Sarat Babu Moka

Curriculum Vitae
Last Updated: April 18, 2025

Lecturer
School of Mathematics and Statistics
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Biography

I am a tenure track Lecturer in the School of Mathematics and Statistics at The University of New South Wales, Sydney, since January 2023. My research and teaching interests span across Statistics, Probability Theory, Machine Learning, and Deep Learning. In the past, I was a Research Fellow in the School of Mathematical and Physical Sciences, Macquarie University, for almost two years. Prior to that, I was an ACEMS (ARC Centre for Excellence for Mathematical & Statistical Frontiers) Postdoc at The University of Queensland for four years. I have obtained a PhD in Applied Probability, and Masters and Bachelors degrees in Engineering with a focus on Electricals, Electronics, and Commincations. Before starting my PhD, I was a scientist at the Indian Space Research Organization working on Communication Networks related to rocket launch activities.

Education

2017 — **Doctor of Philosophy (PhD)** in System Science
Tata Institute of Fundamental Research (TIFR) . . . . . Mumbai, India
Thesis Title: *Invariant Measures for Queueing and Spatial Markov Processes: Algorithms and Analysis*
Advisor: Prof. Sandeep Juneja

2008 — **Master of Engineering (ME)** in Telecommunication
Indian Institute of Science (IISc) . . . . . Bangalore, India
Thesis Title: *Optimization of Antenna Cross Correlation in Multi Antenna System*
Advisor: Prof. K. J. Vinoy

2005 — **Bachelor of Engineering (BE)** in Electronics and Communication Engineering
Andhra University (AU) . . . . . Andhra Pradesh, India
Thesis Title: *Designs of Antenna Linear Arrays using Genetic Algorithms*

Employment

Jan' 23 – present — **The University of New South Wales** . . . . . Sydney, Australia
Lecturer (Tenure Track)

Jan' 23 – present — **Macquarie University** . . . . . Sydney, Australia
Honorary Research Fellow

Mar' 21 – Jan' 23 — **Macquarie University** . . . . . Sydney, Australia
Research Fellow

Jul' 17 – Feb' 21 **The University of Queensland** . . . . . Brisbane, Australia
Postdoctoral Research Fellow

Feb' 17 – Jun' 17 **Tata Institute of Fundamental Research** (TIFR) . . . . . Mumbai, India
Visiting Research Fellow

Sep' 08 – May' 10 **Indian Space Research Organization** (ISRO), Dept. of Space . . . . . Sriharikota, India
Scientist/Engineer-SC

Book

[B1] **Mathematical Engineering of Deep Learning**. Jointly with Prof. Liquet (Macquarie University) and A/Prof. Nazarathy (University of Queensland). Publishing in October 2024 via CRC Press [click here].
Book chapters are (freely) available at https://deeplearningmath.org/.

Research Publications

In Review/Sumitted

[R1] **Moka, S.**, Hirsch, C., Schmidt, V. and Kroese, D. *"Efficient Rare-Event Simulation for Random Geometric Graphs via Importance Sampling"*. **[Submitted]** [arXiv]

[R2] Nguyen, T., **Moka, S.**, Mengersen, K., and Liquet, B. *"Spatial Autoregressive Model on a Dirichlet Distribution"*. At **Statistics and Computing** journal [arXiv]

2025

[P1] [Book Chapter] Liquet, B., **Moka, S.**, and Nazarathy, Y. *"Navigating Mathematical Basics: A Primer for Deep Learning in Science"*. For the book *Computational Neurosurgery* in the book series **Advances in Experimental Medicine and Biology**. Editors: Antonio Di Ieva, Eric Suero Molina, Sidong Liu and Carlo Russo. [pdf] [Link]

[P2] Liquet-Weiland, B., **Moka, S.**, and Muller, S. *"Best Subset Selection for Linear Dimension Reduction Models using Continuous Optimization"*. **Biometrical journal**. [Link] [arXiv]

2024

[P3] **Moka, S.**, Liquet, B., Zhu, H., and Muller, S. (2024) "COMBSS: Best Subset Selection via Continuous Optimization", **Statistics and Computing**, [Link].

