National Conference on

STOCHASTIC DIFFERENTIAL EQUATIONS AND APPLICATIONS

CSDEA-19

Department of Mathematics
Indian Institute of Space Science and Technology
Thiruvananthapuram

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COMMITTEE | CONTACT

Organizers

- K. Sakthivel, IIST, Thiruvananthapuram
- Manil T. Mohan, IIT, Roorkee

Invited Speakers

- Suprio Bhar, IIT, Kanpur
- Imran Biswas, IISER, Kolkata
- V. S. Borkar, IIT, Bombay
- Ujjwal Koley, TIFR, Bangalore
- Suresh Kumar, IIT, Bombay
- Chaman Kumar, IIT, Roorkee
- Utpal Manna, IISER, Trivandrum
- B. Rajeev, ISI, Bangalore
- Sivaguru S. Sritharan, M.S. Ramaiah University of Applied Sciences, Bangalore

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CONTACT

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WELCOME

DEAR PARTICIPANT,

The purpose of this conference is to bring together the renowned experts working in stochastic differential equations and applications in various institutes of the country and exchange the current status of the field. Also, introduce the importance of SDEs to graduate students and state of the art methods and new results to research scholars on this field.

We wish you a fruitful and stimulating time at the conference, and hope you will enjoy your stay in Kerala!

The organizing committee

PREAMBLE

INTRODUCTION

The research area of Stochastic differential equations (SDE) has been one of the primary areas of applied mathematics for the last several decades providing fundamental tools for understanding the complex physical systems arising, for instance in, fluid dynamics, mathematical physics, statistical mechanics and finance etc., whose dynamics is subject to random fluctuations. One has to come up with most sophisticated tools from probability theory, functional analysis, partial differential equations etc., to understand the dynamical behaviour of these systems. This conference aims to cover but not limited to the following topics:

- **Solvability of SDEs**
- **Control and Stability of SDEs**
- **Optimal Control of SDEs**
- **Ergodic Theory of SDEs**
- **Large Deviation Theory of SDEs**
- **Numerical Analysis of SDEs**

SCHEDULE | THURSDAY, JUNE 6

Council Hall Administrative Block, IIST	**08:30 AM - 09:30 AM**	**Registration**	
	09:30 AM – 10:00 AM	**Inauguration**	
		Welcome Address	***Raju K George, Dean R&D, Sr.Professor, Department of Mathematics, IIST***
		Inaugural Address	***V.K. Dadhwal, Director, IIST***
		Keynote Address	***S. S. Sritharan, Vice-Chancellor, M S Ramaiah University of Applied Sciences, Bangalore***
		Vote of Thanks	***K. Sakthivel, Convener, NCSDEA-19, IIST***
	10:00 AM – 10:15 AM	**High Tea**	

Council Hall Administrative Block, IIST	**10:15 AM - 11:15 AM**	**Invited Talk** Chair: V.S. Borkar [1] *S. S. Sritharan*	*Hilbert's Sixth Problem.*
	11:15 AM - 12:15 PM	Chair: S. S. Sritharan [2] *V.S. Borkar*	*Small Noise Limits.*
	12:15 PM - 12:45 PM	**Contributed Talk** Chair: TG Deepak [1] *Akash Ashirbad Panda*	*Martingale Solutions of Nematic Liquid Crystals Driven by Pure Jump Noise in the Marcus Canonical Form.*
		[2] *Ravi Shankar*	*Risk Sensitive Portfolio Optimization With an Illiquid Asset Having Random Liquidation Time.*
	12:45 PM - 02:00 PM	**Lunch**	
	02:00 PM - 03:00 PM	**Invited Talk** Chair: Suprio Bhar [3] *Suresh Kumar*	*Nonzero Sum Risk-Sensitive Stochastic Differential Game.*
	03:00 PM - 03:15 PM	**Tea Break**	
	03:15 PM - 04:15 PM	**Invited Talk** Chair: Suresh Kumar [4] *Suprio Bhar*	*Mild Solutions For Stochastic Pdes in Infinite Dimensions.*
	04:15 PM - 05:30 PM	**Contributed Talk** Chair: Kaushik Mukherjee [3] *Shruthi Gopal*	*Large Deviations for Nonlocal Random Stochastic Functional Integral Equation.*
		[4] *K. Ravikumar*	*Existence and Stability Results of Nonlinear Impulsive Stochastic Functional Partial Integrodifferential Equations with Infinite Delay and Poisson Jumps.*
		[5] *Jothilakshmi G*	*Controllability Criteria of Fractional Langevin Delay Stochastic Differential Systems.*
		[6] *Gokila C*	*Stationary Distribution and Global Stability Analysis of a Stochastic Predator-Prey Model with Disease in the Prey.*
		[7] *Lata Lamani*	*Haar Wavelet Based Numerical Method for the Solution of Stochastic Integral Equations.*

