List of topics for midterm projects

APMA 2811Z, Fall 2019

Topic I: Stabilization or destabilization

- Stabilization of ODEs

- Stochastic stabilization and destabilization By XuerongMao, Systems & Control Letters Volume 23, Issue 4, October 1994, Pages 279-290 https://doi.org/10.1016/0167-6911(94)90050-7
- Stabilization and Destabilization of Nonlinear Differential Equations by Noise By John A. D. Appleby ; Xuerong Mao ; Alexandra Rodkina https://ieeexplore.ieee.org/document/4484185/authors#authors
- Stochastic stabilization and destabilization of nonlinear differential equations By LirongHuang , Systems & Control Letters, Vol 62, Issue 2, February 2013, Pages 163-169 https://doi.org/10.1016/j.sysconle.2012.11.008

- Neural SDE: Stabilizing Neural ODE Networks with Stochastic Noise by Xuanqing Liu, Tesi Xiao, Si Si, Qin Cao, Sanjiv Kumar, Cho-Jui Hsieh https://arxiv.org/abs/1906.02355
- Neural Stochastic Differential Equations: Deep Latent Gaussian Models in the Diffusion Limit by Belinda Tzen, Maxim Raginsky https://arxiv.org/abs/1905.09883

- Stabilization of PDEs

- On stabilization of partial differential equations by noise by T Caraballo, K Liu, X Mao - Nagoya Mathematical Journal, 2001 https://doi.org/10.1017/S0027763000022169
- Stabilisation of linear PDEs by Stratonovich noise by Tomás Caraballoa and James C. Robinson https://doi.org/10.1016/j.sysconle.2004.02.020

- Regularization by Noise in Ordinary and Partial Differential Equations
https://impa.br/wp-content/uploads/2017/08/31CBM_07.pdf

- Stabilization of Navier–Stokes Flows

https://link.springer.com/chapter/10.1007/978-0-85729-043-4_3

Topic II: Numerical methods for SDEs

⌑ Runge-Kutta methods

- High strong order explicit Runge-Kutta methods for stochastic ordinary differential equations by P.M.Burrage, Volume 22, Issues 1–3, November 1996, Pages 81-101, Applied Numerical Mathematics https://doi.org/10.1016/S0168-9274(96)00027-X

- Numerical Methods for Second-Order Stochastic Differential Equations By Kevin Burrage, Ian Lenane, and Grant Lythe https://doi.org/10.1137/050646032

- Order Conditions of Stochastic Runge--Kutta Methods by B-Series By K. Burrage and P. M. Burrage SIAM J. Numer. Anal., 38(5), 1626–1646. (21 pages) https://doi.org/10.1137/S0036142999363206

- Runge–Kutta Methods for the Strong Approximation of Solutions of Stochastic Differential Equations by Andreas Rößler SIAM J. Numer. Anal., 48(3), 922–952. https://doi.org/10.1137/09076636X

- General order conditions for stochastic Runge-Kutta methods for both commuting and non-commuting stochastic ordinary differential equation systems by P.M.Burrage, Applied Numerical Mathematics Volume 28, Issues 2–4, October 1998, Pages 161-177 https://doi.org/10.1016/S0168-9274(98)00042-7

⌑ Backward differentiation formula for SDEs

- Multistep methods for SDEs and their application to problems with small noise By Evelyn Buckwar and Renate Winkler https://epubs.siam.org/doi/abs/10.1137/040602857

- Improved linear multi-step methods for stochastic ordinary differential equations By Evelyn Buckwar and RenateWinkler https://doi.org/10.1016/j.cam.2006.03.038

- Multistep methods for SDEs and their application to problems with small noise by Evelyn Buckwar and Renate Winkler https://epubs.siam.org/doi/10.1137/040602857

¤ Structure-preserving schemes for SDEs

- Convergence of numerical methods for stochastic differential equations in mathematical finance by Peter Kloeden and Andreas Neuenkirch https://doi.org/10.1142/9789814436434_0002

- Quasi-symplectic methods for Langevin-type equations by G. N. Milstein, M. V. Tretyakov, IMA Journal of Numerical Analysis, Volume 23, Issue 4, 2003, Pages 593–626, https://doi.org/10.1093/imanum/23.4.593

- A Gentle Stochastic Thermostat for Molecular Dynamics https://link.springer.com/article/10.1007/s10955-009-9734-0

- Stochastic variational integrators by Nawaf Bou-Rabee and Houman Owhadi https://ieeexplore.ieee.org/abstract/document/8160997

