INVITED SPEAKERS:

Cewen Cao	(Zhengzhou University, China)
Baofeng Feng	(University of Texas-Pan American, USA)
Jingsong He	(Ningbo University, China)
Jarmo Hietarinta	(Turku University, Finland)
Ryogo Hirota	(Professor Emeritus, Waseda University, Japan)
Xingbiao Hu	(Chinese Academy of Sciences, China)
Jun-ichi Inoguchi	(Yamagata University, Japan)
Masataka Iwao	(Waseda University, Japan)
Kenji Kajiwara	(Kyushu University, Japan)
Koichi Kondo	(Doshisha University, Japan)
Jibin Li	(Zhejiang Normal University, China)
Qingping Liu	(China University of Mining & Technology (Beijing), China)
Senyue Lou	(Ningbo University, China)
Kenichi Maruno	(University of Texas-Pan American, USA)
Tetsu Masuda	(Aoyama Gakuin University, Japan)
Junta Matsukidaira	(Ryukoku University, Japan)
Yukitaka Minesaki	(Tokushima Bunri University, Japan)
Masatoshi Noumi	(Kobe University, Japan)
Yasuhiro Ohta	(Kobe University, Japan)
Changzheng Qu	(Northwest University, China)
Daisuke Takahashi	(Waseda University, Japan)
Lixin Tian	(Jiangsu University, China)
Tetsuji Tokihiro	(The University of Tokyo, Japan)
Satoshi Tsujimoto	(Kyoto University, Japan)
Yoshihide Watanabe	(Doshisha University, Japan)
Ralph Willox	(The University of Tokyo, Japan)
Haruo Yoshida	(National Astronomical Observatory of Japan, Japan)
Fumitaka Yura	(Future University -Hakodade, Japan)
Yunbo Zeng	(Tsinghua University, China)
Dajun Zhang	(Shanghai University, China)
Youjin Zhang	(Tsinghua university, China)
Ruguang Zhou	(Xuzhou Normal University, China)
Zixiang Zhou	(Fudan University, China)
Zuonong Zhu	(Shanghai JiaoTong University, China)

LIST OF THE POSTERS:

Juan Hu	(Chinese Academy of Sciences, China)
Jie Ji	(Zhejiang Gongshang University, China)
Shuhei Kamioka	(Kyoto University, Japan)
Kinji Kimura	(Kyoto University, Japan)
Chunxia Li	(Capital Normal University, China)
Mingli Li	(Capital Normal University, China)
Hiroshi Miki	(Kyoto University, Japan)
Hidetomo Nagai	(Waseda University, Japan)
Shinya Nakamura	(Waseda University, Japan)
Hiroto Sekido	(Kyoto University, Japan)
Changguang Shi	(Shanghai University of Electric Power, China)
Yang Shi	(University of Sydney, Australia)
Kai Tian	(Chinese Academy of Sciences, China)
Kouichi Toda	(Toyama Prefecture University, Japan)
Ning Wang	(Ocean University of China, China)
Yi Zhang	(Zhejiang Normal University, China)
Junxiao Zhao	(Graduate University of CAS, China)

EXECUTIVE COMMITTEE:

Baofeng Feng	(The University of Texas-Pan American)
Xingbiao Hu	(Academy of Mathematics and Systems Science, CAS)
Qingping Liu	(China University of Mining & Technology, Beijing)
Senyue Lou	(Ningbo University)
Kenichi Maruno	(The University of Texas-Pan American)
Daisuke Takahashi	(Waseda University)
Satoshi Tsujimoto	(Kyoto University)
Ralph Willox	(The University of Tokyo)

LOCAL ORGANIZING COMMITTEE:

Ling Jin	(Shaoxing University)
Xianmin Qian	(Shaoxing University)
Junmu Yang	(Shaoxing University)
Jun Yu	(Shaoxing University)

SPONSORS:

Academy of Mathematics and Systems Science, Chinese Academy of Sciences

State Key Laboratory of Scientific and Engineering Computing

Shaoxing University

The National Natural Science Foundation of China

China-Japan Joint Workshop on Integrable Systems

ON the Occasion of Prof. Ryogo Hirota's 77^{th} Birthday

Shaoxing, China, January 7--10, 2010

January 6, 2010 (Wednesday) Arrival day. Register time: 10:00–22:00.

January 7, 2010 (Thursday)

Opening ceremony (8:30–9:10) Chair: Senyue Lou & Daisuke Takahashi		
8:30–9:00	Welcome address	
9:00–9:10	Group photo	
Morning Session (9:10–10:40) Chair: Ryogo Hirota		
9:10–9:40	Cewen Cao	From the Rosochatius system to the KdV equation
9:40–10:10	Junta Matsukidaira	Constructing two dimensional integrable mappings which possess invariants of high degree
10:10-10:40	Masataka Iwao	N-periodic points on discrete systems of 3-cyclic Lotka-Volterra type
10:40–11:00	Coffee break	
Morning Session (11:00–12:30) Chair: Yunbo Zeng		
11:00–11:30	Jarmo Hietarinta	Hirota's method and the search for integrable systems
11:30–12:00	Qingping Liu	Hirota's approach to supersymmetric integrable systems
12:00–12:30	Jibin Li	Exact embedded solitons, gap solitions and quasi-periodic solutions for the Lax KdV5 equation
12:30	Lunch time	
Afternoon Session (14:00-15:30) Chair: Masatoshi Noumi		
14:00–14:30	Tetsuji Tokihiro	Correlation function of periodic box-ball system
14:30–15:00	Ralph Willox	Constructing ultradiscretisable Yang-Baxter maps
15:00–15:30	Kenji Kajiwara	Ultradiscretization of solvable chaotic systems
15:30–16:00	Coffee break	
Afternoon Session (16:00-18:00) Chair: Jarmo Hietarinta		
16:00–16:30	Ryogo Hirota	Ultradiscretization of the identities of Pfaffians (Determinants)
16:30–17:00	Daisuke Takahashi	Traffic congestion models and ultradiscretization
17:00–17:30	Zuonong Zhu	On the new explicit exact solutions for a coupled Volterra lattice system
17:30–18:00	Fumitaka Yura	Integrable systems in sequential cellular automata
18:00–19:00	Poster	
19:00	Banquet Chair: B.F. Feng, Q.P. Liu, K. Maruno & S. Tsujimoto	

January 8, 2010 (Friday)

Morning Session (8:30–10:00) Chair: Cewen Cao		
8:30–9:00	Youjin Zhang	Jacobi structures of evolutionary partial differential equations
9:00–9:30	Haruo Yoshida	Criteria for integrability of Hamiltonian systems based on differential Galois theory vs singular point analysis
9:30–10:00	Ruguang Zhou	The mixed hierarchy of soliton equations
10:00–11:00	Coffee break and Poster	
Morning Session (11:00–12:30) Chair: Ralph Willox		
11:00–11:30	Changzheng Qu	Geometric Bäcklund transformations to integrable invariant geometric flows
11:30–12:00	Jun-ichi Inoguchi	Differential geometry of cosh-Gordon equation
12:00–12:30	Zixiang Zhou	Darboux transformations for two dimensional elliptic affine Toda equations
12:30	Lunch time	
Afternoon Session (14:00–16:00) Chair: Daisuke Takahashi		
14:00–14:30	Satoshi Tsujimoto	Orthogonal polynomials and nonautonomous integrable systems
14:30–15:00	Xingbiao Hu	Convergence acceleration algorithms and integrable systems
15:00-15:30	Koichi Kondo	Solvable chaotic systems derived from tridiagonal determinant and Newton's method
15:30-16:00	Lixin Tian	Solitary-wave solutions to a dual equation of the Kaup-Boussinesq system
16:00–16:20	Coffee break	
Afternoon Session (16:20–18:20) Chair: Tetsuji Tokihiro		
16:20–16:50	Baofeng Feng	Integrable semi-and full-discretizations for the short-wave limit of the Camassa-Holm equation
16:50–17:20	Ken-ichi Maruno	Discretization of the short pulse equation
17:20–17:50	Yoshihide Watanabe	Applications of Gröbner basis to combinatorial optimization problems
17:50–18:20	Yukitaka Minesaki	Conservative discretization of the gravitational three-body Problem
18:30	Dinner time	

