Christian Scimiterna

Curriculum Vitae

Sesso: Maschile
Data e luogo di nascita: 18 Luglio 1973, Spoleto (PG), Italia
Nazionalità: Italiana
Indirizzo di lavoro: Liceo Scientifico "A. Volta", via Visso 43, 06049 Spoleto (PG), Italia
Indirizzo per corrispondenza: viale Guglielmo Marconi 451, 06049 Spoleto (PG), Italia
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Qualifiche accademiche

01.06.2015 - 31.08.2015	
01.06.2013 - 31.05.2015	
01.03.2013 - 31.05.2013	**Posizioni di post dottorato**, Dip. di Matematica e Fisica, Università Roma Tre
02.04.2012 - 31.12.2012	**Posizione di post dottorato**, Dip. di Ingegneria Elettronica, Università Roma Tre
01.02.2011 - 31.01.2012	**Posizione di post dottorato**, Dip. di Fisica, Università Roma Tre
07.05.2010 - 07.11.2010	
30.04.2009 - 30.09.2009	**Posizioni di post dottorato**, Dip. di Ingegneria Elettronica, Università Roma Tre
03.02.2009	**Diploma di dottorato in fisica**, Università Roma Tre
01.09.2006 - 31.12.2006	**Posizione pre dottorato**, Université Pierre et Marie Curie, Paris VI, LPTHE laboratoire. Progetto *ENIGMA*, "European Network in Geometry, Mathematical Physics and Applications", responsabile Prof. C. M. Viallet
05.11.2005 - 04.11.2008	**Scuola dottorale in fisica** Università Roma Tre, responsabile Prof. D. Levi
18.07.2002	**Diploma di laurea v.o. in fisica**, relatore Prof. Y. Srivastava
05.11.1992 - 18.07.2002	**Corso di laurea in fisica v.o.** Università degli Studi di Perugia

Tesi

Multiscale techniques for nonlinear difference equations http://hdl.handle.net/2307/408;	tesi di dottorato, febbraio 2009.
The critical role of relativistic position operators in the formulation of the basic concepts of quantum mechanics	tesi di laurea v.o., luglio 2002.

Istruzione superiore

09.1987 - 09.07.1992 **Liceo scientifico:** Liceo Scientifico A. Volta, Spoleto

Esperienze d'insegnamento Università Roma Tre

1. Settembre-ottobre 2015: corso di preparazione in matematica per il test di ammissione al corso di laurea Ottica ed Optometria e corso di recupero obblighi formativi aggiuntivi.

2. Settembre 2015: corso di recupero in matematica per immatricolati a.a. 2014-2015 al corso di laurea Ottica ed Optometria: *serie numeriche, integrali, equazioni differenziali, funzioni di più variabili.*

3. Settembre 2014: corso di preparazione in matematica per il test di ammissione al corso di laurea Ottica ed Optometria e corso di recupero obblighi formativi aggiuntivi.

4. Anno accademico 2014-2015: supporto alla didattica per il corso di *Matematica*, corso di laurea Ottica ed Optometria, responsabili Proff. G. Palumbo, E. Scoppola: *esercitazioni su integrali, equazioni differenziali.*

5. Anno accademico 2013-2014: Supporto alla didattica per il corso *Elementi di analisi*, corso di laurea Ottica ed Optometria, responsabile Prof. D. Levi: *equazioni differenziali.*

6. Anno accademico 2012-2013: Supporto alla didattica per il corso *Complementi di Metodi Matematici per la Fisica*, corso di laurea Fisica, responsabile Prof. O. Ragnisco (coordinatore Prof. L. Chierchia): *introduzione alle equazioni integrali.*

7. Anno accademico 2012-2013: Supporto alla didattica per il corso *Elementi di Analisi*, corso di laurea Ottica ed Optometria, responsabile Dott. V. Lacquaniti: *esercitazioni.*

8. Speaker alla *ASIDE Summer School*, Ningbo University, Cina dal 04/06/2012 al 09/06/2012: lezioni sulle *simmetrie di Lie per equazioni alle differenze.*

9. Supporto alla didattica del Prof. D. Levi in qualità di dottorando, corso di laurea Fisica:

a. Corso *Fisica dei Sistemi Non Lineari:* derivate frazionarie, integrali frazionari, trasformate frazionarie di Fourier e Laplace e loro applicazioni alla fisica;
b. Corso *Fondamenti di Teoria dei Gruppi per Fisici:* gruppi continui, gruppi di Lie, gruppo delle rotazioni, algebre di Lie.

Docenza di ruolo nella scuola secondaria di secondo grado

Dal 01/09/2021 docente per la classe di concorso di *Matematica e Fisica* (*A*027) presso il Liceo Scientifico dell'Istituto di Istruzione Superiore "Sansi-Leonardi-Volta" di Spoleto a seguito della vincita del concorso straordinario, per titoli ed esami, del 2020.