¤ Stability theory of numerical methods for SDEs

- Towards a Systematic Linear Stability Analysis of Numerical Methods for Systems of Stochastic Differential Equations by Evelyn Buckwar and Cónall Kelly SIAM J. Numer. Anal., 48(1), 298–321. https://doi.org/10.1137/090771843
- Almost sure asymptotic stability analysis of the θ-Maruyama method applied to a test system with stabilising and destabilising stochastic perturbations By Gregory Berkolaiko, Evelyn Buckwar, Cónall Kelly and Alexandra Rodkina https://doi.org/10.1112/S1461157012000010

¤ Wong-Zakai approximation

W.-R. Cao, Z. Zhang, and G. E. Karniadakis. Numerical methods for stochastic delay differential equations via Wong-Zakai approximation. SIAM J. Sci. Comput., 37(1): A295-A318, 2015.

¤ Weak convergence

- Weak Convergence Rate of a Time-Discrete Scheme for the Heston Stochastic Volatility Model by Chao Zheng SIAM J. Numer. *Anal.*, 55(3), 1243–1263. https://doi.org/10.1137/16M1060315

- Rate of convergence and asymptotic error distribution of Euler approximation schemes for fractional diffusions by Yaozhong Hu, Yanghui Liu, and David Nualart
  https://projecteuclid.org/euclid.aoap/1458651830
- Convergence of the Euler scheme for a class of stochastic differential equation by G Marion, X Mao, E Renshaw
  https://pdfs.semanticscholar.org/0dcc/3c76e29762321ed57ed316b2e01528714864.pdf
- Bally, V. and Talay, D. (1996). The law of the Euler scheme for stochastic differential equations(I): convergence rate of the distribution function, *Probability Theory and Related Fields*, 102, 43–60.

(II) convergence rate of the density function, Monte Carlo Methods and Applications, 1996

- The Euler scheme for stochastic differential equations: error analysis with Malliavin calculus (May skip this one as advanced stochastic calculus is needed.) VladBally andDenisTalay

https://doi.org/10.1016/0378-4754(93)E0064-C

- Other important numerical methods: stochastic Hamiltoninian systems (quasi-symplectic methods, Hamiltonian Monte Carlo methods), numerical stochastic dynamical systems such as invariant measures, simulation of rare events

¤ Some introductory papers on numerical SDEs:

- Matlab: An Algorithmic Introduction to Numerical Simulation of stochastic differential equations by DJ Higham
  https://epubs.siam.org/doi/pdf/10.1137/S0036144500378302

- Methods: A brief introduction to numerical analysis of (ordinary) stochastic differential equations without tears by Schurz, Henri (1999), IMA Preprints Series [2486] Series/Report Number 1670
  http://hdl.handle.net/11299/5032

Topic III: Nonlinear SDEs

- A Fundamental Mean-Square Convergence Theorem for SDEs with Locally Lipschitz Coefficients and Its Applications By M. V. Tretyakov and Z. Zhang https://doi.org/10.1137/120902318

- On a perturbation theory and on strong convergence rates for stochastic ordinary and partial differential equations with non-globally monotone coefficients by M Hutzenthaler, A Jentzen
  https://arxiv.org/abs/1401.0295
- Asymptotic error distributions for the Euler method for stochastic differential equations by Jean Jacod and Philip Protter
- The truncated Euler–Maruyama method for stochastic differential equations by X Mao - Journal of Computational and Applied Mathematics, 2015
  -- Convergence rates of the truncated Euler–Maruyama method for stochastic differential equations by XuerongMao
  https://doi.org/10.1016/j.cam.2015.09.035

¤ Holder continuous coefficients

- Euler scheme for SDEs with non-Lipschitz diffusion coefficient: strong convergence by Abdel Berkaoui , Mireille Bossy and Awa Diop DOI: https://doi.org/10.1051/ps:2007030

- High order discretization schemes for the CIR process: application to affine term structure and Heston models by A Alfonsi - Mathematics of Computation, 2010
  https://www.ams.org/journals/mcom/2010-79-269/S0025-5718-09-02252-2/

- Functional limit theorems for additive and multiplicative schemes in the Cox--Ingersoll--Ross model by Yuliia Mishura, Yevheniia Munchak

https://arxiv.org/abs/1604.01584

- STRONG CONVERGENCE FOR EULER–MARUYAMA AND MILSTEIN SCHEMES WITH ASYMPTOTIC METHOD by HIDEYUKI TANAKA and TOSHIHIRO YAMADA https://doi.org/10.1142/S0219024914500149