SCHEDULE | THURSDAY, JUNE 6

Conference Room (313) Library Block, IIST	**04:15 PM - 05:30 PM**	**Contributed Talk** Chair: E Natarajan **[8]** *G. Amali Paul Rose*	*Large Deviations for a Stochastic Kuramoto-Sivashinsky Equation with Multiplicative Noise.*
		[9] *M. H. Kantli*	*Wavelet Preconditioned Method for the Numerical Solution of Stochastic Differential Equations.*
		[10] *Vivek Kumar*	*On a Generalized Stochastic Burgers' Equation Perturbed by Volterra Noise.*
		[11] *Mattuvarkuzhali. C*	*Exponential Stability Behaviour Analysis of Neutral Stochastic Fractional Integro-differential Equation with Poisson Jump and Impulsive Effects by using Mainardi's Function.*
		[12] *Trisha Maitra*	*Asymptotic Theory of Bayes Factor in Stochastic Differential Equations with Increasing Number of Individuals.*

SCHEDULE | FRIDAY, JUNE 7

Council Hall Administrative Block, IIST	**09:00 AM - 10:00 AM**	**Invited Talk** Chair: Raju K George **[5]** *B. Rajeev*	*The Monotonicity Inequality.*
	10:00 AM - 11:00 AM	Chair: Imran Biswas **[6]** *Ujjwal Koley*	*On a Fractional Conservation Laws with Noise.*
	11:00 AM - 11:15 AM	**Tea Break**	
	11:15 AM - 12:15 PM	**Invited Talk** Chair: Ujjwal Koley **[7]** *Imran Biswas*	*Stochastic Conservation Laws: Path-wise Uniqueness and Stability*
	12:15 PM - 01:45 PM	**Special Lunch**	
	01:45 PM - 02:45 PM	**Invited Talk** Chair: Chaman Kumar **[8]** *Utpal Manna*	*Weak Solutions of a Stochastic Landau–Lifshitz–Gilbert Equation Driven by Pure Jump Noise*
	02:45 PM - 03-45 PM	Chair: Utpal Manna **[9]** *Chaman Kumar*	*On Milstein Approximations with Varying Coefficients: the Case of Super-linear Diffusion Coefficients*
	03:45 PM - 04:00 PM	**Tea Break**	
	04:00 PM - 04:45 PM	**Contributed Talk** Chair: Sarvesh Kumar **[13]** *R. Kaviya*	*Convergence and Exponential stability of Neutral Stochastic Impulsive Delay Differential Equations via Θ-Maruyama Method*
		[14] *K. Priya*	*Nonlinear Fractional Order Stochastic Dynamical Systems with Distributed Delay and Poisson Jumps*
		[15] *Durga N*	*Optimal Control of Stochastic BBM Equation with Non-instantaneous Impulses*
	04:45 PM - 05:15 PM	**Valedictory Function and Feedback Session**	

ABSTRACTS

INVITED TALKS

1

Sivaguru S. Sritharan, M.S. Ramaiah University of Applied Sciences, Bangalore.

Title: Hilbert's Sixth Problem

E-mail: provostsritharan@gmail.com

Abstract: In this talk we will discuss the microscopic (statistical mechanical) to macroscopic (continuum) derivation of fluid dynamics and Magneto hydrodynamics starting from Liouville to Boltzmann to the Navier-Stokes and the Euler equations and beyond (Burnett and super-Burnett equations) indicating rigorous questions and opportunities for research problems in stochastic analysis and control theory.

2

V.S. Borkar, IIT Bombay

Title: Small Noise limits

E-mail: borkar@ee.iitb.ac.in

Abstract: This talk will discuss small noise limits for diffusions and describe some work by the speaker and collaborators on the applications thereof, specifically, 1. to derive a selection principle in ill-posed cases, 2. to averaging with small noise limit, and 3. to equilibrium selection in a control system.

