello Caleffi (University of Naples Federico II, Italy), Jessica Illiano (University of Naples Federico II, Italy), Seid Koudia (University of Naples Federico II, Italy), and Angela Sara Cacciapuoti (University of Naples Federico II, Italy)</i>	
A Complete Quantum Circuit to Solve the Information Set Decoding Problem	366
<i>Simone Perriello (Politecnico di Milano, Italy), Alessandro Barenghi (Politecnico di Milano, Italy), and Gerardo Pelosi (Politecnico di Milano, Italy)</i>	

Quantum Workforce and Society

GraphStateVis: Interactive Visual Analysis of Qubit Graph States and their Stabilizer Groups	378
<i>Matthias Miller (Universität Konstanz, Germany) and Daniel Miller (Heinrich-Heine Universität Düsseldorf, Germany)</i>	
Teaching Quantum Computing with an Interactive Textbook	385
<i>James R. Wootton (IBM Quantum), Francis Harkins (IBM Quantum), Nicholas T. Bronn (IBM Quantum), Almudena Carrera Vazquez (IBM Quantum), Anna Phan (IBM Quantum), and Abraham T. Asfaw (IBM Quantum)</i>	
IBM-HBCU Quantum Center: A Model for Industry-Academic Partnerships to Advance the Creation of a Diverse, Quantum Aware Workforce	392
<i>Kayla B. Lee (IBM Quantum, NY) and Thomas A. Searles (Howard University, USA)</i>	
Quantum Computing for Undergraduate Engineering Students: Report of an Experience	397
<i>Laura Gatti (Universidad de Montevideo, Uruguay) and Rafael Sotelo (Universidad de Montevideo, Uruguay)</i>	

Quantum Engineering, Devies, and Sensing

Practical Implications of SFQ-Based Two-Qubit Gates	402
<i>Mohammad Reza Jokar (University of Chicago, USA), Richard Rines (University of Chicago, USA), and Frederic T. Chong (University of Chicago, USA)</i>	
Efficient Quantum Gate Discovery with Optimal Control	413
<i>Paul Kairys (University of Tennessee, United States of America, Oak Ridge National Laboratory, United States of America) and Travis S. Humble (University of Tennessee, United States of America, Oak Ridge National Laboratory, United States of America)</i>	
Adaptive Circuit Learning for Quantum Metrology	419
<i>Ziqi Ma (University of Chicago, USA), Pranav Gokhale (University of Chicago, USA), Tian-Xing Zheng (University of Chicago, USA), Sisi Zhou (University of Chicago, USA), Xiaofei Yu (University of Chicago, USA), Liang Jiang (University of Chicago, USA), Peter Maurer (University of Chicago, USA), and Frederic T. Chong (University of Chicago, USA)</i>	

Posters

Measurement of Ion Motion Caused by Laser-Induced Stray Charges on Microfabricated Ion Trap Chip Surfaces	431
<i>Changhyun Jung (Seoul National University, South Korea), Woojun Lee (Seoul National University, South Korea), Junho Jeong (Seoul National University, South Korea), Taehyun Kim (Seoul National University, South Korea), and Dong-Il "Dan" Cho (Seoul National University, South Korea)</i>	
Detecting Energy Levels of Spin Systems on IBM's Quantum Computer by Evolution of Mean Value of Physical Quantity	433
<i>Kh. P. Gnatenko (Ivan Franko National University of Lviv, Ukraine), H. P. Laba (Lviv Polytechnic National University, Ukraine), and V. M. Tkachuk (Ivan Franko National University of Lviv, Ukraine)</i>	
Implementing the Simplex Method with Grover's Search	435
<i>Adeline Jordon (University of Victoria, Canada), Prashanti Priya Angara (University of Victoria, Canada), and Saasha Joshi (University of Victoria, Canada)</i>	
Simulation of Continuous-Variable Quantum Systems with Tensor Network	437
<i>Ryutaro Nagai (blueqat inc., Japan), Takao Tomono (Toppan Inc., Japan), and Yuichiro Minato (blueqat inc., Japan)</i>	
Optimistic Entanglement Purification With Few Quantum Memories	439
<i>Mohammad Mobayenjarihani (University of Massachusetts, Amherst), Gayane Vardoyan (Delft University of Technology), and Don Towsley (University of Massachusetts, Amherst)</i>	
qopt: An Experiment-Oriented Qubit Simulation and Quantum Optimal Control Package	441
<i>Julian D. Teske (RWTH Aachen University, Germany) and Hendrik Bluhm (RWTH Aachen University, Germany)</i>	