January 9, 2010 (Saturday)

Morning Session (8:30–10:00) Chair: Satoshi Tsujimoto		
8:30–9:00	Yunbo Zeng	An extended matrix KP hierarchy
9:00–9:30	Yasuhiro Ohta	Determinant identities arising from soliton theory
9:30–10:00	Dajun Zhang	The differential-difference KP equation: from Casoratian solutions to symmetries
10:00–10:30	Coffee break	
Morning Session (10:30–12:30) Chair: Youjin Zhang		
10:30–11:00	Masatoshi Noumi	Some remarks on τ-functions for the elliptic difference Painlevé equation
11:00–11:30	Senyue Lou	Multilinearization and variable separation
11:30–12:00	Tetsu Masuda	The anti-self-dual Yang-Mills equation and the third Painlevé equation
12:00–12:30	Jingsong He	Additional symmetry for the bigraded Toda hierarchy
12:30	Lunch time	
Afternoon		
Tour		

January 10, 2010 (Sunday)

Tour.

January 11, 2010 (Monday)

Departure day.

ABSTRACTS

From the Rosochatius System to the KdV Equation

Cewen Cao
Department of Mathematics, Zhengzhou University

Abstract:

An integrable mechanical system, discovered by E. Rosochatius in 1877, is investigated, which describes the motion of a particle on the sphere $|q| = 1$ in $\mathbb{R}^n$ under the influence of a potential:

$$U = \frac{1}{2}\sum_{j=1}^{N}(\alpha_j q_j^2 + \gamma_j q_j^{-2}) \quad .$$

To avoid the complicated presentations usually occurred in the presence of the sphere constraint, the Rosochatius system is put in a suitably chosen Hamiltonian form (H_1), where

$$H_1 = \frac{1}{2 < q, q >^{1/2}} \left(< Aq, q > + < p, p >< q, q > - < p, q >^2 + < q, q >< \gamma q^{-1}, q^{-1} > \right) ,$$

with a constant of motion $H_0 =< q, q >$; thus the sphere is a natural invariant subset. Higher order Rosochatius systems (H_k), $(k = 0, 1, 2, \dots)$ are constructed and straightened out in the Jacobi variety of the associated hyperelliptic curve Γ:

$$\frac{d\phi}{d\tau_k} = (\phi, H_k) = -\Omega_k$$

where the constant vector Ω_k is the coefficient in the expansion of the basis of the normalized holomorphic differentials of Γ.
A direct relation is found between the Rosochstius hierarchy and the KdV equation:

$$4u_t - 6uu_x + u_{xxx} = 0 \quad .$$

Let $(p(x,t), q(x,t)) = g_{H_1}^x g_{H_2}^t (p^0, q^0)$ be the compatible solution of (H_1) and (H_2). Then a special solution $u(x,t)$ of the KdV equation is generated through the mapping:

$$q \to u = \frac{2 < Aq, q >}{< q, q >} - \frac{2H_1}{H_0} \quad .$$

An explicit presentation of the finite genus solution of the KdV equation, the Its-Matveev formula, is calculated in the context of the Rosochatius hierarchy:

$$u(x,t) = -\partial_x^2 \ln \theta(x\Omega_1 + t\Omega_2 - \phi_0 - K - \eta) + D \quad .$$

Integrable semi-and full-discretizations for the short-wave limit of the Camassa-Holm equation

Baofeng Feng
Department of Mathematics, University of Texas-Pan American
Edinburg,TX, 78539-2999 U.S.A.

Abstract:

In this talk, the integrable discretizations for the short-wave model of the Camassa-Holm (SCH) equation

$$w_{TXX} - 2\kappa^2 w_X + 2w_X w_{XX} + w w_{XXX} = 0. \tag{1}$$

will be presented based on Hirota's bilinear method [1]. Eq. (1) belongs to the Dym hierarchy, which was studied in [2]. When $\kappa = 0$, it is called the Hunter-Saxton equation being used as a model for the propagation of waves in nematic liquid crystals [3]. We first link the SCH equation with the bilinear form of the two-dimensional Toda lattice (2DTL), and provide its N-cuspon solution in determinant form. Then, we propose an integrable semi-discretization of the SCH equation. Further, the full-discretization of the SCH equation is constructed by using the Bäcklund transformation of 2DTL. The N-cuspon solutions for the semi- and full-discretizations of the SCH equations are also given.
This is a joint work with my colleague, Dr. Kenichi Maruno, and Dr. Yasuhiro Ohta at Kobe University of Japan.

References:

1. R. Hirota, *Direct Method in Soliton Theory*, Cambraidge University Press, 2004.
2. M. Alber, R. Camassa, D. D. Holm, and J. Marsden, On the link between umbilic geodesics and soliton solutions of nonlinear PDEs, *Pro. R. Soc. Lond. A*, **450** (1995) 667-692.
3. J. K. Hunter, Y. Zheng, On a completely integrable nonlinear hyperbolic variational equation, *Physica D*, **79** (1994) 361-386.

Additional Symmetry for the Bigraded Toda Hierarchy

Jingsong He
Department of Mathematics, Ningbo University, China

Abstract:

In this talk, we shall define Orlov-Schulman's M_L, M_R operators and then give the additional symmetry flows of bigraded Toda hierarchy. We shall further show that these additional symmetry flows form an infinite dimensional algebra. This is a joint work with Chuanzhong Li and Yi Cheng from USTC(China).

Hirota's method and the search for integrable systems

Jarmo Hietarinta
Department of Physics and Astronomy, University of Turku
FIN-20014 Turku, Finland

Abstract:

Professor Hirota proposed in 1971 a direct method for constructing soliton solutions. For this purpose the nonlinear equation first has to be converted into Hirota' bilinear form, characterized by gauge invariance. Once a bilinear form is given the construction of one- and two-soliton solutions is quite algorithmic, but three-soliton solutions only work for integrable systems. Thus Hirota's method can be used as a tool for searching integrable equations. The setting is then quite different from other search methods (such as the symmetry approach), for example the nonlinearity is fixed from the outset but the equation does not have to have evolutionary form. We review the progress in this approach to integrability.