3

Suresh Kumar, IIT Bombay

Title : Nonzero Sum Risk-Sensitive Stochastic Differential Game.

E-mail: suresh@math.iitb.ac.in

Abstract : In the talk, we discuss a two person non zero sum risk sensitive sdg. We establish existence of Nash equilibrium under suitable conditions.

4

Suprio Bhar, IIT Kanpur

Title: Mild Solutions for Stochastic PDEs in Infinite Dimensions.

E-mail: suprio@iitk.ac.in

Abstract: Stochastic PDEs has become an integral tool in many models in Mathematics, allowing us to describe evolutions of complex systems. Existence and uniqueness of solutions for such equations is therefore of importance. We first give an introduction to the so-called 'Mild solutions' for Stochastic PDEs in the Hilbert space setting. We will then take up a special model on the space of tempered distributions, which is a dual of a Nuclear space and discuss about recent results on mild solutions for such equations. This talk will be based on a joint work with B. Sarkar and B. Rajeev.

5

B. Rajeev, ISI Bangalore

Title : The Monotonicity Inequality.

E-mail: brajeev@isibang.ac.in

Abstract : In this talk we will give a short survey of the `Monotonicity Inequality' and its applications to existence and uniqueness problems relating to stochastic partial differential equations.

6

Ujjwal Koley, TIFR Bangalore.

Title: On a Fractional Conservation Laws with Noise.

E-mail: ujjwal@tifrbng.res.in

Abstract: In this talk, we discuss some of the main mathematical problems connected to multidimensional degenerate fractional conservation laws with noise. In particular we show existence & uniqueness of entropy solutions, and derive continuous dependence estimate on the nonlinearities of the entropy solutions.

7

Imran Biswas, IISER, Kolkata

Title: Stochastic Conservation Laws: Path-wise Uniqueness and Stability

E-mail: imran@iiserkol.ac.in

Abstract: A large number of physical phenomenon can be mathematically described with the help of hyperbolic con-servation laws. In view of the inherent complexities, it is very crucial to be able to account for possible randomness/noise in their descriptions and conservation laws with noise becomes an important object of study. In this talk, we will discuss our ongoing work on path-wise analysis of stochastic entropy solutions for conservation laws with noise. We will emphasize on path-based uniqueness results and stability of the paths of entropy solutions.

8

Utpal Manna, IISER, Trivandrum

Title: Weak Solutions of a Stochastic Landau–Lifshitz–Gilbert Equation Driven by Pure Jump Noise

E-mail: manna.utpal@iisertvm.ac.in

Abstract: In this work we study a stochastic three-dimensional Landau-Lifschitz-Gilbert equation perturbed by pure jump noise in the Marcus canonical form. We show existence of weak martingale solutions taking values in a two-dimensional sphere S^2 and discuss certain regularity results. The construction of the solution is based on the classical Faedo-Galerkin approximation, the compactness method and the Jakubowski version of the Skorokhod Theorem for nonmetric spaces. This is a joint work with Zdzislaw Brzezniak (University of York) and has been published in Commun. Math. Phys. (2019).
https://doi.org/10.1007/s00220-019-03359-x.

9

Chaman Kumar, IIT, Roorkee

Title: On Milstein Approximations with Varying Coefficients: the Case of Super-linear Diffusion Coefficients

E-mail: c.kumarfma@iitr.ac.in

Abstract: A new class of explicit Milstein schemes, which approximate stochastic differential equations (SDEs) with super linearly growing drift and diffusion coefficients, is proposed in this article. It is shown, under very mild conditions, that these explicit schemes converge in L^p to the solution of the corresponding SDEs with optimal rate.

SELECTED ABSTRACTS FOR PRESENTATION

CONTRIBUTED TALKS

1

Akash Ashirbad Panda, IISER Thiruvananthapuram

Title: Martingale Solutions of Nematic Liquid Crystals Driven by Pure Jump Noise in the Marcus Canonical Form.

Akash Ashirbad Panda

E-mail: akash.panda13@iisertvm.ac.in

Abstract: In this work we consider a stochastic evolution equation which describes the system governing the nematic liquid crystals driven by a pure jump noise in the Marcus canonical form. The existence of a martingale solution is proved for both two and three dimensions. The construction of the solution relies on a modified Faedo-Galerkin method based on the Littlewood-Paley-decomposition, compactness method and the Jakubowski version of the Skorokhod representation theorem for non-metric spaces. Furthermore, we prove that in the two dimensions, the martingale solution is pathwise unique and hence deduce the existence of a strong solution.

