

Sahani Pathiraja, Ph.D.

CONTACT INFORMATION	Institute of Mathematics University of Potsdam Haus 29, Karl-Liebknecht-Str. 24-25 Potsdam 14476 Germany	+49 331 977 203158 pathiraja@uni-potsdam.de Nationality: Australian
RESEARCH INTERESTS	data assimilation, Monte Carlo methods, Bayesian inference, uncertainty quantification, stochastic analysis, optimal control, hydrologic and medical applications	
EDUCATION	University of New South Wales, Sydney, Australia Doctor of Philosophy (Civil & Environmental Engineering), 2014 - 2018 <ul style="list-style-type: none">• Dissertation Topic: <i>Improving data assimilation algorithms for enhanced environmental predictions</i>• Advisor: Professor Ashish Sharma & Associate Professor Lucy Marshall University of New South Wales, Sydney, Australia Bachelor of Science (Mathematics), 2007 - 2011 Bachelor of Engineering (Environmental), 2007 - 2011 <ul style="list-style-type: none">• University Medal (for exceptional academic performance)• First Class Honours	
ACADEMIC POSITIONS	Institute of Mathematics, University of Potsdam, Germany Postdoctoral Researcher, November 2017 - present Researcher in the Collaborative Research Center on Data Assimilation. Research activities include: <ul style="list-style-type: none">• investigate theoretical properties of a general class of controlled particle filters;• develop improved Monte Carlo filtering & smoothing algorithms;• identify and guide new applications of data assimilation methods, e.g. intracranial haemodynamic modelling.	
ARTICLES UNDER REVIEW	Pathiraja, S. , van Leeuwen, P. (2021) Multiplicative non-Gaussian model error estimation in data assimilation, <i>Journal of Advances in Modeling Earth Systems</i> , [under review]. arXiv:1807.09621 Pathiraja, S. (2020) L^2 convergence of smooth approximations of Stochastic Differential Equations with unbounded coefficients, <i>Stochastic Analysis & Applications</i> , [under review]. arXiv:2011.13009	
PEER-REVIEWED PUBLICATIONS	Pathiraja, S. , Stannat, W. (2021) Analysis of the Feedback Particle Filter with diffusion map based approximation of the gain, <i>Foundations of Data Science</i> , 3(3), pp.615-645. doi:10.3934/fods.2021023, arXiv:2109.02761 Pathiraja, S. , Reich, S., Stannat, W. (2020) McKean-Vlasov SDEs in non-linear filtering, <i>SIAM Journal on Control and Optimization</i> , [accepted]. arXiv:2007.12658 Gaidzik, F., Pathiraja, S. , Saalfeld, S., Stucht, S., Speck, O., Thevenin, D., Janiga, G. (2020) Hemodynamic data assimilation in a subject-specific Circle of Willis geometry. <i>Clinical Neuroradiology</i> , doi: 10.1007/s00062-020-00959-2.	

de Wiljes, J., **Pathiraja, S.** and Reich, S. (2020) Ensemble transform algorithms for nonlinear smoothing problems, *SIAM Journal on Scientific Computing*, 42(1), pp.A87-A114. doi: 10.1137/19M1239544.

Pathiraja, S. and Reich, S. (2019). Discrete gradients for computational Bayesian inference. *Journal of Computational Dynamics*, 6(2), pp.385-400. doi:10.3934/jcd.2019019.

Bishop, A. N., del Moral, P. and **Pathiraja, S.** (2018) Perturbations and projections of Kalman-Bucy semigroups, *Stochastic Processes and their Applications*, 128(9). doi: 10.1016/j.spa.2017.10.006.

Pathiraja, S., Moradkhani, H., Marshall, L., Sharma, A. and Geenens, G. (2018) Data-driven model uncertainty estimation in hydrologic data assimilation, *Water Resources Research*, 54(2), pp. 1252-1280. doi: 10.1002/2018WR022627.

Pathiraja, S., Anghileri, D., Burlando, P., Sharma, A., Marshall, L. and Moradkhani, H. (2018) Time-varying parameter models for catchments with land use change: The importance of model structure, *Hydrology and Earth System Sciences*, 22(5), pp. 2903-2919. doi: 10.5194/hess-22-2903-2018.

Moradkhani, H., Nearing, G., Abbaszadeh, P. and **Pathiraja, S.** (2018) Fundamentals of data assimilation and theoretical advances, in Duan, Q., Pappenberger, F., Thielen, J., Wood, A., Cloke, H. L., and Schaake, J. C. (eds) *Handbook of Hydrometeorological Ensemble Forecasting*. Berlin, Heidelberg: Springer Berlin Heidelberg, pp. 1-26. doi: 10.1007/978-3-642-40457-3_30-1.

Pathiraja, S., Anghileri, D., Burlando, P., Sharma, A., Marshall, L. and Moradkhani, H. (2018) Insights on the impact of systematic model errors on data assimilation performance in changing catchments, *Advances in Water Resources*, 113(December 2017), pp. 202-222. doi:10.1016/j.advwatres.2017.12.006.