Ultradiscretization of the Identities of Pfaffians (Determinants)

Ryogo Hirota
Professor Emeritus, Waseda University
email: hirotar@minos.ocn.ne.jp

Abstract:

Recent progress in the direct method in soliton theory reveals that a soliton equation which exhibits multi-soliton solution is reduced to an identity of pfaffians. The identity of determinants such as the Plücker relation and Jacobi's identity of determinants are special cases of the identity of the pfaffians [1].
Takahashi and I have shown that soliton solutions to the box and ball system follow a form of ultradiscretized *permanent* [2]. A permanent is a signature free determinant. The fact suggests that there must be an identity of ultradiscretized permanents instead of determinants. More generally we expect an identity of ultradiscretized hafnians instead of pfaffians. A hafnian is a signature free pfaffian introduced by Caieniello [3]. We show an algebraic identity of ultradiscretized hafnians. The identity stems from a decomposition of a product of the hafnians.

References:

1. Ryogo Hirota, *The direct method in soliton theory*, Cambridge tracts in mathematics;155, Cambridge University Press, 2004.
2. D.Takahashi and R.Hirota, "Ultradiscrete Soliton Solution of Permanent Type", J.Phy.Soc.Jpn, **76** (2007) 104007.
3. E.R.Caieniello, *Combinatorics and renormalization in quantum field theory*, Frontiers in Physics. W.A. Benjamin, Inc., Reading, Mass.-London-Amsterdam, 1973.

A three-dimensional three-wave resonant interaction equation with self-consistent sources

Juan Hu & Xing-Biao Hu
LSEC, ICMSEC, Academy of Mathematics and Systems Science
Chinese Academy of Sciences
Beijing 100190, China
Email: hujuan@lsec.cc.ac.cn

Abstract:

In this paper, a three-dimensional three-wave resonant interaction equation with self-consistent sources (3D3WRI ESCS) are constructed via the source generation procedure. The corresponding Gram-type determinant solutions are then derived. As a simple case, the (1, 1, 1) lump solution is subsequently examined. A new feature of this 3D3WRI ESCS is that we allow $(a_1X_1 + a_2X_2 + a_3X_3)$-dependence of the arbitrary constants in the determinant solution for the 3D3WRI equation while applying the source generation procedure. Finally, we show how this 3D3WRI ESCS is transformed into other cases of 3D3WRI ESCS.

Convergence acceleration algorithms and integrable systems

Xingbiao Hu
LSEC, ICMSEC, Academy of Mathematics and Systems Science
Chinese Academy of Sciences
Beijing 100190, China
Email: hxb@lsec.cc.ac.cn

Abstract:

As is known, there is a close relation between convergence acceleration algorithms and integrable systems. For examples, the ϵ-algorithm and η-algorithm are equivalent to the discrete potential KdV and discrete KdV equations, respectively while the ρ-algorithm can be viewed as a discrete version for the cylindrical KdV equation.
In this talk, several known results on convergence acceleration algorithms are firstly reviewed and then some new concergence acceleration algorithms are reported. The connection between new convergence acceleration algorithms and discrete integrable systems is also mentioned.
This talk is joint work with C. Brezinski, Y. He, J.Q. Sun, H.W. Tam, S. Tsujimoto and E. J. Weniger.

Differential Geometry of Cosh-Gordon equation

Jun-ichi Inoguchi
Department of Mathematical Sciences, Yamagata University, Yamagata, 990-8560, Japan.
email: inoguchi@sci.kj.yamagata-u.ac.jp

Abstract:

In this talk, we discuss initial value problem of cosh-Gordon equation

$$-\omega_{tt} + \omega_{xx} + \cosh\omega = 0$$

and its elliptic counterpart

$$\omega_{xx} + \omega_{yy} + \cosh\omega = 0$$

by using certain Riemann-Hilbert splittings of loop groups [2],[3].
As is well known, every surface in Euclidean 3-space has real principal curvatures. On the other hand, in $(2+1)$-dimensional Minkowski spacetime $R^{2,1}$ with metric $dx^2 + dy^2 - dz^2$, timelike surfaces may have non real principal curvatures. Such surfaces have no Euclidean analogues.
The cosh-Gordon equation is realised as the structure equation (integrability condition) of timelike surfaces of constant positive Gaussian curvature in (2+1)-dimensional Minkowski spacetime with imaginary principal curvatures.
We should point out that there exist two kinds of Darboux transfornations of cosh-Gordon equation [1].
On the other hand, the elliptic cosh-Gordon equation is the structure equation of constant mean curvature in hyperbolic 3-space H^3 with mean curvature less than 1. Note that such surfaces have no corresponding surfaces in Euclidean 3-space R^3 and spherical 3-space S^3.

References:

1. C.-H. Gu, H.-S. Hu and J. Inoguchi, J. Geom. Phys. 41, 296-311 (2002).
2. J. Dorfmeister, J. Inoguchi and M. Toda, Contemp. Math. 308, 77–99 (2002).
3. J. Dorfmeister, J. Inoguchi and S.-P. Kobayashi, in preparation.

N-periodic points on discrete systems of 3-cyclic Lotka-Volterra type

Masataka Iwao

Department of Mathematics, School of Fundamental Science and Engineering,
Waseda University, 3-4-1 Okubo, Shinjuku-ku, Tokyo 169-8555, Japan
Tel: 011-81-3-5386-2484, email: m.iwao@aoni.waseda.jp

Abstract:

A discrete time system of Lotka-Volterra (LV) type, with 3-cyclic boundary condition, forms

$$\begin{cases} U^{t+1} + f(W^{t+1}) = U^t + f(V^t), \\ V^{t+1} + f(U^{t+1}) = V^t + f(W^t), \\ W^{t+1} + f(V^{t+1}) = W^t + f(U^t). \end{cases} \tag{1}$$

Here, $f(x) := \varepsilon \log(1+e^{x/\varepsilon})$ gives 3-cyclic version of the discrete LV system originated in [1], which also can be ultradiscrete one replacing $f(x) := \max(0, x)$ as $\varepsilon \to +0$ in the way of [2]. In this talk, sys.(1) will be discussed, under the following weak assumption: 'Let f be continuous and monotone increasing.' Some simple topological observations will turn out rough sketch about the distribution of N-periodic initial points on the system.

References:

1. R. Hirota and S. Tsujimoto, J. Phys. Soc. Jpn. **64** (1995), 3125.
2. T. Tokihiro, D. Takahashi, J. Matsukidaira and J. Satsuma, Phys. Rev. Lett. **76** (1996), 3247-3250.

Soliton scattering with amplitude changes of negative order AKNS equation

Jie Ji
Zhejiang Gongshang University

Abstract:

The motivation that the authors consider negative order equations is the following. First, many physically meaningful systems, such as the Camassa-Holm equation, the Degasperis-Procesi equation and the short pulse equation, are associated to negative order equations through reciprocal transformations[1-7]. Second, recently we found negative order flows can be used to construct infinitely many symmetries for the non-isospectral Ablowitz-Ladik hierarchy[8]. We note that infinitely many symmetries are usually found for integrable isospectral hierarchies. So, we hope that negative order equations might provide something new for integrable systems[9], not only new integrable characteristics, but also interesting dynamics, both physically and mathematically. In this paper, we will ivvestigate a nagative order equation of which wolutions admit amplitude in interactions.

Ultradiscretization of solvable chaotic systems

Kenji Kajiwara
Faculty of Mathematics, Kyushu University, 744 Motooka, Fukuoka 819-0395, JAPAN
e-mail: kaji@math.kyushu-u.ac.jp

Abstract:

We apply the technique of ultradiscretization to the discrete dynamical systems known as the "solvable chaotic systems", which lie on the border of integrable and non-integrable systems. As an example, we ultradiscretize a certain one-dimensional rational mapping and its general solution arising from the duplication formula of an elliptic function, which yields the tent map and its general solution simultaneously. We also present another example of two-dimensional case. As a by-product, geometric formulations for those piecewise linear sytems are given in terms of the tropical geometry.