2

Ravi Shankar, BITS-PILANI, Goa

Title: Risk Sensitive Portfolio Optimization with an Illiquid Asset Having Random Liquidation Time

Ravi Shankar

E-mail: p20150021@goa.bits-pilani.ac.in

Abstract: Many financial institute have to solve practical problems connected with a liquidation of the assets with a very low liquidity where such illiquid assets provide stochastic income or down payments (e.g. dividend, maintenance cost etc.). We consider a portfolio having investment in m ≥ 1 risky liquid asset, a risk free liquid asset, an illiquid asset having some paper values which can be liquidated at some random time 'τ' and which pays some stochastic income. The price dynamics of these assets are affected by n economic factors. We apply the stochastic control theory in the Merton optimal consumption framework to study the problem of maximizing the average utility consumed up to the time 'τ' . We derive the Hamilton-Jacobi-Bellman equation for the associated value function under the risk sensitive criterion. We use an approximation in policy space to show the existence of a $C^{1,2}$ solution to the risk sensitive Hamilton-Jacobi-Bellman equation.

3

Shruthi Gopal, Bharathiar University, Coimbatore

Title: Large Deviations for Nonlocal Random Stochastic Functional Integral Equation

Shruthi Gopal

E-mail: shruthigopal89@gmail.com

Abstract: In this work, a nonlocal functional stochastic integral equation of Volterra- Ito- Doob type [1] is considered and Freidlin –Wentzell type large deviation principle for its solution processes is studied. The randomness here is multiplicative and is real martingale. We adopt weak convergence approach to establish Laplace Principle, which in turn is equivalent to large deviation principle.

Keywords: Large Deviation Principle; Nonlocal conditions; Weak Convergence

References:

[1] M M Elborai and M I Youssef, On stochastic solutions of nonlocal random functional integral equations, **Arab Journal of Mathematical Sciences(2019)**, article in press.

4

K. Ravikumar, PSG College Arts & Science, Coimbatore

Title: Existence and Stability Results of Nonlinear Impulsive Stochastic Functional Partial Integrodifferential Equations with Infinite Delay and Poisson Jumps

A. Anguraj [1], K. Ravikumar [2]

E-mail: [1] angurajpsg@yahoo.com, [2] ravikumarkpsg@gmail.com

Abstract: In this paper, we are focused upon the results on existence, uniqueness and stability of mild solution of impulsive stochastic functional partial integrodifferential equations with poisson jumps . The theory of resolvent operator is utilised to exhibit the existence of these mild solutions. The results are obtained by using the method of successive approximation and Bihari's inequality.

5

Jothilakshmi G, Alagappa University, Karaikudi

Title: Controllability Criteria of Fractional Langevin Delay Stochastic Differential Systems

Jothilakshmi G, Sundaravadivoo B*

*E-mail: * sundaravadivoob@alagappauniversity.ac.in*

Abstract: This manuscript explores the Controllability criteria of Fractional Langevin delay stochastic dynamical systems with Caputo derivative. Suitably to obtain the solution representation for the considered system, we employ the Laplace transformation. Necessary and Sufficient conditions for Linear Fractional Langevin Delay stochastic Dynamical system are derived by using the Grammian matrix. Sufficient condition for non-linear Fractional Langevin Delay stochastic Dynamical system are derived by using Banach fixed point theorem. Examples are provided for linear and non-linear Delay Dynamical system to illustrate the validity of the obtained controllability criteria.

Keywords: Wiener process, complete controllability, Langevin delay, Caputo derivative, Laplace transform

References

[1] O. Baghani, On fractional Langevin equation involving two fractional orders, **Communications in Nonlinear Science and Numerical Simulation**, 42 (2017), 675-681.

[2] K. Balachandran, V. Govindaraj, L. Rodrguez-Germa, J.J. Trujillo, Controllability results for nonlinear fractional-order dynamical systems, **Journal of Optimization Theory and Applications**, 156, (2013), 33-44.

[3] R.Sakthivel, Y. Ren, Approximate controllability of fractional di_erential equations with state- dependent delay, **Results in Mathematics**, 63,(2013), 949-963.