[P4] Mathur, A., **Moka, S.**, Liquet-Weiland, B., and Botev, Z. *"Group COMBSS: Group Selection via Continuous Optimization"*. Proceedings of **Winter Simulation Conference 2024** [Link] [arXiv]

[P5] Reimann, H., **Moka, S.**, and Sofronov, G. *"Continuous Optimization for Offline Change Point Detection and Estimation"*. Proceedings of **Winter Simulation Conference 2024** [Link] [arXiv]

2023

[P6] Mathur, A., **Moka, S. B.**, and Botev, Z. I. (2024) *"Column Subset Selection and Nyström Approximation via Continuous Optimization"*, Proceedings of **Winter Simulation Conference** [arXiv].

[P7] Mathur, A., **Moka, S. B.**, Botev, Z. (2023) "Feature Selection in Generalized Linear models via the Lasso: To Scale or Not to Scale?", **OPT 2023: Optimization for Machine Learning** [Link] [arXiv].

2022

[P8] **Moka, S. B.**, Nazarathy, Y. and Scheinhardt, W. (2022) "Diffusion Parameters of Flows in Stable Multi-class Queueing Networks", **Queueing Systems** [Link] [arXiv] .

[P9] Mathur, A., **Moka, S. B.**, and Botev, Z. I. (2022) *"Coordinate Descent for Variance Component Models"*, **Algorithms** [Link].

2021

[P10] **Moka, S. B.**, Juneja, S. and Mandjes, M. R. H. (2021) "Rejection and Importance Sampling based Perfect Simulation for Gibbs Hard-Spheres Processes", **Advances in Applied Probability** [Link] [arXiv].

[P11] Mathur, A., **Moka, S. B.**, and Botev, Z. I. (2021) "Variance Reduction for Black Box MatrixSimulation with Applications to Gaussian Processes", **ValueTools**.

[P12] Hirsch, C., **Moka, S. B.**, Taimre, T. and Kroese, D. (2021) "Rare Events in Random Geometric Graphs", **Methodology and Computing in Applied Probability** [Link], [arXiv].

[P13] Dandekar, R., Henderson, S. G., Jansen, M., McDonald, J., **Moka, S. B.**, Nazarathy, Y., Rackauckas, C., Taylor, P. G., Vuorinen, A. (2021) "Safe Blues: A Method for Estimation and Control in the Fight Against COVID-19", **Patterns Cell Press** [Link] [medRxiv] [Website].

2020

[P14] **Moka, S. B.** and Kroese, D.(2020) "Perfect Sampling for Gibbs Point Processes using Partial Rejection Sampling", **Bernoulli** , no. 3, 2082–2104 [link] [arXiv].

[P15] Ankit Shukla, Thu H. M. Nguyen, **Sarat B. Moka**, Jonathan J. Ellis, John P. Grady, Harald Oey, Alexandre S. Cristino, Kum Kum Khanna, Dirk P. Kroese, Lutz Krause, Eloise Dray, J. Lynn Fink, Pascal H. G. Duijf. (2020) "Chromosome Arm Aneuploidies Shape Tumour Evolution, Cancer Prognosis and Drug Response", **Nature Communications** 11, 449, 14 pages, [link].

≤ 2019

[P16] **Moka, S. B.**, Juneja, S., and Kroese, D. (2019)"Unbiased Estimation of the Reciprocal Mean for Non-negative Random Variables", Proceedings of **Winter Simulations Conference**, 404-415, [arXiv]

[P17] Jing Fu, Yoni Nazarathy, **Sarat Moka**, Peter Taylor. (2019) "Towards Q-learning the Whittle Index for Restless Bandits", **Australian & New Zealand Control Conference**, 249-254 [link]

[P18] **Moka, S. B.**, Juneja, S. and Mandjes, M. R. H. (2018) "Analysis of Perfect Sampling Methods for Hard-sphere Models", **SIGMETRICS Perform. Eval. Rev.** 45 (2), 69-75, [link].

[P19] Foss, S., Juneja, S., Mandjes, M. R. H. and **Moka, S. B.** (2015) "Spatial Loss Systems: Exact Simulation and Rare Event Behavior", **SIGMETRICS Perform. Eval. Rev.** 43, 2 , 3-6 [link].

[P20] **Moka, S. B.** and Juneja, S. "Regenerative Simulation for Queueing Networks with Exponential or Heavier Tail Arrival Distributions", **ACM Trans. Model. Comput. Simul. (2015)** 25, 4, Article 22, 22 pages [link].