References:

1. K. Kajiwara, A. Nobe and T. Tsuda, J. Phys. A: Math. Theor. **41**(2008) 395202.
2. K. Kajiwara, M. Kaneko, A. Nobe and T. Tsuda, Kyushu, J. Math. **63**(2009) 315–338.

A combinatorial aspect of integrable systems in terms of paths on directed graphs

Shuhei Kamioka
Department of Applied Mathematics and Physics, Graduate School of Informatics,
Kyoto University, Kyoto 606-8501, Japan
email: kamioka@i.kyoto-u.ac.jp

Abstract:

A combinatorial aspect of integrable systems will be shown in terms of paths on specific directed graphs. Such integrable systems as the discrete Toda equation and the discrete Lotka-Volterra equation have determinant solutions, called molecule solutions, on the semi-infinite lattice. In the molecule solutions, the dependent variables of integrable systems are substituted by ratios of determinants whose entries satisfy special linear relations. In this talk, for several discrete integrable systems, the determinants in the molecule solutions are expanded and then the entries of the determinants are represented as polynomials in the dependent variables (and parameters) of the systems. In particular, the polynomials in the representation are concretely defined in totally combinatorial words, namely, by means of directed graphs whose edges are labeled by the dependent variables (and parameters). The polynomials are given as generating functions of the paths on the directed graphs which connect two specified vertices. The following topics are also discussed: a relationship with orthogonal functions and their combinatorial structure; applications to enumerative problems of non-intersecting paths (vicious walkers) on graphs.

References:

1. S. Kamioka and S. Mizutani, *A combinatorial aspect of a discrete-time semi-infinite Lotka-Volterra equation*, J. Syst. Sci. Complex (2010, to appear)

Super fast determinant computation and challenge for computing the discriminant formula with degree 15

Kinji Kimura
Graduate School of Informatics, Kyoto University, Yoshida-Honmachi, Sakyo-ku, KYOTO 606-8501 Japan
email: kkimur@amp.i.kyoto-u.ac.jp

Abstract:

In this talk, we propose new methods for computing determinants and resultants with multivariate polynomials. The methods are based on multivariate Newton interpolation with many degree bounds. From inputs, we get many degree bounds of outputs. By virtue of many degree bounds, we can interpolate by using a few of interpolation points. And, we evaluate values at interpolation points in parallel. Therefore, we can compute determinants and resultants in high performance.
The discriminant formula with degree 15 can be expressed by determinants. As a benchmark, we challenged for computing the formula. That is the world record for computing discriminant formulas.

References:

1. K. O. Geddes, S. R. Czapor, and G. Labahn. *Algorithms for computer algebra*. Kluwer Academic Publishers, 1992.
2. A. J. Goldstein, R. L. Graham. A Hadamard-type bound on the coefficient of a determinant of polynomials, *SIAM Review*, 16 (1974) 394–395.

Solvable chaotic systems derived from tridiagonal determinant and Newton's method

Koichi Kondo

Faculty of Science and Engineering, Doshisha University
1-3, Tatara Miyakodani, Kyotanabe City, Kyoto, 610-0394, Japan
email: kokondo@mail.doshisha.ac.jp

Abstract:

In this talk, some solvable chaotic systems related to Newton's method are considered. Newton's method is well known as root finding method for nonlinear equation. Nourein's method[1)] is presented as a higher order extension for Newton's method. We derive solvable chaotic systems[2)] from applying these Newton type methods to quadratic equation. We show they have exact solution given by addition formula of tridiagonal determinant. We also derive solvable chaotic systems from an extension of Steffensen's method[3)] which is higher order root finding method and does not employ any derivative. Moreover, we prove some of equations presented by Sakaki and Kakei[4)] have exact solutions. And we clarify behavior of their solutions and relationship to the solvable chaotic system related to Newton's method.

References:

1. A.-W. M. Nourein, Root determination by use of Padé approximants, BIT 16, 291–297 (1979).
2. K. Kondo and Y. Nakamura, Determinantal solutions of solvable chaotic systems, J. Comp. Appl. Math. 145, 361-372 (2002).
3. K. Kondo and Y. Nakamura, An extension of the Steffensen iteration and its computational complexity, Interdisciplinary Information Sciences 4, 129-138 (1998).
4. T. Sakaki and S. Kakei, Difference equations with an invariant expressed in terms of the hypergeometric function (in Japanese), Trans. Japan Soc. Indust. Appl. Math. 17, 455–462 (2007).

Darboux transformations for a twisted derivation and quasideterminant solutions to the super KdV equation

Chunxia Li
Capital Normal University, China

Abstract:

This paper is concerned with a generalized type of Darboux transformations defined in terms of a twisted derivation D satisfying $D(AB) = D(A) + \sigma(A)B$ where σ is a homomorphism. Such twisted derivations include regular derivations, difference and q-difference operators and superderivatives as special cases. Remarkably, the formulae for the iteration of Darboux transformations are identical with those in the standard case of a regular derivation and are expressed in terms of quasideterminants. As an example, we revisit the Darboux transformations for the Manin-Radul super KdV equation, studied in Q.P. Liu and M. Mañas, Physics Letters B **396** 133–140, (1997). The new approach we take enables us to derive a unified expression for solution formulae in terms of quasideterminants, covering all cases at once, rather than using several subcases. Then, by using a known relationship between quasideterminants and superdeterminants, we obtain expressions for these solutions as ratios of superdeterminants. This coincides with the results of Liu and Mañas in all the cases they considered but also deals with the one subcase in which they did not obtain such an expression. Finally, we obtain another type of quasideterminant solutions to the Main-Radul super KdV equation constructed from its binary Darboux transformations. These can also be expressed as ratios of superdeterminants and are a substantial generalization of the solutions constructed using binary Darboux transformations in earlier work on this topic.

Exact Embedded Solitons, Gap Solitions and Quasi-Periodic Solutions for the Lax KdV5 Equation

Jibin Li
Zhejiang Normal University, China

Abstract:

For the Lax KdV5 equation, corresponding four-dimensional traveling wave system is studied by using Congrove's method. Exact explicit gap soliton, embedded soliton and quasi-periodic wave solutions are obtained. The existence of homoclinic manifolds to a hyperbolic equilibrium, center-saddle and the equilibrium with zero pair of eigenvalues is revealed. The bifurcation conditions of equilibria are given.

Prolongation structure of the couple KdV equation

Mingli Li
Capital Normal University, China

Hirota's Approach to Supersymmetric Integrable Systems

Qingping Liu
Department of Mathematics
China University of Mining & Technology (Beijing)
Beijing 100083, China
Email: qpl@cumtb.edu.cn

Abstract:

In this talk, we will review our results on the supersymmetric integrable systems. As in the classical case, we will show that Hirota's method is also powerful for supersymmetric systems. The equations considered include supersymmetric MKdV, classical Boussinesq, $N = 2$ KdV.

