Dear colleagues,

We would like to announce an upcoming visiting scholar workshop on "Mathematics and Their Applications in related fields " on Saturday, Nov 19, 2016, 8:45am – 5:00pm, MAGC 1.302, organized by Zhaosheng Feng, Zhijun Qiao, Ranadhir Roy, Josef Sifuentes, Erwin Suazo, Vesselin Vatchev, Karen Yagdjian, and Jasang Yoon.

This one-day workshop, annually held and sponsored by School of Mathematical and Statistical Sciences, College of Sciences, University of Texas Rio Grande Valley, is devoted to pure mathematics, applied mathematics, mathematics education, and their applications in related fields. In the workshop, there will be twelve visiting scholars (Dr. Slavisa Djordjevi, Dr. Junbiao Guan, Dr. Azucena Herrera, Dr. Guangping Hu, Dr. Jiemei Li, Dr. Gerardo Mendoza, Dr. Sergei Suslov, Mr. Gangwei Wang, Ms. Minzhi Wei, Ms. Rong Yin, Dr. Junfang Zhao, and Dr. Ye Zhao), and several students and faculty to attend/present their work at both theoretical and computational level together with a view towards applications. In particular, let us welcome three faculty (Dr. Bing Fu, Dr. Ben Xu, and Dr. Yong Zhou) from the College of Engineering & Computer Science to join us and give their presentations. Our goal is to develop collaborations in the interdisciplinary research and even for the future Ph. D. program**.** All faculty and students are warmly welcome to attend. If you have any questions, please do not hesitate to contact any of us or Dr. Qiao at zhijun.qiao@utrgv.edu. The detailed schedule will be announced on November 17, 2016. Thank you.

Sincerely,

Organizers of 2016 Fall Visiting Scholar Workshop:
Dr. Zhaosheng Feng, Dr. Zhijun Qiao, Dr. Ranadhir Roy, Dr. Josef Sifuentes, Dr. Erwin Suazo, Dr. Vesselin Vatchev, Dr. Karen Yagdjian, and Dr. Jasang Yoon.

SMSS Visiting Scholars:

1. Dr. Slavisa V. Djordjevic*
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   Email: junbiaoguan@gmail.com

3. Dr. Azucena Herrera*
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4. Dr. Guangping Hu
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10. Ms. Rong Yin*
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*Speaker

UTRGV Faculty:

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11. Dr. Yong Zhou*, Interim Department Chair
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*Speaker

2016 Fall Visiting Scholars, Faculty, and Students Workshop on Mathematics and Their Applications in related fields

School of Mathematical and Statistical Sciences, College of Sciences, University of Texas Rio Grande Valley, Edinburg, Texas 78539

Time: November19, 2016 (Saturday, 8:45am – 5:00pm)
Location: MAGC 1.302

Organizers:

Dr. Zhaosheng Feng	zhaosheng.feng@utrgv.edu
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Description: This one-day workshop, annually held and sponsored by School of Mathematical and Statistical Sciences, College of Sciences, University of Texas Rio Grande Valley, is devoted to pure mathematics, applied mathematics, mathematics education, and their applications in related fields. In the workshop, there will be twelve visiting scholars (Dr. Slavisa Djordjevi, Dr. Junbiao Guan, Dr. Azucena Herrera, Dr. Guangping Hu, Dr. Jiemei Li, Dr. Gerardo Mendoza, Dr. Sergei Suslov, Mr. Gangwei Wang, Ms. Minzhi Wei, Ms. Rong Yin, Dr. Junfang Zhao, and Dr. Ye Zhao), and several students and faculty to attend/present their work at both theoretical and computational level together with a view towards applications. In particular, let us welcome three faculty (Dr. Bing Fu, Dr. Ben Xu, and Dr. Yong Zhou) from the College of Engineering & Computer Science to join us and give their presentations. Our goal is to develop collaborations in the interdisciplinary research and even for the future Ph. D. program.

