

Dr. Aritra Sarkar

PERSONAL DATA

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Birth : 7 July 1991, Purulia, India
Nationality : Indian



PROFESSIONAL EXPERIENCE

QuTech	Delft, The Netherlands
Postdoctoral Researcher	<i>Jul'22 – present</i>
Quantum Machine Learning research group	
Delft University of Technology	Delft, The Netherlands
Doctoral Candidate	<i>Nov'18 – Jul'22</i>
Department of Quantum & Computer Engineering	
TCS Research and Innovation	Kolkata, India
Research Intern	<i>Jul'17 – Sep'18</i>
Embedded Devices and Intelligent Systems research team	
Indian Space Research Organisation	Bengaluru, India
Scientist	<i>Oct'13 – Jul'16</i>
ISRO Satellite Centre (now U R Rao Satellite Centre), Controls and Digital Area	

RESEARCH KEYWORDS

Explainable Quantum Artificial Intelligence; Quantum Software Design Automation; Quantum Computer Architecture
Automated Science; Neuro-Symbolic and Neuro-Evolution Approaches; Algorithmic Information Theory
Artificial General Intelligence; Causal Inference; Computational Genomics; Reinforcement Learning

EDUCATION

Delft University of Technology	Delft, The Netherlands
Doctorate	<i>Nov'18 – Jul'22</i>
<i>Dissertation:</i> Applications of Quantum Computation and Algorithmic Information for Causal Modeling in Genomics and Reinforcement Learning	
Master of Science in Computer Engineering, <i>cum laude</i>	<i>Sep'16 – Jun'18</i>
<i>Thesis:</i> Quantum Algorithms for Pattern-Matching in Genomic Sequences	
Indian Institute of Space Science and Technology	Thiruvananthapuram, India
Bachelor of Technology in Avionics	<i>Aug'09 – May'13</i>
<i>Thesis:</i> Elevation Mapping using Stereo Vision enabled Heterogeneous Multi-Agent Network	

PROFESSIONAL AFFILIATIONS

IEEE International Conference on Quantum Computing and Engineering

QCE 2023 Workshop Organizer	<i>Sep'23</i>
Quantum Algorithm Design Automation	
QCE 2023 Poster Program Committee	<i>Sep'23</i>
QCE 2022 Tutorial Organizer	<i>Sep'22</i>
Machine Learning for Full-Stack Quantum Computation	

IEEE International Conference on Quantum Software

QSW Publicity Chair	<i>Nov'22 - present</i>
QSW Symposium Organizing Committee	<i>Dec'23 - present</i>

QWorld Association

Member, QBoard	<i>Jul'22 - present</i>
Coordinator, QResearch	<i>Oct'21 - present</i>

QIndia

Member, Steering Committee	<i>Apr'21 - present</i>
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ISRO Satellite Centre

Project Manager, SSR subsystem, HySIS	<i>Jul'15 - Jul'16</i>
Team Leader, SSR firmware standardisation	<i>Oct'14 - Jul'16</i>
FPGA Design Review Committee	<i>Mar'14 - Mar'15</i>

Delft Aerospace Rocket Engineering

Electronics team member, Project Stratos	<i>Jan'17 - Jan'18</i>
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CERTIFICATIONS

Wolfram Summer School :	Metamodeling Metamathematical Observers (<i>Jul'22</i>)
edX :	Understanding Artificial Intelligence through Algorithmic Information Theory (<i>Dec'21</i>)
	Quantum Machine Learning (<i>Apr'19</i>)
	Introduction to Genomic Data Science (<i>Nov'18</i>)
	The Quantum Internet and Quantum Computers (<i>May'18</i>)
Santa Fe Institute :	Introduction to Complexity (<i>Oct'19</i>)
IBM Cognitive Class :	Hadoop 101, MapReduce and YARN, Apache Pig 101, Watson Analytics 101, Big Data 101, R 101, Bitcoin 101, Build Your Own Chatbot (<i>Sep'16 - Jun'18</i>)
Coursera :	Quantum Mechanics and Quantum Computation (<i>Dec'12</i>)
Udacity :	Artificial Intelligence for Robotics (<i>Apr'14</i>)
Stanford Online :	Machine Learning (<i>Dec'11</i>), Introduction to Artificial Intelligence (<i>Dec'11</i>)