Esperienze d'insegnamento pre-ruolo nella scuola secondaria di secondo grado

1. Anno scolastico 2020-2021: dal 30/09/2020 al 30/06/2021 docente per la classe di concorso di *Matematica e Fisica* (*A*027) presso il Liceo delle Scienze Umane, Liceo Economico-Sociale,

Liceo Linguistico e Liceo Classico del Liceo "F. Frezzi-Beata Angela" di Foligno;

2. Anno scolastico 2019-2020: dal 23/09/2019 al 30/06/2020 docente per la classe di concorso di *Matematica e Fisica* (*A*027) presso il Liceo delle Scienze Umane dell'Istituto di Istruzione Superiore "Sansi-Leonardi-Volta" di Spoleto;

3. Anni scolastici 2017-2018 e 2018-2019: dal 26/09/2017 al 30/06/2018 e dal 19/09/2018 al 31/08/2019 docente per le classi di concorso di *Matematica* (*A*026) e di *Matematica e Fisica* (*A*027) presso il Liceo Scientifico dell'Istituto Statale di Istruzione Secondaria "Giuseppe Mazzatinti" di Gubbio;

4. Anni scolastici 2015-2016 e 2026-2017: dal 18/12/2015 al 30/06/2016 e dal 07/12/2016 al 30/06/2017 docente di potenziamento dei corsi di *Matematica* e *Fisica* presso il Liceo Scientifico dell'Istituto Statale di Istruzione Secondaria Superiore "Raffaele Casimiri" di Gualdo Tadino.

Esperienza di Referee

Dal 2009 referee per il *Journal of Physics A: Mathematical and Theoretical* e dal 2010 per *SIGMA, Symmetry, Integrability and Geometry: Methods and Applications.*

Esperienza in qualità di responsabile di progetti

Coordinatore locale nodo di Roma Tre per l'anno 2014 dell'iniziativa specifica $Mmnlp$ (*Mathematical Methods of the Nonlinear Physics*) dell'$INFN$ (*Istituto Nazionale di Fisica Nucleare*).

Conoscenze linguistiche

Inglese	Molto buone. In possesso del certificato *TOEFL*, test of English as a foreign language. Nel 2009 attività di traduttore dall'inglese per la *Newton Compton Editori*, Roma.

Conoscenze informatiche

Buona conoscenza di softwares di manipolazione simbolica quali *Mathematica* e *Maple*; conoscenza molto buona di $\LaTeX$, sistema di composizione testuale specialmente indirizzato alla produzione di testi scientifici.

Campi di ricerca/specializzazione e contributi (i riferimenti sono alla lista completa delle pubblicazioni)

1. Analisi perturbativa multiscala per sistemi non lineari definiti su reticolo [2-5], [7-13], [16], [20], [29]: Sviluppo di un test d'integrabilità tramite riduzione multiscala per equazioni alle differenze parziali; classificazione dei sistemi multilineari, integrabili e dispersivi definiti su reticolo quadrato;
2. Tecniche di linearizzazione per equazioni non lineari alle differenze [17], [19], [21], [24]: Derivazione di condizioni necessarie per la linearizzazione di sistemi non lineari definiti su reticolo e determinazione della trasformazione linearizzante nei casi puntuale e di tipo Cole-Hopf; classificazione delle equazioni alle differenze parziali multilineari, linearizzabili definite su tre punti e su reticolo quadrato;

3. Sistemi non lineari definiti su reticolo quadrato e consistenti sul cubo [27], [30-32]: Dimostrazione della linearizzazione delle famiglie H^4 trapezoidale e H^6 appartenenti alla classificazione di R. Boll tramite l'indicatore entropia algebrica e metodi di soluzione diretta; dimostrazione della falsità delle relative coppie di Lax, dell'appartenenza delle simmetrie generalizzate alla classe dell'equazione $YdKN$ non autonoma e generalizzazione non autonoma dell'equazione Q_V;
4. Simmetrie continue per equazioni non lineari discrete [1], [18], [22-23]: Definizione delle simmetrie di contatto per equazioni definite su reticolo; criterio di linearizzazione tramite simmetrie per sistemi non lineari discreti.

Partecipazione a scuole

1. Dal 04/06/2012 al 09/06/2012: *ASIDE Summer School*, Ningbo University, Cina;
2. Dal 09/06/2008 al 20/06/2008: *SMS 2008: Symmetries and Integrability of Difference Equations*, CRM, Centre de Recherches Mathématiques, Université de Montréal, Canada;
3. Dal 15/06/2007 al 17/06/2007: *NEEDS 2007, Nonlinear Evolution Equations and Dynamical Systems*, L'Ametlla de Mar, Spagna;
4. Dal 10/09/2007 al 22/09/2007: *XXXII Scuola Estiva di Fisica Matematica*, Ravello, Italia.