Schedule

	8:45 – 9:00 Welcome Remarks	Dr. Parwinder Grewal, COS Dean Dr. Cristina Villalobos, SMSS Interim Director	
Session Chair	**Time**	**Speaker**	**Title**
Dr. Zhijun Qiao	09:00-09:30	Dr. Sergei K. Suslov, (Visiting Scholar, SMSS, ASU)	On Hidden Symmetry of Quantum Harmonic Oscillator
	09:30-10:00	Dr. Vesselin Vatchev (SMSS,UTRGV)	Intrinsic Fourier Mode Functions
Dr. Erwin Suazo	10:00-10:30	Dr. Slavisa V. Djordjevic (Visiting Scholar, Benemerita Universidad Autonoma de Puebla, Mexico)	Recent developments in the Fredholm theory
	10:30-11:00	Dr. Jasang Yoon (SMSS,UTRGV)	Aluthge transforms and common invariant subspaces for a commuting n-tuple of operators
Dr. Jasang Yoon	11:00-11:30	Mr. Gangwei Wang (Visiting Scholar, Ph. D. Student, Beijing Institute Technology, China)	A new (2+1)-dimensional sine-Gordon and sinh-Gordon equations with symmetries and kink wave solutions
	11:30-12:00	Dr. Ranadhir Roy (SMSS, UTRGV)	Investigate Effect of Combined Anticancer Drags Treatment on Heterogeneous Brain Tumors
	12:00-13:00	**Lunch**	
Dr. Zhaosheng Feng	13:00-13:30	Dr. Bin Fu (Department of Computer Sciences, UTRGV)	Partial Sublinear Time Approximation and Inapproximation for Maximum Coverage
	13:30-14:00	Dr. Azucena Leticia Herrera (Visiting Scholar, Universidad Tecnológica de Puebla, México)	Proposal of a curricular design: content with competence approach
Dr. Ranadhir Roy	14:00-14:30	Dr. Yong Zhou, Interim Department Chair (Department of Electrical Engineering, UTRGV)	Time-Reversal Based Microwave Imaging for Biomedical Detection
	14:30-15:00	Ms. Rong Yin (Visiting Scholar, Ph. D. Student, Nanjing Normal University, China)	Distribution of solutions of a kind of free boundary problem
Dr. Josef Sifuentes	15:00-15:30	Dr. Ben Xu (Department of Mechanical Engineering, UTRGV)	Effects of internal circulation and particle mobility during nanofluid droplet evaporation
	15:30-16:00	Dr. Ye Zhao (Visiting Scholar, Shijiazhuang Tiedao University, China)	Classical Liouville completely integrable systems associated with the solutions of the coupled Kdv-mKdv equations

Dr. Vesselin Vatchev	16:00-16:30	Dr. Josef Sifuentes (SMSS,UTRGV)	Approximate Murphy-Golub-Wathen Preconditioning For Saddle Point Problems
	16:30-17:00	Mr. Ligang Sun (SMSS,UTRGV)	Numerical Simulations of Shock Waves Reflection and Interaction

ABSTRACTS

1. Title: On Hidden Symmetry of Quantum Harmonic Oscillator

Sergei K. Suslov,
School of Mathematical and Statistical Sciences, Arizona State University
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Abstract: We discuss the so-called "missing" solutions for the quantum harmonic oscillators and some of their applications to quantum optics.

2. Title: Intrinsic Fourier Mode Functions

Vesselin Vatchev
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Abstract: An Intrinsic Mode Function (IMF) represents a simple oscillatory mode as a counterpart to the simple harmonic function but with variable amplitude and frequency along the time axis. The idea of studying IMF stems from the notion of instantaneous frequency. In the talk we introduce a class of generalized trigonometric polynomials that exhibit properties expected from IMF and provide sufficient conditions for positiveness of the instantaneous frequency, the difference between the number of zeros and number of extrema, and the proximity of upper and lower envelopes. The necessity of the conditions are discussed in numerical examples. A Greedy type algorithm for decomposition into IMF is introduced.