Multilinearization and variable separation

Senyue Lou & Xiaoyan Tang
Ningbo University & Shanghai Jiao Tong University

Abstract:

By means of the multilinearization procedure for $(2+1)$-dimensional integrable systems, a special variable separation approach, the multilinear variable separation approach (MLVSA), can be established. From the MLVSA, a common formula with some arbitrary functions has been obtained for some suitable physical quantities of various $(2+1)$-dimensional models such as the Davey-Stewartson (DS) model, the Nizhnik-Novikov-Veselov (NNV) system, asymmetric NNV equation, asymmetric DS equation, dispersive long wave equation, Broer-Kaup- Kupershmidt system, long wave-short wave interaction model, Maccari system, and a general $(N+M)$-component Ablowitz-Kaup-Newell-Segur (AKNS) system. Selecting the arbitrary functions appropriately, one may obtain abundant stable localized interesting excitations such as the multidromions, lumps, ring soliton solutions, breathers, instantons, etc. It is shown that some types of lower dimensional chaotic patterns such as the chaotic-chaotic patterns, periodic-chaotic patterns, chaotic line soliton patterns, chaotic dromion patterns, fractal lump patterns, and fractal dromion patterns may be found in higher dimensional soliton systems. The interactions between the traveling ring type soliton solutions are completely elastic. The traveling ring solitons pass through each other and preserve their shapes, velocities, and phases. Some types of localized weak solutions, peakons, compactons and foldons, are also discussed.

Discretization of the short pulse equation

Ken-ichi Maruno
Department of Mathematics, University of Texas – Pan American, Edinburg, TX, 78539-2999, U.S.A.
email: kmaruno@utpa.edu

Abstract:

The short pulse (SP) equation

$$u_{xt} = u + \frac{1}{6}(u^3)_{xx} \tag{1}$$

was derived recently as a model equation for the propagation of ultra-short optical pulses in nonlinear media [1,2]. Apart from the context of nonlinear optics, the SP equation has also been derived as an integrable differential equation associated with pseudospherical surfaces [3]. The SP equation admits loop soliton solutions as well as smooth soliton solutions [4,5].
We present integrable semi-discretization and fully discretization of the SP equation. Using the semi-discrete analogue of the SP equation, we perform numerical computations. This is joint work with Dr. Bao-Feng Feng (UTPA) and Dr. Yasuhiro Ohta (Kobe).

References:

1. T. Schäfer T and C. E. Wayne, Physica D, **196**, 90-105 (2004).
2. Y. Chung, C. K. R. T. Jones, T. Schäfer and C. E. Wayne, Nonlinearity, **18**, 1351-1374 (2005).
3. M. L. Robelo, Stud. Appl. Math. **81**, 221–248 (1989).
4. A. Sakovich and S. Sakovich J. Phys. A, **39**, L361–367 (2006).
5. Y. Matsuno, J. Phys. Soc. Jpn. **76**, 084003 (2007).

The anti-self-dual Yang-Mills equation and the third Painlevé equation

Tetsu Masuda

Department of Physics and Mathematics, Aoyama Gakuin University,
Sagamihara, 229-8558 Japan
email: masuda@gem.aoyama.ac.jp

Abstract:

The classical transcendental solutions to the Painlevé III equation are derived from a family of solutions to the $SL(2, \mathbf{C})$ anti-self-dual Yang-Mills equation. It is also shown that the affine Weyl group symmetry of $\mathrm{P_{III}}$ are recovered from the symmetry of Yang's equation.

References:

1. Tetsu Masuda, The anti-self-dual Yang-Mills equation and the Painlevé III equation, J. Phys. A. **40** (2007) 14433-14445.

Constructing two dimensional integrable mappings which possess invariants of high degree

Junta Matsukidaira
Department of Applied Mathematics and Informatics, Ryukoku University, Seta, Otsu, Shiga 520-2194, Japan.
email: junta@rins.ryukoku.ac.jp

Abstract:

We propose a method for constructing two-dimensional integrable mappings that possess invariants with degree higher than two. Such integrable mappings are obtained by making a composition of a QRT mapping and a mapping that preserves the invariant curve of the QRT mapping except for changing the integration constant involved. We show several concrete examples whose integration constants change with period 2 and 3.

References:

1. Constructing two-dimensional integrable mappings that possess invariants of high degree, Hironori Tanaka, Junta Matsukidaira, Atsushi Nobe and Teruhisa Tsuda, RIMS Kokyuroku Bessatsu B13, 75-84(2009)

Discrete integrable systems associated with skew orthogonal polynomials

Hiroshi Miki

Department of Applied Mathmatics and Physics, Graduate School of Informatics, Kyoto University, Kyoto 606-8501, Japan
email: miki@amp.i.kyoto-u.ac.jp

Abstract:

Skew orthogonal polynomials (SOPs) are polynomials having an orthogonality with respect to an antisymmetic bilinear form. Originally SOPs are introduced by Dyson in order to calculate the correlation functions of the orthogonal or symplectic ensembles in random matrix theory[1]. In recent years, however, SOPs are shown to have a close relation with integrable systems[2].
In this presentation, we reveal the relation between SOPs and discrete integrable systems. First, we show that even degree SOPs can be seen as the wave function of the discrete coupled KP equation[3]. Then, we obtain a nonlinear equation from the compatiblity conditions for the transformations of the even degree SOPs. Finally, we derive the nonlinear equation in a 2×2 matrix form associated with even and odd degree SOPs. This is a joint work with Hiroaki Goda and Satoshi Tsujimoto (Kyoto University).

References:

1. F. J. Dyson, J. Phys. Math. **13**. 90-97, 1972
2. M. Adler, E. Horozov and P. van Moerbeke, Int. Math. Res. Notices, **11**. 569-588, 1999
3. C. R. Gilson, J. J. C. Nimmo and S. Tsujimoto, J. Phys. A: Math. Gen. **34**(9) 10569-10575, 2001

Conservative Discretization of the Gravitational Three-Body Problem

Yukitaka Minesaki
Tokushima Bunri University, Tokushima, 770-8514, Japan
email: minesaki@tokushima.bunri-u.ac.jp

Abstract: The gravitational three-body problem can be regarded as a constrained mechanical system. After regularization, application of totally conservative integrator to the constrained system yields a discrete system where numerical error does not grow. We found the following properties: (i) the resulting discrete system keeps the values of all conserved quantities, namely, the linear momentum, the angular momentum, the position of center of mass and the enegry; (ii) it has the same linearly stable special solutions as the three-body problem.

References:

1. Y. Minesaki and Y. Nakamura, J. Phys. A. 39, 9453-9476 (2006)
2. Y. Minesaki and Y. Nakamura, Phys. Lett. A. 306, 127-133 (2002)

Ultradiscrete Plücker relation specialized for soliton solutions

Hidetomo Nagai
Department of Applied Mathematics, School of Fundamental Science and Engineering,
Waseda University, Japan
email: hdnagai@aoni.waseda.jp

Abstract:

A new form of solutions to some ultradiscrete soliton equations are given recently. It is expressed by the ultradiscrete permanent, which is defined by ultradiscretizing the permanent, that is, signature-free determinant. In this talk, we show the ultradiscrete analogue of Plücker relation for the ultradiscrete permanent. Moreover, we prove soliton solutions to the ultradiscrete KP and the ultradiscrete 2D Toda equations using the relation specialized for ultradiscrete soliton solution.