Open-Source Multi-Channel Smart Arbitrary Waveform Generators (SAWG) for Quantum Information Processing	443
<i>David Allcock (University of Oregon & NIST, United States), Christopher Ballance (University of Oxford, United Kingdom), Sébastien Bourdeauducq (M-Labs Ltd., China), Joseph Britton (Army Research Laboratory, United States), Michał Gąska (Warsaw University of Technology, Poland), Thomas Harty (University of Oxford, United Kingdom), Jakub Jarosiński (Warsaw University of Technology, Poland), Robert Jördens (QUARTIQ GmbH, Germany), Grzegorz Kasprowicz (Warsaw University of Technology, Poland), Norman Krackow (M-Labs Ltd., China), Paweł Kulik (Warsaw University of Technology, Poland), David Nadlinger (Oxford University, United Kingdom), Dorota Nowicka (Warsaw University of Technology, Poland), Krzysztof Późniak (Warsaw University of Technology, Poland), Tomasz Przywózki (Warsaw University of Technology, Poland), Daniel Slichter (QUARTIQ GmbH, Germany), Mikołaj Sowiński (Warsaw University of Technology, Poland), Marius Weber (Oxford University, United Kingdom), and Weida Zhang (University of Oxford, United Kingdom)</i>	
Extended Abstract: Joint Parity-Time and Anti-Parity-Time-Symmetric Qubits	445
<i>Julia Cen (Los Alamos National Laboratory, U.S.) and Avadh Saxena (Los Alamos National Laboratory, U.S.)</i>	
On Generating a Probability Distribution Amenable to NISQ Using Modifications to Grover's Algorithm	447
<i>Sayantan Pramanik (TCS Research, India) and M Girish Chandra (TCS Research, India)</i>	
A low-Noise and Scalable FPGA-Based Analog Signal Generator for Quantum Gas Experiments. .	450
<i>D. Pahl (ETH Zürich, Switzerland), L. Pahl (ETH Zürich, Switzerland), E. Mustafa (ETH Zürich, Switzerland), Z. Liu (ETH Zürich, Switzerland), P. Fabritius (ETH Zürich, Switzerland), J. Mohan (ETH Zürich, Switzerland), P. Clements (ETH Zürich, Switzerland), A. Akin (ETH Zürich, Switzerland), and T. Esslinger (ETH Zürich, Switzerland)</i>	
Optimal Policies for Distributed Quantum Computing with Quantum Walk Control Plane Protocol	452
<i>Matheus Guedes de Andrade (University of Massachusetts Amherst), Wenhan Dai (University of Massachusetts Amherst; Quantum Photonics Laboratory, Massachusetts Institute of Technology), Saikat Guha (University of Arizona), and Don Towsley (University of Massachusetts Amherst)</i>	
Quantum Algorithms for Monte Carlo Integration using Pseudo-Random Numbers	454
<i>Koichi Miyamoto (Osaka University, Japan)</i>	
Optimal Linear Optical Discrimination of Bell-Like States	456
<i>Dov Fields (Hunter College, Army Research Lab, USA), Vladimir S. Malinovsky (Army Research Lab, USA), Janos Bergou (Hunter College, USA), and Mark Hillery (Hunter College, USA)</i>	
Developing SLH Theory for Use with Microwave Circuits	459
<i>Antonio J. Cobarrubia (San Diego State University, USA) and Kyle M. Sundqvist (San Diego State University, USA)</i>	

