UTRGV SCHOOL OF MATHEMATICAL AND STATISTICAL SCIENCES PRESENTS

RECENT DEVELOPMENTS IN INTEGRABLE SYSTEMS AND SOLITONS: SPRING 2017 RESEARCH WORKSHOP

MARCH 6 - 8

March 6
9:30 - 12:15, STEM Center
1:00 - 3:00, MAGC 3.502

March 7
10:00 - 12:15, MAGC 3.502
1:00 - 4:30, STEM Center

March 8
2:00 - 4:00, MAGC 3.502

INVITED SPEAKERS:

DR. ALEJANDRO ACEVES
Southern Methodist University

DR. STEPHEN ANCO
Brock University

DR. YONG CHEN
East China Normal University

DR. SEN-YUE LOU
Ningbo University

LOCAL SPEAKERS:

DR. BAOFENG FENG
DR. ZHAOSHENG FENG
DR. ZHIJUN QIAO (co-organizer)
DR. ERWIN SUAZO (co-organizer)
University of Texas Rio Grande Valley

Please contact zhijun.qiao@utrgv.edu or erwin.suazo@utrgv.edu with any questions.

SIMONS FOUNDATION

UTRGV President's Endowed Professorship Program

Recent Developments in Integrable Systems and Solitons: Spring 2017 Research Workshop

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

Monday, March 6	9:15am – 12:00pm, STEM Center (MAGC 2.412)
	1:00pm – 4:00pm, MAGC 3.502
Tuesday, March 7	10:00am – 12:00pm, MAGC 3.502
	1:00pm – 4:30pm, STEM Center (MAGC 2.412)
Wednesday, March 8	2:00pm – 4:30pm, MAGC 3.502

Organizers:
Dr. Zhijun Qiao zhijun.qiao@utrgv.edu
Dr. Erwin Suazo erwin.suazo@utrgv.edu

Contact: Dr. Zhijun Qiao or Dr. Erwin Suazo, School of Mathematical and Statistical Sciences, College of Sciences, University of Texas Rio Grande Valley, 1201 W. University Drive, Edinburg, Texas 78539; Phone: (956) 665-3406; Emails: zhijun.qiao@utrgv.edu or erwin.suazo@utrgv.edu.

Description: This two-half-day workshop, held and sponsored by the School of Mathematical and Statistical Sciences, College of Sciences, University of Texas Rio Grande Valley, is devoted to applied mathematics and mathematical physics, and their applications in related fields. In the workshop, there will be four external well-known experts in nonlinear sciences: Dr. Alejandro Aceves, Dr. Stephen Anco, Dr. Yong Chen, and Dr. Senyue Lou to present their own research work at both theoretical and computational level together with a view towards some real-world applications. **Our goal is to develop collaborations in the interdisciplinary research and to train our students how to make an advanced study in their research.** All faculty and students are warmly welcome to attend. Particularly, graduate students are encouraged to discuss with those experts and share your ideas to find a possible joint work. This workshop has partially been supported by the UTRGV Endowed Professorship Program and the Simons Foundation.

Workshop Schedule

Monday, March 6, 2017				
9:15 – 9:30 Welcome Remarks		College Dean	Dr. Parwinder Grewal	
Session Chair	**Time**	**Location**	**Speaker**	**Title**
Dr. Zhijun Qiao	9:30 – 10:30	STEM Center MAGC 2.412	Dr. Alejandro Aceves	New trends in nonlinear photonics: A mathematical modeling perspective
	10:45 – 11:45		Dr. Senyue Lou	Space-Time reversal symmetry invariant and symmetry breaking solutions of Alice-Bob systems
	12:00 – 1:00	Lunch		
Dr. Erwin Suazo	1:00 – 2:00	MAGC 3.502	Dr. Alejandro Aceves	Modeling Simulation and Experiments of Two-Color Light Filaments
	2:00– 3:00		Dr. Baofeng Feng	KP-Toda hierarchy reduction method for soliton equations
	3:00 – 4:00		Discussion	
Tuesday, March 7, 2017				
Dr. Senyue Lou	10:00 –11:00	MAGC 3.502	Dr. Stephen Anco	Integrable multi-component peakon equations from a modified AKNS scheme
	11:00 –12:00		Dr. Zhaosheng Feng	Wave solutions to Kuramoto-Sivashinsky Equation
	12:00 – 1:00	Lunch		
Dr. Stephen Anco	1:00 – 2:00	STEM Center MAGC 2.412	Dr. Yong Chen	Constructing two-dimensional optimal system of the group invariant solutions
	2:00 – 3:00		Dr. Erwin Suazo	On similarity transformations and nonautonomous solitons
	3:00 – 4:00		Discussion	
Wednesday, March 8, 2017				
Dr. Yong Chen	2:00 – 3:00	MAGC 3.502	Dr. Stephen Anco	Negative flows in hierarchies of integrable scalar evolution equations
	3:00 – 4:00		Dr. Zhijun Qiao	Short pulse systems produced through the negative WKI hierarchy
	4:00 – 4:30		Discussion	

ABSTRACTS

1. Title: New trends in nonlinear photonics. A mathematical modeling perspective
   Alejandro Aceves, Southern Methodist University
   Abstract: Nonlinear photonics relates to light matter interactions and it continues to advance new knowledge and new technologies. In a similar way models need to evolve and be tested. In this talk we present recent results on areas connected to solitons. Examples will include PT-symmetric systems and optical rogue waves.

