ROBERT SIMON FONG

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RESEARCH INTERESTS

- Differential Geometry, Information Geometry: theory and applications in Manifold Optimization
- Machine Learning and Dynamical Systems: Reservoir Computing
- Black-box Optimization: Bayesian Optimization, Zeroth-order Optimization.

EDUCATION

University of Birmingham   *Sept. 2015 - July 2020*
Ph.D., Computer Science
Thesis: Stochastic Optimization on Riemannian Manifolds
Supervisors: Prof. Peter Tiňo, Prof. Joshua Knowles

University of Waterloo   *Sept. 2013 - Aug. 2014*
Master of Mathematics, Computational Mathematics
Thesis: Optimization with Funcation Values Only
Supervisor: Prof. Thomas Coleman

University of Waterloo   *Sept. 2007 - Apr. 2012*
Bachelor of Mathematics, Pure Mathematics (Honours)

ACADEMIC POSITIONS

Post-Doctoral Research Fellow, University of Tokyo   *May. 2025 - present*

- **Research:** Neuromorphic Reservoir Computing
- Funded the International Research Center for Neurointelligence (WPI-IRCN) at The University of Tokyo Institutes for Advanced Study

Research Fellow, University of Birmingham   *Feb. 2021 - present*

- **Research:** Reservoir Computing: Universality and applications on time series forecasting.
- **Teaching:** Mathematical Foundations of Artificial Intelligence and Machine Learning (MSc) [06 32250], Algorithms for Data Science (MSc) [06 32258]
- Funded by Alan Turing Institute; Prof. Peter Tiňo's Alan Turing Institute Fellowship
  Machine Learning in the Space of State-Space Dynamic Models

Ph.D. Candidate, University of Birmingham   *Sept. 2015 - Jul. 2020*

- **Research** Manifold Optimization using Differential Geometry, Information Geometry and Simplicial Geometry.
- **Teaching**: MSc/ICY Software Workshop (Java) (1,2), Mathematical Foundations of Computer Science

Master Student, University of Waterloo   *Sept. 2013 - Aug. 2014*

- **Research:** Derivative-free optimization: Simulated Annealing and Derivative-Free Zeroth-Order surrogate directional search methods. (with Prof. Thomas Coleman)
- **Research:** Computational Algebra: Solving multivariate polynomials using diagonal subgroup of linear group action. (with Prof. George Labahn)

- **Teaching:** Math 106 Linear Algebra for Arts (Co-organized).

Undergraduate Research Assistant, University of Waterloo *Jan. 2012 - Apr. 2012*

- Integer Programming and applications on Quary Crane Scheduling problem (special case of Traveling Salesman problem)

Undergraduate Research Assistant, Penn State University *Jan. 2009 - Mar. 2009*

- Optimization of Gravitational Wave Detectors in Laser Interferometer Gravitational-Wave Observatory(LIGO).

INDUSTRY EXPERIENCE

Senior Researcher, Theory Lab, Huawei *Aug. 2022 - Mar. 2024*

- Quantum-Inspired Optimization – theory of Hamiltonian-based solver and its applications:
  - Boolean Satisfiability Problem, Electronic Design Automation (EDA), Hardware Verification, Graph partitioning, and MIMO Decoding.
- Reservoir Computing-based Time Series Forecasting
- Hardware Placement and Routing modelling in Integrated Circuits

Researcher, Noah's Ark Lab, Huawei *Aug. 2020 - Aug. 2021*

- Theory of Deep Neural Nets: convexity, modelling, and optimization
- Application and implementation of Deep Neural Nets and Bayesian Optimization:
  - 5G+ High Frequency Surface antenna design and Integrated Circuit Partition.

Research Analyst, Cayuga Research Associates *Jan. 2013 - Aug. 2015*

- Optimization and Simulation of Container Port control system.