Rebalancing Bike Sharing Systems Under Uncertainty using Quantum Bayesian Networks	461
<i>Ramkumar Harikrishnakumar (Wichita State University, USA), Sima .E. Borujeni (Wichita State University, USA), Syed Farhan Ahmad (R.V Engineering College, India), and Saideep Nannapaneni (Wichita State University, USA)</i>	
Solving Sensor Placement Problems In Real Water Distribution Networks Using Adiabatic Quantum Computation	463
<i>Stefano Speziali (Idea-re S.r.l., Italy), Federico Bianchi (Idea-re S.r.l., Italy), Andrea Marini (Idea-re S.r.l., Italy), Lorenzo Menculini (Idea-re S.r.l., Italy), Massimiliano Proietti (Idea-re S.r.l., Italy), Loris F. Termite (K-Digitale S.r.l., Italy), Alberto Garinei (Idea-re S.r.l., Italy; Guglielmo Marconi University, Italy), Marcello Marconi (Idea-re S.r.l., Italy; Guglielmo Marconi University, Italy), and Andrea Delogu (BlueGold S.r.l., Italy)</i>	
Quantifying Geometric Measure of Entanglement of Multi-Qubit Graph States on the IBM's Quantum Computer	465
<i>N. A Susulovska (Ivan Franko National University of Lviv, USA) and Kh. P. Gnatenco (Ivan Franko National University of Lviv, USA)</i>	
A Modular Quantum Key Distribution Software Stack for Rapid Experimental Prototyping	467
<i>Omar Amer (University of Connecticut, USA), Kevin Freyberg (University of Connecticut, USA), Vaibhav Garg (Comcast Cable, USA), and Walter O. Krawec (University of Connecticut, USA)</i>	
A Polarization Diversity CV-QKD Detection Scheme for Channels with Strong Polarization Drift	469
<i>Daniel Pereira (Instituto de Telecomunicações, University of Aveiro, Portugal), Nuno A. Silva (Instituto de Telecomunicações, University of Aveiro, Portugal), and Armando N. Pinto (Instituto de Telecomunicações, University of Aveiro, Portugal)</i>	
Experiments on Fraud Detection use Case with QML and TDA Mapper	471
<i>Satanik Mitra (HCL Technologies, India) and Kameshwar Rao JV (HCL Technologies, India)</i>	
Multi-Qubit Size-Hopping Deutsch-Jozsa Algorithm with Qubit Reordering for Secure Quantum Key Distribution	473
<i>Rohit De (Del Norte High School, USA), Raymond Moberly (Faster Logic, LLC, USA), Colton Beery (Faster Logic, LLC, USA), Jeremy Juybari (Faster Logic, LLC, USA), and Kyle Sundqvist (San Diego State University, USA)</i>	
Graph State Distribution: Integer Formulation	475
<i>Wenbo Xie (Department of Computer Science, Purdue University), Wenhan Dai (Quantum Photonics Laboratory, Massachusetts Institute of Technology, University of Massachusetts Amherst), and Don Towsley (University of Massachusetts Amherst)</i>	
A Quantum Binary Classifier Based on Cosine Similarity	477
<i>Davide Pastorello (University of Trento, Italy) and Enrico Blanzieri (University of Trento, Italy)</i>	

Trainable Discrete Feature Embeddings for Quantum Machine Learning	479
<i>Napat Thumwanit (The University of Tokyo, Japan), Chayaphol Lortaraprasert (University of Tokyo, Japan), Hiroshi Yano (Keio University, Japan), and Rudy Raymond (IBM Quantum, IBM Research, Japan)</i>	
Discriminating Quantum States with Quantum Machine Learning	481
<i>David Quiroga (Universidad de Antioquia, Colombia), Prasanna Date (Oak Ridge National Laboratory, Colombia), and Raphael Pooser (Oak Ridge National Laboratory, Colombia)</i>	
An Engineer's Brief Introduction to Microwave Quantum Optics	483
<i>Malida Hecht (San Diego State University, California), Antonio Cobarrubia (San Diego State University, California), and Kyle Sundqvist (San Diego State University, California)</i>	
Author Index	485