ROBERT SIMON FONG

r.s.fong@bham.ac.uk ⋄ rsfong@gmail.com ⋄ (+852) 9192 6282 ⋄ rsimonfong.github.io

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)

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
- Photonic Circuit: Hardware Placement and Routing modelling

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

ACADEMIC POSITIONS

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

- Reservoir Computing: Universality and applications on time series forecasting.

- 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*

- Manifold Optimization using Differential Geometry, Information Geometry and Simplicial Geometry.

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

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

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).

TEACHING EXPERIENCE

Teaching Assistant, University of Birmingham *Sept. 2021 - Jan. 2022*

- **Courses:** Mathematical Foundations of Artificial Intelligence and Machine Learning (MSc) [06 32250], Algorithms for Data Science (MSc) [06 32258]

Teaching Assistant, Lab Demonstrator, University of Birmingham *Sept. 2015 - Jan. 2019*

- **Courses:** MSc/ICY Software Workshop (Java) (1,2), Mathematical Foundations of Computer Science

Graduate Teaching Assistant, University of Waterloo *Sept. 2013 - Dec. 2013*

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

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 PUBLICATIONS

- 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**, Boyu Li, and Peter Tiňo. Universality of Real Minimal Complexity Reservoir. In *2025 AAAI Conference on Artificial Intelligence (AAAI)*, pages 1–9, 2025
- **Robert Simon Fong**, Boyu Li, and Peter Tino. Linear simple cycle reservoirs at the edge of stability perform fourier decomposition of the input driving signals. *arXiv preprint arXiv:2412.00295*, 2024

- **Robert Simon Fong**, Yanming Song, and Alexander Yosifov. Efficient Digital Quadratic Unconstrained Binary Optimization Solvers for SAT Problems. *arXiv preprint arXiv:2408.03757*, 2024
- 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. *Stochastic optimization on Riemannian manifolds*. PhD thesis, University of Birmingham, 2020
- **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

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)