References:

1. D. Takahashi, R. Hirota, J. Phys. Soc. Japan 76 (2007) 104007–104012.
2. H. Nagai, J. Phys. A: Math. Theor. **41** (2008), 235204(12pp).
3. H. Nagai, `http://www.gem.aoyama.ac.jp/~isojima/RIMS2009/rims09_nagai.pdf`.

Periodic phase soliton of ultradiscrete hungry Lotka–Volterra equation

Shinya Nakamura
Major in Pure and Applied Mathematics, Graduate School of Fundamental Science and Engineering, Waseda University, 3-4-1, Okubo, Shinjuku-ku, Tokyo 169-8555, Japan
email: s-nakamura@moegi.waseda.jp

Abstract:

In this talk, I will report a new type of solutions to the ultradiscrete hungry Lotka–Volterra (uhLV) equation. The solution is obtained by introducing the periodic phase into the known soliton solution. I call this type of solution a 'periodic phase soliton' (PPS). PPS is a traveling wave showing a periodic variation. The interaction among PPS's and solitons is different from that of solitons.

References:

1. Shinya Nakamura, "Periodic phase soliton of ultradiscrete hungry Lotka–Volterra equation", accepted to J. Phys. A. 2009

Some remarks on τ-functions for the elliptic difference Painlevé equation

Masatoshi NOUMI
Department of Mathematics, Kobe University, Rokko, Kobe 657-8501, Japan
email: noumi@math.kobe-u.ac.jp

Abstract:

In this talk, I will give a survery on the theory of τ-functions for the elliptic difference Painlevé equation, as well as a description of its particular solutions of hypergeometic type.

References:

1. K. Kajiwara, T. Masuda, M. Noumi, Y. Ohta and Y. Yamada: ${}_{10}E_9$ solution to the elliptic Painlevé equation, J. Phys. A. 36(2003), L263–L272.
2. K. Kajiwara, T. Masuda, M. Noumi, Y. Ohta and Y. Yamada: Point configurations, Cremona transformations and the elliptic difference Painlevé equation, in *Théories asymptotiques et équations de Painlevé* (*Angers, juin 2004*), Séminaires et Congrès 14(2006), 175–204.

Determinant identities arising from soliton theory

Yasuhiro Ohta
Department of Mathematics, Kobe University, Rokko, Kobe 657-8501, Japan
email: ohta@math.kobe-u.ac.jp

Abstract:

Identities of determinants such as Plücker relations and Jacobi formula are useful in soliton theory for verifying various solutions. In this talk, some determinant identities derived by using soliton equations and their particular solutions are presented and discussed.

Geometric Bäcklund transformations to integrable invariant geometric flows

Changzheng Qu
Center for Nonlinear Studies, Northwest University, Xi'an, 710069

Abstract:

It is well known that certain invariant geometric flows are associated with integrable systems, so these invariant geometric flows are integrable. In this talk, the Backlund transformation to these integrable geometric flows is studied, which are derived respectively for integrable plane curve flows respectively in Euclidean, centro affine, affine, similarity and projective geometries etc.

Construction of D-optimal designs using canonical moments and discrete integrable systems

Hiroto Sekido

Department of Applied Mathematics and Physics, Graduate School of Informatics, Kyoto University, Kyoto 606-8501, Japan
email: sekido@amp.i.kyoto-u.ac.jp

Abstract:

Statistical design of experiments is a methodology to make efficient experiments. In statistical design of experiments, optimal designs are sets of observation points which give the highest accuracy estimators based on a particular optimality criterion. In particular, D-optimal designs are defined using the determinant of a Fisher information matrix. D-optimal designs for trigonometric regression models were calculated by Lau and Studden [1] using trigonometric canonical moments. Trigonometric canonical moments are defined as normalized trigonometric moments. Trigonometric canonical moments are written down using Toeplitz determinants of trigonometric moments. In this talk, trigonometric regression models with prior information are considered. In order to calculate D-optimal designs for these models, a useful relationship between trigonometric canonical moments and discrete integrable systems is used. By using canonical moments and discrete integrable systems, a method for calculating D-optimal designs for these models is proposed.

References:

1. T. S. Lau, W. J. Studden, Optimal designs for trigonometric and polynomial regression using canonical moments, *Ann. Stat.*, **13**, 383–394, (1985).

Exact solutions of modified Skyrme model

Changguang Shi
Shanghai University of Electric Power, China

Abstract:

The modified Skyrme model is investigated. Two classes of solutions are obtained. It is shown that, although the field configurations of these two classes are different, the energy densities for two classes take the same form.

q-discrete Painlevé equation and its associated linear problems

Yang Shi
University of Sydney

Abstract:

q-discrete Painlevé equations have been found to possess many properties similar to those of the classical differential Painlevé equations. Such as, having the associated linear problems (Lax pair); admits special solutions when the parameters in the equation take on particular values; having Bäcklund transformation which relates one solution of the equation to another solution of the equation with different parameters that can be used to generates hierarchies of special solutions from simple seed solutions, etc.
It has been shown for differential Painlevé equations, its hierarchies of special solutions can be represented in determinantal forms involving elementary special functions (orthogonal polynomials, hypergeometric type functions), and their derivatives. For q-discrete Painlevé equations, determinantal forms of hierarchies of special solutions have already been found via algebraic and geometric perspectives. There is another method, asymptoticly analyze of the associated linear problems to study the Painlevé equations which has not been explored in the study of discrete Painlevé equations. We show that by studying the associated linear problems analytically we can obtain various informations of the Painelvé equations, of which the most interesting result is the derivation of determinantal representations of special solutions.

Traffic congestion models and ultradiscretization

Daisuke Takahashi
Department of Applied Mathematics, School of Fundamental Science and Engineering,
Waseda University, Japan
email: daisuket@waseda.jp

Abstract:

There are many traffic models describing the congestion due to the delay of driver response. There are also different levels of discreteness of models, for example, differential equations, coupled map lattices, differenece equations, and cellular automata. The ultradiscretization is a key method to link the models directly. In my talk, I will report about the linkages and show how effective models have a common mathematical structure of solutions.

Symmetry approach to $N = 1$ supersymmetric systems

Kai Tian
LSEC, ICMSEC, Academy of Mathematics and Systems Science
Chinese Academy of Sciences
Beijing 100190, China
Email: tiankai@lsec.cc.ac.cn

Abstract:

Within the framework of symmetry approach, we investigate $N = 1$ supersymmetric systems of polynomial type, which admit at least one higher order generalized symmetry. Among these systems, the most interesting ones include a supersymmetric Sawada-Kotera equation, a 3rd order supersymmetric Burgers equation and a novel supersymmetric Kaup-Kupershmidt equation. Some properties of these equations are presented. Furthermore, we also consider the supersymmetric counterparts of the generalized nonlinear Schrödinger equation.

