

# Sarat Babu Moka

## Curriculum Vitae

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Lecturer  
School of Mathematics and Statistics  
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Australia

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## Biography

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

## 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	<b>Macquarie University</b> ..... Sydney, Australia Research Fellow
Jul' 17 – Feb' 21	<b>The University of Queensland</b> ..... Brisbane, Australia Postdoctoral Research Fellow
Feb' 17 – Jun' 17	<b>Tata Institute of Fundamental Research (TIFR)</b> ..... Mumbai, India Visiting Research Fellow
Sep' 08 – May' 10	<b>Indian Space Research Organization (ISRO)</b> , Dept. of Space ..... Sriharikota, India Scientist/Engineer-SC

## Book Writing

- [B1] **Mathematical Engineering of Deep Learning**. Jointly with Prof. Liquet (Macquarie University) and A/Prof. Nazarathy (University of Queensland). Chapters are freely available at <https://deeplearningmath.org/>.

## Research Publications

### Submitted

- [S1] Mathus, A., **Moka, S.**, Liquet-Weiland, B., and Botev, Z. “Group COMBSS: Group Selection via Continuous Optimization”. Submitted to *Winter Simulation Conference 2024*
- [S2] Reimann, H., **Moka, S.**, and Sofronov, G. “Continuous Optimization for Offline Change Point Detection and Estimation”. Submitted to *Winter Simulation Conference 2024*
- [S3] [Book Chapter] Liquet, B., Moka, S., and Nazarathy, Y. “Navigating Mathematical Basics: A Primer for Deep Learning in Science”. [[pdf](#)]
- [S4] Nguyen, T., **Moka, S.**, Mengersen, K., and Liquet, B. “Spatial Autoregressive Model on a Dirichlet Distribution”. [[arXiv](#)]

### In Review

- [R1] Liquet-Weiland, B., **Moka, S.**, and Muller, S. “Best Subset Selection for Linear Dimension Reduction Models using Continuous Optimization”. At *Biometrical journal*. [[arXiv](#)]

### 2024

- [P1] **Moka, S.**, Liquet, B., Zhu, H., and Muller, S. (2024) “COMBSS: Best Subset Selection via Continuous Optimization”, **Statistics and Computing**, [[Link](#)].
- [P2] 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](#)].

### 2023

- [P3] 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

- [P4] **Moka, S. B.**, Nazarathy, Y. and Scheinhardt, W. (2022) “Diffusion Parameters of Flows in Stable Multi-class Queueing Networks”, **Queueing Systems** [[Link](#)] [[arXiv](#)].
- [P5] Mathur, A., **Moka, S. B.**, and Botev, Z. I. (2022) “Coordinate Descent for Variance Component Models”, **Algorithms** [[Link](#)].

## 2021

- [P6] **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](#)].
- [P7] Mathur, A., **Moka, S. B.**, and Botev, Z. I. (2021) “Variance Reduction for Black Box MatrixSimulation with Applications to Gaussian Processes”, **ValueTools**.
- [P8] 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](#)].
- [P9] 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

- [P10] **Moka, S. B.** and Kroese, D.(2020) “Perfect Sampling for Gibbs Point Processes using Partial Rejection Sampling”, **Bernoulli** , no. 3, 2082–2104 [[link](#)] [[arXiv](#)].
- [P11] 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

- [P12] **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](#)]
- [P13] 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](#)]
- [P14] **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](#)].
- [P15] 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](#)].
- [P16] **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](#)].
- [P17] **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](#)].

## Invited Talks

- [1] **Best Subset Selection in Regression Models**  
IMS APRM ..... University of Melbourne, Jan 2024
- [2] **Group Variable Selection via Unconstrained Continuous Optimization**  
Australian Statistical Society.....University of Wollongong, Dec 2023

- [3] **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
- [4] **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
- [5] **Partial Rejection Sampling for Markov Random Fields**  
Annual Meeting of Australian Mathematical Society ..... Online, 2022
- [6] **Best Subset Selection via Continuous Optimization**  
Statistical Society of Australia, Sydney ..... University of Sydney, 27 April 2022
- [7] **Graph Coloring via Partial Rejection Sampling**  
AustMS ..... Online, 2021
- [8] **Rare-Event Simulation for Random Geometric Graphs**  
AustMS ..... Online, 2020
- [9] **Importance Sampling Based Rare-event Simulation for Gilbert Graphs**  
ACEMS Annual Retreat ..... Online, 2020
- [10] **Perfect Sampling and Unbiased Estimation for Gibbs Point Processes**  
Mathematisches Kolloquium [[link](#)] ..... University of Ulm, Ulm, Germany, 2019
- [11] **Unbiased Estimation of the Reciprocal Mean for Non-negative Random Variables with Applications**  
Monte Carlo Methods and Applications [[link](#)] ..... UNSW, Sydney, Australia, 2019
- [12] **Unbiased Estimation of the Reciprocal Mean for Non-negative Random Variables**  
INFORMS Applied Probability Society [[link](#)] ..... Brisbane, Australia, 2019
- [13] **Perfect Sampling for Gibbs Point Processes Using Partial Rejection Sampling (extended results)**  
AustMS Meeting ..... University of Adelaide, Adelaide, Australia, 2018
- [14] **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
- [15] **Importance Sampling Based Unbiased Estimation for Hard-core Models**  
ACEMS Workshop on Multiscale Models [[link](#)] Monash University, Melbourne, Australia, 2018
- [16] **Combined Acceptance-rejection and Importance Sampling Methodologies for Perfect Sampling from Gibbs Point Processes**  
INFORMS Annual Meet [[link](#)] ..... Houston, Texas, USA, 2017

## Teaching Experience

Upcoming:

- [17] **Data Mining and Machine Learning** ..... Term 2, 2024  
The University of New South Wales, Australia.
- [18] **Data Science Project** ..... Term 3, 2024  
The University of New South Wales, Australia.