LANGUAGE SKILLS

English : Full professional proficiency
Hindi : Bilingual proficiency

Bengali : Native proficiency
Dutch : Basic proficiency

COMPUTER SKILLS

Quantum Programming :	IBM Qiskit, OpenQL, cQASM, OpenQASM, Quantum Inspire, Rigetti Forest, D-Wave Ocean, Xanadu PennyLane, pyGSTi
Softwares :	MS Office, Git, VS Code, LaTeX, Discord, Anaconda, Virtual Box, GPT
Programming (frequent) :	Python (SciPy, NumPy, SymPy, Matplotlib, Jupyter Notebook), Shell Scripting
Programming (past) :	Assembly, MATLAB, Java, C++, C, ADA, VHDL, OpenCL, CUDA, AWS, ROS, Libero IDE, ModelSim, Docker, AFL, KLEE, Android Studio, Camtasia
Hardware :	Intel 8086, Actel 54SX32 FPGA, Raspberry Pi, Arduino, AVR Atmel

PUBLICATIONS

Google Scholar : Qo84iBgAAAAJ
ORCID : 0000-0002-3026-6892

Patents

- S. Dey, A. Mukherjee, [A. Sarkar](#), "Context based path planning for vector navigation in hexagonal spatial maps," Priority number: IN201821007023 20180223

Preprints

- [A. Sarkar](#), "Automated Quantum Software Engineering: why? what? how?," arXiv:2212.00619 [quant-ph]
- T. Acharya, A. Kundu, [A. Sarkar](#), "Quantum Accelerated Causal Tomography: circuit considerations towards applications," arXiv:2209.02016 [quant-ph] (in peer-review)
- [A. Sarkar](#), Z. Al-Ars, H. Gandhi, K. Bertels, "QKSA: Quantum Knowledge Seeking Agent – resource-optimized reinforcement learning using quantum process tomography," arXiv:2112.03643 [quant-ph]
- [A. Sarkar](#), Z. Al-Ars, K. Bertels, "Quantum circuit design for universal distribution using a superposition of classical automata," arXiv:2006.00987v2 [quant-ph]

Journals

- B.G. Bach, A. Kundu, T. Acharya, [A. Sarkar](#), "Visualizing quantum circuit probability: estimating quantum state complexity for quantum program synthesis," Entropy 2023, 25(5), 763.
- A.M. Krol, [A. Sarkar](#), I. Ashraf, Z. Al-Ars, K. Bertels, "Efficient Decomposition of Unitary Matrices in Quantum Circuit Compilers," Applied Sciences. 2022; 12(2):759.
- K. Bertels, [A. Sarkar](#), I. Ashraf, "Quantum Computing - From NISQ to PISQ," IEEE Micro, vol. 41, no. 05, pp. 24-32, 2021.
- [A. Sarkar](#), Z. Al-Ars, C.G. Almudever, K. Bertels, "QiBAM: Approximate Sub-String Index Search on Quantum Accelerators Applied to DNA Read Alignment," Electronics. 2021; 10(19):2433.
- [A. Sarkar](#), Z. Al-Ars, K. Bertels, "QuASeR: Quantum Accelerated de novo DNA sequence reconstruction," PLoS ONE 16(4): e0249850.
- [A. Sarkar](#), Z. Al-Ars, K. Bertels, "Estimating Algorithmic Information Using Quantum Computing for Genomics Applications," Applied Sciences. 2021; 11(6):2696.