[P21] **Moka, S. B.** and Juneja, S. (2013) "Regenerative Simulation for Multiclass Open Queueing Networks", Proceedings of **Winter Simulation Conference**, Washington DC. IEEE, 643-654 [link].

Funds/Grants

Current

[1] Estimating the Number of Tyres in Stockpiles: Phase II (2024). Project commissioned by *Environmental Protection Authority (EPA) Victoria*. Jointly with Prof. Muller, Macquarie University. Value: A$55,962.

Past

[2] Estimating the Number of Tyres in Stockpiles: Phase I (2022). Project commissioned by *Environmental Protection Authority (EPA) Victoria*. Jointly with Prof. Muller, Macquarie University. Value: A$39,900.

[3] Translational Launchpad Fund (2023). The University of New South Wales. Value: A$2,000.

[4] ACEMS International Mobility Programme funding for the collaboration research with the University of Ulm. Value: A$8,887.

[5] First Prize in ACEMS Sampling and Exploration Competition, 2017 (Research Fellow Category). Value: A$1,200.

[6] International Travel Support (2015), Science and Engineering Research Board, Department of Science, India. Value: A$3,500.

Current Industry Links

[1] *Environmental Protection Authority* (EPA) Victoria, Australia

[2] *Commonwealth Scientific and Industrial Research Organisation* (CSIRO), Australia

Supervision of Students

Current

[1] **Anant Mathur, PhD**, School of Mathematics and Statistics, UNSW. Jointly with Dr. Zdravko Botev. On *Computational Statistics and Data Science*.

[2] **Joseph Gurr, Masters**, School of Mathematics and Statistics, UNSW. Jointly with Dr Pathiraja and Colleagues from CSIRO. On *Hierarchical Implicit Networks for Prediction and Uncertainty Quantification for Hydrological and Agricultural Time Series*.

Graduated

[3] **Teo Nguyen, PhD, 2024**, School of Mathematical and Physical Sciences, Macquarie University. Jointly with Prof. Benoit Liquet. On *Machine Learning Models for Satellite-based Coral Reef Mapping*.

[4] **Hua Hu (Yang), Honours**, School of Mathematics and Statistics, UNSW. On *Best Subset Selection in Linear Regression*

[5] **Seungjoo Lee (Eric), Honours**, School of Mathematics and Statistics, UNSW. On *Model Pruing in Deep Learning*. Completed in Term 2, 2024

[6] **Ava Vahedi, Masters**, School of Mathematics and Statistics, UNSW. On *Partial Rejection Sampling for Graph Coloring*. Completed in Term 1, 2024

[7] **Hongyu Xu, Masters**, School of Mathematics and Statistics, UNSW. On *Rating Players of CS:GO Based on Plus/Minus Score*. Completed in Term 1, 2024

[8] **Alice Shen, Jingyi Liu, Zih-Yi Liu**, and **Yihan Jin**, **Masters Group Project**. School of Mathematics and Statistics, UNSW. On *Change Point Detection via Best Subset Selection*. Term 2 2024

Invited Research Talks

2024

[1] **Rare-Event Simulation for Random Geometric Graphs via Importance Sampling**
AustMS Annual Retreat 2024 . . . . . Auckland University, New Zealand, Dec 2024

[2] **Optimization Methods for Best Subset Selection Problem in High-dimensional Linear Dimension Reduction Models**
EcoSta2024 . . . . . Beijing Normal University, China, July 2024

[3] **Best Subset Selection in Regression Models**
Changsha . . . . . Central South University, China, July 2024

[4] **A Brief Introduction to Deep Neural Networks**
ML Climate Science Workshop . . . . . uDASH, UNSW, March 2024

[5] **Best Subset Selection in Regression Models**
IMS APRM . . . . . University of Melbourne, Jan 2024

2023

[6] **Group Variable Selection via Unconstrained Continuous Optimization**
Australian Statistical Society . . . . . University of Wollongong, Dec 2023

[7] **Importance Sampling for Estimation of Rare-event Probabilities in Random Graphs**
MATRIX Event on Monte Carlo Algorithms in Statistical Mechanics . . . . . University of Melbourne, July 2023

[8] **Best Subset Selection in Linear and Non-linear Regression via Continuous Optimization**
MATRIX Event on Computational Mathematics for High-dimensional Data in Statistical Learning . . . . . University of Melbourne, Feb 2023