Pathiraja, S., Marshall, L., Sharma, A. and Moradkhani, H. (2016) Hydrologic modeling in dynamic catchments: a data assimilation approach, *Water Resources Research*, 52, pp. 3350-3372. doi: 10.1002/2015WR017192.

Pathiraja, S., Marshall, L., Sharma, A. and Moradkhani, H. (2016) Detecting non-stationary hydrologic model parameters in a paired catchment system using data assimilation, *Advances in Water Resources*. 94, pp. 103-119. doi: 10.1016/j.advwatres.2016.04.021.

Pathiraja, S., Westra, S. and Sharma, A. (2012) Why continuous simulation? The role of antecedent moisture in design flood estimation, *Water Resources Research*. 48(6), doi: 10.1029/2011WR010997.

CONFERENCE &
SEMINAR TALKS

[Invited Talk] *Continuous time nonlinear filtering techniques and high frequency observations*, Data Assimilation Research Centre (DARC) seminar series, University of Reading, United Kingdom (March 2021)

[Invited Talk] *Dimension-free accuracy results for the diffusion map approximation of the Feedback Particle Filter*, Society for Industrial & Applied Mathematics Conference on Computational Science and Engineering, Texas, USA (March 2021)

[Invited Talk] *McKean-Vlasov SDEs in non-linear filtering and Bayesian inverse problems*, Potsdam-Lappeenranta seminar on Data Assimilation and Bayesian Inversion, Virtual Seminar, (November 2020)

Discrete gradient methods for computational Bayesian inverse problems, Society for Industrial & Applied Mathematics Conference on Uncertainty Quantification 2020, Munich, Germany (April 2020) [Cancelled due to COVID-19]

[Invited Talk] *McKean-Vlasov SDEs in non-linear filtering*, Oberwolfach Workshop 2020, Oberwolfach Research Institute for Mathematics, Germany (April 2020) [Cancelled due to COVID-19]

[Invited Talk] *Analysis of the Feedback Particle Filter and the diffusion map approximation*, International Congress on Industrial and Applied Mathematics 2019, Valencia, Spain (July 2019)

[Invited Talk] *Well-posedness of a weighted Poisson equation arising in the FPF*, Stochastic Analysis Seminar, Technical University of Berlin, Germany (February 2019)

[Invited Talk] *Algorithms for non-linear smoothing and filtering problems*, Workshop on Conservation Principles, Data, and Uncertainty in Atmosphere-Ocean Modeling, Potsdam-Griebnitzsee, Germany (April 2019)

Model uncertainty quantification for data assimilation in partially observed Lorenz 96, 7th International Symposium on Data Assimilation, Kobe, Japan (January 2019)

Perturbations & projections of Kalman-Bucy Semigroups, Society for Industrial & Applied Mathematics Conference on Uncertainty Quantification 2018, Anaheim, USA (April 2018)

Model uncertainty quantification for data assimilation in partially observed multi-scale systems, Workshop scales and scaling cascades in geophysical systems, Hamburg, Germany (April 2018)

[Invited Talk] *Model uncertainty quantification methods in data assimilation*, American Geophysical Union Fall Meeting 2017, New Orleans, USA (December 2017)

[Invited Talk] *Model uncertainty estimation methods*, Sydney Dynamics Group Seminar Series, University of Sydney, Australia (May 2017)

Improving forecasts through realistic uncertainty estimates: a novel data driven method for model uncertainty quantification in data assimilation, American Geophysical Union Fall Meeting 2016, San Francisco, USA (December 2016)

[Invited Talk] *Dynamically evolving models for dynamic catchments: using data assimilation for modelling catchments with land use change*, ETH Zurich, Switzerland (April 2016)

So what's the answer? Moving beyond the point estimate, American Geophysical Union Fall Meeting 2014, San Francisco, USA (December 2014)

How connected are urban catchments? Estimating the effective impervious area, 34th Hydrology & Water Resources Symposium, Sydney, Australia (November 2012)

POSTER
PRESENTATIONS

Numerous posters (first author and co-author) at SIAM Conference on Uncertainty Quantification (2016), IAHS workshop on Statistical Hydrology (STAHY) (2016), American Geophysical Fall Meeting (2014, 2015, 2016, 2017), International Association of Hydrological Sciences Meeting (IAHS) (2017), MODSIM Workshop on Modeling & Simulation of Systems and Applications (2015, 2017), European Geophysical Union Meeting (2016, 2018), CRC1294 Data Assimilation Spring School (2018,2019), World Environment and Water Resources Congress (EWRI) (2016), HEPEX Workshop (2018), Australian Water and Energy Exchange Initiative Workshop (OZEWEX) (2014), NCAR Institute for Mathematics applied to Geosciences (IMAGe) & Data Assimilation Research Testbed (DART) workshop on frontiers in ensemble data assimilation for geoscience applications (2015)

RESEARCH VISITS **Aalto University & Lappeenranta University of Technology, Finland**

Visiting Researcher, August 2021

- Visit as part of a German Academic Exchange Service (DAAD) funded grant to initiate international collaborations with researchers based in Germany. The research focus is on synergies between data assimilation and Bayesian inversion techniques.