Static Hopfions in an extended Skyrme-Faddeev model

L. A. Ferreira[a], Nobuyuki Sawado[b] and Kouichi Toda[c]

[a]Instituto de Física de São Carlos; IFSC/USP, Universidade de São Paulo - USP, Caixa Postal 369, CEP 13560-970, São Carlos-SP, Brazil
email: laf@ifsc.usp.br

[b]Department of Physics, Tokyo University of Science, Noda, Chiba 278-8510, Japan
email: sawado@ph.noda.tus.ac.jp

[c]Department of Mathematical Physics, Toyama Prefectural University, Kurokawa 5180, Imizu, Toyama, 939-0398, Japan
email: kouichi@yukawa.kyoto-u.ac.jp

Abstract:

In this talk, we construct static soliton solutions with non-zero Hopf topological charges, for a field theory that has found interesting applications in many areas of Physics. It is a $(3+1)$-dimensional Lorentz invariant field theory for a triplet of scalar fields $\vec{n}$, living on the two-sphere S^2, $\vec{n}^2=1$, and defined by the Lagrangian density[1]:

$$\mathcal{L}=M^2\partial_\mu\vec{n}\cdot\partial^\mu\vec{n}-\frac{1}{e^2}\left(\partial_\mu\vec{n}\wedge\partial_\nu\vec{n}\right)^2+\frac{\beta}{2}\left(\partial_\mu\vec{n}\cdot\partial^\mu\vec{n}\right)^2, \tag{1}$$

where the coupling constants e^2 and β are dimensionless, and M has dimension of mass. The first two terms correspond to the so-called Skyrme-Faddeev model, as the generalization to $3+1$ dimensions of the CP^1 model in $2+1$ dimensions. In a Minkowski space-time the static Hamiltonian associated to (1) is

$$\mathcal{H}_{\text{static}}=M^2\partial_i\vec{n}\cdot\partial_i\vec{n}+\frac{1}{e^2}\left(\partial_i\vec{n}\wedge\partial_j\vec{n}\right)^2-\frac{\beta}{2}\left(\partial_i\vec{n}\cdot\partial_i\vec{n}\right)^2, \tag{2}$$

with $i,j=1,2,3$. Therefore, it is positive definite for $M^2>0$, $e^2>0$ and $\beta<0$. By an axially symmetric ansatz based on toroidal coordinates, we construct numerical solutions with Hopf charge up to four, and calculate their analytical behavior in some limiting cases. The solutions present an interesting behavior under the changes of a special combination of the coupling constants of the quartic terms. Their energies and sizes tend to zero as that combination approaches a particular special value. In addition, the model presents an integrable sector with an infinite number of local conserved currents which apparently are not related to symmetries of the action. In the intersection of those two special sectors the theory possesses exact vortex solutions (static and time dependent) which were constructed by one of the authors[2]. It is believed that such model describes some aspects of the low energy limit of the pure SU(2) Yang-Mills theory, and our results may be important in identifying important structures in that strong coupling regime.

This talk is based on [3].

References:

1. H. Gies, Phys. Rev., D **Vol. 63**, 125023 (2001).
2. L. A. Ferreira, JHEP05(2009)001.
3. L. A. Ferreira, Nobuyuki Sawado and Kouichi Toda, JHEP11(2009)124.

Correlation function of periodic box-ball system

Tetsuji Tokihiro
Graduate School of Mathematical Sciences, University of Tokyo, Japan
email: toki@ms.u-tokyo.ac.jp

Abstract:

In this talk, I present some results on the correlation functions of periodic box-ball system. For the two point functions of short distance, we give explicit formulae obtained by combinatorial methods. We show the expressions for general N-point functions in terms of ultradiscrete theta functions. This work was collaborated with Jun Mada.

References:

1. J. Mada and T. Tokihiro, "Correlation function of periodic box–ball system" (preprint).

Orthogonal polynomials and nonautonomous integrable systems

Satoshi Tsujimoto
Department of Applied Mathematics and Physics, Graduate School of Informatics,
Kyoto University, Kyoto 606-8501, Japan
email: tujimoto@i.kyoto-u.ac.jp

Abstract:

Orthogonal polynomials and integrable systems are closely related from various views. In this talk, we review the relation between orthogonal polynomials and nonautonomous integrable systems from the point of view of τ-function. After some elementary introduction of the spectral transformations of the orthogonal polynomials, we show how orthogonal polynomials appear as a solution of the nonautonomous discrete Toda equation[1,4]. Then we consider other types of nonautonomous integrable systems such as the Toda type chain in multi-diagonal matrix form, the R_{II}-chain and the FST-chain[2,3].

References:

1. V. Spiridonov and A. Zhedanov, Discrete Darboux transformations, the discrete-time Toda lattice, and the Askey-Wilson polynomials, Meth. Appl. Anal. 2, 369–398 (1995).
2. A. Mukaihira and S. Tsujimoto, Determinant structure of non-autonomous Toda-type integrable systems, J.Phy. A: Math. and Gen. 39, 779–788 (2006).
3. V. Spiridonov, S. Tsujimoto and A. Zhedanov, Integrable discrete time chains for the Frobenius-Stickelberger-Thiele polynomials, CMP 27, 139–165, (2007).
4. S. Tsujimoto, Determinant solutions of the nonautonomous discrete Toda equation associated with the deautonomized discrete KP hierarchy, J. of Syst. Sci. and Complexity (To appear)

On operatorial formulation of Dispersionless KP hierarchy

Ning Wang
Ocean University of China, China

Applications of Gröbner Basis to Combinatorial Optimization Problems

Yoshihide Watanabe
Department of Mathematical Science, Doshisha University,
Tanabe, Kyoto 610-0123, JAPAN
email: yowatana@mail.doshisha.ac.jp

Abstract:

In this talk, I will introduce some results on the applications of Gröbner basis to combinatorial optimization problems. First I have to note that the present talk is based on the joint work with Dr. Daisuke Ikegami and my graduate students. The talk is devided into two parts: the fisrt part is on the Maximum likelihood decoding of binary codes. Ikegami and Kaji heve presented the algorithm for the maximum likelihood decoding of binary codes using Gröbner basis of lattice ideals associated with binary codes. This algorithm is the variant of Conti-Traverso's algorithm for Integer Programming. Computer experiments shows that the computation of the Gröbner basis consumes lots of memory and spend extermely much time even for the codes with relatively short code length. So the computation of the Gröbner basis using Buchberger's algorithm directly from the generator of the ideal is not a realistic strategy in the the practical decoding of the codes. We will talk about a result on the characterization of the Grönber basis for perfect codes. This will be the first step to compute the Gröbner basis not by using Buchberger's algorithm but by using the combinatorial properties of the codes. The second part is on the network flow problems defined on directed graphs, especially on the maximum flow problems. The maximum flow problem can be formulated as an integer programming (IP) problem. Then Conti-Traverso's algorithm for IP problems can be applicable. In the formulation of of the maximum flow problem, the matrix obtained from the incidence matrix of the graph by removing two rows corresponding to the two specified vertices called the saurce and the sink play an important role. We call such a matrix as truncated incidence matrix and we have characterized the generator of the toric ideal associated with the truncated incidence matrix in terms of the combinatorial properties of the graph. There are various kinds formulations of the maximum flow problem as IP problem. We adopt the formulation by Natsuko Miyagi. In her formulation, the matrix coefficients of the problem are of the Lawrence type, so the reduced Gröbner basis of the toric ideal associated with the matrix coefficients of the problem with respect to a monomial ordering becomes the universal Gröbner basis. Finally We will talk about the characterization of the universal Gröbner basis of the toric ideal associated with the maximum flow problmes in terms of combinatorial properties such as paths and circuits of the graph.

References:

1. P. Conti and C. Traverso, Lect. Note Comp. Sci. Vol.539, pp. 130-139(1991)
2. D. Ikegami and Y. Kaji, IEICE Trans. Vol.E86-A(No.3), pp. 643-651(2003).