≤ 2022

[9] **Partial Rejection Sampling for Markov Random Fields**
Annual Meeting of Australian Mathematical Society . . . . . Online, 2022

[10] **Best Subset Selection via Continuous Optimization**
Statistical Society of Australia, Sydney . . . . . University of Sydney, 27 April 2022

[11] **Graph Coloring via Partial Rejection Sampling**
AustMS . . . . . Online, 2021

[12] **Rare-Event Simulation for Random Geometric Graphs**
AustMS . . . . . Online, 2020

[13] **Importance Sampling Based Rare-event Simulation for Gilbert Graphs**
ACEMS Annual Retreat . . . . . Online, 2020

[14] **Perfect Sampling and Unbiased Estimation for Gibbs Point Processes**
Mathematisches Kolloquium [link] . . . . . University of Ulm, Ulm, Germany, 2019

[15] **Unbiased Estimation of the Reciprocal Mean for Non-negative Random Variables with Applications**
Monte Carlo Methods and Applications [link] . . . . . UNSW, Sydney, Australia, 2019

[16] **Unbiased Estimation of the Reciprocal Mean for Non-negative Random Variables**
INFORMS Applied Probability Society [link] . . . . . Brisbane, Australia, 2019

[17] **Perfect Sampling for Gibbs Point Processes Using Partial Rejection Sampling (extended results)**
AustMS Meeting . . . . . University of Adelaide, Adelaide, Australia, 2018

[18] **Perfect Sampling for Gibbs Point Processes Using Partial Rejection Sampling**
ACEMS workshop on Advances and Challenges in Monte Carlo Methods [link] .... UQ, Brisbane, Australia, 2018

[19] **Importance Sampling Based Unbiased Estimation for Hard-core Models**
ACEMS Workshop on Multiscale Models [link] Monash University, Melbourne, Australia, 2018

[20] **Combined Acceptance-rejection and Importance Sampling Methodologies for Perfect Sampling from Gibbs Point Processes**
INFORMS Annual Meet [link] ..... Houston, Texas, USA, 2017

Conference Sessions & Workshops (Co-)organized

2025

[1] INFORMS International Meeting, Session on *Probability and Optimization for Statistical Learning*, 20-23 July, 2025, Singapore. [Link]

[2] INFORMS Applied Probability Society, Session on *Stochastic Models – Theoretical*, 30 June - 03 July, 2025, Georgia Tech, Atlanta, USA. [Link]

2024

[3] EcoStat2024, Session on *Applied Probability and Optimisation Methods in Data Science*, 17 - 19 July, 2024, Being, China. [Link]

2023

[4] Mathematical Engineering of Deep Learning – Part 1: Foundations, 20 Apr 2023. Jointly with Prof. Liquet-Weiland. [Link]

[5] The 25th International Congress on Modelling and Simulation (**MODSIM2023**), 9 - 13 July 2023. A session on *Applied Probability and Optimisation Methods in Data Science*. [Link]

≤ 2022

[6] A Crash Course on Using Machine Learning Methods Effectively in Practice, 22 November 2022. [Link]

[7] The 20th INFORMS Applied Probability Society Conference, Brisbane, 3-5 July, 2019. Jointly with A/Prof. Nazarathy et al. [link].

[8] Workshop on Applied Probability, March 31 - April 02, 2017, TIFR, Mumbai. Jointly with Prof. Juneja.

[9] Tutorial and Workshop on Learning and Related Probabilistic Applications, Feb 25-26, 2015, TIFR, Mumbai. Jointly with Prof. Juneja.

[10] Tutorial and Workshop on Applications of Game Theory, May 03-04, 2013, TIFR, Mumbai. Jointly with Prof. Juneja.

Teaching

Course in Development

[1] **Statistical Machine Learning Theory** ..... Jointly with Dr Sahani Pathiraja
The University of New South Wales, Australia.

2025

[2] **Data and Machine Learning** ..... Term 2, 2025
The University of New South Wales, Australia.

[3] **Data Mining and Machine Learning** ..... Hexamester 2, 2025
The University of New South Wales, Australia.

2024

[4] **Data Mining and Machine Learning** ..... Hexamester 3, 2024
The University of New South Wales, Australia.

[5] **Data Science Project** ..... Hexamester 3, 2024
The University of New South Wales, Australia.