Partecipazione a conferenze

1. Dal 03/07/2016 al 09/07/2016: *SIDE-12, Symmetries and Integrability of Difference Equations*, Sainte-Adèle, Québec, Canada. Speaker invitato. Esposizione del seminario: *Quad equations consistent on the cube. I: classification, linearizability and generalized symmetries*;
2. Dal 24/05/2015 al 31/05/2015: *NEEDS 2015, Nonlinear Evolution Equations and Dynamical Systems*, Santa Margherita di Pula, Cagliari, Italia. Speaker invitato. Esposizione del seminario: *R. Boll consistent around the cube systems and their linearizability*;
3. Dal 09/04/2015 al 10/04/2015: *2DAMC, Two Days on Applied Mathematics in Cagliari*, Cagliari, Italia. Speaker invitato. Esposizione del seminario: *R. Boll consistent around the cube systems and their linearizability*;
4. Dal 15/05/2014 al 17/05/2014: *National Group of Mathematical Physics (GNFM), scientific meeting 2014*, Montecatini Terme, Italia. Speaker invitato. Esposizione del seminario: *Simmetrie generalizzate, rappresentazioni di Lax e trasformazioni di Miura per sistemi dispersivi discreti definiti sul quadrato*;
5. Dal 22/06/2013 al 29/06/2013: *PMNP 2013, Physics and Mathematics of Nonlinear Phenomena*, Gallipoli, Italia. Speaker invitato. Esposizione del seminario: *Classification of C- and $S-$integrable dispersive equations defined on a four-points lattice*;
6. Dal 06/02/2013 al 08/02/2013: *Nonlinear Waves and Integrable Systems 2013*, SISSA, Trieste, Italia. Speaker invitato. Esposizione del seminario: *Classification of C-integrable multilinear equations defined on a three or four-points lattice*;
7. Dal 08/07/2012 al 15/07/2012: *NEEDS 2012, Nonlinear Evolution Equations and Dynamical Systems*, Kolymbari, Creta, Grecia. Speaker invitato. Esposizione del seminario: *Classification of linearizable discrete equations through multiscale and functional techniques*;
8. Dal 10/06/2012 al 16/06/2012: *SIDE-10, Symmetries and Integrability of Difference Equations*, Xikou, Ningbo, Cina. Speaker invitato. Esposizione del seminario: *Classification of linearizable discrete equations through multiscale and functional techniques*;
9. Dal 27/09/2011 al 01/10/2011: *Bi-Hamiltonian Systems and All That*, conferenza in onore del 65mo compleanno di Franco Magri, Milano, Italia;
10. 25/03/2011: *Integrability and Physics Conference*, conferenza internazionale per celebrare il 70mo compleanno del Professor Antonio Degasperis, Roma, Italia. Speaker invitato.

Esposizione del seminario: *An integrability test based on multiscale analysis and functional techniques: classification of real, multilinear, dispersive, quad-graph equations*;
11. Dal 23/06/2010 al 03/07/2010: *Nonlinear Physics: Theory and Experiment. VI*, Gallipoli, Italy. Speaker invitato. Esposizione del seminario: *An integrability test based on multiscale analysis: classification of real, dispersive, multilinear, quad-graph equations*;
12. Dal 14/06/2010 al 18/06/2010: *SIDE-9, Symmetries and Integrability of Difference Equations*, Varna, Bulgaria. Speaker invitato. Esposizione del seminario: *An integrability test based on multiscale analysis: classification of real, dispersive, multilinear, quad-graph equations*;
13. Dal 17/05/2010 al 22/05/2010: *GSDE 2010, Geometry and Symmetry of Differential Equations*, Santa Marinella, Italia;
14. Dal 01/10/2009 al 03/10/2009: *National Group of Mathematical Physics (GNFM), scientific meeting 2009*, Montecatini Terme, Italia. Speaker invitato. Esposizione del seminario: *Multiscale reductions on the lattice and integrability of dispersive difference equations*;
15. Dal 16/05/2009 al 23/05/2009: *NEEDS 2009, Nonlinear Evolution Equations and Dynamical Systems*, Isola Rossa, Italia. Speaker invitato. Esposizione del seminario: *Multiscale expansion on the lattice and integrability of difference equations*;
16. Dal 22/06/2008 al 28/06/2008: *SIDE-8, Symmetries and Integrability of Difference Equations*, Montréal, Canada. Speaker invitato. Esposizione del seminario: *Integrability of discrete systems via multiscale expansions*;
17. Dal 14/03/2008 al 19/03/2008: *Problemi attuali di fisica teorica*, Vietri sul Mare, Italia. Speaker invitato. Esposizione del seminario: *Multiscale analysis and integrability of lattice equations*;
18. Dal 18/06/2007 al 23/06/2007: *NEEDS 2007, Nonlinear Evolution Equations and Dynamical Systems*, L'Ametlla de Mar, Spagna. Esposizione del poster: *Symmetries and integrability of the lattice Schwarzian KdV Equation*;
19. Dal 02/06/2007 al 09/06/2007: *SPT 2007, Symmetry and Perturbation Theory*, Otranto, Italia. Speaker invitato. Esposizione del seminario: *Multiscale expansion of the lpKdV equation, of its symmetries and of the Hietarinta equation on functions of infinite order of slow-varyness*;
20. Dal 22/06/2006 al 01/07/2006: *Nonlinear Physics. Theory and Experiment. IV*, Gallipoli, Italia. Esposizione del poster: *Discrete reductive perturbation technique: results and numerics.*