6

Gokila C, Periyar University, Salem

Title : Stationary Distribution and Global Stability Analysis of a Stochastic Predator-prey Model with Disease in the Prey

Gokila C

E-mail: gokilamuthu3594@gmail.com

Abstract: The stochastic four species predator-prey model with Beddington-DeAngelis functional response and disease in the first prey is analyzed. Firstly, we give the stochastic model with some biological assumptions and establish the existence of globally positive solutions. Moreover, a condition for species to be permanent is given and extinction condition is also found. Through Lyapunov functions we discuss the asymptotic stability of positive equilibrium solution of our model. Besides, it is also shown that the system has a stationary distribution. Numerical simulations are workout, to validate our theoretical findings.

7

Lata Lamani, Karnatak University, Dharwad

Title: Haar Wavelet Based Numerical Method for the Solution of Stochastic Integral Equations

S. C. Shiralashetti, Lata Lamani*

E-mail: latalamani@gmail.com; Mob.: 09008923542

Abstract: In this paper, we develop an accurate and efficient Haar wavelet based numerical method for the solution of Stochastic Integral equations. Initially, we study the properties of stochastic integral equations and Haar wavelets. Then, Haar wavelets operational matrix of integration and Haar wavelets stochastic operational matrix of integration are developed. Convergence and error analysis of the Stochastic Haar wavelet method is presented for the solution of Stochastic Integral equations. Efficiency of the proposed method is justified through the illustrative examples.

Keywords: Haar wavelets, Stochastic Integral equations, stochastic operational matrix of integration.

Corresponding author

8

G. Amali Paul Rose, Bharathiar University, Coimbatore

Title: Large Deviations for a Stochastic Kuramoto-Sivashinsky Equation with Multiplicative Noise

G. Amali Paul Rose

Email: amalipaulrose@gmail.com

Abstract: The Kuramoto-Sivashinsky equation is a nonlinear parabolic partial differential equation which describes the instability and turbulence of waves in chemical reactions and laminar flames. The aim of this work is to prove the large deviation principle for the stochastic Kuramoto-Sivashinsky equation driven by a multiplicative noise. The weak convergence approach is used here to establish the large deviation principle which relies on proving basic qualitative properties of controlled versions of the original stochastic partial differential equation.

Keywords: Large Deviation Principle; Weak Convergence; Stochastic Partial Differential Equations; Uniform Laplace Principle.

References

[1] A Budhiraja, P Dupuis, A variational representation for positive functional of infinite dimensional Brownian motions, **Probab., Math. Statist**. 20 (2000), 39-61.

[2] A Budhiraja, P Dupuis, and V Maroulas, Large deviations for infinite dimensional stochastic dynamical systems, **The Annals of Probability** 36 (2008), 1390-1420.

9

M. H. Kantli, KLE Society's J. T. College, Gadag

Title: Wavelet Preconditioned Method for the Numerical Solution of Stochastic Differential Equations

M. H. Kantli

E-mail: mkantli@gmail.com

Abstract: In this paper, wavelet preconditioned method is used for the numerical solution of stochastic differential equations. The proposed method is the robust technique for faster convergence with low computational cost which is acceptable through operator complexity, grid complexity and rate of convergence. It is concluded that the wavelet preconditioned technique easily outperforms over existing standard classical preconditioned methods.

Keywords: Wavelet preconditioned, Stochastic differential equation, Operator complexity, Grid complexity.

10

Vivek Kumar, IIT Roorkee

Title: On a Generalized Stochastic Burgers' Equation Perturbed by Volterra Noise

Vivek Kumar, M. T. Mohan and Ankik Kumar Giri

E-mail: vivekmsc118@gmail.com, maniltmohan@gmail.com, ankik.math@gmail.com.

Abstract: In this article, we investigate the existence and uniqueness of local mild solutions for the one-dimensional generalized stochastic Burgers' equation (GSBE) containing a non-linearity of polynomial type and perturbed by α-regular cylindrical Volterra process and having Dirichlet boundary conditions. The Banach fixed point theorem (or contraction mapping principle) is used to obtain the local solvability results. The L^{∞}-estimate on both time and space for the stochastic convolution involving the α-regular cylindrical Volterra process is obtained with the help of Garsia-Rodemich-Rumsey inequality. Further, the existence and uniqueness of global mild solution of GSBE up to third order nonlinearity is shown.