Conferences

- A.M. Krol, K. Mesman, [A. Sarkar](#), M. Möller, Z. Al-Ars, "Efficient parameterised compilation for hybrid quantum programming," Third International Workshop on Integrating High-Performance and Quantum Computing (WIHPQC 2023) (accepted)
- [A. Sarkar](#), Z. Al-Ars, K. Bertels, "QKSA: Quantum Knowledge Seeking Agent," 15th International Conference on Artificial General Intelligence (AGI), Seattle, WA, USA, August 2022.
- T. Hubregtsen, C. Segler, J. Pichlmeier, [A. Sarkar](#), T. Gabor, K. Bertels, "Integration and Evaluation of Quantum Accelerators for Data-Driven User Functions," 2020 21st International Symposium on Quality Electronic Design (ISQED), Santa Clara, CA, USA, 2020, pp. 329-334.
- K. Bertels, [A. Sarkar](#), T. Hubregtsen, M. Serrao, A.A. Mouedenne, A. Yadav, A. Krol, I. Ashraf, "Quantum Computer Architecture: Towards Full-Stack Quantum Accelerators," 2020 Design, Automation & Test in Europe Conference & Exhibition (DATE), Grenoble, France, 2020, pp. 1-6.
- S. Dey, [A. Sarkar](#), A. Mukherjee, "A Brain-inspired Approach to Robotic Mapping and Navigation," 2019 IEEE RO-MAN, Workshop on Cognitive and Interactive Robotics, New Delhi, India, 2019.
- [A. Sarkar](#), R. Srividhya, J. Soman, S. Udupa, "Approaches towards standardization of software for on-board storage systems in space programs," Proceedings of Enabling Spacecraft Systems Realization through Industries Conference, ESSRI-16, June 2016.
- [A. Sarkar](#), E.J. Jafi, R. Srividhya, J. Soman, S. Udupa, N. Valarmathi, "On-board payload data store and forward design for remote sensing satellites," Proceedings of National Conference on Recent Trends in Microsystems, IIINC-15, October 2015.
- [A. Sarkar](#), S. Srivastava, B.S. Manoj, "Elevation mapping using stereo vision enabled heterogenous multi-agent robotic network," 2013 IEEE Global Humanitarian Technology Conference: South Asia Satellite (GHTC-SAS), Trivandrum, 2013, pp. 340-345.
- S. Srivastava, [A. Sarkar](#), B.S. Manoj, "Hazard control algorithms for heterogenous multi-agent cloud-enabled robotic network," 2013 IEEE International Conference on Advanced Networks and Telecommunications Systems (ANTS), Kattankulathur, 2013, pp. 1-6.

Posters

- T. Acharya, A. Kundu, [A. Sarkar](#), "Quantum Accelerated Causal Tomography: circuit considerations towards applications," Causalworlds conference, ETH Zürich, September 2022

TEACHING EXPERIENCE

Delft University of Technology

Apr'19 – present

Quantum Computing Architecture and Electronics

Delivered lectures involving quantum compilation, error-correction, quantum algorithms, and simulators. I was responsible for preparing and evaluating the assignments and exams.

Modelling, Algorithms and Data Structures

Delivered lectures on scientific modelling and graph theory, was responsible for conducting exercise sessions, and preparation of the exams.

Electronics and Computer Engineering for QIST

Planned course content and prepared lectures on number systems, memory architecture, microprocessors, and assembly language.

Supercomputing for Big Data

Prepared projects involving Scala, Spark, Hadoop, AWS, Docker, Open Street Map, ALOS and Kafka. Responsible for the final evaluation of the projects and oral examinations.

Technical University of Munich

Nov'20 – Jul'21

Quantum Entrepreneurship Laboratory

Technical project assistant for quantum algorithms and quantum computer architecture. Guided student teams on the quantum computation viability of the project proposals and algorithmic formulations.

University of Porto

Sep'20 – Dec'20

Advanced Computer Architectures

Delivered lectures on quantum computing applications and algorithm development.

edX, University of Toronto

May'19 – Oct'19

Quantum Machine Learning

Aided Dr. P. Wittek in moderating the community discussions on quantum machine learning algorithms, IBM Qiskit, Rigetti Forest and D-Wave Ocean.

