

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 Miszcza
- 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

- 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

- 2022 Ludmila Botelho, Adam Glos, Akash Kundu, Jarosław Adam Mischczak, Özlem Salehi, and Zoltán Zimborás, Phys. Rev. A **105**, 022441 (2022)
- 2021 Ashish Arya and Ludmila Botelho and Fabiola Cañete and Dhruvi Kapadia and Özlem Salehi, *arXiv:2201.10557* (2021)
- 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 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