UCLM
UNIVERSIDAD DE CASTILLA-LA MANCHA

DPTO. DE MATEMÁTICAS

Instituto de Matemática Aplicada
a la Ciencia y la Ingeniería

Programme

Nonlinear waves, fractional calculus, numerics and noise

A conference in honor of the 60+1 birthday of Prof. Luis Vazquez

Palacio de los Condes de Valdeparaiso, Almagro, Ciudad Real, January 25-26, 2010

Nonlinear waves, fractional calculus, numerics and noise

A conference in honor of the 60+1 birthday of Prof. Luis Vazquez

	Mon, Jan 25	Tue, Jan 26
		Session 4: Interdisciplinary applications
9:15 – 9:40		A. Sánchez
9:40 – 10:05		H. Herrero
10:05 – 10:30		G. F. Calvo
10:30 – 10:50		*Cofee break*
		Session 5: Numerical methods and nonlocal problems
10:50 – 11:15		E. Cuesta
11:15 – 11:40		S. Jiménez
11:40 – 12:05		E. Alfimov
12:05 – 12:15	Opening	*Break*
	Session 1: Fractional calculus	**Session 6: Nonlinear waves**
12:15 – 12:40	I. Díaz	V. Vekslerchik
12:40 – 13:05	J. Trujillo	J. A. González
13:05 – 13:30	R. Vilela	V. V. Konotop
13:30 – 16:00	Lunch at Parador de Almagro	
	Session 2: Nonlinear phenomena	
16:00 – 16:25	V. M. Pérez-García	
16:25 – 16:50	M. A. F. Sanjuán	
16:50 – 17:15	D. Usero	
17:15 – 17:45	Cofee break	
	Session 3: Space exploration	
17:45 – 18:10	L. Vázquez	
18:10 – 18:35	A. F. Rañada	
18:35 – 19:15	Round table: INTA + UCM + UCLM	
20:30 –	Dinner at Parador	

“Piecewise linear vs. nonlinear models: example of nonlocal sine-Gordon equation”

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In the contribution two simple models are compared: (i) pendulum equation perturbed by a fourth derivative term and (ii) its approximation where the sine nonlinearity is replaced by a piecewise one. Both of these models have been discussed in the context of nonlocal Josephson electrodynamics. It is known that the model (i) does not admit 2-pi-kink solutions whereas the model (ii) admits infinite number of them. We consider the sequence of intermediate models between (i) and (ii) and demonstrate phenomenon of 2-pi-kink accumulation when passing from (i) to (ii) along this sequence. This is an illustration of the fact that such a replacing of nonlinearity for the sake of simplicity may be a dangerous operation.

“Mathematical modelling of tumour growth and therapies at UCLM: A case study of interdisciplinary research”

GABIEL F. CALVO, A. MARTÍNEZ, V. M. PÉREZ GARCÍA

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In this talk I will introduce the field of mathematical modelling of tumour growth and the difficultities involved in its realistic modelling using clinical data, as well as our own activity in the field.

“On the stability on Quadratures with variable step size for non-local equations”

EDUARDO CUESTA

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In this occasion I intend to show an open problem related with numerics and more precisely with the stability of quadratures with variable step-size.

This is a problem which has been closely studied in the framework of classical equations, even in the case of Volterra equations (including the fractional-type ones) with constant step-size but which is still open in the case of variable step-size.

"La extinción en tiempo finito de la solución de una clase de EDPs no lineales es más lenta si la derivada temporal es fraccionaria"

ILDEFONSO DIAZ, T. PIERANTOZZI

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The finite time extinction phenomenon (the solution reaches an equilibrium after a finite time) is peculiar to certain nonlinear problems whose solutions exhibit an asymptotic behavior entirely different from the typical behavior of solutions associated to linear problems. The main goal of this work (in collaboration with T. Pierantozzi and L. Vázquez) is twofold. Firstly, we extend some of the results known in the literature to the case in which the ordinary time derivative is considered jointly with a fractional time differentiation. Secondly, we consider the limit case when only the fractional derivative remains. The latter is the most extraordinary case, since we prove that the finite time extinction phenomenon still appears, even with a non-smooth profile near the extinction time. Some concrete examples of quasi-linear partial differential operators are proposed. The results can also be applied in the framework of suitable nonlinear Volterra integro-differential equations

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"Hawking radiation in soliton-bearing systems"

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The escape of solitons over a potential barrier is analyzed within the framework of a nonlinear Klein-Gordon equation. It is shown that the creation of a kink-antikink pair near the barrier through an internal mode instability can be followed by escape of a kink in a process analogous to Hawking radiation.

We discuss phenomena that can be explained as intrinsic non-local effects attributable to the extended character of the soliton.

"Modelos matemáticos en Geofísica"

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Se estudia un problema de ecuaciones en derivadas parciales de mecánica de fluidos con convección térmica con variantes aplicables en geofísica. En concreto, la aparición de vórtices por efectos de calentamiento localizado, que es de gran relevancia para la comprensión de los factores térmicos que generan y modifican la intensidad de fenómenos atmosféricos como los huracanes. Y fenómenos asociados a fluidos con viscosidad variable, que es importante para comprender la convención del manto terrestre. Estudiamos estos problemas desde distintas perspectivas: modelado matemático, resolución numérica, análisis de bifurcaciones y existencia de soluciones.

"A Fractional Strauss-Vázquez numerical scheme"

SALVADOR JIMÉNEZ

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We present a numerical scheme to simulate a second orderdifferential equation with a fractional derivative. We consider two applications: a fractional Duffing equation and a quartic potential with nonlinear dissipation and an external force.