Permanenze in centri ricerca di rilevanza interanzionale

1. Dal 03/10/2012 al 21/10/2012 collaborazione con l'Universidad Politécnica de Madrid, Escuela Universitaria de Ingeniería Técnica de Telecomunicación, Departamento de Matemática Aplicada; visita alle Universidad de Burgos, Departamento de Física; Universidad de Salamanca, Departamento de Física Fundamental; Universidad Complutense de Madrid, Departamento de Física Teórica II; Universidad de Valladolid, Departamento de Física Teórica.
2. Dal 21/10/2009 al 25/10/2009 collaborazione con l'Universidad Politécnica de Madrid, Escuela Universitaria de Ingeniería Técnica de Telecomunicación, Departamento de Matemática Aplicada;
3. Dal 18/10/2009 al 20/10/2009 visita alla Universidad de Burgos, Departamento de Física;
4. Dal 01/09/2006 al 31/12/2006 posizione pre dottorato presso l'Université Pierre et Marie Curie, Paris VI, LPTHE laboratoire, nel quadro del progetto ENIGMA, European Network in Geometry, Mathematical Physics and Applications. Responsabile: C. M. Viallet.

LISTA DELLE PUBBLICAZIONI

Libri pubblicati

1. A. Reghini, *Dei Numeri Pitagorici I: Dell'equazione indeterminata di secondo grado con due incognite*, a cura di C. Scimiterna e S. Loretoni, Archè-PiZeta, Milano (2006);

2. A. Reghini, *Dei Numeri Pitagorici II: Delle soluzioni primitive dell'equazione di tipo Pell* $x^2 - Dy^2 = B$ *e del loro numero*, curatori C. Scimiterna e S. Loretoni, Archè-PiZeta, Milano (2012);

3. A. Reghini, *Dei Numeri Pitagorici III: Dei numeri triangolari, dei quadrati e dei numeri piramidali a base triangolare o quadrata*, a cura di C. Scimiterna e S. Loretoni, Archè-PiZeta, Milano (2018);
Opera in sette volumi e un prologo sui metodi elementari in teoria dei numeri indirizzati alla soluzione di equazioni diofantee di secondo grado in due incognite e allo studio dei numeri figurati;

4. M. Baistrocchi, *Il Cerchio Magico - riti circumambulatori in Roma antica*, curatore C. Scimiterna, Libri del Graal, Roma (2010);

5. M. Baistrocchi, *Le porte del cielo*, curatore C. Scimiterna, Libreria Editrice Aseq, Roma (2023);

Articoli pubblicati/accettati

2007

1. D. Levi, M. Petrera, C. Scimiterna, *The lattice Schwarzian KdV equation and its symmetries*, Jour. Phys. A: Math. and Theor. **40**, no. 42 (2007), 12753-12761. http://arxiv.org/abs/math-ph/0701044.

Sommario: In this paper, we present a set of results on the symmetries of the lattice Schwarzian Korteweg–de Vries ($lSKdV$) equation. We construct the Lie point symmetries and, using its associated spectral problem, an infinite sequence of generalized symmetries and master symmetries. We finally show that we can use master symmetries of the $lSKdV$ equation to construct non-autonomous non-integrable generalized symmetries;

2. R. Hernandez Heredero, D. Levi, M. Petrera, C. Scimiterna, *Multiscale expansion of the lattice potential KdV equation on functions of an infinite slow-varyness order*, Jour. Phys. A: Math. and Theor. **40**, no. 34 (2007), F831-F840. http://arxiv.org/abs/0706.1046.

Sommario: We present a discrete multiscale expansion of the lattice potential Korteweg–de Vries ($lpKdV$) equation on functions of an infinite order of slow varyness. To do so, we introduce a formal expansion of the shift operator on many lattices holding at all orders. The lowest secularity condition from the expansion of the $lpKdV$equation gives a nonlinear lattice equation, depending on shifts of all orders, of the form of the nonlinear Schrödinger equation;

2008

3. R. Hernandez Heredero, D. Levi, M. Petrera, C. Scimiterna, *Multiscale expansions and integrability properties of the lattice potential KdV equation*, Jour. Nonlinear Math. Phys. **15**, no. 3 (2008), 313-323. http://arxiv.org/abs/0709.3704.

Sommario: We apply the discrete multiscale expansion to the Lax pair and to the first few symmetries of the lattice potential Korteweg-de Vries equation. From these calculations we show that, like the lowest order secularity conditions give a nonlinear Schrödinger equation, the Lax pair gives at the same order the Zakharov and Shabat spectral problem and the symme-

tries the hierarchy of point and generalized symmetries of the nonlinear Schrödinger equation;

4. R. Hernandez Heredero, D. Levi, M. Petrera, C. Scimiterna, *Multiscale expansion on the lattice and integrability of partial difference equations*, Jour. Phys. A: Math. and Theor. **41**, no. 31 (2008), 315208. http://arxiv.org/abs/0710.5299.