2010 Mathematics Subject Classi_cation. Primary: 60H15,60G22; Secondary: 35Q35, 35R60.

Keywords: Stochastic Burgers' equation, Volterra process, Fractional Brownian motion, γ-Radonifying operator.

11

Mattuvarkuzhali. C, Gandhigram Rural Institute, Tamil Nadu

Title: Exponential Stability Behaviour Analysis of Neutral Stochastic Fractional Integro-differential Equation with Poisson Jump and Impulsive Effects by Using Mainardi's Function

C, Mattuvarkuzhali [1], P. Balasubramaniam

E-mail: umakuzhali@gmail.com

Abstract: This paper is concerned with existence of mild solution and behaviour analysis the exponential stability for neutral stochastic fractional Integro-differential equation in Hilbert space. The results are established by employing Schafer fixed point theorem. Finally an illustrative example is provided to verify the obtained the theoretical results.

Keywords: Fractional Integro-differential equation, Mild solution, stability analysis, stochastic differential equation, Schafers' fixed point theorem.

12

Trisha Maitra, Indian Statistical Institute, Kolkata

Title: Asymptotic Theory of Bayes Factor in Stochastic Differential Equations with Increasing Number of Individuals

Trisha Maitra and Sourabh Bhattacharya
E-mail: trishamaitra@yahoo.com

Abstract: Research on asymptotic model selection in the context of stochastic differential equations (SDE's) is almost non-existent in the literature. In particular, when a collection of SDE's is considered, the problem of asymptotic model selection has not been hitherto investigated. Indeed, even though the diffusion coefficients may be considered known, questions on appropriate choice of the drift functions constitute a non-trivial model selection problem.

In this article, we develop the asymptotic theory for comparisons between collections of SDE's with respect to the choice of drift functions using Bayes factors when the number of equations (individuals) in the collection of SDE's tend to infinity while the time domains remain bounded for each equation. Our asymptotic theory covers situations when the observed processes associated with the SDE's are independently and identically distributed (iid), as well as when they are independently but not identically distributed (non-iid). In particular, we allow incorporation of available time-dependent covariate information into each SDE through a multiplicative factor of the drift function; we also permit different initial values and domains of observations for the SDE's.

Our model selection problem thus encompasses selection of a set of appropriate time-dependent covariates from a set of available time-dependent covariates, besides selection of the part of the drift function free of covariates.

For both iid and non-iid set-ups we establish almost sure exponential convergence of the Bayes factor.

Furthermore, we demonstrate with simulation studies that even in non-asymptotic scenarios Bayes factor successfully captures the right set of covariates.

Affiliation: Trisha Maitra is an NBHM Post Doc Fellow and Sourabh Bhattacharya is an Associate Professor in Interdisciplinary Statistical Research Unit, Indian Statistical Institute, 203, B. T. Road, Kolkata 700108.

13

R. Kaviya, Gandhigram Rural Institute, Tamil Nadu

Title: Convergence and Exponential Stability of Neutral Stochastic Impulsive Delay Differential Equations via θ-Maruyama Method

R. Kaviya and P. Muthukumar

E-mail: r.kaviya26@gmail.com

Abstract: This paper is concerned with a following n-dimensional non-linear neutral impulsive stochastic delay differential equations

$$\begin{aligned} d[x(t) - D(x(t-\tau))] =& f(x(t), x(t-\tau))dt + g(x(t), x(t-\tau))dB(t), t \in [0,T], t \neq \tau_k, k = 0,1,2,\ldots,N, \\ \triangle x(\tau_k) =& \beta x(\tau_k^-), \qquad \beta \in \mathbb{R}, \\ x(t) =& \phi(t), \qquad \forall t \in [-\tau, 0], \end{aligned}$$

