

Chaman Kumar, Associate Professor

CONTACT INFORMATION

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Indian Institute of Technology Roorkee
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RESEARCH INTERESTS

Well-posedness and numerical approximations of McKean–Vlasov stochastic differential equations (SDEs), SDEs with delays, SDEs with Markovian switching, Lévy processes.

PUBLICATIONS

[13] S. Biswas, C. Kumar, Neelima, G. dos Reis, C. Reisinger (2024). An explicit Milstein-type scheme for interacting particle systems and McKean–Vlasov SDEs with common noise and non-differentiable drift coefficients, *Annals of Applied Probability*, 34 (2), 2326–2363. DOI: 10.1214/23-AAP2024.

[12] D. Vashistha and C. Kumar (2024). Milstein Scheme for Stochastic Differential Equation with Markovian Switching and Lévy Noise, *Journal of Mathematical Analysis and Applications*, 536, 128175. DOI: 10.1016/j.jmaa.2024.128175.

[11] C. Kumar, Neelima, C. Reisinger and W. Stockinger (2022). Well-posedness and tamed schemes for McKean–Vlasov Equations with Common Noise, *Annals of Applied Probability*, 32(5), 3283–3330. DOI: DOI:10.1214/21-AAP1760.

[10] C. Kumar and Neelima (2021). On Explicit Milstein-type Scheme for McKean–Vlasov Stochastic Differential Equations with Super-linear Drift Coefficient, *Electronic Journal of Probability*, 26 (111), 1–32. DOI: 10.1214/21-EJP676 (Impact Factor: 1.134).

[9] C. Kumar and T. Kumar (2021). A Note on Explicit Milstein-Type Scheme for Stochastic Differential Equation with Markovian Switching, *Journal of Computational and Applied Mathematics*, 395, 113594. DOI:10.1016/j.cam.2021.113594.

[8] C. Kumar (2021). On Milstein-type schemes of SDE driven by Lévy noise with super-linear diffusion coefficients, *Discrete and Continuous Dynamical Systems - Series B*, 26(3), 1405–1446. DOI: 10.3934/dcdsb.2020167.

[7] C. Kumar and T. Kumar (2020). On explicit tamed Milstein-type scheme for stochastic differential equation with Markovian switching, *Journal of Computational and Applied Mathematics*, 377, 112917. DOI: 10.1016/j.cam.2020.112917.

[6] C. Kumar and S. Sabanis (2019). On Milstein approximations with varying coefficients: the case of super-linear diffusion coefficients, *BIT Numerical Mathematics*, 59(4), 929–968. DOI: 10.1007/s10543-019-00756-5.

[5] Huy N. Chau, C. Kumar, M. Rásonyi and S. Sabanis (2019). On fixed gain recursive estimators with discontinuity in the parameters, *ESAIM: Probability and Statistics*, 23, 217–244. DOI 10.1051/ps/2018019.

[4] C. Kumar and S. Sabanis (2017). On Explicit Approximations for Lévy Driven SDEs with Superlinear Diffusion Coefficients, *Electronic Journal of Probability*, 22, 1–19. DOI: 10.1214/17-EJP89.

[3] C. Kumar and S. Sabanis (2017). On tamed Milstein scheme of SDEs driven by Lévy noise, *Discrete and Continuous Dynamical Systems-Series B*, 22(2), 421–463. DOI:

10.3934/dcdsb.2017020.

[2] K. Dareiotis, C. Kumar and S. Sabanis (2016). On tamed Euler approximations of SDEs driven by Lévy noise with application to delay equations, *SIAM Journal on Numerical Analysis*, 54(3), 1840-1872. DOI: 10.1137/151004872.

[1] C. Kumar and S. Sabanis (2014). Strong convergence of Euler approximations of stochastic differential equations with delay under local Lipschitz condition, *Stochastic Analysis and Applications*, 32(2), 207-228. DOI: 10.1080/07362994.2014.858552.

Click here for google scholar page. **h-index:** 11. **i10-index:** 11. **Citations:** 367.

PREPRINTS

[3] T. Kumar and C. Kumar (2023). Tamed Explicit Scheme of Order 2.0 for Stochastic Differential Equations with Super-linear Drift and Diffusion Coefficients, *Working Paper*.

[2] T. Kumar and C. Kumar (2022). On Itô-Taylor expansion for stochastic differential equations with Markovian switching and its application in $\gamma \in \{n/2 : n \in \mathbb{N}\}$ -order scheme, <https://arxiv.org/abs/2211.11657>,.

[1] Neelima, S. Biswas, C. Kumar, G. dos Reis and C. Reisinger (2020). Well-posedness and tamed Euler schemes for McKean–Vlasov equations driven by Lévy noise, Preprint, [arXiv:2010.08585\[math.PR\]](https://arxiv.org/abs/2010.08585).