Sommario: We conjecture an integrability and linearizability test for dispersive Z2-lattice equations by using a discrete multiscale analysis. The lowest order secularity conditions from the multiscale expansion give a partial differential equation of the form of a nonlinear Schrödinger (NLS) equation. If the starting lattice equation is integrable then the resulting NLS-type equation turns out to be integrable, while if the starting equation is linearizable we get a linear Schrödinger equation. On the other hand, if we start with a non-integrable lattice equation the resulting equation can be both integrable and non-integrable. This conjecture is confirmed by many examples;

5. D. Levi, M. Petrera, C. Scimiterna, *On the integrability of the discrete nonlinear Scröedinger equation*, E.P.L. **84** (2008), 10003. http://arxiv.org/abs/0808.0837.

Sommario: In this letter we present an analytic evidence of the nonintegrability of the discrete nonlinear Schröedinger equation, a well-known discrete evolution equation which has been obtained in various contexts of physics and biology. We use a reductive perturbation technique to show an obstruction to its integrability;

6. D. Levi, M. Petrera, C. Scimiterna, R. Yamilov, *On Miura transformations and Volterra-type equations associated with the Adler-Bobenko-Suris equations*, SIGMA **4** (2008), 077. http://arxiv.org/abs/0802.1850.

Sommario: We construct Miura transformations mapping the scalar spectral problems of the integrable lattice equations belonging to the Adler-Bobenko-Suris (ABS) list into the discrete Schrödinger spectral problem associated with Volterra-type equations. We show that the ABS equations correspond to Bäcklund transformations for some particular cases of the discrete Krichever-Novikov equation found by Yamilov ($YdKN$ equation). This enables us to construct new generalized symmetries for the ABS equations. The same can be said about the generalizations of the ABS equations introduced by Tongas, Tsoubelis and Xenitidis. All of them generate Bäcklund transformations for the $YdKN$ equation. The higher order generalized symmetries we construct in the present paper confirm their integrability;

2009

7. D. Levi, C. Scimiterna, *The Kundu-Eckhaus equation and its discretizations*, Jour. Phys. A: Math. and Theor. **42**, no. 46 (2009), 465203. http://arxiv.org/abs/0904.4844.

Sommario: In this paper we show that the complex Burgers and the Kundu-Eckhaus equations are related by a Miura transformation. We use this relation to discretize the Kundu-Eckhaus equation;

8. D. Levi, M. Petrera, C. Scimiterna, *Multiscale reduction of discrete nonlinear Schrödinger equations*, Jour. Phys. A: Math. and Theor. **42**, no. 45 (2009), 454011, special issue on "Symmetries and Integrability of Difference Equations". http://arxiv.org/abs/0903.3418.

Sommario: We use a discrete multiscale analysis to study the asymptotic integrability of discrete nonlinear Scrödinger equations. We show that multiscale perturbation techniques provide an analytic tool to give necessary integrability conditions;

9. C. Scimiterna, *Multiscale reduction of discrete Korteweg-de Vries equations*, Jour. Phys. A: Math. and Theor. **42**, no. 45 (2009), 454018, special issue on "Symmetries and Integrability of Difference Equations".

Sommario: We show how through a multiscale reduction technique, performing the analysis at orders beyond the NLS equation, one can effectively prove if some nonlinear partial difference equation is not integrable. The example is carried out on a symmetric discretization

of the KdV equation and is compared to a similar reduction performed on the integrable lattice potential KdV equation;

2010

10. D. Levi, C. Scimiterna, *Integrability of the Kruskal-Zabusky discrete equation by its Multiscale expansion*, special issue for the proceedings of the first International Workshop on "Nonlinear and Modern Mathematical Physics", Beijing, 15-21 July 2009 (2010), 66-80.

Sommario: In 1965 Kruskal and Zabusky in a very famous article in Physical Review Letters introduced the notion of "soliton" to describe the interaction of solitary waves solutions of the Korteweg de Vries equation (KdV). To do so they introduced a discrete approximation to the KdV, the Kruskal-Zabusky equation (KZ). Here we analize the KZ equation using the multiscale expansion and show that the equation is only A2-integrable;

11. D. Levi, C. Scimiterna, *Integrability test of discrete nonlinear Schröedinger equations via multiscale reduction*, Appl. An. **89**, no. 4 (2010), 507-527, special issue on "Continuous and Discrete Integrable Systems with Applications", edited by Willy A Hereman.