OUTREACH TALKS AND TUTORIALS

- ‘Machine Learning for Quantum Computation’ - Tutorial at IEEE Quantum Week (IEEE QCE’22), Broomfield, USA (21 Sep’22)
- ‘Quantum Technologies’ - Expert Talk on Quantum Computing: Emerging Areas, Bennett University (30 May’22)
- ‘Quantum Computing: naam toh suna hi hoga?’ - IEEE Thakur college of Engineering and Technology (8 Apr’22)
- ‘Quantum Computation: past - now - future, an interdisciplinary introduction’ - Qoffee o’Clock at QIndia (19 Jun’21)
- ‘Introduction to Quantum Computing’ - Seminar on Quantum Technologies: Towards the Second Revolution at IIS-TAA Outreach (9 Jan’21)
- ‘Quantum-accelerated genomics’ - Panel Discussion at Quantum4HealthCare, UK (14 Jul’20)
- ‘Search and optimization on quantum accelerators’ - Guest Seminar at Amsterdam University of Applied Sciences, Amsterdam (23 May’19)
- ‘Search and optimisation algorithms for genomics on quantum accelerators’ Meetup at Munich Quantum Technologies, Munich, Germany (4 Apr’19)
- ‘Quantum algorithms on the QX Simulator’ - Tutorial on Quantum Computer Architecture at HiPEAC Conference 2019, Valencia, Spain (23 Jan’19)
- ‘Quantum algorithms for accelerating DNA sequence reconstruction’ - Software/Theory werkbesprekking at QuTech (12 Jun’18)
- ‘Exploring quantum algorithms for genomics’ - Mini-Symposium on Quantum Computing organised by TU Delft’s Micro-Electronic Systems & Technology Association (24 May’18)

SUPERVISION AND MENTORING

Doctoral research guidance

- "Holographic quantum error correction codes," M. Steinberg, TU Delft, *(ongoing)*
- "Libraries for high-level quantum programming on OpenQL," A.M. Krol, TU Delft, *(ongoing)*
- "Machine learning approaches to quantum gate set tomography," K.K. Yu, TU Delft, *(ongoing)*
- "Design space exploration of spin qubit architectures and compilation," N. Paraskevopoulos, TU Delft, *(ongoing)*
- "Algorithm and device aware quantum circuit mapping," M. Bandic, TU Delft, *(ongoing)*

Master's theses supervision

- "Resource theory of quantum algorithmic complexity," S. Mishra, TU Delft, *(ongoing)*
- "Energy-optimized pulse based universal quantum optimal control," S. Fauquenot, TU Delft, *(ongoing)*
- "Agent-based concept discovery of quantum error correction codes," D. Rajan, IIST, *(ongoing)*
- "Automated design space evaluation of spin qubit architecture," D. Hamel, TU Delft, *(ongoing)*
- "Hardware-aware quantum circuit mapping using reinforcement learning," J. Henstra, TU Delft, *(ongoing)*
- "Transformer-based quantum circuit generator for benchmark dataset synthesis," B. Apak, TU Delft, *(ongoing)*
- "Determining minimal SWAP operations for the qubit-mapping problem using quantum information theory," S. Szkludlarek, TU Delft, *(Jul'23)*
- "Scalable parallelization of quantum computing simulations," L.R.M. Mendes, University of Porto, *(Jul'22)*
- "Quantum algorithms for portfolio management," D. Frazão, University of Porto, *(Jul'21)*
- "A Generic micro-architecture for quantum accelerators," J.L.T. Vieira, University of Porto, *(Jul'21)*
- "QuantumSim - a memory efficient quantum computing simulator," R. Budhrani, TU Delft, *(Oct'20)*
- "Unitary decomposition - implemented in the OpenQL programming language for quantum computation," A.M. Krol, TU Delft, *(Sep'19)*

Bachelor's theses supervision

- "Quantum algorithms for RNA design," E. Larroque, Ecole Normale Supérieur Paris-Saclay, *(Aug'23)*
- "Quantum state tomography and quantum assisted quantum compilation on OpenQL," N. Eelman, Drexel University, *(Sep'19)*

Research project mentoring (QWorld)

- "Gymnasium environment for quantum circuit optimization," K. Knopp, *(ongoing)*
- "Estimating the thermodynamic cost of quantum programs," S. Gosavi, *(ongoing)*
- "Algorithmic probability of quantum circuits for program synthesis," B.G. Bach, *(Mar'23)*
- "Quantum accelerated causal hypothesis testing for gene regulatory networks," T. Acharya, *(Sep'22)*
- "Reinforcement learning agent for quantum foundations," Mentor for QIntern 2021, with 18 interns, *(Aug'21)*
Won 3rd prize for Best Projects

Internship supervision

- "Methods of implementing intelligent agents in quantum environments" H. Gandhi, Guru Gobind Singh Indraprastha University, *(Dec'21)*
- "Distributed quantum circuit simulation," K. Krishnakumar, Birla Institute of Technology and Science, Goa, *(Dec'20)*