3. Title: Recent developments in the Fredholm theory

Slavisa V. Djordjevic
Benemerita Universidad Autonoma de Puebla, Maxico
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Abstract: Let X be a Banach space. Let I(X) be a both side ideal in the algebra B(X) of the bounded linear operators acting on X. We say that B(X)=I(X) is a Calkin algebra and the Fredholm type operators on X coincide with the operators whose class in B(X)=I(X) is

invertible in some sense. We will discuss the cases in which I(X) is the ideal of compact operators or operators of some (finite or not) dimension. Moreover, in Calkin algebra we will observe different kind of invertibility that de ne Fredholm operators, like as (generalized) Drazininvertibility and group invertibility. Some of the methods and techniques of operator theory will be divulged in general Banach algebras.

4. Title: Aluthge transforms and common invariant subspaces for a commuting n-tuple of operators

Jasang Yoon
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Abstract: It is well known that a bounded operator with dense range has a nontrivial invariant subspace if and only if itsAluthge transform does. Recently, R.Curto and J. Yoon have introduced the toral and spherical Aluthge transforms for commuting pairs and studied their basic properties including spherically quasi-normal and spherically isometric 2-variable weighted shifts. In this talk, we first investigate nontrivial common invariant subspaces between the toral (resp. spherical) Aluthge transform and the original n-tuple of bounded operators with dense ranges. We next study the sets of common invariant subspaces among them. Finally, we give an example which shows that the sets of common invariant subspaces between two Aluthge transforms (toral and spherical) are not isomorphic, even though they are equivalent with respect to common nontrivial invariant subspaces.

5. Title: A new (2+1)-dimensional sine-Gordon andsinh-Gordon equations with symmetries and kink-wave solutions

Gangwei Wang[a], Haicheng Gu[b], and Zhijun Qiao[b]
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Abstract: In this paper, a (2+1)-dimensional sine-Gordon equation and a sinh-Gordon equation are derived from the well-known AKNS system. Based on the Hirota bilinear method and Lie symmetry analysis, kink wave solutions and travelling wave solutions of the (2+1)-dimensional sine-Gordon equation are constructed. The traveling wave solutions of the (2+1)-dimensional sinh-Gordon equation can also be provided in a similar manner.

6. Title: Investigate Effect of Combined Anticancer Drags Treatment on Heterogeneous Brain Tumors

Ranadhir Roy
School of Mathematical and Statistical Sciences, University of Texas-Rio Grande Valley, Edinburg, Texas 78539, USA, E-mail: ranadhir.roy@utrgv.edu

Abstract: In this Study, we developed mathematical models to investigate the effects of concurrent application of radiotherapy and chemotherapy in a homogeneous and heterogeneous brain tumor. The objective of this research is to understand whether added chemotherapy, as an independent source to radiotherapy enhances the process of destroying tumor cells and also improve the radiation response. We have developed a finite element method to solve the pressure and convection diffusion equations to analyze the combined effects of both radiotherapy and chemotherapy and also to predict the effect of spatial distribution of base line vascular, tissue, and drugs transport parameters of uniform base line values. We calculated two dimensional spatial interstitial fluid flows, the interstitial fluid velocity, interstitial fluid pressure, and the drug concentration within a spherical tumor. The results are compared with published data. The sensitivity analysis is performed and indicates that the spatial distribution of base line simulation of vascular, tissue, and drugs transport parameters is considerable. The results suggest that chemotherapy improves the therapeutic efficacy of radiation in brain tumor, mostly when administered concurrently. More clinical studies and further model developments are required to validate this prediction.

