ABSTRACTS

COE Conference

Recent Advances and Applications in Nonlinear Science

16 $\sim$ 19 October 2006,
Graduate School of Mathematical Sciences, The University of Tokyo

Adrian S. CARSTEA

National Institute of Physics and Nuclear Engineering, Bucharest

On the dynamics of networks of genetic transcriptional regulators

We examine the dynamics of a network of genes focusing on a periodic chain of arbitrary length. We show that within a given class of sigmoids representing the equilibrium probability of the binding of the RNA polymerase to the core promoter, the system possesses a single stable fixed point. By slightly modifying the sigmoid, introducing stiffer forms, we show that it is possible to find network configurations exhibiting bistable behaviour. Also the existence and dynamics of proteomic waves in the case of a long network is discussed.

Chuan-Jen CHYAN

Tamkang University

Some results on measure chains

First we will give a brief introduction to the calculus on measure chains. Then we will give some motivating examples of dynamic equations on measure chains. Finally we will include some results concerning eigenvalue problems for nonlinear differential equa- tions on measure chains.

Bernadette DORIZZI

Institut National des télécomunications, Evry

Wavelet decomposition for iris recognition

Wavelet theory is a signal processing method which allows the analysis of an image at different resolution levels. In this presentation, we will present the problematic of iris processing for biometric person identification and will show how the Gabor wavelet analysis applied to iris infrared images is efficient on this task.

Claire GILSON

University of Glasgow

Quasideterminant solutions to noncommutative integrable systems

There has be much recent interest in noncommutative integrable systems, both discrete and continuous. In this talk I shall discuss solutions to some of these systems in terms of quasideterminants. I shall also look at direct methods of verification of the solutions without recourse to the bilinear method.

Basile GRAMMATICOS

Université de Paris VII & XI

Is there life after integrability?
An autobiographical exploration of Terra Integrabilitatis

Basil Grammaticos with Alfred Ramani and 56 other collaborators (though you are not mentioned explicitly you are probably among them)

A review of a quarter-century of integrability results based mainly on the work of the Ramani-Grammaticos group.

Jarmo HIETARINTA

University of Turku

Searching for integrable equations

In this talk we review various methods in searching for integrable equations. Such a search depends on the property associated with integrability and the class of equations on which it is applied. Illustration are chosen from Hamiltonian mechanical system, quantum mechanics, soliton equations, Yang-Baxter equations, and lattice difference equations.

Nalini JOSHI

University of Sydney

Asymptotics of the higher order Painlevé equations

It is well-known that the generic solutions of the classical Painleve equations are asymptotic to elliptic functions as the independent variable or a parameter approaches infinity. We show that the generic solutions of higher-order Painleve equations in a hierarchy are asymptotic to hyperelliptic functions in such limits.

Stéphane LAFORTUNE

College of Charleston

When is negativity not a problem for the ultra-discrete limit?

The 'ultra-discrete limit' has provided a link between integrable difference equations and cellular automata displaying soliton like solutions. In particular, this procedure generally turns *strictly positive* solutions of algebraic difference equations with *positive* coefficients into corresponding solutions to equations involving the "Max" operator. Although it certainly is the case that dropping these positivity conditions creates potential difficulties, it is still possible for solutions to persist under the ultra-discrete limit even in their absence. To recognize when this will occur, one must consider whether a certain expression, involving a measure of the rates of convergence of different terms in the difference equation and their coefficients, is equal to zero. Applications discussed include the solution of elementary ordinary difference equations, a discretization of the Hirota Bilinear Difference Equation and the identification of integrals of motion for ultra-discrete equations. This work was done in collaboration with Alex Kasman, from the College of Charleston.

Alain LAVERNE

Université de Paris VII & XI

Some uses of dimensional analysis in physics

Through specific examples taken in various branches, I will present a brief review of the well known role of dimensional analysis in predicting the form of physical laws. A less well known method consisting in giving different dimensions to otherwise equivalent quantities will be recalled.

Jyh-Hao LEE

Academia Sinica

Solvability of the derivative nonlinear schrödinger equation and solitons of the resonant nonlinear schrödinger equation

In this talk, we show some results on derivative nonlinear Schrödinger equations(DNLS) and solitons of the resonant nonlinear Schrödinger equation with nontrivial boundary condition by the Hirota method.
In the first part, we review some results about two by two AKNS-ZS system with quadratic spectral parameter, then we discuss the solvalbility of DNLS via various approaches [2].
In the second part , we will make a brief report on the resonant nonlinear Schrödinger equations and reation-diffusion systems and the application [1]. A novel integrable version of the NLS equation, namely [1],

$$i\frac{\partial\psi}{\partial t}+\frac{\partial^2\psi}{\partial x^2}+\frac{\Lambda}{4}|\psi|^2\psi=s\frac{1}{|\psi|}\frac{\partial^2|\psi|}{\partial x^2}\psi \tag{1}$$

has been termed the *resonant nonlinear Schrödinger equation* (RNLS). It can be regarded as a third version of the NLS, intermediate between the defocusing and focusing cases. For $s<1$ the model is reducible to the conventional NLS, (focusing for $\Lambda>0$ and defocusing for $\Lambda<0$). However, for $s>1$ it is not reducible to the usual NLS, but rather to a reaction-diffusion system. In this case, the model exhibits novel solitonic phenomena [1].
The RNLS can be interpreted as an NLS-type equation with an additional 'quantum potential' $U_Q=|\psi|_{xx}/|\psi|$. Very recently it was shown that RNLS naturally appears in the plasma physics, where it describes the propagation of one-dimensional long magnetoacoustic waves in a cold collisionless plasma subject to a transverse magnetic field [3]. A Hirota bilinear representation of the Reation-Diffusion system with non-zero boundary condition is given. Here one dissipaton and two-dissipaton exact solutions are obtained by Hirota bilinear method.
(The second part is a joint work with O.K. Pashaev.)

