Ludmila Botelho

Curriculum Vitae

Education

2021–Now **Ph.D. in Information and Communication Technology**, *Institute of Theoretical and Applied Informatics, Polish Academy of Sciences*, Poland
Main Subjects: Quantum Computation Theory, Optimization, Quantum Algorithms
Supervisor: Jarosław Miszczak

2018–2020 **Ph.D. in Physics**, *Universidade Federal de Minas Gerais*, Brazil
Main subjects: Quantum Information Theory, Entanglement and Optimization
Supervisor: Reinaldo Oliveira

2016–2018 **M.Sc. in Physics**, *Universidade Federal de Minas Gerais*, Brazil
Main subjects: Quantum Information Theory, Tomography, Continuous Variable Systems
Dissertation Title: Tomography on Continuous Variable Quantum Systems

2014–2015 **Student Exchange**, *Waseda University*, Japan
Title: *Theory of Many-Particle Quantum Systems*. Supervisor: Kazuya Yuasa

2011–2016 **B.S in Physics**, *Universidade Federal de Minas Gerais*, Brazil
Scientific Initiation
– 2013-2014. Title: *Typical Bell Inequality Violations for Many Parts Quantum States. Supervisor: Raphael Drumond*

Experience

2020–Now **Scientist/Programmer**, IITiS PAN, Poland
Research on Quantum Computation Theory, Quantum Algorithms and its applications.
- *Error mitigation and Quantum Approximate Optimization Algorithms*
  - Research and applications of Error Mitigation with Post-Selection for Variational Quantum Circuits
  - Algorithm design and Quantum Circuit simulations with Qiskit
  - Developed simulations and optimizations for quantum circuits on Julia with Optim and BinaryOptimization
- *Music and Quantum Annealing*
  - Researched and development of music composition on Quantum Annealing devices
  - Research and development job scheduling algorithm applied to music reduction on Quantum Annealing and Simulated Annealing devices
  - Mathematical formulation of the problem (QUBO and LIP)
  - Parsing data with Music21 and setup experiments
- *Railroad scheduling optimization*
  - Built initial parsing data code and setup for railroad optimization
- Data management and analyses in Python with Pandas, NumPy and Matplotlib
- Conducted study group about Conventional Quantum Algorithms

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2016–2020 **Scientist/Physicist**, Infoquant, UFMG, Brazil
Main topic on Quantum Information Theory and its applications.
- Worked on tomography for continuous variable states and phase space representation
- Applied semidefinite programming approach for state reconstruction optimization
- Developed programs on MATLAB using MOSEK, YALMIP, Qlib and QETLAB.

2012–2017 **Tutor**, Freelancer, Brazil
Tutoring of Mathematics and Physics subjects

2016 **Teacher**, Espaço EDS, Brazil, Internship
Tutoring of Mathematics and Physics subjects

2012–2013 **Radio Host Assistant**, Rádio Itatiaia, Brazil, Internship
Played the role of character "Atenciosa" at the talk show "Universo Fantástico"
- Communication with audience via email and phone
- Guests management
- Research, documentation and scripting

2012–2013 **Monitor**, Observatório Astronômico Frei Rosário - UFMG, Brazil, Internship
Tutoring of astronomy and telescope maintenance

Research Projects

2022 *Application of the Hybrid Algorithm Based on the Quantum Annealing to Solve a Metropolitan Scale Railway Dispatching Problem*
Coordinator: Krzysztof Domino

2021 *Music Composition Using Quantum Annealing*
Coordinator: Özlem Salehi

2021 *Impact of input data alteration and modification of the algorithm parameters on the efficiency of quantum programs*
Coordinator: Jarosław Miszczak
Research project founded by the Polish National Science Centre under the OPUS call, 30.01.2020–29.01.2023.

2016–2019 *Correlations and Dynamics in Quantum Systems of Many Bodies: Non-Markovianity, Mode Entanglement and Discord, Tomography with Incomplete Information for Continuous Variable*.
Coordinator: Reinaldo O. Vianna

2013–2014 *Typical Bell Inequality Violations for Many Parts Quantum States*.
Coordinator: Raphael C. Drumond

Accessibility and Inclusion Projects

2020 *Support Program for Inclusion and Promotion of Accessibility*.
Coordinator: Pablo Saldanha

Computational Skills

Programming Python, Julia, MATLAB, Bash, C++, HTML

OS Unix, Windows, MacOS

Technology and Tools: Git, Machine Learning, Pandas, Spark, CUDA, QuTip, Qiskit, Pennylane, Matplotlib, Scipy, Music21, Optim.jl, NumPy, Pytest, PyUnit, CPPUnit, gprof, gdb, Valgrind, VIM, Visual Code, Atom, LaTeX, Libre Office

Publications and Preprints

2023
- Akash Kundu, Ludmila Botelho, Adam Glos, "Hamiltonian-Oriented Homotopy QAOA",arXiv preprint arXiv:2301.13170 (2023)

2022
- Ludmila Botelho, Adam Glos, Akash Kundu, Jarosław Adam Miszczak, Özlem Salehi, and Zoltán Zimborás, "Error mitigation for variational quantum algorithms through mid-circuit measurements", Phys. Rev. A **105**, 022441 (2022)
- Ashish Arya and Ludmila Botelho and Fabiola Cañete and Dhruvi Kapadia and Özlem Salehi,"Applications of Quantum Annealing to Music Theory", Quantum Computer Music: Foundations, Methods and Advanced Concepts, 373-406 (2022)

2020
- L. A. S Botelho, R. O. Vianna, "Efficient Quantum Tomography of Two-Mode Wigner Functions", Eur. Phys. J. D **74**, 42 (2020)

