Andrew Gordon Wilson

CONTACT INFORMATION

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RESEARCH INTERESTS

I am interested in developing expressive and scalable machine learning models, particularly for kernel learning and deep learning. I have expertise in probabilistic modelling, Gaussian processes, Bayesian nonparametrics, kernel methods, neural networks, scalable algorithms, and automatic machine learning. My work has been applied to time series, image, and video extrapolation, geostatistics, gene expression and natural sound modelling, kernel discovery, Bayesian optimisation, econometrics, cognitive science, NMR spectroscopy, PET imaging, spatiotemporal statistics, and general relativity.

CURRENT POSITION

Research Fellow, Carnegie Mellon University — **March 2014 – Present**
Machine Learning Department, School of Computer Science

- **Mentors**: Eric P. Xing and Alexander J. Smola

EDUCATION

PhD, Trinity College, University of Cambridge — **October 2009 – March 2014**
Machine Learning, Department of Engineering

- **Supervisor**: Zoubin Ghahramani
- **Thesis**: *Covariance Kernels for Fast Automatic Pattern Discovery and Extrapolation with Gaussian Processes.* January 2014.

BSc (Hons), University of British Columbia — **May 2008**
Mathematics and Physics

- A+ Graduating Average, Highest Ranking Honours Physics Thesis.
- **Thesis**: *Position and Energy Reconstruction from Scintillation Light in a Liquid Xenon Gamma Ray Detector designed for PET.*

AWARDS

- Outstanding PhD Dissertation (£10,000), G-Research — 2014
- Outstanding Reviewer Award, Neural Information Processing Systems (NIPS) — 2013
- Best Student Paper Award, Uncertainty in Artificial Intelligence (UAI) — 2011
- Schiff Foundation Studentship — 2009-2014
- NSERC Postgraduate Scholarship (Doctoral) (PGS-D) — 2010-2013
- Trinity College Overseas Bursary — 2009-2013
- Cambridge Commonwealth Trust — 2009-2013
- NSERC Canadian Graduate Scholarship (Masters) (CGS-M) (Declined) — 2009
- John Collison Memorial Scholarship in Mathematics — 2007-2008
- Dean's Honour List, Science Scholar, Undergraduate Program Scholarship, TRIUMF Research Scholarship, NSERC Undergraduate Research Scholarship (USRA)

PRE-PRINTS

[1] A.G. Wilson, C. Dann, and H. Nickisch. Thoughts on massively scalable Gaussian processes. arXiv pre-print 2015. *Extended version in preparation for the Journal of Machine Learning Research* (JMLR).

[2] S. Flaxman, A. Gelman, D.B. Neill, A.J. Smola, A. Vehtari, and A.G. Wilson. Fast hierarchical Gaussian processes. 2015.

[3] A.G. Wilson, Y. Wu, D. J. Holland, S. Nowozin, M.D. Mantle, L.F Gladden, and A. Blake. Bayesian inference for NMR spectroscopy. arXiv pre-print 2014. *In preparation for the Electronic Journal of Statistics.*

[4] A.G. Wilson*, E. Gilboa* (equal contribution), A. Nehorai, and J.P. Cunningham. GPatt: Fast multidimensional pattern extrapolation with Gaussian processes. arXiv pre-print 2013. Extended into: *Fast kernel learning for multidimensional pattern extrapolation* at NIPS 2014.

Refereed Publications

[5] A.G. Wilson*, Z. Hu* (equal contribution), R. Salakhutdinov, and E.P. Xing. Deep kernel learning. To appear in *Artificial Intelligence and Statistics* (AISTATS), 2016. *Extended version in preparation for the Journal of Machine Learning Research* (JMLR).

[6] W. Herlands, A.G. Wilson, S. Flaxman, H. Nickisch, D.B. Neill, and E.P. Xing. Scalable Gaussian processes for characterizing multidimensional change surfaces. To appear in *Artificial Intelligence and Statistics* (AISTATS), 2016.

[7] J. Oliva*, A. Dubey* (equal contribution), A.G. Wilson, B. Poczos, J. Schneider, and E.P. Xing. Bayesian nonparametric kernel learning. To appear in *Artificial Intelligence and Statistics* (AISTATS), 2016. *Extension in preparation for JMLR.*

[8] A.G. Wilson, C. Dann, C.G. Lucas, and E.P. Xing. The human kernel. In *Neural Information Processing Systems* (NIPS), 2015. **Spotlight**.