Sommario: In this paper one is considering the multiscale reduction around the harmonic solution of a general discrete Nonlinear Schrödinger Equation ($dNLSE$) depending on constant coefficients. According to the values of the coefficients we can have both integrable and nonintegrable $dNLSE$'s. For all values of the coefficients entering the $dNLSE$, non-secularity conditions provide at the lowest order in the perturbation parameter an integrable $NLSE$. However at higher order in the perturbation expansion the request that the expansion is compatible with the $NLSE$ hierarchy gives integrability conditions which are not satisfied for the non-integrable $dNLSE$'s;

12. C. Scimiterna, D. Levi, *C-integrability test for discrete equations via multiscale expansions*, SIGMA **6** (2010), 070. http://arxiv.org/abs/1005.5288.

Sommario: In this paper we are extending the well known integrability theorems obtained by multiple scale techniques to the case of linearizable difference equations. As an example we apply the theory to the case of a differential-difference dispersive equation of the Burgers hierarchy which via a discrete Hopf–Cole transformation reduces to a linear differential difference equation. In this case the equation satisfies the A_1, A_2 and A_3 linearizability conditions. We then consider its discretization. To get a dispersive equation we substitute the time derivative by its symmetric discretization. When we apply to this nonlinear partial difference equation the multiple scale expansion we find out that the lowest order nonsecularity condition is given by a non-integrable nonlinear Schrödinger equation. Thus showing that this discretized Burgers equation is neither linearizable not integrable;

13. R. Hernandez Heredero, D. Levi, C. Scimiterna, *A discrete linearizability test based on multiscale analysis*, Jour. Phys. A: Math. and Theor. **43**, no. 50 (2010), 502002. http://arxiv.org/abs/1011.0141.

Sommario: In this paper we consider the classification of dispersive linearizable partial difference equations defined on a quad-graph by the multiple scale reduction around their harmonic solution. We show that the A_1, A_2 and A_3 linearizability conditions restrain the number of the parameters which enter into the equation. A subclass of the equations which pass the A_3 C-integrability conditions can be linearized by a Möbius transformation;

2011

14. C. Simiterna, B. Grammaticos, A. Ramani, *On two integrable lattice equations and their interpretation*, fast track communication, Jour. Phys. A: Math. and Theor., **44**, no. 3 (2011), 032002.

Sommario: We examine two lattice equations, obtained through the application of multi-scale perturbative analysis, from the point of view of integrability. We show that both equations are integrable and related to the discrete sine-Gordon. We compute the limit of both systems whereby they become linearisable, obtaining the discrete Liouville equation and a linearisable lattice system recently proposed by Hydon and Viallet. We present the explicit solution of the latter;

15. B. Grammaticos, A. Ramani, C. Scimiterna, R. Willox, *Miura transformations and the various guises of integrable lattice equations*, fast track communication, Jour. Phys. A: Math. and Theor., **44**, no. 15 (2011), 152004.

Sommario: We present various Miura-type transformations that exist between integrable lattice equations, which lead to some new and quite unexpected relations between these lattice equations. In particular, we show that in the discrete case, contrary to the continuous one, the sine-Gordon and mKdV equations are essentially the same. We also examine two new equations recently proposed by Hydon and Viallet and show that they can be transformed to the discrete $mKdV$ and/or sine-Gordon equations;

16. C. Scimiterna, D. Levi, *Integrability of differential-difference equations with discrete kinks*, Theor. Math. Phys., **167**, no. 3 (2011), 826-842, special issue for the proceedings of the workshop "Nonlinear Physics. Theory and Experiment. VI", Gallipoli, Italy, June 23-July 3, 2010. http://arxiv.org/abs/1011.0068v1.

Sommario: In this article we discuss a series of models introduced by Barashenkov, Oxtoby and Pelinovsky to describe some discrete approximations to the ϕ^4 theory which preserve travelling kink solutions. We show, by applying the multiple scale test that they have some integrability properties as they pass the A_1 and A_2 conditions. However they are not integrable as they fail the A_3 conditions;

17. D. Levi, C. Scimiterna, *Linearizability of nonlinear equations on a quad-graph by a point, two points and generalized Hopf-Cole transformations*, SIGMA **7** (2011), 079, special issue for the proceedings of the conference "Symmetries and Integrability of Difference Equations (SIDE-9)", Varna, Bulgaria, June 14–18, 2010. http://arxiv.org/abs/1108.3648.

Sommario: In this paper we propose some linearizability tests of partial difference equations on a quad-graph given by one point, two points and generalized Hopf-Cole transformations. We apply the so obtained tests to a set of nontrivial examples;

2012

18. D. Levi, C. Scimiterna, Z. Thomova, P. Winternitz, *Contact transformations for difference schemes*, Jour. Phys. A: Math. and Theor., **45**, no. 2 (2012), 022001. http://arxiv.org/abs/1110.3409v1.

Sommario: We define a class of transformations of the dependent and independent variables in an ordinary difference scheme. The transformations leave the solution set of the system invariant and reduces to a group of contact transformations in the continuous limit. We use a simple example to show that the class is not empty and that such 'contact transformations for discrete systems' genuinely exist;

19. D. Levi, C. Scimiterna, *Classification of multilinear real quadratic partial difference equations linearizable by point and Hopf-Cole transformations*, Int. Jour. of Geom. Meth. in Mod. Phys., **9**, no. 2 (2012), 1260004, special issue for the proceedings of the workshop "Folding and Unfolding: Interactions from Geometry" in honor of Giuseppe Marmo's 65^{th} birthday, Ischia, 8-12 June 2011.