ETH Zurich, Switzerland

Visiting Researcher, April 2016

- Invited to work with Professor Paolo Burlando at the Department of Civil, Environmental & Geomatic engineering and his team on applying methods I developed during my doctoral studies for time varying model parameter estimation. This fruitful collaboration led to 2 publications.

Portland State University, USA

Visiting Researcher, July - December 2016

- Invited to develop my ideas for model uncertainty quantification techniques in data assimilation studies with Professor Hamid Moradkhani at the Department of Civil & Environmental Engineering, which led to many highly cited journal publications. Collaborated with Professor Moradkhani's PhD students on data assimilation problems.

University of New South Wales, Australia

Elite Student Research Scholar, December 2009 - March 2010

- Summer research position in the School of Civil & Environmental Engineering. Researched the importance of catchment antecedent moisture conditions in flood estimation using bootstrapping and multivariate regression. This work was developed into an honours thesis and culminated in a journal publication.

Climate Change Research Centre, University of New South Wales, Australia

Research Intern, July - August 2008

- Verified mathematical models for their ability to characterise climatic phenomenon (eg. ocean heat content) using various statistical techniques (e.g. EOF analysis)

HONORS, AWARDS AND CERTIFICATIONS	2021–2024	€200,000	Membership in FRIAS Young Academy for Sustainability Research
	2019–2020		University of Potsdam International Teaching Professionals Certificate
	2017	\$10,000	UNSW Postdoctoral Writing Fellowship
	2014–2017	\$30,000	UNSW Research Excellence Award <i>for outstanding Ph.D. research potential and proposal</i>
	2014–2017	\$39,000	Commonwealth Scientific and Industrial Research (CSIRO) Flagship Postgraduate Award <i>third party funded award for Ph.D. research proposal of national significance</i>
	2016		Outstanding Student Paper Award, American Geophysical Union Fall Meeting <i>for talk entitled ‘Improving forecasts through realistic uncertainty estimates: a novel data driven method for model uncertainty quantification in data assimilation’</i>
	2015	\$1000	UNSW Global Mobility Award
	2012		UNSW University Medal <i>for highest GPA/WAM in Bachelors degree</i>
	2010		The SKM Environmental Engineering Discipline Prize <i>for the best thesis in environmental engineering</i>
	2007, 2008 2008–2011		UNSW Faculty of Engineering Dean’s Award <i>for top 10 % of undergraduates in academic year</i>
	2008, 2011		UNSW Faculty of Science Dean’s Award <i>for top 10 % of undergraduates in academic year</i>
	2007–2010	\$50,000	UNSW Scientia Scholarship <i>for UAI (rank) of 99.9/100 in university entrance exams (HSC)</i>
	TEACHING EXPERIENCE	2020	
2015, 2016			Tutor (Teaching Assistant), Fluid Dynamics I
2014, 2017			Tutor (Teaching Assistant), Engineering Mechanics I
2014, 2017			Tutor (Teaching Assistant), Engineering Hydrology I
STUDENT SUPERVISION	2018– present		Co-supervision (informal) ¹ of doctoral candidate Franziska Gaidzik at Otto-von-Guericke-University Magdeburg, Germany. Topic: <i>Using data assimilation to improve hemodynamic intracranial modeling.</i>
REVIEW ACTIVITIES			Reviewer for: IEEE Transactions on Automatic Control, SIAM Journal on Control and Optimization, Foundations of Data Science, Frontiers in Big Data, Water Resources Research, Journal of Hydrology, Environmental Modelling & Software, Quarterly Journal of the Royal Meteorological Society.

¹In Germany, only tenured staff may formally supervise doctoral students

INDUSTRY
POSITIONS

Cardno Consulting Pty Ltd, Sydney, Australia

Water Engineer, 2012 - 2014

- Industry based research project on updating the Australian water engineering design guidelines. Statistical assessment of hydrologic loss models for urban catchments
- Hydrologic and hydraulic modelling with finite element packages (e.g. D-FLOW Flexible mesh)

OUTREACH &
ORGANISATIONAL
ACTIVITIES

2020 Co-organizer minisymposium entitled *Particle methods for inverse problems* at SIAM Conference on Uncertainty Quantification (SIAMUQ)

2018 – Organising and volunteering at Coder Dojo events at the University of Potsdam, teaching children to code through robotics

2018 Postdoctoral Representative for the Collaborative Research Center on Data Assimilation at the University of Potsdam

2009-2010 Volunteer at the Sustainability Resource Centre, Sydney, Australia, educating the community on sustainable living standards.