7. Title: Partial Sublinear Time Approximation and Inapproximation for Maximum Coverage

Bin Fu
Department of Computer Science University of Texas-Rio Grande Valley
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Abstract: We develop a randomized approximation algorithm for the classical maximum coverage problem, which given a list of sets $A_1, A_2, \cdots A_m$ and integer parameter k, select k sets $A_{i1}, A_{i2}, \cdots A_{ik}$ for maximum union $A_{i1} \cup A_{i2} \cup \cdots \cup A_{ik}$ In our algorithm, each input set A_i is a black box that can provide its size $|A_i|$, generate a random element of A_i, and answer the membership query ($x \in A_i$?) in O(1) time. Our algorithm gives (1-1/e)-approximation for maximum coverage problem in O(poly(k)m)logm) time, which

is independent of the sizes of the input sets. No existing O(p(m)n^(1-ϵ)) time (1-1/e)-approximation algorithm for the maxi- mum coverage has been found for any function p(m) that only depends on the number of sets, where n = max($|A_1|, |A_2| \cdots |A_m|$) (the largest size of input sets). The notion of partial sublinear time algorithm is introduced. For a computational problem with input size controlled by two parameters n and m, a partial sublinear time algorithm for it runs in a O(p(m)n^(1-ϵ)) time or O(q(n)m^(1-ϵ)) time. The maximum coverage has a partial sublinear time O(poly(m)) constant factor approximation since $k \leq m$. On the other hand, we show that the maximum coverage problem has no partial sublinear O(q(n)m^(1-ϵ)) time constant factor approximation algorithm. This separates the partial sublinear time computation from the conventional sublinear time computation by disproving the existence of sublinear time approximation algorithm for the maximum coverage problem.

8. Title: Proposal of a curricular design: content with competence approach

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Abstract: The present research is exploratory with a qualitative approach. It is discussed the theories of reference for conceptualization of the curriculum and competences in education, and then establishes the conditions of a curriculum bounded to contents with a focus on competences, starting from the graduation profile of the student. Having detected the profile of generic egress for competences that should be generated in university students in the field of mathematics, it is proposed one example based on to the subject College Algebra of UTRGV. The result is a curriculum limited to content with a focus on generic and specific competences approach.

9. Title: Time-Reversal Based Microwave Imaging for Biomedical Detection

Yong Zhou
Department of Electrical Engineering, University of Texas-Rio Grande Valley, Edinburg, Texas 78539, USA
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Abstract: Active research has been carried out in microwave imaging since ultra-wideband (UWB) frequency spectrum (3.1-10.6 GHz) was approved by the FCC in 2002. Microwave signals can penetrate through foliage, fog and smoke to detect the hidden objects, and mm-waves can propagate inside walls, clothing and packaging. Compared to the traditional

X-ray technique, microwave imaging is relatively safe and convenient for routine screening. Practical and functional radar-technique based microwave imaging system covers a wide frequency band, where lower frequencies can provide enough penetration depth, and higher frequencies can provide high resolution. Existing challenges mainly exist on its capability of distinguishing between healthy and malignant tissues, which usually have weak difference in their dielectric properties. Several classical approaches exist for radar surveillance and localization, such as Doppler processing and spatial beam-forming. This presentation introduces a new method of UWB operation, time reversal (TR) technique. The idea was originally introduced by Fink. Time reversal method requires multiple antennas to form the multi-static matrix. The TR technique is based on a fundamental symmetry of physics, i.e., the time reversal invariance. According to time reversal invariance, signals echoed from an object in lossless media can be captured and time reversed by a time reversal array, then sent back towards the object to be automatically refocused on the original source location. This property has been exploited in acoustics and in electromagnetics in recent years, leading to a broad area of applications. It has been demonstrated that in an environment where multi-path scattering dominates focusing of acoustic waves with super resolution can be achieved using timereversal method. The standard DORT and TR-MUSIC methods will be introduced.

10. Title:Distribution of solutions of a kind of free boundary problem

Rong Yin
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Abstract: In this talk, we consider a free boundary problem of parabolic equations which is induced from a reaction-diffusion system with the parameter r on diffusion term. We will show that, if r is sufficiently large, the problem has the global solution; while, if r is sufficiently small, the solution exists only atthe finite time.

