Sarat Babu Moka

Curriculum Vitae
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Lecturer (Tenure Track)
School of Mathematics and Statistics
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Biography

My research and teaching interests span across Deep Learning, Machine Learning, Probability Theory, and Statistics. 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 Commincations. 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 **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

Research Publications

In Review

[R1] Liquet-Weiland, B., **Moka, S. B.**, and Muller, S. *"Best Subset Selection for Linear Dimension Reduction Models using Continuous Optimization"*. Submitted to *Biometrical journal*.

2024

[P1] **Moka, S. B.**, 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"*, Winter Simulation Conference 2023 [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 and before

[P12] **Moka, S. B.**, Juneja, S., and Kroese, D. (2019)"Unbiased Estimation of the Reciprocal Mean for Non-negative Random Variables", **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", **Winter Simulation Conference**, Washington DC. IEEE, 643-654 [link].

Book Writing

[B1] **The Mathematical Engineering of Deep Learning**. Jointly with Prof. Liquet (Macquarie University) and A/Prof. Nazarathy (University of Queensland).
Visit https://deeplearningmath.org/ for draft chapters of the book.

Invited Talks

[1] **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, 2023

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

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

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

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

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

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

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

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

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

[11] **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

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

[13] **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:

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

Past:

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

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

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

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

[5] **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.

[6] **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.

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

Past:

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

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

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

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

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

Supervision of Students

Current

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

[2] **Anant Mathur, PhD**, School of Mathematics and Statistics, the University of New South Wales (UNSW). Jointly with Dr. Zdravko Botev. On *Computational Statistics and Data Science*.

Past

[1] **5 intern students of Bachelor of Technology** at the Indian Space Research Organization, India, 2008. On *Developing Impedance Measuring Techniques for Long Communication Copper Cables*.

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.

Journals Refereed

[1] Biostatistics.

[2] INFORMS Journal on Computing.

[3] Environmental Modeling & Assessment, Springer Journal.

[4] Australian & New Zealand Journal of Statistics.

[5] 4OR - A Quarterly Journal of Operations Research, Springer.

[6] Stochastic Models.

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

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 Sihan Qiu from the Department of Statistics, The University of Auckland.

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.

Macquarie University, Sydney, AUSTRALIA, February 20, 2024