PhD Thesis Supervised

- Tejinder Kumar (Completed).

Initial Date of Registration : 07 July 2017.

Submission Date : 30 Jan 2023.

Thesis Defence Date : 9 May 2023.

External Examiner: Prof. Michael Tretyakov, School of Mathematical Sciences of the University of Nottingham, United Kingdom.

Title: Itô–Taylor Expansion and Explicit Numerical Schemes for Stochastic Differential Equations with Markovian Switching.

- Sani Biswas (Completed).

Initial Date of Registration : 05 July 2018.

Submission Date : 19 December 2023.

Thesis Defence Date : 24 June 2024.

External Examiner: Prof. Peter Tankov, ENSAE, Institut Polytechnique de Paris, France.

Title: Well-posedness and Explicit Numerical Schemes for McKean-Vlsov Stochastic Differential Equations.

- Divyanshu Vashistha (Ongoing)

- Raj Karan Gupta (Ongoing)

- Megha Dhiman (Ongoing)

COLLABORATORS

- Christoph Reisinger, Professor, University of Oxford, United Kingdom.

- Gonçalo dos Reis, Associate Professor (Reader), University of Edinburgh, United Kingdom.

- Sotirios Sabanis, Professor, University of Edinburgh, United Kingdom.

- Miklós Rósonyi, Reader, MTA Alfréd Rényi Institute of Mathematics, Hungary.

- Konstantinos Dareiotis, Lecturer, University of Leeds, United Kingdom.

- Neelima, Associate Professor, Ramjas College, University of Delhi, India.

- Châu Ngọc Huy, Lecturer, Department of Mathematics,, University of Manchester, Manchester, United Kingdom.
- Tejinder Kumar, former PhD student, Indian Institute of Technology Roorkee
- Sani Biswas, PhD student, Indian Institute of Technology Roorkee.
- Wolfgang Stockinger, former PhD student, University of Oxford, United Kingdom.
- Divyanshu Vashishtha, PhD student, Indian Institute of Technology Roorkee.

ACADEMIC EXPERIENCE

Indian Institute of Technology Roorkee, Roorkee, Uttarakhand
Associate Professor **March 2024 - till date**
Assistant Professor **Nov 2016 - March 2024**

University of Edinburgh, Edinburgh, United Kingdom
Whittaker Research Fellow in Stochastic Analysis **June 2016 - Nov 2016**

Indian Statistical Institute Delhi Center, Delhi, India
Visiting Scientist **Nov 2015 - May 2016**

University of Delhi, Delhi, India
Lecturer in Statistics, Ramjas College **Aug 2006 - Sep 2012**
Temporary Lecturer in Statistics, Lady Shri Ram College for Women **Jul - Aug 2006**
Ad-hoc Lecturer in Statistics, Ramlal Anand College **Jul 2005 - Mar 2006**

EDUCATION

University of Edinburgh, Edinburgh, United Kingdom.
 PhD Probability and Stochastic Analysis (Award: 22 July 2015, Graduation: 26 November 2015):

- Thesis Title: “Explicit Numerical Schemes of SDEs Driven By Lévy Noise with Super-Linear Coefficients and Their Applications to Delay Equations”.
- Principal Advisor: Dr. Sotirios Sabanis, Reader, School of Mathematics, University of Edinburgh, United Kingdom.
 Assistant Advisor: Prof. István Gyöngy, Professor of Probability and Fellow of Royal Society of Edinburgh (FRSE), School of Mathematics, University of Edinburgh, United Kingdom.
- Courses: Pure Analysis (Grade A), Statistics (Grade A), Probability (Grade A).

MSc Financial Mathematics, November 2011 (passed with *distinction*):

- Dissertation Title: “Bounds for Arithmetic Asian Option Prices”.
- Advisor: Dr. Sotirios Sabanis, Reader, School of Mathematics, University of Edinburgh, United Kingdom.

University of Delhi, Delhi, India.
 MPhil, Statistics, July 2004 (passed with *distinction*).
 MSc, Statistics, July 2002.
 BSc (Hons.), Statistics, July 2000.

RESEARCH VISITS

July 2018:
Host: Prof. Peter Tankov, Professor of Quantitative Finance, ENSAE, ParisTech, 5, Avenue Henry Le Chatelier-91120 Palaiseau, Paris, France.
Financial Support : Local expenses by ENSAE, Paris (host institution) and travel expenses from PDA of IIT Roorkee.

June-July 2018:
Host: Dr David Siska, Lecturer, School of Mathematics, University of Edinburgh, Edin-

burgh, United Kingdom.

Financial Support: PDA of IIT Roorkee.