Constructing ultradiscretisable Yang-Baxter maps

Ralph Willox
Graduate School of Mathematical Sciences, The University of Tokyo,
3-8-1 Komaba, Meguro-ku, 153-8914 Tokyo, Japan
email: willox@ms.u-tokyo.ac.jp

Abstract:

In this talk it will be explained how to construct ultradiscretisable Yang-Baxter maps from the discrete KP and BKP hierarchies. The relationship between the piece-wise linear Yang-Baxter maps thus obtained and known combinatorial R-matrices will be discussed. This talk is base on joint work with S. Kakei and J.J.C. Nimmo.

References:

1. "Yang-Baxter maps and the discrete KP hierarchy", S. Kakei, J.J.C. Nimmo and R. Willox, Glasgow Math. J. **51A** (2009) 107–119
2. "Yang-Baxter maps from the discrete BKP equation", S. Kakei, J.J.C. Nimmo and R. Willox, arXiv:0911.2684v1 [nlin.SI] (2009).

Criteria for integrability of Hamiltonian systems based on differential Galois theory vs singular point analysis

Haruo Yoshida
Division of Theoretical Astronomy, National Astronomical Observatory of Japan,
Tokyo 181-8588, Japan
email: h.yoshida@nao.ac.jp

Abstract:

In this talk, recent developments of criteria for integrability of Hamiltonian systems will be reviewed which are based on differential Galois theory. The best application so far known is the result for homogeneous potential systems, which include the gravitational N-body systems. These criteria partially justify the so-called singular point analysis as a detection tool for integrable systems. Criteria for super-integrability will be also discussed.

References:

1. H. Yoshida, Physica D 29, 128-142 (1987).
2. H. Yoshida, Physica D 128, 53-69 (1999).
3. H. Yoshida, Physica A 288, 424-430 (2000).
4. A. J. Maciejewski, M. Przybylska, H. Yoshida, Physics Letters A, 372, 5581-5587 (2008).

Integrable systems in sequential cellular automata

Fumitaka Yura
Department of Complex Systems, School of Systems Information Science, Future University – HAKODATE, 116-2 Kamedanakanocho, Hakodate, Hokkaido, 041-8655 Japan
email: yura@fun.ac.jp

Abstract:

In this talk, we propose sequential cellular automata that contain integrable systems in the case of special rules. These cellular automata has sequential updating rule, which is interpreted as a lattice model. Especially this system provides the new representation for ultradiscrete hungry Lotka-Volterra equation.

An extended matrix KP hierarchy

Yunbo Zeng
Department of Mathematical Sciences, Tsinghua University
Beijing 100084, China

Abstract:

Based on the square eigenfunctions symmetry constraint, we construct a new extended matrix KP hierarchy from the matrix KP hierarchy by adding a new τ_B flow, which consists of t_A flow, τ_B flow and t_A evolution of eigenfunction and adjoint eigenfunctions. Its Lax representation is presented. The extended matrix KP hierarchy contains two types of matrix KP equations with self-consistent sources. The generalized dressing approach for solving the extended matrix KP hierarchy is proposed.

The Differential-difference KP equation: from Casoratian solutions to symmetries

Dajun Zhang
Shanghai University, China

Abstract:

The talk starts from searching for more solutions in Casoratian form for the Differential-difference KP (DDKP) equation. This leads to a single-parameter invariant group for the equation and the invariance consists of a combination of Galilean and scalar transformations. However, the related symmetry looks different compared with the continuous KP equation. This motivates us to look at more symmetries. We then from pseudo-difference operator construct isospectral and non-isospectral flows which further compose two sets of infinitely many symmetries for the DDKP equation. These symmetries form Lie algebra which is not a usual centreless Kac-Moody-Virasoro algebra. Finally, we hope to consider the continuum limit to understand this distinctiveness.

Integrable discretizations and soliton solutions of KdV and mKdV equation

Yi Zhang, Da-jun Ding, Teng-fei Cheng, Xiao-lan Dang
Department of Mathematics, Zhejiang Normal University, Jinhua 321004, PR China

Abstract:

A method of discreting soliton equations is presented. The method is based on the bilinear formalism. From the bilinear forms of KdV equation and mKdV equation, we can obtain kinds of new bilinear forms through properly substituting the hyperbolic operator into Hirota operator. Meanwhile we can get the soliton solutions of these new equations by Hirota's method.

Jacobi Structures of Evolutionary Partial Differential Equations

Youjin Zhang
Tsinghua University, China

Abstract:

We introduce the notion of infinite dimensional Jacobi structure to describe the geometrical structure of a class of nonlocal Hamiltonian systems which appear naturally when applying reciprocal transformations to Hamiltonian evolutionary PDEs. We prove that our class of infinite dimensional Jacobi structures is invariant under reciprocal transformations. The main technical tool is in a suitable generalization of the classical Schouten-Nijenhuis bracket to the space of the so called quasi-local multivectors, and a simple realization of this structure in the framework of supermanifolds. These constructions are used to the computation of the Lichnerowicz-Jacobi cohomologies of Jacobi structures. We also introduce the notion of bi-Jacobi structures and consider the integrability of a system of evolutionary PDEs that possesses a bi-Jacobi structure.

On the solutions of the coupled two-dimensional Toda equation

Junxiao Zhao
Graduate University of Chinese Academy of Sciences, China
Email: jxzhao@gucas.ac.cn

Abstract:

In this paper, we present a class of solutions of the coupled two-dimensional Toda equation and show that these solutions are of web-like structure.

The mixed hierarchy of soliton equations

Ruguang Zhou
School of Mathematical Sciences,Xuzhou Normal University
Xuzhou, 221116, P.R. China

Abstract:

The mixed hierarchy of soliton equations is introduced. An approach for constructing the mixed hierarchy of soliton equations, together with their zero curvature representations, based on the Lenard scheme are proposed. It is shown that the nonholonomic deformation of Kupershmidt type is just the simplest case of the mixed soliton equations. Some interesting examples and equivalent forms are discussed.

Darboux transformations for two dimensional elliptic affine Toda equations

Zixiang Zhou
School of Mathematical Sciences, Fudan University
Shanghai 200433, China
Email: zxzhou@fudan.edu.cn

Abstract:

The Darboux transformations for the two dimensional elliptic affine Toda equations corresponding to all seven infinite series of affine Kac-Moody algebras, including $A_l^{(1)}$, $A_{2l}^{(2)}$, $A_{2l-1}^{(2)}$, $B_l^{(1)}$, $C_l^{(1)}$, $D_l^{(1)}$ and $D_{l+1}^{(2)}$, are presented. The Darboux transformation is constructed uniformly for the latter six series of equations with suitable choice of spectral parameters and the solutions of the Lax pairs so that all the reality symmetry, cyclic symmetry and complex orthogonal symmetry of the corresponding Lax pairs are kept invariant. The exact solutions of all these two dimensional elliptic affine Toda equations are obtained by using Darboux transformations.

On the new explicit exact solutions for a coupled Volterra lattice system

Zuonong Zhu
Shanghai Jiao Tong University, China

Abstract:

In this talk, we aim to find new explicit solutions including multi-soliton, multi-positon, multi-negaton, and multi-periodic for a coupled Volterra lattice system which yields an integrable coupled KdV system in the continuous limit. The dynamical properties of these new solutions are discussed in detail. We also show that these solutions lead to the corresponding solutions of the KdV system in the continuous limit.