Courses and Certifications

2022 CERN School of Computing 2022
- Physics computing
- Software Engineering
- Data Technologies

2022 Fundamentals of Accelerated Computing with CUDA C/C++, NVIDIA

2020 Machine Learning - Stanford University, Coursera

2019-2020 Deep Learning Specialization - Coursera
- Sequence Models
- Convolutional Neural Networks
- Structuring Machine Learning Projects
- Improving Deep Neural Networks: Hyperparameter tuning, Regularization and Optimization
- Neural Networks and Deep Learning

Poster Presentations

2022 ICTP Conference on Adiabatic Quantum Computation & Quantum Annealing
Title: *"Fixed interval scheduling problem with minimal idle time with an application to music arrangement problem"*

2021 International Conference on Unconventional Computation and Natural Computation 2021
Title: *"Self-Organized Maps and Quantum States Classification"*

2021 Summer School: Machine Learning in Quantum Physics and Chemistry 2021
Title: *"Self-Organized Maps and Quantum States Classification"*

2021 24th Annual Conference on Quantum Information Processing
Title: *"Efficient Quantum Tomography of Continuous Variable Quantum States"*

2020 Q-Turn 2020
Title: *"Efficient Quantum Tomography of Continuous Variable Quantum States"*

2020 15th Conference on the Theory of Quantum Computation, Communication and Cryptography
Title: *"Tomography and Entanglement Detection on Continuous Variable Quantum State"*

2019 Workshop on Skills for Young Scientists
Title: *"Tomography and Entanglement Witnesses for Continuous Variable States"*

2019 VII Paraty Quantum Information School and Workshop
Title: *"Tomography and Entanglement Witnesses for Continuous Variable States"*

2019 III Postgraduate Workshop in Physics
Title: *"Tomography and Entanglement on Continuous Variable Quantum States"*

2018 Modern Topics in Quantum Information Workshop
Title: *"Tomography on Continuous Variable States"*

2017 VI Paraty Quantum Information School
Title: *"Tomography Toolbox for Continuous Variable States"*

2013 XXII Scientific Initiation Week.
Title: *"The Quantum Teleport"*

Talks

2022 QWorld Quantum Science Days 2022
Title: *"Fixed interval scheduling problem with minimal idle time with an application to music arrangement problem"*

2022 QWorld Quantum Science Days 2022
Title: *"Applications of Quantum Annealing to Music Theory"*

2022 Institute of Computer Science AGH and IBM Software Laboratory in Krakow
Title: *"Applications of Quantum Annealing to Music Theory"*

2021 Politechnika Śląska
Title: *"Quantum Annealing and music reduction for chiptune"*

2021 1st International Symposium on Quantum Computing and Musical Creativity
Title: *"Applications of Quantum Annealing to Music Theory"*

2021 QWorld Quantum Science Days 2021
Title: *"Infeasible space reduction for QAOA through encoding change"*

2021 7th Qoffee O Clock - QIndia
Title: *"Tomography and Continuous Variable Quantum State"*

2019 Universidade de São Paulo
Title: *"Tomography and Entanglement on Continuous Variable Quantum States"*

2019 III Postgraduate Workshop in Physics
Title: *"Tomography and Entanglement on Continuous Variable Quantum States"*

2015 Winter Festival of Curralinho Title: *"The Brazilian Flag Stars"*

2015 IV Cultural Week of Catas Altas
Title: *"Easy Physics: How does a Telescope Works?"*

2013 XXII Scientific Initiation Week.
Title: *"The Quantum Teleport"*

Conferences, Schools and Workshops

2022 CERN School of Computing 2022, Kraków, Poland

2021 Summer School: Machine Learning in Quantum Physics and Chemistry 2021, Warsaw, Poland

2020 School on Quantum Information Theory and Thermodynamics at the Nanoscale

2019 III Postgraduate Workshop in Physics at *Universidade Federal de Minas Gerais, Physics Department*

2019 Workshop on Skills for Young Scientists/Increasing Diversity in STEM

2019 VII Paraty Quantum Information School and Workshop

2018 Q-Turn: changing paradigms in quantum science

2018 Minicourse on Quantum Computation and Simulability

2018 Modern Topics in Quantum Information Workshop

2017 VI Paraty Quantum Information School

2014 Summer School at *Universidade Federal de Pernambuco, Physics Department*

2013 XXIV Winter School at *Universidade Federal de Minas Gerais, Physics Department*

2013 Summer School at *Instituto de Matemática Pura e Aplicada* - Linear Algebra and Foundations of Probability

2013 XXII Scientific Initiation Week at *Universidade Federal de Minas Gerais, Physics Department*

2012 XXIII Winter School at *Universidade Federal de Minas Gerais, Physics Department*

Interests

Professional I am interested in vanguard science and technologies, such as development and researching of new technologies, methods, algorithms, proofs and etc. I mostly deal with data analysis, statistical analysis, inference schemes and information architecture. I have a some experience analysing and performing optimisations. I am also interested in high performance computing, parallelism and distributed algorithms.

Personal On my free time, I like playing and listening to music. I also enjoy computer gaming and I would like to develop my own game some day. I also practiced many different martial arts, nowadays I am focused on Capoeira. I have rats as pets. I love cycling and I think it is perfect to commute.

Professional References

– Prof. Dr. Jarosław Miszczak (current advisor)
  Institute of Theoretical and Applied Informatics, Polish Academy of Sciences
  jmiszczak@iitis.pl
– Dr. Adam Glos
  Algorithmiq
  adamglos92@gmail.com
– Dr. Özlem Salehi
  Institute of Theoretical and Applied Informatics, Polish Academy of Sciences
  ozlemsalehi@gmail.com