2023

[6] **Data Mining and Machine Learning** ..... Hexamester 3, 2023
The University of New South Wales, Australia.

[7] **Data Science Project** ..... Hexamester 3, 2023
The University of New South Wales, Australia.

≤ 2022

[8] **Statistical Inference** ..... Sem 2, 2022
Macquarie University, Australia.

[9] **The Mathematical Engineering of Deep Learning** ..... AMSI Summer School, 2021
Adelaide, Australia. [Link]

[10] **Problems & Applications in Modern Statistics (STAT3500/7500)** ..... Sem 2, 2020
The University of Queensland, Brisbane, Australia.

[11] **Problems & Applications in Modern Statistics (STAT3500/7500)** ..... Sem 2, 2019
The University of Queensland, Brisbane, Australia.

[12] **Characteristic functions and Weak Convergence** as a part of the Course on Advanced Probability (with Juneja, S.) ..... Autumn 2015
Tata Institute of Fundamental Research, Mumbai, India.

[13] **Output Analysis** and *Perfect Sampling* as a part of the Course on Monte Carlo Methods and Rare Events (with Juneja, S.) ..... Autumn 2014
Tata Institute of Fundamental Research, Mumbai, India.

[14] **Markov Chains and Stochastic Stability** as a part of the course on *Topics in Applied Probability*. . ..... Autumn 2011
Tata Institute of Fundamental Research, Mumbai, India.

Review Activities

Book Proofreading/review

[1] *Data Science and Machine Learning: Mathematical and Statistical Methods* by Dirk P. Kroese, Zdravko Botev, Thomas Taimre, Radislav Vaisman.

[2] *COVID Transmission Modeling: An Insight into Infectious Diseases Mechanism* by D. M. Basavarajaiah, and B. N. Murthy.

Journals Refereed

[1] Optimization for Machine Learning (OPT) at NeurIPS

[2] Springer Nature Computational Statistics

[3] Annals of Operational Research

[4] Computational Statistics

[5] Computational Statistics and Data Analysis

[6] Methodology and Computing in Applied Probability

[7] Biostatistics.

[8] INFORMS Journal on Computing.

[9] Environmental Modeling & Assessment, Springer Journal.

[10] Australian & New Zealand Journal of Statistics.

[11] 4OR - A Quarterly Journal of Operations Research, Springer.

[12] Stochastic Models.

[13] ACM Transactions on Modeling and Computer Simulation (TOMACS).

Thesis Review (Outside UNSW)

[1] PhD thesis on *Reinforcement Learning for Partially Observable Environments* by Jun Ju from School of Mathematics and Physics at The University of Queensland.

[2] Master Thesis on *Modelling and Control of Epidemics Spread: Safe Blues Simulation* by Sihan Qiu from the Department of Statistics, The University of Auckland.

Thesis Review (within UNSW)

[1] Yuxin Ma, Masters. *A Study on Convolutional Generative Adversarial Network with Different Classifiers on Time Series*. Term 2, 2024

[2] Group Project, Masters. *Large Language Models for Sentiment Ananlysis of Newspaper Articles During COVID-19: The Guardian*. Term 1, 2024

[3] Group Project, Masters. *Classification Using Semi-supervised Learning Algorithms*. Term 3, 2023

[4] Christopher Gordon, Honours. *Gaussian Process Based Baysian Optimization for STERGM EGMME*. Term 3, 2023

[5] Sean Luo, Masters. *Evaluating the Peformance of GANS Using Dimensionality Reduction Approaches*. Term 1, 2023

School Activities

2024

[1] **Ambassador Program** - Data Science and Decisions

[2] Member of **EDI Committee**

[3] Involving in **Open Day** activities on 7 Sept 2024

Past

[4] Member of **Computing Committee**, 2023

[5] Member of **Co-op Scholarship Program** Interview Panel, 2023.

Learning

[1] Associate Fellow of Higher Edcuation Academy (AFHEA), UK Professional Standards Framework for teaching and learning support in higher education, 2023

[2] Foundations of University Learning and Teaching (FULT), UNSW, 2023

[3] ally@UNSW training workshop, UNSW, 2023

Programming Languages

C, Python, Matlab, R.

Extracurricular Activities

Hiking/Trekking, Rock Climbing, Running, Squash, and Painting

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UNSW, Sydney, AUSTRALIA, April 18, 2025