Master's theses guidance and evaluation

- "QPack: A cross-platform quantum benchmark-suite: quantitative performance metrics for application-oriented quantum computer benchmarking," H. Donkers, TU Delft, *(Jul'22)*
- "QPack: QAOA as scalable application-level quantum benchmark," K. Mesman, TU Delft, *(Sep'21)*
- "Resource optimal executable quantum circuit generation using approximate computing," S. Adarsh, TU Delft, *(Jul'21)*

INTERESTS AND ACTIVITIES

Gamification, Esolangs, Fractals, Brain Computer Interface, Gesture-based control, Crowdsourcing
Second-Order Cybernetics, Metaphysics (participatory epistemology, finitism), Causal Set Theory
Singing, Musical instruments (keyboard, harmonium, santoor), Poetry, Cooking, Archery
Sculpting (kirigami, impossible architectures), Art (oil painting, tessellations), Photography (long exposure)

RESEARCH PROJECTS

GitHub : prince-ph0en1x

- YAQQ: Novelty search on quantum gate sets (*QuTech, ongoing*)
 - AME-state based spin qubit processor benchmarking (*QuTech, ongoing*)
 - Algorithmic probability guided quantum geometric machine learning (*QuTech, ongoing*)
 - Logic programming and circuit interpretability for quantum accelerators (*QuTech, ongoing*)
 - Automated thought experiments for quantum foundations concept discovery (*QuTech, ongoing*)
 - Quantum algorithms for mRNA codon optimization and RNA design (*QBee, QuTech, ongoing*)
 - Quantum neural networks for satellite image classification (*QBee, ongoing*)
 - Evolutionary resource-bounded universal reinforcement learning in quantum environments (*Ph.D. research '22*)
 - Gate based quantum automata for estimation of algorithmic information (*Ph.D. research '21*)
 - De novo DNA read assembly using QAOA and quantum annealing (*Ph.D. research '20*)
 - Design of quantum algorithms for accelerating DNA read alignment (*M.Sc. thesis '18*)
 - Quantum Innovation Environment (QuInE), a PyQT based IDE for visual quantum programming (*TU Delft '18*)
 - Spiking neural network based associative memory evolution for context-based navigation (*TCSRI '18*)
 - Brain-inspired robotic mapping and navigation using time-series of hexagonal grid and place cells (*TCSRI '17*)
 - System design of warehouse automation using multi-agent collaborative box-pushing strategies (*TCSRI '17*)
 - Human brain simulation in GPU with Inferior Olive model in OpenCL and CUDA (*TU Delft '17*)
 - GATK based human genome sequencing for distributed Spark platform in Scala (*TU Delft '17*)
 - Fuzzing and concolic execution on RERS-2016 problems using AFL and KLEE (*TU Delft '17*)
 - Optimizing a SoC using ρ -VEX VLIW processors (*TU Delft '17*)
 - Enhancing the Plasma processor IP core (*TU Delft '17*)
 - Accelerating object tracking in OMAP3530 application processor (*TU Delft '17*)
 - Solar energy forecasting using ORCA system (*TU Delft '17*)
 - Earthquake occurrence analysis and aftershock prediction using MATLAB and Tableau (*TU Delft '17*)
 - Technology demonstrator of satellite firmware update via telecommands (*ISRO '16*)
 - Software design of onboard memory management subsystem for Chandrayaan-2 orbiter (*ISRO '16*)
 - Project management of onboard memory management subsystem for HySIS satellite (*ISRO '16*)
 - Software design of onboard memory management subsystem for Resourcesat satellites (*ISRO '15*)
 - Hardware design of onboard memory management subsystem for ScatSat-1 (*ISRO '15*)
 - Software design and implementation of onboard memory management subsystem for Cartosat-2C (*ISRO '15*)
 - Software design and implementation of onboard memory management subsystem for Astrosat (*ISRO '14*)
 - Elevation mapping using stereo vision enabled heterogeneous multi-agent network (*B.Tech. thesis '13*)
 - Self-configuring classical logic gate circuits using genetic programming in Java (*IIST '12*)
 - Multi-vehicle path planning in dynamically changing environments using genetic optimised TSP (*IIST '12*)
 - Computer vision based centralized multi-agent system on MATLAB and Arduino (*IIST '11*)
-