Activities: I worked on major revision of my joint work with S. Sabanis titled '*On Milstein approximations with varying coefficients: the case of super-linear diffusion coefficients*', which is now published in *BIT Numerical Mathematics* (2019). I learned basics of stochastic partial differential equations (SPDEs) through very helpful discussions with my host Dr David Siska.

June-July 2017:

Host: Dr David Siska, Lecturer, School of Mathematics, University of Edinburgh, Edinburgh, United Kingdom.

Financial Support: PDA of IIT Roorkee.

Activities: I wrote one single author research paper titled '*Milstein-type schemes of SDE driven by Lévy Noise with super-linear diffusion coefficients*' during this research visit which is now published in *Discrete and Continuous Dynamical System-Series B* (2020). I also worked on major revision of my joint work with S. Sabanis titled '*On Explicit Approximations for Lévy Driven SDEs with Super-linear Diffusion Coefficients*' which is now published in *Electronic Journal of Probability* (2017).

June-August 2016: 3 visits each of one week

Host: Dr Sotirios Sabanis, Turing Fellow, Alan Turing Institute, London, United Kingdom.

Financial Support: Alan Turing Institute, London (host institution).

Activities: I wrote a research paper jointly with H. N. Chau, M. Rásonyi and S. Sabanis titled '*On fixed gain recursive estimators with discontinuity in the parameter*' which is now published in *ESAIM: Probability and Statistics* (2019).

ONGOING PROJECTS *Title: Generalization of Stochastic-Taylor Expansion and Applications*

Funding Agency: Core Research Grant, Science and Engineering Research Board (SERB).

Amount: ₹2,163,750

Duration: Feb 2024 to Feb 2027 (3 years).

Title: Regime switching stochastic differential equations and their numerical studies.

Funding Agency: National Board of Higher Mathematics.

Amount: 16, 52, 400 including a JRF and overhead cost.

Duration: Oct 2023 to Oct 2026 (three years).

COMPLETED PROJECTS

Title: Higher order approximation of stochastic differential equation.

Funding Agency: Mathematical Research Impact Centric Support (MATRICS), Science and Engineering Research Board (SERB).

Amount: 6 lacs (2 lacs/annum) + overhead cost of 60 thousands (20 thousand/annum).

Duration: March 2019 to March 2022 (three years).

Progress: I have written four papers so far under the project, one of them (with Neelima, C. Reisinger and W. Stockinger) is accepted for publication in the *Annals of Applied Probability* (2022), another one (with Neelima) is published in the *Electronic Journal of Probability* (2021) and two of them (with T. Kumar) are published in the *Journal of Computational and Applied Mathematics* (2020, 2021).

Title: GIAN Course on Numerical Methods for Stochastic Differential Equations.

Funding Agency: Ministry of Education, Government of India.

Amount: 9.12 Lakh.

Duration: 09-01-2023 to 17-01-2023.

Venue: Indian Institute of Technology Roorkee, Roorkee.

Foreign Expert: Prof. Michael Tretyakov.

Affiliation: Professor of Mathematics, Faculty of Science, Room C04, Mathematical Sciences University Park, Nottingham, NG7 2RD, United Kingdom.

Title: GIAN Course on Jump Processes in Risk Management.

Funding Agency: Ministry of Education, Government of India.

Amount: 5.44 Lakh.

Duration: 17 – 21 December 2018.

Venue: Indian Institute of Technology Roorkee, Roorkee.

Foreign Expert: Prof. Peter Tankov.

Affiliation: Professor of Quantitative Finance, ENSAE ParisTech 5, avenue Henry Le Châtelier - 91120 Palaiseau, France.

TALKS & POSTER
PRESENTATIONS

An explicit first-order approximation of interacting particle system with common noise and non-differentiable drift coefficient, Manchester University, UK, 13 Dec 2023.

Well-posedness and tamed scheme for McKean–Vlasov stochastic differential equations, *One World Stochastic Numerics and Inverse Problems*, online, United Kingdom, May 10, 2023. (Invited)

Well-posedness and tamed schemes for distribution dependent SDEs, *National Conference on Applied Mathematics and Numerics*, 8-10 March 2023, Mar Ivanios College (Autonomous) and Indian Institute of Space Science and Technology Thiruvananthapuram, India (Invited).

Well-posedness and Euler scheme for McKean–Vlasov SDE with super-linear coefficients, *Summer School to the 10th International Conference on Lévy Processes*, 16-17 July 2022, Mannheim, Germany.

Tamed Milstein-type scheme for the McKean–Vlasov SDEs, *The 9th International Colloquium on BSDEs and Mean Field Systems*, 27 June to 1 July 2022, Annecy, France.

Remark: I have also co-organized a special session with Gonçalo dos Reis (University of Edinburgh, UK) on ‘Numerical methods for nonlinear McKean–Vlasov SDEs’ during the colloquium.