[9] A.G. Wilson and H. Nickisch. Kernel interpolation for scalable structured Gaussian processes (KISS-GP). *International Conference on Machine Learning* (ICML), 2015.

[10] S. Flaxman, A.G. Wilson, D.B. Neill, H. Nickisch, and A.J. Smola. Fast kronecker inference in Gaussian processes with non-Gaussian likelihoods. *International Conference on Machine Learning* (ICML), 2015.

[11] Z. Yang, A.J. Smola, L. Song, and A.G. Wilson. À la carte – learning fast kernels. *Artificial Intelligence and Statistics* (AISTATS), 2015. **Oral presentation**.

[12] A.G. Wilson*, E. Gilboa* (equal contribution), A. Nehorai, and J.P. Cunningham. Fast kernel learning for multidimensional pattern extrapolation. *Neural Information Processing Systems* (NIPS), 2014.

[13] Y. Wu, D.J. Holland, M.D., Mantle, A.G. Wilson, S. Nowozin, A. Blake, and L.F. Gladden. A Bayesian method to quantifying chemical composition using NMR: application to porous media systems. *European Signal Processing Conference* (EUSIPCO), 2014.

[14] A. Shah, A.G. Wilson, and Z. Ghahramani. Student-t processes as alternatives to Gaussian processes. *Artificial Intelligence and Statistics* (AISTATS), 2014.

[15] A.G. Wilson and R.P. Adams. Gaussian process kernels for pattern discovery and extrapolation. *International Conference on Machine Learning* (ICML), 2013. **Oral presentation**.

[16] A.G. Wilson and Z. Ghahramani. Modelling input dependent correlations between multiple responses. *European Conference on Machine Learning* (ECML), 2012. **Nectar Track** for "*significant machine learning results*". **Oral presentation**.

[17] A.G. Wilson, D.A. Knowles, and Z. Ghahramani. Gaussian process regression networks. *International Conference on Machine Learning* (ICML), 2012. **Oral presentation**.

[18] A.G. Wilson and Z. Ghahramani. Generalised Wishart processes. *Uncertainty in Artificial Intelligence* (UAI), 2011. **Best Student Paper Award**.

[19] A.G. Wilson and Z. Ghahramani. Copula processes. *Neural Information Processing Systems* (NIPS), 2010. **Spotlight**.

Refereed Workshop Papers

[20] M. Van der Wilk, A.G. Wilson, and C.E. Rasmussen. Variational inference for latent variable modelling of correlation structure. *NIPS Workshop on Advances in Variational Inference*, 2014.

[21] A. Shah, A.G. Wilson, and Z. Ghahramani. Student-t processes for Bayesian optimisation. *NIPS Workshop on Bayesian Optimization*, 2013.

Reports

[22] A.G. Wilson. Covariance kernels for fast automatic pattern discovery and extrapolation with Gaussian processes. PhD Thesis, University of Cambridge. January 2014.

[23] A.G. Wilson. The change point kernel. Tech report, University of Cambridge. Nov 2013.

[24] A.G. Wilson. A process over all stationary covariance kernels. Tech report, University of Cambridge. June 2012.

[25] A.G. Wilson. Latent Gaussian process models. First year report, University of Cambridge. August 2010.

[26] A.G. Wilson. Position and energy reconstruction from scintillation light in a liquid xenon gamma ray detector designed for PET. Honours undergraduate thesis, UBC. May 2008.

