2014 Fall Visiting Scholar Workshop on Pure Mathematics, Applied Mathematics, and Their Applications in Physics and Engineering

Department of Mathematics, University of Texas Pan-American, Edinburg, Texas 78539

Time: November 8, 2014 (Saturday, 8:45am-5:00pm)
Location: MAGC 2.208

Organizers:

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Description:

This one-day workshop, annually held and sponsored by Department of Mathematics of the University of Texas Pan-American, is devoted to pure mathematics, applied mathematics, and their applications in physics and engineering. In the workshop, there will be ten visiting scholars (Yuping Duan, Mostafa Jani, Ho Jeon, Yongxin Jiang, Hyoun Kim Zhenguo Luo, Bing Sun, Yongqi Wu, Bianxia Yang, and Zhaqilao) and several students and faculty to present their work both at theoretical and computational level together with a view towards applications, in particular in image reconstructions and engineering mechanics.

Schedule of Talks

Session Chair	Time	Speaker	Title
	08:45-09:00	Welcome Remarks by Dr. Andras Balogh, Mathematics Department Chair	
Dr. Zhijun Qiao	09:00-09:30	Dr. Zhaqilao (Inner Mongolia Normal University, China)	Darboux transformation (DT) and generalized DT for the nonlinear coupled dispersionless systems
	09:35-10:05	Dr. Bing Sun (Beihang Univ., China)	An Unbiased-Average MinBAD Speckle Denoising Approach for SAR images
Dr. Dambaru Bhatta	10:10-10:40	Mr. Mostafa Jani (Visiting Student, UTPA)	Use of Bernstein Polynomials in Solving Integral and Fractional Differential and Integro-Differential Equations
	10:45-11:15	Dr. Jasang Yoon (UTPA)	Aluthge transforms for a commuting pair of bounded operators
	11:20-11:50	Mr. Haicheng Gu (UTPA)	From Classical to Fractional: Applying Fractal Market Hypothesis to Financial Forecasting
	11:50-12:45	**Lunch**	
Dr. Zhaosheng Feng	12:45-13:15	Dr. Yongxin Jiang (Hohai University, China)	Lyapunov functions for general nonuniform trichotomy with different growth rates
	13:20-13:50	Ms. Bianxia Yang (Lanzhou Univ., China)	Eigenvalue, unilateral global bifurcation and constant sign solutions for a fractional Laplace problem
	13:55-14:25	Mr. Eric Tovar (UTPA)	On nonlinear equations with general dispersion term and the Whitham Equation
Dr. Mircea Chipara	14:30-15:00	Dr. Yuping Duan (Dalian University of Technology, China)	Controlled Synthesis and Microwave Electromagnetic Properties of Micro–nano MnO2 Powder
	15:05-15:35	Dr. Yongqi Wu (Lingnan Normal University, China)	Quasi-periodic wave solution and asymptotic behavior for the (2+1)-dimensional Toda lattice equation
Dr. Jasang Yoon	15:40-16:10	Dr. Hyoun Kim Incheon National University South Korea	On the quasi-class A operators
	16:15-16:45	Dr. Zhenguo Luo (Hengyang Normal University, China)	Existence of positive periodic solutions for a nonautonomous neutral delay n-species competitive model with impulses

ABSTRACTS OF TALKS

1. Title: Darboux transformation (DT) and generalized DT for the nonlinear coupled dispersionless systems

Zhaqilao
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Abstract: In this talk, I will briefly introduce what is Integrability in nonlinear systems? And give an overview on DT and generalized DT. Then I investigate a more general set of coupled dispersionless system as my main results. This system is shown integrable with its bi-Hamiltonian structure, Lax pair, infinitely many conservation laws and N-soliton solutions. With the help of the generalized DT method, I also study Nth-order rogue wave solution to a spectral case of this system.

2. Title: An Unbiased-Average MinBAD Speckle Denoising Approach for SAR images

Bing Sun[a], Jie Chen[a], and Zhijun Qiao[b]
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Abstract: Average value represents the radiation density of scene in SAR images, and its preservation for the application of SAR images is significant in speckle denoising. This paper provides an improved scheme of PDEs-based minimum biased diffusion (MinBAD) speckle denoising algorithm. Considering the characteristics of SAR speckle and the radiation accuracy of post-processing's need, several improvements including normalization, homomorphic transformation and average-preserving processing are introduced into the MinBAD algorithm. Besides the equivalent look number (ENL) and edge preserving index (EPI), a new index, radiation accuracy error (RAE), is defined to evaluate the denoising effect. Experimental results for both an artificial image and a real SAR image validated the performance of the proposed unbiased-average MinBAD speckle reducing approach.

3. Title: Use of Bernstein Polynomials in Solving Integral and Fractional Differential and Integro-Differential Equations

Mostafa Jani and Dambaru Bhatta
Department of Mathematics
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Abstract: Integral and fractional differential equations play an important role in many science and engineering problems in modern days. In this talk, we introduce fractional derivatives with examples. We present Riemann-Liouville, Caputo and Grunwald-Letnikov operators. Also we discuss some properties of Bernstein polynomials. Finally, we use Bernstein polynomials to obtain the numerical solutions of integral equations, fractional differential equations and fractional integro-differential equations using the collocation technique.

4. Title: Aluthge transforms for a commuting pair of bounded operators

Jasang Yoon
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Abstract: In this talk we define Aluthge transforms for a commuting pair of bounded operators and consider their invariant properties for hyponormality and Taylor spectrum.