- Monte Carlo Simulation with Asymptotic Method by Akihiko Takahashi, Nakahiro Yoshida https://doi.org/10.14490/jjss.35.171

Topic IV: Gaussian processes

¤ Simulation of Gaussian processes

- Simulation of Nonstationary Gaussian Processes by Random Trigonometric Polynomials by Mircea Grigoriu, Member, ASCE https://ascelibrary.org/doi/abs/10.1061/%28ASCE%290733-9399%281993%29119%3A2%28328%29

- Simulation of Multi-Dimensional Gaussian Stochastic Fields by Spectral Representation by Masanobu Shinozuka and George Deodatis
  Appl. Mech. Rev. Jan 1996, 49(1): 29-53

https://doi.org/10.1115/1.3101883

- Mixed-Stationary Gaussian Process for Flexible Non-Stationary Modeling of Spatial Outcomes

https://arxiv.org/pdf/1807.06656.pdf

- Stochastic partial differential equation based modelling of large space–time data sets by Fabio Sigrist, Hans R. Künsch and Werner A. Stahel https://doi.org/10.1111/rssb.12061

- Models for Continuous Stationary Space-Time Processes By Richard H. Jones and Yiming Zhang

https://link.springer.com/chapter/10.1007/978-1-4612-0699-6_25

- Think continuous: Markovian Gaussian models in spatial statistics

Author links open by DanielSimpson, Finn Lindgren and HåvardRue
https://doi.org/10.1016/j.spasta.2012.02.003

- How Deep Are Deep Gaussian Processes?

http://www.jmlr.org/papers/volume19/18-015/18-015.pdf

- Deep Spectral Kernel Learning

https://www.ijcai.org/proceedings/2019/0558.pdf

- Nonstationary Covariance Functions for Gaussian Process Regression by Christopher J. Paciorek and Mark J. Schervish

http://papers.nips.cc/paper/2350-nonstationary-covariance-functions-for-gaussian-process-regression.pdf

- Dependent Gaussian Processes by Phillip Boyle and Marcus Frean

http://papers.nips.cc/paper/2561-dependent-gaussian-processes.pdf

Topic V: Connection to PDEs

- A probabilistic representation for the vorticity of a three-dimensional viscous fluid and for general systems of parabolic equations by Barbara Busnello, Franco Flandoli and Marco Romito DOI:

https://doi.org/10.1017/S0013091503000506

- (Book) Functional Intergration and Partial Differential Equations by M. Freidlin, Annals of Math. Studies, Princeton Univ. Press, Princeton (1985)

Topic VI: SPDE with white noise, space-time white/color noise.

¤ Hyperbolic equations

- Well-posedness of the transport equation by stochastic perturbation https://link.springer.com/article/10.1007/s00222-009-0224-4
- Well-posedness by noise for scalar conservation laws by Benjamin Gess & Mario Maurelli https://doi.org/10.1080/03605302.2018.1535604
- INVARIANT MEASURES FOR NONLINEAR CONSERVATION LAWSDRIVEN BY STOCHASTIC FORCING by GUI-QIANG G. CHENPETER H.C. PANG

http://arxiv-export-lb.library.cornell.edu/pdf/1908.04879

- Passive scalar equation in a turbulent incompressible Gaussian velocity field by S V Lototskii and B L Rozovskii[1] https://iopscience.iop.org/article/10.1070/RM2004v059n02ABEH000719
- Conservation laws with a random source https://link.springer.com/article/10.1007/BF02683344
- Diffusion of passive scalars under stochastic convection, Physics of Fluids 6, 349 (1994); https://doi.org/10.1063/1.868089
- Statistics and geometry of passive scalars in turbulence, Physics of Fluids 17, 125107 (2005); https://doi.org/10.1063/1.2140024

¤ Parabolic equations

- Regularization by noise and flows of solutions for a stochastic heat equation, The Annals of Probability 47(1) 2016 10.1214/18-AOP1259

- Fully nonlinear stochastic partial differential equations by Pierre-Louis Lions and Panagiotis E.Souganidis https://doi.org/10.1016/S0764-4442(98)80161-4

- Sharp Space-Time Regularity of the Solution to StochasticHeat Equation Driven by Fractional-Colored Noise by Randall Herrell, Renming Song, Dongsheng Wu, and Yimin Xiao https://arxiv.org/pdf/1810.00066.pdf