Sommario: We use the conditions of linerizability by point and by Hopf-Cole transformations, introduced recently by the authors, to classify all real multilinear equations on a square lattice with at most quadratic nonlinearity. We find that, up to a linear transformation of the

dependent variable and an exchange of the independent variables, only two equations in this class are linearizable by point transformations and none by Hopf-Cole transformations;

20. R. Hernandez Heredero, D. Levi, C. Scimiterna, *Classification of discrete systems on a square lattice*, Theor. Math. Phys., **172**, no. 2 (2012), 1097-1108, special issue for the proceedings of the workshop "Solitons in 1+1 and 2+1 dimensions - DS, KP and all that" in honor of the 70^{th} birthday of Marco Boiti and Flora Pempinelli, Lecce, 13-14 September 2011.

Sommario: We consider the classification up to a Mobiüs transformation of real linearizable and integrable difference equations with dispersion defined on a square lattice by the multiscale reduction around their harmonic solution. We show that the A_1, A_2 and A_3 linearizability and integrability conditions constrain the number of parameters in the equation, but these conditions insufficient for a complete characterization of the subclass of multilinear equations on the square lattice;

2013

21. C. Scimiterna, D. Levi, *Three-point partial difference equations linearizable by local and nonlocal transformations*, Jour. Phys. A: Math. and Theor., **46**, no. 2 (2013), 025205.

Sommario: We consider a class of nonlinear partial difference equations defined on three points of a plane lattice. We construct conditions for this class of partial difference equations to be linearizable through a point or a Cole–Hopf transformation. Using these conditions we are able to classify all multilinear linearizable equations belonging to this class;

22. D. Levi, C. Scimiterna, *Linearization through symmetries for discrete equations*, Jour. Phys. A: Math. and Theor., **46**, no. 32 (2013), 325204. http://arxiv.org/abs/1302.0154.

Sommario: We show that one can devise through the symmetry approach a procedure to check the linearizability of a difference equation via a point or a discrete Cole–Hopf transformation. If the equation is linearizable, then the symmetry provides the linearizing transformation. At the end, we present a few examples of applications for equations defined on four lattice points;

23. D. Levi, C. Scimiterna, *Four points linearizable lattice schemes*, J. Geom. Symmetry Phys., **31** (2013), 93-104. http://arxiv.org/abs/1301.0732.

Sommario: We provide conditions for a lattice scheme defined on a four points lattice to be linearizable by a point transformation. We apply the obtained conditions to a symmetry preserving difference scheme for the Burgers potential introduced by Dorodnitsyn and show that it is not linearizable;

24. C. Scimiterna, D. Levi, *Classification of discrete equations linearizable by a point transformation on a square lattice*, Front. Math. China, **8**, no. 5 (2013), 1067-1076. http://arxiv.org/abs/1301.2426.

Sommario: We provide a complete set of linearizability conditions for nonlinear partial difference equations defined on four points and, using them, we classify all linearizable multilinear partial difference equations defined on four points up to a Möbious transformation;

2014

25. C. Scimiterna, M. Hay, D. Levi, *On the integrability of a new lattice equation found by multiple scale analysis*, Jour. Phys. A: Math. and Theor., **47**, no. 26 (2014), 265204. http://arxiv.org/abs/1401.5691.

Sommario: In this paper we discuss the integrability properties of a nonlinear partial difference equation on the square obtained by the multiple scale integrability test from a class of multilinear dispersive equations defined on a four points lattice;

26. B. Grammaticos, A. Ramani, C. Scimiterna, J. Satsuma, *On the integrability of a new*

lattice equation, Jour. Phys. A: Math. and Theor., **47**, no. 40 (2014), 405201.

Sommario: We examine a lattice equation recently derived by one of us (C. S.) together with Heredero and Levi. We show that this equation has confined singularities, possesses integrable one- and two-dimensional reductions, can be bilinearised and possesses multisoliton solutions. All the arguments, together with the fact that, as shown in the initial pubblication, the equation has zero algebraic entropy, plead in favour of its integrable character;

2016

27. G. Gubbiotti, C. Scimiterna, D. Levi, *Linearizability and fake Lax pair for a consistent around the cube nonlinear non–autonomous quad–graph equation*, Theoretical and Mathematical Physics, **189**, no. 1 (2016), 1459-1471. http://arxiv.org/abs/1510.01527.

Sommario: We discuss the linearization of a non–autonomous nonlinear partial difference equation belonging to the Boll classification of quad–graph equations consistent around the cube. We show that its Lax pair is fake. We present its generalized symmetries which turn out to be non–autonomous and depending on an arbitrary function of the dependent variables defined in two lattice points. These generalized symmetries are differential difference equations which, in some case, admit peculiar Bäcklund transformations;

28. G. Gubbiotti, D. Levi, C. Scimiterna, *On partial differential and difference equations with symmetries depending on arbitrary functions*, Acta Polytechnica, **56**, no. 3 (2016), 193-201. https://arxiv.org/abs/1512.01967.