5. Title: From Classical to Fractional: Applying the Fractal Market Hypothesis to Financial Forecasting

Haicheng Gu
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Abstract: In financial mathematics, capital asset pricing is always considered to be a critical problem which closely related to many areas of financial markets. Since published, the Black-Scholes Model becomes to one of the most effective tool to explain and forecasting financial derivatives. Along with the development of research, people realize that classical model cannot perfectly describe the nature of financial markets and forecast it. Fractal Market Hypothesis is one of the approaches to generalize the

classical hypothesis by using the fractal theory. In this presentation, we are going to derive and generalize the fractional diffusion equation and find its Green's Function solution. Then we will discuss its application in finance and economics.

6. **Title:** Lyapunov functions for general nonuniform trichotomy with different growth rates

Yongxin Jiang
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Abstract: For nonautonomous linear equations x' = A(t)x that may exhibit stable, unstable and central behaviors in different directions. We give a complete characterization of nonuniform (μ,ν) trichotomies in terms of strict Lyapunov functions. In particular, we obtain an inverse theorem giving explicitly Lyapunov functions for each given trichotomy. The main novelty of our work is that we consider a very general type of nonuniform exponential trichotomy, which admits different growth rates in the uniform and the nonuniform parts.

7. Title: Eigenvalue, unilateral global bifurcation and constant sign solutions for a fractional Laplace problem

Bian-Xia Yang[a,b], Hong-Rui Sun[a], and Zhaosheng Feng[b]
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Abstract: In this paper, by the Ljusternik-Schnirelmann theory, we first study the eigenvalues and eigenfunctions of the fractional Laplace problem. In particular, we show that there exists a simple, isolated, principle eigenvalue λ_1. Furthermore, under some natural hypotheses on perturbation function g, we show that $(\lambda_1, 0)$ is a bifurcation point of the problem

$$\begin{cases} (-\Delta)^{\alpha}u(x) = \lambda a(x)u(x) + g(x, u; \lambda), & x \in \Omega, \\ u = 0, & on \ \mathbb{R}^n \backslash \Omega, \end{cases}$$

and there are two distinct unbounded sub-continua $\mathcal{C}_+$ and $\mathcal{C}_-$, consisting of the continuum $\mathcal{C}$ emanating from $(\lambda_1,0)$. As an application of the above result, we study the existence of constant sign solutions for a class of nonlinear fractional Laplace problem. The main results of this paper can be seen as extend the known results in classical Laplace operator to the non-local framework of the fractional Laplace type operators.

8. Title: On nonlinear equations with general dispersion term and the Whitham Equation

Eric Tovar
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Abstract: For this talk, we study nonlinear partial differential equations with a general dispersion term. We also look at the Whitham Equation first proposed in [1] and its possible applications to tsunami modeling.

References
[1] G. B Whitham, Variational Methods and Applications to Water Waves, Proceedings of the Royal Society of London. Series A, Mathematical and Physical Sciences., 229 (1969), 6-25.

9. Title: Controlled Synthesis and Microwave Electromagnetic Properties of Micro–nano MnO2 Powder

Y.P. Duan, J.L. Chen, H. Ma, Z. Liu, J. Zhang
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Abstract: The manganese dioxides, in combination with their novel chemical and physical properties, have paved the way for their wide use as catalysts and electrochemical materials, but the microwave absorption properties of MnO2 have not been exploited. Our research group has found that manganese dioxides own excellent dielectric loss. However, the magnetic loss is relatively low. Besides, the low frequency absorption performance is relatively poor and the bandwidth is relatively narrow. On these bases, our research group synthesized new type of manganese dioxides absorbent in high magnetic field and by doping with magnetic cations. As a result, we found that the magnetic loss was significantly enhanced and the effective absorption bandwidth was broadened evidently as well. Interestingly, through the investigation of

the growth behavior of MnO2 prepared in high field and the doped MnO2, we found that the morphology of MnO2 synthesized under high magnetic field is sea urchin ball chain shape, and the permeability was clearly increased under a high magnetic field. Results showed that, after Ni/Co doping, the phase structure and morphology of α-MnO2 were kept the bunchy nanowires as those before doping, while the imaginary part of complex permittivity and the dielectric loss tangent were increased with evident frequency response character. Moreover, the possible mechanism of the improved properties of manganese dioxides was discussed based on first-principles calculations.

10. Title: Quasi-periodic wave solution and asymptotic behavior for the (2+1)-dimensional Toda lattice equation

Yongqi Wu
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Abstract: One- and two-periodic wave solutions for the (2+1)-dimensional Toda lattice equation are presented based on the Hirota bilinear method and the Riemann theta function. The asymptotic behaviors of these two solutions are considered and the rigorous proof is given that the periodic wave solutions tend to the soliton solutions in an appropriate limiting procedure.

11. Title: On the quasi-class A operators

Hyoun Kim
Incheon National University, South Korea

Abstract: In this talk, we introduce quasi-class A operators and study Weyl's theorem and spectral properties of them. This is a joint work with In Ho Jeon.

12. Title: Existence of positive periodic solutions for a nonautonomous neutral delay n-species competitive model with impulses

Zhenguo Luo
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Abstract: By using some analysis techniques and a new existence theorem, which is different from Gaines and Mawhin's continuation theorem and abstract continuation

theory for k-set contraction, we obtain some sufficient and realistic conditions for the existence of positive periodic solution of a general neutral delay n-species competitive model with impulses. As an application, we also examine some special cases which have been studied extensively in the literature. Some known results are improved and generalized.