Past:

- [1] **Data Mining and Machine Learning** ..... Term 2, 2023  
The University of New South Wales, Australia.
- [2] **Data Science Project** ..... Term 3, 2023  
The University of New South Wales, Australia.
- [3] **Statistical Inference** ..... Sem 2, 2022  
Macquarie University, Australia.
- [4] **The Mathematical Engineering of Deep Learning** ..... AMSI Summer School, 2021  
Adelaide, Australia. [\[Link\]](#)
- [5] **Problems & Applications in Modern Statistics (STAT3500/7500)** ..... Sem 2, 2020  
The University of Queensland, Brisbane, Australia.
- [6] **Problems & Applications in Modern Statistics (STAT3500/7500)** ..... Sem 2, 2019  
The University of Queensland, Brisbane, Australia.
- [7] **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.
- [8] **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.
- [9] **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.

## Conferences/Workshops (Co-)organized

### Upcoming:

- [1] EcoStat2024, Session on *Applied Probability and Optimisation Methods in Data Science*, 17 - 19 July, 2024, Beijing, China. [\[Link\]](#)

### Past:

- [1] Mathematical Engineering of Deep Learning – Part 1: Foundations, 20 Apr 2023. Jointly with Prof. Liqueur-Weiland. [\[Link\]](#)
- [2] The 25th International Congress on Modelling and Simulation (MODSIM2023), 9 - 13 July 2023. Organization of the session on *Applied Probability and Optimisation Methods in Data Science*. [\[Link\]](#)
- [3] A Crash Course on Using Machine Learning Methods Effectively in Practice, 22 November 2022. [\[Link\]](#)
- [4] The 20th INFORMS Applied Probability Society Conference, Brisbane, 3-5 July, 2019. Jointly with A/Prof. Nazarathy et al. [\[link\]](#).
- [5] Workshop on Applied Probability, March 31 - April 02, 2017, TIFR, Mumbai. Jointly with Prof. Juneja.
- [6] Tutorial and Workshop on Learning and Related Probabilistic Applications, Feb 25-26, 2015, TIFR, Mumbai. Jointly with Prof. Juneja.
- [7] Tutorial and Workshop on Applications of Game Theory, May 03-04, 2013, TIFR, Mumbai. Jointly with Prof. Juneja.

## 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] **Ava Vahedi, Masters**, School of Mathematics and Statistics, UNSW. On *Partial Rejection Sampling for Graph Coloring*
- [3] **Hongyu Xu, Masters**, School of Mathematics and Statistics, UNSW. On *Rating Players of CS:GO Based on Plus/Minus Score*
- [4] **Seungjoo Lee (Eric), Honors**, School of Mathematics and Statistics, UNSW. On *Model Pruning in Deep Learning*
- [5] **Hua Hu (Yang), Honors**, School of Mathematics and Statistics, UNSW. On *Best Subset Selection in Linear Regression*

### Graduated

- [1] **Teo Nguyen, PhD**, School of Mathematical and Physical Sciences, Macquarie University. Jointly with Prof. Benoit Lique. On *Developing Methods for Model Selection in High-dimensional Setup*. Starting from 2 September 2022.

## Mentorship

- [1] Dr Farzaneh Boroumand in the School of Mathematical and Physical Sciences at Macquarie University.
- [2] Mentored 18 economically under-privileged undergrad students through Freedom Employability Academy in building their career plans.

## Other Professional 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. Basavarajiah, and B. N. Murthy.

### Thesis Review

- [1] PhD thesis on *Reinforcement Learning for Partially Observable Environments* by Jun Ju from the School of Mathematics and Physics at The University of Queensland.
- [2] Master Thesis on *Modelling and Control of Epidemics Spread: Safe Blues Simulation* by Sihon Qiu from the Department of Statistics, The University of Auckland.

### Journals Refereed

- [1] Annals of Operational Research
- [2] Computational Statistics and Data Analysis
- [3] MDPI Mathematics
- [4] Methodology and Computing in Applied Probability
- [5] Biostatistics.
- [6] INFORMS Journal on Computing.
- [7] Environmental Modeling & Assessment, Springer Journal.

- [8] Australian & New Zealand Journal of Statistics.
- [9] 4OR - A Quarterly Journal of Operations Research, Springer.
- [10] Stochastic Models.
- [11] ACM Transactions on Modeling and Computer Simulation (TOMACS).

## Programming Languages

C, Python, Matlab, R.

## Fundings and Award

### Current

- [1] Estimating the Number of Tyres in Stockpiles. Project commissioned by *Environmental Protection Authority (EPA) Victoria*. Value: A\$39,900.

### Past

- [1] ACEMS International Mobility Programme funding for the collaboration research with the University of Ulm. Value: A\$8,887.
- [2] First Prize in ACEMS Sampling and Exploration Competition, 2017 (Research Fellow Category). Value: A\$1,200.
- [3] International Travel Support (2015), Science and Engineering Research Board, Department of Science, India. Value: A\$3,500.

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UNSW, Sydney, AUSTRALIA, April 15, 2024