Selected Talks

- University of Cambridge — Cambridge, UK, August 2015
- International Conference on Machine Learning — Lille, France, July 2015
- New York University — NYC, USA, June 2015
- Neural Information Processing Systems Workshop — Montreal, Canada, December 2014
- Oxford University — Oxford, UK, November 2014
- University College London — London, UK, November 2014
- Machine Learning Summer School (MLSS) — Pittsburgh, USA, July 2014
- International Conference on Machine Learning — Atlanta, USA, June 2013
- Xerox Research Seminar — Grenoble, France, November 2012
- ECML Nectar Track — Bristol, UK, September 2012
- Microsoft Research — Cambridge, UK, September 2012
- International Conference on Machine Learning — Edinburgh, UK, June 2012
- University of California — Berkeley, USA, May 2012
- Harvard University — Cambridge, USA, April 2012
- International Joint Conference on Artificial Intelligence — Barcelona, Spain, July 2011
- Uncertainty in Artificial Intelligence — Barcelona, Spain, July 2011
- Bayesian Econometrics Workshop — Rimini, Italy, June 2011
- ETH — Zurich, Switzerland, February 2011
- Latent Gaussian Models Workshop — Zurich, Switzerland, February 2011
- University College London — London, UK, October 2010

Reviewing and Service

Biometrika, Neurocomputing, Journal of Machine Learning Research (JMLR), Electronic Journal of Statistics, Journal of Artificial Intelligence Research (JAIR), IEEE Transactions on Neural Networks, IEEE Transactions on Pattern Analysis and Machine Intelligence (Special Bayesian Nonparametrics Issue), Neural Information Processing Systems (NIPS), International Conference on Machine Learning (ICML), Artificial Intelligence and Statistics (AISTATS), Uncertainty in Artificial Intelligence (UAI), International Joint Conference on Artificial Intelligence (IJCAI).

- Co-organiser of the NIPS 2015 workshop:
  Nonparametric Methods for Large Scale Representation Learning.
- Co-organiser of the ICML 2015 workshop:
  Large Scale Kernel Learning: Challenges and New Opportunities.
- Co-organiser of the NIPS 2014 workshop:
  Modern Nonparametrics 3: Automating the Learning Pipeline.
- Lecturer on Markov chain Monte Carlo, Model Selection, and Advanced Gaussian Processes in Probabilistic Graphical Models (10-708), CMU.
- Lecturer on Kernel Methods at the 2014 Machine Learning Summer School.

Video Lectures

2015: Kernel interpolation for scalable structured Gaussian processes:
`http://videolectures.net/icml2015_wilson_kernel_interpolation/`
2014: Kernel methods for large scale representation learning
2013: Kernels for automatic pattern discovery and extrapolation
2012: Gaussian process regression networks
2010: Copula processes

Employment

Microsoft Research, Cambridge, UK **07/2012 – 09/2012**
Research Intern, Supervisor: Sebastian Nowozin

- I developed Bayesian inference techniques, and new Bayesian nonparametric models, for NMR spectroscopy. These new machine learning techniques can be used to make predictions about chemical concentrations and the progress of chemical reactions, and are markedly different from conventional NMR spectroscopy techniques.

TRIUMF, Vancouver, Canada **09/2007 – 08/2008**
Researcher, Supervisor: Douglas Bryman

- Positron Emission Tomography (PET) is used to visualise functional activity, as opposed to anatomical structure; for example, it can be used to trace thought processes. At TRIUMF, the world's largest cyclotron laboratory, I independently devised image reconstruction algorithms necessary for the operation of a groundbreaking new PET device.

University of British Columbia, Vancouver, Canada **05/2007 – 08/2007**
Teaching Assistant, Mathematics Department

- I was the teaching assistant for a third year class in partial differential equations. I graded approximately 70 assignments weekly, and gave tutorial lectures twice weekly, where I derived theorems and explained concepts. I also tutored individuals and groups, and helped students with test preparation.

University of British Columbia, Vancouver, Canada **05/2006 – 08/2006**
Researcher, Physics Department, Supervisor: Matthew Choptuik

- I worked on developing a scientific programming language. I wrote a grammar and a parser to interpret the rules of the language. The language numerically solves partial differential equations, given the equations and the boundary conditions. The language also generates `C` and `Fortran` solution templates, and animated visualizations of the solution. I used `C`, `Fortran`, `Perl`, `Flex` (`Lex`), `Bison` (`Yacc`), `tcsh` and `bash`. The project consisted of 182 sources written in these languages. I also worked on a code-driver, using `Perl`, to generate fully functioning `C` and `Fortran` programs from a small number of declarations in an input file. This work was motivated to assist in using general relativity to model physical problems.

Misc

I am a classically trained pianist. I particularly like Glenn Gould's playing of Bach. I also enjoy reading about modern physics, and writing essays.