[1] Pashaev ,O. K. and Lee, J.-H., Resonance Solitons as Black Holes in Madelung Fluid. *M*od. Phys. Lett. A **17** 1601–1619 (2002).
[2] Lee, Jyh-Hao, Global Solvability of the Derivative Nonlinear Schrodinger Equation. *T*rans. Amer. Math. Soc. **3**14 , no. 1, 107–118 (1989)
[3] Lee,J.-H.,Pashaev,O. K.,Rogers, C. and Schief, W. K.,The Resonant Nonlinear Schrödinger Equation in Cold Plasma Physics.Application of Bäcklund-Darboux Transformations and Superposition Principles. to appear in J. Plasma Physics, 2006

Fon-che LIU

Tamkang University

Nonlinear systems of inequalities – a revisit of separation principles

Consistency of systems of (generally nonlinear) functions will be considered. In general one has to be content with consistency of weaker sense. For example, in von Neumann's minimax theorem, one looks for mixed strategies rather than pure strategies. We consider this question in a general setting; in doing so, a classical separation principle of Mazur and Orlicz comes into play. We give a convenient form of this principle with several of its applications.

M. MIMURA

Meiji University

Combustion under micro-gravity: modeling and simulation

Yoshimasa NAKAMURA

Kyoto University

mdLVs: A new numerical algorithm for singular values designed by using discrete integrable systems

Many people have considered the unexpected relationship between numerical algorithms and integrable systems of Lax form the 1980'. However, any new efficient numerical algorithm has not been presented from this point of view. Recently a new algorithm with a shift of origin for computing singular values of bidiagonal matrices was desinged by M. Iwasaki and the speaker. A shift is introduced into the recurrence relation defined by a discrete integrable dynamical system. A suitable shift strategy is given so that the singular value computation becomes numerically stable and has locally a cubic convergence rate. Therefore the algorithm is shown to be more accurate and faster than credible LAPACK routines for singular values.

J.J.C. NIMMO

University of Glasgow

Darboux transformations and quasideterminants

The application of the theory of quasideterminants to Darboux transformations for noncommutative integrable systems will be described. Relevant parts of this theory will be reviewed and then several examples (KP, Hirota-Miwa, Self-dual Yang-Mills) will be discussed.

Katsuhiro NISHINARI

The University of Tokyo

Jammology – Physics of self-driven particles

A new research field of "Jammology" is an interdisciplinary study of congestion phenomena ranging from vehicles, pedestrians, insects and internet traffic, etc. Some central ideas of this research and various applications we have considered so far will be presented in detail.

Yves POMEAU

Ecole Normale Supérieure

Eigenvalues and eigenfunctions of the Laplacian to a very large power

The classical problem of the eigenvalues of the Laplacian in a bounded domain has been a topic of interest since a very long time for mathematicians and physicists. Usually there is no closed form solution, except in simple geometries and/or for highly excited modes. Basile Grammaticos, Alfred Ramani and myself investigated an interesting limit where results can be obtained by rather unusual methods, the limit of a Laplacian raised to a very high power. I shall explain how things work and give some results for the 1D and for the spherically symmetric case. I'll present also conjectures for domains of arbitrary shape.

Alfred RAMANI

Ecole Polytechnique

Junkichi SATSUMA

Aoyama Gakuin University

From continuous to ultradiscrete

Walter STRAMPP

Universität Kassel

Isobaric Polynomials and Bilinear Operators

Faa di Bruno gave a general chain rule for the n-derivative derivative of a function $f(g(x))$. With his formula he trumped attemps made around 1850 to develop formulas for higher order derivatives of $\log(f(x))$ and $1/f(x)$. We discuss the derivative of logarithms and quotients and find closed formulas with the help of isobaric polynomials and bilinear operators. The formulas lead directly to the KP hierarchy.

K.M. TAMIZHMANI

University of Pondicherry

Integrability of Differential-Difference Equations – Singularity Confinement Approach

We present an integrability criterion, singularity confinement approach that is adapted to differential-difference equations. The method used is the combination of two well known integrability detectors: the Painleve method (for continuous systems) and the singularity confinement (for discrete systems). The wide applicability of the method is reviewed with the study of the Toda lattice, Kac-van Moerbeke system and various types of integro-differential equations belonging to the Benjamin-Ono family. We also show that this method is applicable to delay type equations as well. In particular, the derivation of delay Painleve equations will be shown.

In collaboration with B. Grammaticos and A. Ramani.

Tamizharasi TAMIZHMANI

Kanchi Mamunivar Centre for Post-Graduate Studies, Pondicherry

From integrable lattices to non-qrt mappings and other stories

Reductions of integrable evolution equations are expected to lead to simpler integrable systems. For instance, similarity reductions of integrable partial differential equations usually lead to one of the equations discovered by Painlevé and his group. The same applies to discrete systems. Second-order mappings obtained as reductions of integrable lattice equations are generally expected to have integrals that are ratios of biquadratic polynomials, i.e., to be of QRT-type. In our talk we shall present reductions of integrable lattice equations that are *not* of this type. The mappings we consider are exact reductions of integrable lattice equations proposed by Adler, Bobenko and Suris and some of them possess invariants that are of the type originally studied by Hirota, Kimura and Yahagi. Several other mappings obtained are linearisable. We show that a particular equation, obtained by J. Hietarinta using the ABS approach (without the tetrahedron assumption) is indeed solvable by linearization and we present its nonautonomous extension.

In collaboration with N. Joshi, B. Grammaticos and A. Ramani.

Yoshisuke UEDA

Future University Hakodate

My encounter with Chaos and where we are now