Explicit Milstein-type Scheme for McKean–Vlasov Stochastic Differential Equations with Super-linear Coefficients, *Bernoulli–IMS One World Symposium*, 24 – 28 August, 2020 (pre-recorded talk).

On Milstein approximations with varying coefficients: the case of super-linear diffusion coefficients, *National Conference on Stochastic Differential Equations and Applications*, IIST Trivandrum, 6–7 June, 2019 (invited speaker).

On tamed Euler approximations of SDEs driven by Lévy noise with applications to delay equations, *Indian Statistical Institute Kolkata*, 22 April, 2019.

Towards higher order explicit scheme for SDE with super-linear coefficients, *Lectures in Probability and Stochastic Processes XIII*, Indian Statistical Institute Bangalore, 07 – 11 December, 2018 (invited short talk).

Explicit Milstein schemes of SDEs: the case of super-linear coefficients, *3rd Barcelona Summer School on Stochastic Analysis*, Centre de Recerca Matemàtica, Bellaterra, 27 June – 1 July 2016 (contributed talk).

On tamed Euler approximations of SDEs driven by Lévy noise with application to delay equations, *Indian Institute of Technology, Roorkee, India*, 27 April 2016.

Explicit schemes with varying coefficients of SDEs: the case of super-linear coefficients, *Indian Institute of Technology, Guwahati, India*, 11 March 2016.

Explicit approximations with varying coefficients: the case of super-linear coefficients, *Indian Institute of Science Education and Research, Mohali, India*, 19 February 2016.

Tamed Euler schemes of SDEs (SDDEs) driven by Lévy noise, *Indian Statistical Institute, Delhi Center, India*, 5 September 2015 (invited talk).

Explicit numerical schemes of SDEs driven by Lévy noise with super-linear coefficients and their applications to delay equations, *Ruhr-Universität Bochum, Germany*, 8 July 2015 (invited talk).

On tamed Milstein scheme of SDEs driven by Lévy noise, *Oxford's SIAM Conference, Mathematical Institute, University of Oxford, UK*, 26 February 2015 (contributed talk).

On tamed Euler schemes of SDEs driven by Lévy noise with application to delay equations, *3rd SIAM National Student Chapter Conference, Mathematical Institute, University of Oxford, UK*, 28 May 2014 (poster presentation).

Moment estimates of SDEs, *Probability Working Seminar, University of Edinburgh, UK*, Feb – March 2014.

Numerical approximations of SDEs, *Annual meeting of the probability groups of the Maxwell Institute for the Mathematical Sciences, International Centre for Mathematical Sciences, Edinburgh, UK*, 6 December 2013 (invited talk).

Numerical techniques for SDEs with random coefficients and jumps, *Summer School on Numerical Methods for Stochastic Differential Equations, Vienna University of Technology, Vienna, Austria*, 2–4 September 2013 (contributed talk).

BMO martingales and related Inequalities, *Probability Working Seminar, University of Edinburgh, UK*, March 2012.

HONOURS & AWARDS

Whittaker Research Fellow in Stochastic Analysis, School of Mathematics, University of Edinburgh, UK, June – Nov 2016.

PhD Scholarship from the School of Mathematics, University of Edinburgh, UK covering full overseas tuition fees and living expenses, Sep 2011 – Feb 2015.

MSc Scholarship from the Universität 21 covering full overseas tuition fees and living expenses to pursue MSc Financial Mathematics at the University of Edinburgh, UK, Sep 2010 – Aug 2011.

Junior Research Fellowship (NET) from CSIR, India, 2005.

Grants awarded for National Conference on Stochastic Differential Equations and Applications (IIST, Trivendrum), Advances in Applied Probability (ICTS, Bangalore), 3rd Barcelona Summer School on Stochastic Analysis (Centre de Recerca Matemàtica, Bellaterra), Indo-UK Workshop on Stochastic Partial Differential Equations (IISc, Bangalore), Lectures on Probability and Stochastic Processes X (IISc, Bangalore), Oxford's SIAM Conference (Oxford University), 14th Winter School on Mathematical Finance (Congesentrum

De Werelt, Lunteren), Statistical Inference for Lévy Processes (Lorentz Center, Lieden), From Microscopic Randomness to Macroscopic Phenomena (UK Probability Meeting 2014, Imperial College), 2nd Barcelona Summer School on Stochastic Analysis (Centre de Recerca Matemàtica, Bellaterra), 3rd SIAM National Student Chapter Conference (Oxford University), Summer School on Numerical Methods for Stochastic Differential Equations (Vienna University of Technology), LMS-EPSRC Short Course (Spring School): Common Themes in Financial and Actuarial Mathematics (University of Liverpool).

COMPUTING SKILLS

- Statistical Packages: R, some experience with SAS and SPSS.
- Languages: C, C++, FORTRAN, MPI, OPENMPI.