11. Title: Effects of internal circulation and particle mobility during nanofluid droplet evaporation

Ben Xu
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Abstract: The effect of internal circulation on evaporation of fluid droplets containing nano-sized particles is analytically investigated, where internal circulation is caused by viscous effects at the liquid–gas interface in the convective environment. The competing

time scales of liquid diffusion, convection, and particle diffusion are first analyzed as influenced by gas phase velocity, relative viscosities of gas and liquid phases, and the droplet size. The results reveal the importance of internal recirculation for droplets of practical sizes. To demonstrate the role of internal circulation plays on particle distribution and shell formation during the evaporation process, a symmetric Hill vortex and strong circulation are assumed for solving a one-dimensional governing equation, which to yield (i) the particle redistribution during the evaporation process, (ii) the time and the size upon shell formation (i.e., the end of the first-stage evaporation/drying) due to inclusion of particles at the droplet surface, and (iii) internal particle distribution that forecast possible morphologies of particle aggregates once the drying process is complete. These results are found to be dependent upon (a) the relative time scales of liquid diffusion and particle mobility (the effect of Lewis number, Le), and (b) the relative importance or evaporation rate (K) and particle mobility (the effect of Peclet number, Pe). Comparisons with previous results without internal circulation are made, as related to the time for shell formation and possible morphologies. Such comparisons reveal some distinctly different, and surprising, phenomena during and at the end of the first-stage evaporation.

12. Title:Classical Liouville completely integrable systems associated with the solutions of the coupled Kdv-mKdv equations

Ye Zhao
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Abstract: The 3rd-order spectral problem(∂^3 + ∂q∂ + p∂ + ∂p + r)ϕ = λϕx related to the coupled KdVmKdV type equation are discussed. The relations between the potentials (q, p, r) and the eigenvector are obtained. Based on the Euler-Lagrange equations and Legendre transformations, a reasonable JacobiOstrogradsky coordinate systems has been found.It is that the Hamilton systems are completely integrable in the Liouville sense. Therefore, the involutive representative of the solutions for the coupled KdV-mKdV type equation are obtained.

13. Title: Approximate Murphy-Golub-Wathen Preconditioning For Saddle Point Problems

Josef Sifuentes
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Abstract: Several important preconditioners for saddle point problems yield linear systems for which GMRES converges exactly in just a few iterations. However, these

preconditioners all involve inverses of large submatrices. In practical computations such inverses are only approximated, and more iterations are required to solve the preconditioned linear system. How many more iterations? Recent perturbation analysis for GMRES leads to rigorous upper bounds on the number of iterations as a function of the accuracy of the preconditioner and spectral properties of the constituent matrices. Numerical computations verify these results for problems from optimization and fluid dynamics.

14. Title: Numerical Simulations of Shock Waves Reflection and Interaction

Ligang Sun
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Abstract: The main objective of this project is to detect and study the phenomena of reflection of one shock wave and interaction of two shock waves using numerical methods. In theory, solutions of non-linear Euler equations of compressive inviscid gas dynamics in two dimensions can display various features including shock waves and rarefaction waves. To capture the shock waves properly, highly accurate numerical schemes are designed according to second order Lax-Wendroff method. In this presentation, three numerical experiments were designed to show the reflection and interaction phenomena. Firstly, one shock was formed due to the encounter of two high speed gas flows, a reflected flow was formed due to the rigid wall. It is clear to find the jump of the physical parameters, such as density, pressure, velocity (both in x and y directions) and energy, in the track of the incident shock wave and reflected shock wave. In the second experiment, two shock waves were formed symmetrically in a long and narrow area. Under the similar conditions with the previous experiment, these two shock waves intersect in the middle. The changes of various parameters get drastic and chaotic in the interaction area (but still symmetric), while they are regular and clear in the outside of the interaction area. Conclusions and comparisons of the experiment results and its counterpart in theory were given in the end.