“Nonlinear patterns in complex periodic potentials with linear pump”

VLADIMIR V. KONOTOP and Y. V. BLUDOV

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It is shown that the one-dimensional nonlinear Schrödinger equation with a dissipative periodic potential, nonlinear losses and linear pump allow for the existence of stable nonlinear Bloch states which are attractors. The model describes a Bose-Einstein condensate with inelastic two-- and three--body interactions loaded in an optical lattice with losses due to inelastic interactions of the atoms with photons.

“**Supersolitons: Solitonic excitations of soliton chains**”

VÍCTOR M. PÉREZ GARCÍA

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I will discuss the concept and propose a scheme for the generation of supersolitons, i.e., localized collective excitations on soliton chains. First I will describe the phenomenon and provide an intuitive explanation. Next I will support the ideas with a perturbative analysis, and confirm it by direct simulations. I will discuss a specific example of the supersolitons with matter waves, and demonstrate that the setting can be used to build an analog of the Newton's cradle composed of solitons.

"Sobre una propuesta para explicar la anomalía del Pioneer"

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Las naves Pioneer 10 y 11 de NASA fueron lanzadas en 1972 y 1973. Cuando decayó lo suficiente el efecto del viento solar, al llegar a la órbita de Urano en 1980, los ingenieros de la misión confirmaron un efecto inexplicable que se venía notando. Las naves no se movían de acuerdo con las teorías de la gravedad. Por el contrario parecían alejarse del Sol más despacio de los debido, como si el Sol ejerciese una fuerza atractiva nueva y constante, independiente de la distancia sobre los Pioneers. Pero una fuerza así plantea muchos problemas. por ejemplo sería incompatible con la cartografía del sistema solar y con el principio de equivalencia, piedra angular de las teorías de la gravedad. Treinta años más tarde, la llamada Anomalía del Pioneer sigue inexplicada, a pesar de los esfuerzos de muchos científicos. En la comunicación se explicará el problema y las ideas en que se basa una propuesta de solución, cuyas consecuencias podrían ser importantes.

“Redes sociales y emergencia de la cooperación”

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El problema de la emergencia de la cooperación entre individuos a distintos niveles (células, organismos, etc.) es uno de los más importantes de la teoría evolutiva desde la época de Darwin. Uno de los mecanismos que se ha propuesto para entenderlo es la reciprocidad en red: las interacciones entre individuos tienen lugar entre los pares indicados por una red o grafo, que en el caso de los humanos sería fundamentalmente una red social.

En esta charla revisaré esta propuesta y presentaré resultados de simulación y experimentales que exploran su validez.

“Transient Chaos Partially Controlled in Presence of Noise”

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In a region in phase space where there is a chaotic saddle, all initial conditions will escape from it after a transient with the exception of a set of points of zero Lebesgue measure. The action of an external noise makes all trajectories escape faster. Attempting to avoid those escapes by applying a control smaller than noise seems to be an impossible task. Here we show, however, that this goal is indeed possible, based on the existence of a horseshoe. The horseshoe implies that there exists what we call safe sets, which assures that there is a general strategy that allows one to keep trajectories inside that region with a control smaller than noise. We call this type of control partial control of chaos [1,2] that allows one to keep the trajectories of a dynamical system close to the saddle even in presence of a environmental noise stronger than the applied control. This is joint work with James A Yorke (USA) and Samuel Zambrano (Spain).

“The Fractional Laplacian: The optimum definition”

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It is well known the different definitions of the Laplacian operator than can be find in the literature. Such definition are besed in the known power of operator theory, or in the calculus of the inverse of one of the n-dimensional operator of Riesz or through the using of the Fourier Transform. Al the mentioned definition present meny restrictions, in one ot they the domain are very narrow and in other cases the operator is hypersingular or the definition is ambiguous. Here we will introduce a coherent and consistent new definition of the fractional Laplacian completing the theory present by Riest in 1949 in his famous paper dedicate to introduce and study the generalization of the Riemann-Liouvilñle operators to the case n-dimensional. We point oup here that this definition it is very important in the area dedicate to use the Fractional Models in the simulation of the dynamics of anomalous processes.

“Dark Solitary-Wave Solutions of a Nonlocal Nonlinear Model”

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Dark soliton-like solutions are analyzed in the context of a certain nonlocal nonlinear Schrˆdinger Equation with nonlocal dispersive term of Kac-Baker type. Main purpose is to investigate such solutions with negative nonlinear term and the presence of general integral dispersive terms. First the model is presented and the properties of the fundamental solution, the continuous wave, is studied. Dark solitary waves are perturbations of this plane wave. The study of dark type of solutions is divided in two different cases black and dark solitary waves. An analytical work is developed to obtain their physical quantities like norm, momentum and energy, finding usual behavior of nonlinear systems under nonlocal dispersive terms.

“De la Nolinealidad a Marte: Invariancia y Periodicidad”

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Se presenta una panorámica de un proyecto de investigación Marciana no estándar que pone de manifiesto la invariancia y periodicidad vivientes de la investigación transdisciplinar.

“Dark solitons of the Lenells-Fokas equation”

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The present work is devoted to an integrable generalization of the nonlinear Schrödinger equation proposed recently by Lenells and Fokas.I discuss the relationships between this equation and other integrablemodels. Using the reduction of the Lenells-Fokas equation to the already known ones I obtain the N-dark soliton solutions.

“The fractional Poisson measure in infinite dimensions"

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Using the Bochner-Minlos theorem a fractional version of the infinite-dimensional Poisson measure is constructed. The support of the measure is identified in the framework of configuration spaces. Some tools for theinfinite-dimensional fractional analysis are then developed, namely the correlation measures, the unitary isomorphisms and a set of fractional "Charlier" kernels