Consultant, Hong Kong International Terminals Limited *Apr. 2012 - Jan. 2013*

- Integer Programming Modelling and Abstraction of ISO container placement

BOOKS AND MONOGRAPHS

- **Robert Simon Fong** and Peter Tiňo. *Population-Based Optimization on Riemannian Manifolds*, volume 1046 of *Studies in Computational Intelligence (SCI)*. Springer, 2022. ISBN: 978-3-031-04292-8 (eBook ISBN: 978-3-031-04293-5)

SELECTED JOURNAL ARTICLES

- **Robert Simon Fong**, Gouhei Tanaka, and Kazuyuki Aihara. Symplectic reservoir representation of legendre dynamics, 2025
- **Robert Simon Fong**, Boyu Li, and Peter Tiňo. Linear simple cycle reservoirs at the edge of stability perform fourier decomposition of the input driving signals. *Chaos*, 35(4):043109, 2025
- **Robert Simon Fong**, Yanming Song, and Alexander Yosifov. Efficient digital quadratic unconstrained binary optimization solvers for sat problems. *New Journal of Physics*, 27(1):013027, Jan 2025
- Boyu Li, **Robert Simon Fong**, and Peter Tiňo. Simple Cycle Reservoirs are Universal. *Journal of Machine Learning Research*, 25(158):1–28, 2024
- Robert Simon Fong. *Stochastic optimization on Riemannian manifolds*. PhD thesis, University of Birmingham, 2020

SELECTED CONFERENCE PAPERS(REFERRED)

- Ziqiang Li, **Robert Simon Fong**, Kantaro Fujiwara, Kazuyuki Aihara, and Gouhei Tanaka. Structuring Multiple Simple Cycle Reservoirs with Particle Swarm Optimization. In *2025 International Joint Conference on Neural Networks (IJCNN)*, pages 1–9, 2025

- **Robert Simon Fong**, Boyu Li, and Peter Tino. Universality of real minimal complexity reservoir. *Proceedings of the AAAI Conference on Artificial Intelligence*, 39(16):16622–16629, 2025

- Peter Tiňo, **Robert Simon Fong**, and Roberto Fabio Leonarduzzi. Predictive Modeling in the Reservoir Kernel Motif Space. In *2024 International Joint Conference on Neural Networks (IJCNN)*, pages 1–8, 2024

- **Robert Simon Fong** and Peter Tiňo. Extended stochastic derivative-free optimization on riemannian manifolds. In *Proceedings of the Genetic and Evolutionary Computation Conference Companion*, GECCO '19, pages 257–258, New York, NY, USA, 2019. ACM

- **Simon Fong** and Peter Tiňo. Induced dualistic geometry of finitely parametrized probability densities on manifolds, 2018

- David Tsang, Andrew Lundgren, Ruxandra Bondarescu, **Simon Fong**, and Mihai Bondarescu. Optimizing finite mirrors for advanced gravitational wave detectors. In *APS April Meeting Abstracts*, 2009

AWARDS AND SCHOLARSHIPS

Honorary Research Fellowship, University of Birmingham	*2021 - 2026*
President's Scholarship, University of Waterloo	*2008*
AP Scholar with Distinction , The College Board	*2007*
Second Honour , Third Pan Pearl Delta plus Chinese Elite Schools Physics Olympiad	*2007*
Third Honour, Hong Kong Physics Olympiad	*2007*
Third Honour, Hong Kong Physics Olympiad	*2006*

INVITED TALKS

Drexel University, Philadelphia, PA, USA	*28. Feb. 2025*
Universality of Simple Cycle Reservoirs and Dilation Theory	
Seminar Talk with Boyu Li	
Southern University of Science and Technology, Shenzhen, China	*23. Aug. 2024*
Universality of Simple Cycle Reservoirs	
Invited Talk	

SKILLS

Programming Languages and Frameworks
MATLAB, Python, R, Java, LaTeX, Microsoft Office

Languages
English (native), Chinese Mandarin (fluent), Chinese Cantonese (native)

REVIEW SERVICES

- SIAM Journal on Optimization

- ACM/SIGEVO Conference on Foundations of Genetic Algorithms (FOGA)