where $B(t) = (B_1(t), \ldots B_m(t))^T$ be an $m-$dimensional Brownian motion defined on the complete probability space $(\Omega, \mathcal{F}, P)$ with a filtration $\{\mathcal{F}_t\}_{t\geq 0}$ satisfying the usual conditions, $T \in \mathbb{R}^+, f : \mathbb{R}^n \times \mathbb{R}^n \to \mathbb{R}^n$, $g : \mathbb{R}^n \times \mathbb{R}^n \to \mathbb{R}^{n\times m}$ and $D : \mathbb{R}^n \to \mathbb{R}^n$. Let $\tau > 0$ is the constant delay and the symbol $\triangle x(\tau_k) = x(\tau_k^+) - x(\tau_k^-)$ where $x(\tau_k^-) = \lim_{t\to\tau_k^-} x(t)$ and $x(\tau_k^+) = \lim_{t\to\tau_k^+} x(t)$. The initial function $\phi(t)$ is assumed to be continuous $\mathcal{F}_{t_0}-$measurable $\mathbb{R}^n$-valued random variable with $E(\sup_{-\tau\leq t\leq 0}|\phi(t)|^2) < \infty$ and $t_0 \leq \tau_0 < \tau_1 < \tau_2 < \ldots < \tau_N < \tau_{N+1} \leq T$, $\tau_k = k\tau, k = 0,1,2,\ldots,N$.

In this work the relationship between solutions of the neutral impulsive stochastic delay differential equations and the corresponding system without impulsive effects is given. The suitable approximate solution is defined by modified θ-Maruyama method for the proposed neutral stochastic delay system with impulses. Mean square consistent and convergence analysis of the approximate solution is proved by comparing the corresponding system without impulses. Similarly, the p-th moment exponential stability of the given problem is analyzed. Finally, the obtained theoretical results are illustrated by a neutral stochastic delay Lotka-Volterra population model with impulses.

Keywords: non-linear neutral stochastic impulsive delay differential equations, $\theta-$Maruyama method, mean-square consistency, mean-square convergence, $p-$the moment exponential stability.

14

K. Priya, Gandhigram Rural Institute, Tamil Nadu

Title: Nonlinear Fractional Order Stochastic Dynamical Systems with Distributed Delay and Poisson Jumps

K. Priya and P. Balasubramaniam

E-mail: priyak250796@gmail.com

Abstract: In this paper, we focus on stability of solution to initial value problems for nonlinear fractional order stochastic dynamical systems with distributed delay and Poisson jumps in finite dimensional space. New set of sufficient conditions are derived based on Banach contraction principle to establish stability of fractional order differential equations. Our main results are obtained in a weighted Banach space. Finally, a numerical example has been given to validate the efficiency of the proposed theoretical results.

15

Durga N, Gandhigram Rural Institute, Tamil Nadu

***Title: Optimal Control of Stochastic BBM Equation with Non-instantaneous Impulses*[1]**

N. Durga and P. Muthukumar [2]

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Abstract: This article is devoted to study the existence of optimal control for the non-instantaneous impulsive stochastic Benjamin-Bona-Mahony (BBM) equation, which describes the model for propagation of long waves and used in the analysis of surface waves for long wavelength in liquids, hydromagnetic waves in cold plasma, acoustic-gravity waves in compressible fluids, and acoustic waves in harmonic crystals [4]. Many mathematicians paid their attention to the study of dynamics of the BBM equation (see [1,2]) and optimal control of stochastic PDE with impulses [3]. In this paper, we will discuss about the existence of mild solution and existence of optimal control in an abstract form of stochastic BBM equation driven by non-instantaneous impulses in Hilbert space as follows:

$$\begin{aligned} z'(t) &= -\mathcal{A}z(t) + SB_w u(t) + F(t, z(t)) + \int_Z H(t, z(t), \eta(t))\tilde{N}(dt, d\eta), t \in \bigcup_{k=0}^{m}(a_k, b_{k+1}] \subset J := [0, T], \\ a_0 &:= 0,\ b_{m+1} := T, \quad T > 0 \\ z(t) &= g_k(t, z(b_k^-)), \quad t \in (b_k, a_k],\ k = 1, 2, \ldots, m, \\ z(0) &= z_0, \end{aligned} \tag{1}$$

where $S = (I + cA)^{-1}$ and $\mathcal{A} = dSA$, with $c \geq 0$, $d > 0$ are real constants. Initially, the existence of a mild solution is proved with the aid of Krasnoselskii's fixed point theorem, Gronwall's inequality and stochastic analysis in the mean square sense. Further, the sufficient condition for an existence of optimal control is established by employing Balder theorem for the proposed system (1) with the cost function

$$\mathcal{J}(z, u) = \mathbb{E}\int_0^T \mathcal{L}(t, z(t), u(t))dt.$$

Finally, an application is provided to validate the developed theoretical results.

Keywords: Existence of mild solutions; Non-instantaneous impulses; Optimal control; Poisson jumps; Stochastic Benjamin-Bona-Mahony equation.
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