2. Title: Space-Time reversal symmetry invariant and symmetry breaking solutions of Alice-Bob systems
   Senyue Lou, Ningbo University
   Abstract: In natural and social science, there are many events may be happened in different places and times which are correlated each other. If one event depends on another, we call it as an Alice-Bob (AB) system or a two-place physical problem. In this report, we mainly report the exact solutions on the AB systems related to the parity (space reversal) and time reversal symmetries.

3. Title: Modeling Simulation and Experiments of Two-Color Light Filaments
   Alejandro Aceves, Southern Methodist University
   Abstract: At intense energies, laser filaments propagating in media such as crystals or air evolve in a complex way. In this talk we will start from the description of classical collapse phenomena governed by the two dimensional nonlinear Schroedinger equation and follow up with new theoretical results for co-propagation of two-color (2 frequencies) light filaments.

4. Title: KP-Toda hierarchy reduction method for soliton equations
   Baofeng Feng, University of Texas Rio Grande Valley
   Abstract: We give a review for the KP-Toda hierarchy reduction method to find multi-soliton and rogue wave solutions to soliton equations which was developed by Kyoto School. The KPToda hierarchy reduction method usually starts with the bilinear equations satisfied by the tau functions of the KP-Toda hierarchy, then through a series of reductions such as dimension and symmetry reductions, finally the multi-soliton or rogue wave solution can be derived in either determinant or pfaffian form. In this talk, I will take the nonlinear Schr¨odinger (NLS) equation and its vector form as an example to show how we can derive the multi-bright, multi-dark and mixed soliton solutions. If time permits, I will report nonsingular soliton solutions with zero and nonzero boundary conditions to a nonlocal NLS equation with PT symmetry. This is a joint work with Mark Ablowitz, Yasuhiro Ohta and Kenichi Maruno.

5. Title: Integrable multi-component peakon equations from a modified AKNS scheme
   Stephen Anco, Brock University, Canada

Abstract: The standard AKNS scheme for generating integrable evolution systems is modified to obtain integrable peakon systems. In the simplest case, the modified scheme yields a large family of integrable multi-component peakon equations, together with their recursion operators, symmetries, conservation laws, and bi-Hamiltonian structure.

6. Title: Wave solutions to Kuramoto-Sivashinsky Equation
   Zhaosheng Feng, University of Texas-Rio Grande Valley
   Abstract: In this talk, we are concerned with the Kuramoto-Sivashinsky equation which occupies a prominent position in describing physical processes in unstable systems. By means of the Lie symmetry reduction method and the Preller-Singer procedure, we show that there exist nontrivial bounded solitary wave solutions under certain parametric conditions. Numerical simulations of wave phenomena are illustrated, which provide us rich dynamic information and are in agreement with our theoretical analysis.

7. Title: Constructing two-dimensional optimal system of the group invariant solutions
   Yong Chen, East China Normal University
   Abstract: To search for inequivalent group invariant solutions of two-dimensional optimal system, a direct and systematic approach is established, which is based on commutator relations, adjoint matrix, and the invariants. The details of computing all the invariants for two-dimensional algebra are presented, which is shown more complex than that of one-dimensional algebra. The optimality of two-dimensional optimal systems is shown clearly for each step of the algorithm, with no further proof. To leave the algorithm clear, each stage is illustrated with a couple of examples: the heat equation and the Novikov equation. Finally, two-dimensional optimal system of the (2+1) dimensional Navier-Stokes (NS) equation is found and used to generate intrinsically different reduced ordinary differential equations. Some interesting explicit solutions of the NS equation are provided.

8. Title: On similarity transformations and nonautonomous solitons
   Erwin Suazo, University of Texas-Rio Grande Valley
   Abstract: By means of similarity transformations we study soliton solutions for variable coefficient nonlinear Schrodinger (VCNLS) and Burgers equations with variable coefficients. VCNLS appears in literature describing the evolution of coherent light in a nonlinear Kerr medium, Bose-Einstein condensates phenomena and high intensity pulse propagation in optical fibers. By restricting the coefficients to satisfy Ermakov-Riccati systems with multiparameter solutions, we present conditions for existence of explicit solutions with singularities and a family of oscillating periodic soliton-type solutions.

9. Title: Negative flows in hierarchies of integrable scalar evolution equations
   Stephen Anco, Brock University, Canada

Abstract: A one-parameter generalization of the hierarchy of negative flows is introduced for integrable hierarchies of evolution equations, which yields a wider (new) class of non-evolutionary integrable nonlinear wave equations. As main results, several integrability properties of these generalized negative flow equation are established, including their symmetry structure, conservation laws, and bi-Hamiltonian formulation. (The results also apply to the hierarchy of ordinary negative flows). The first generalized negative flow equation is worked out explicitly for each of the following integrable equations: Burgers, Korteweg-de Vries, modified Korteweg-de Vries, Sawada-Kotera, Kaup-Kupershmidt, Kupershmidt.

10. Title: Short pulse systems produced through the negative WKI hierarchy
Zhijun Qiao, University of Texas-Rio Grande Valley
Abstract: In this talk, we present a two-component short pulse system produced through a negative integrable flow associated with the WKI hierarchy. The Lax representation will be given for the the whole hierarchy. The multi-soliton solutions for the two short pulse system investigated, in particular, one-, two-, three-loop soliton, and breather soliton solutions are discussed in details with interesting dynamical interactions and shown through figures. This is a joint work with Qiaoyi Hu and Qilao Zha.