Sommario: In this note we present some ideas on when Lie symmetries, both point and generalized, can depend on arbitrary functions. We show on a few examples, both in partial differential and partial difference equations when this happens. Moreover we show that the infinitesimal generators of generalized symmetries depending on arbitrary functions both for continuous and discrete equations effectively plays the role of master symmetries;

29. G. Gubbiotti, C. Scimiterna, D. Levi, *Algebraic entropy, symmetries and linearization of quad equations consistent on the cube*, Journal of Nonlinear Mathematical Physics, **23**, no. 4 (2016), 507-543. https://arxiv.org/abs/1603.07930.

Sommario: We discuss the non autonomous nonlinear partial difference equations belonging to Boll classiffcation of quad graph equations consistent around the cube. We show how starting from the compatible equations on a cell we can construct the lattice equations, its Bäcklund transformations and Lax pairs. By carrying out the algebraic entropy calculations we show that the H^4 trapezoidal and the H^6 families are linearizable and in a few examples we show how we can effectively linearize them;

2017

30. G. Gubbiotti, C. Scimiterna, D. Levi, *The non autonomous $YdKN$ equation and generalized symmetries of Boll equations*, Journal of Mathematical Physics, **58**, no 5 (2017), 053507. https://arxiv.org/abs/1510.07175.

Sommario: In this paper we study the integrability of a class of nonlinear non autonomous quad graph equations compatible around the cube introduced by Boll. We show that all these equations possess three point generalized symmetries which are subcases of either the Yamilov discretization of the Krichever–Novikov equation or of its non autonomous extension. We also prove that all those symmetries are integrable as pass the algebraic entropy test;

31. G. Gubbiotti, C. Scimiterna, D. Levi, *A two-periodic generalization of the Q_V equation*, Journal of Integrable Systems, **2** (2017), 1-13. https://arxiv.org/abs/1512.00395.

Sommario: In this paper we introduce a non-autonomous generalization of the Q_V equation introduced by Viallet. All the equations of Boll's classiffcation appear in it for special

choices of the parameters. Using the algebraic entropy test we infer that the equation should be integrable and with the aid of a formula introduced by Xenitidis we find its three point generalized symmetries;

2018

32. G. Gubbiotti, C. Scimiterna, *Reconstructing a lattice equation: a non-autonomous approach to the Hietarinta equation*, SIGMA, **14** (2018), 004. https://arxiv.org/abs/1705.00298. *Sommario*: In this paper we construct a non-autonomous version of the Hietarinta equation [Hietarinta J., *J. Phys. A: Math. Gen.*, **37** (2004): L67-L73] and study its integrability properties. We show that this equation possesses linear growth of the degrees of iterates, generalized symmetries depending on arbitrary functions, and that is Darboux integrable. We use the first integrals to provide a general solution of this equation. In particular we show that this equation is a particular case of the non-autonomous QV equation, and we provide a non-autonomous Möbious transformation to another equation found in [Hietarinta J., *J. Nonlinear Math. Phys.*, **12** (2005), suppl. 2, 223-230] and appearing also in Boll's classification [Boll R., Ph.D. Thesis, Technische Universität Berlin, 2012];

33. G. Gubbiotti, C. Scimiterna, R. I. Yamilov, *Darboux integrability of trapezoidal H^4 and H^6 families of lattice equations II: General solutions*, SIGMA, **14** (2018), 008. https://arxiv.org/abs/1704.05805. *sommario*: In this paper we construct the general solutions of two families of partial difference equations defined on the quad graph, namely the trapezoidal H^4 equations and the H^6 equations. These solutions are obtained exploiting the properties of the first integrals in the Darboux sense, which were derived in [Gubbiotti G. and Yamilov R.I., *J. Phys. A: Math. Theor.* **50** (2017), 345205, 26 pages]. These first integrals are used to reduce the problem to the solution of some linear or linearizable non-autonomous ordinary difference equations which can be formally solved;

2024

34. R. Hernandez Heredero, D. Levi, C. Scimiterna, *High order multiscale analysis of discrete integrable equations*, Open Communications in Nonlinear Mathematical Physics, 11690 (2024). http://arxiv.org/abs/1311.1905.

Sommario: In this article we present the results obtained applying the multiple scale expansion up to the order ε^6 to a dispersive multilinear class of equations on a square lattice depending on 13 parameters. We show that the integrability conditions given by the multiple scale expansion give rise to 4 nonlinear equations, 3 of which seem to be new, depending at most on 2 parameters.

Articoli sottomessi/in corso

35. P. M. Santini, C. Scimiterna, *Multiscale expansions of difference equations in the small lattice spacing regime II*, in corso.

Spoleto, 23/03/2025 Christian Scimiterna