Special Session 16: Differential , Integral Equations And Their Applications

Onur Alp Ilhan, Erciyes University Faculty of Education, Turkey

Existence of solutions for some degenerate parabolic equation with initial data in L^r

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The existence of local (in time) solutions of the following initial-boundary value problem with $u_0 \in L^r(\Omega)$ is proved under $r > N(q-p)/p$ without imposing any smallness on u_0 and f:

$$\begin{cases} u_t(x,t) - \Delta_p u(x,t) & - \quad |u|^{q-2}u(x,t) = f(x,t)\,, \\ & \quad\; (x,t) \in \Omega \times (0,T), \\ u(x,t) = 0 & , \quad (x,t) \in \partial\Omega \times (0,T), \\ u(x,0) = u_0(x) & , \quad x \in \Omega, \end{cases}$$

where $2 \le p < q < +\infty$, Ω is a bounded domain in $\mathbb{R}^N$ with smooth boundary $\partial\Omega$, $T > 0$, $f : \Omega \times (0,T) \to \mathbb{R}$ is given and Δ_p denotes the so-called p-Laplacian defined by $\Delta_p u := \nabla \cdot (|\nabla u|^{p-2}\nabla u)$.

Our proof relies on the reduction of the above problem into the Cauchy problem for an evolution equation governed by the difference of two subdifferentials in a reflexive Banach space, and moreover, several useful properties of subdifferential operators and the potential well method are employed to establish energy estimates. Particularly, L^r-estimates of solutions play a crucial role to construct a time-local solution and reveal the dependence of the time interval $[0, T_0]$ in which the problem admits a solution. More precisely, T_0 depends only on $|u_0|_{L^r}$ and f.

Furthermore, sufficient conditions for the existence of global (in time) solutions are also presented.

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Homoclinic snaking in the forced complex Ginzburg Landau equation

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and Edgar Knobloch

Many pattern forming systems contain a multiplicity of coexisting stationary spatially localized states. The spatial dynamics of such systems is characterized by homoclinic orbits which are organized around heteroclinic cycles between a fixed point and a periodic orbit. These states occupy an extended region in parameter space called the snaking region. A similar behavior is present in systems which contain heteroclinic orbits between two fixed point, though in this case the solutions collapse to a single point in parameter space. In this talk we present a novel hybrid example, found in the forced complex Ginzburg Landau equation, which combines aspects from both types of behavior: homoclinic snaking involving a heteroclinic connection between a fixed point and a periodic orbit which collapses to a point in parameter space.

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Existence result for a binary-mixture transport model with different densities

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We consider a model for the displacement of a binary-mixture in porous media. The components have different densities. It leads to the analysis of a system of nonlinear coupled parabolic partial differential equations. The main mathematical diffculty is the triangular flow matrix. Using two sequences of regularizing kernels we state the existence of a weak solution for the problem.

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On solutions to nonlinear equations modeling compressible fluid flow with capillary stress effects

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We study the initial-value problem for a system of differential equations that models the flow of a compressible fluid with capillary stress effects. The system includes a hyperbolic equation for the density, a parabolic equation for the temperature, a hyperbolic equation for the velocity, and an algebraic equation (the equation of the state) for the pressure.

We prove the existence of a unique, classical solution to an initial-value problem for this system of equations under periodic boundary conditions. The key to the proof is an a priori estimate for the divergence of velocity in a high Sobolev norm.

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Research on the Costing and Data Mining Based on ABC in Logistics Firms

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Abstract.

The costing and data mining of logistics costs will become increasingly important to all firms seeking competitive advantages. Activity Based Costing (ABC) is considered as the optimized and most promising method of costing and controlling logistics cost now, and logistics cost data mining based on ABC is playing a very important role in business management. The paper firstly analyses the principle of ABC for logistics cost project, and according to the basic principle of ABC and business management, the paper put forward the basically technical route of logistics project cost costing and data mining based on ABC for business management and decisions, moreover, the concrete costing process and model of applying ABC are deduced, then the further application forms of data mining based on ABC are summarized and elaborated for business management and decisions.

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Problems in the Theory of Semilinear PDE's and their Connection to Probability

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We will discuss some problems related to semilinear parabolic and elliptic PDE's (existence, uniqueness of nonnegative solutions, solutions on punctured domains etc.) and their probabilistic counterpart (measure valued processes).

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Positive Periodic Solutions of The Nonlinear Parabolic Equations

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In this paper we consider the initial value problem

$$\begin{array}{ll} (1) & \partial_t u = \nu\Delta u + F(t,x,u(t,x),D_x^2 u(t,x)), \quad x \in \mathcal{R}^n, \\ (1') & u \quad is \quad periodic \quad in \quad t, \\ (1'') & u(0,x) = u_0 \in \dot{B}^{\gamma}_{p,q}(\mathcal{R}^n), \end{array}$$

where $\nu \neq 0$,$q \geq 1$, 10 is arbitrary chosen and fixed.

Here we propose new approach for investigation of the periodicity problem (1), (1′), (1″) which is based on the theory of completely continuous vector field presented by M. Krasnosel'skii and P. Zabrejko . This method is used for investigation of the periodicity problem for the Korteweg de Vries equation. In the accessible literature there are too many methods for investigations of the periodicity problem (1), (1′), (1″) which are different than the method which we propose in this paper. This method gives new results for the periodicity problem (1), (1′), (1″).

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SOLVABILITY OF SOME PARTIAL INTEGRAL EQUATIONS IN BANACH SPACE

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An integral equation of contact problem of the theory of visco elasticity of mixed Fredholm and Volterra type in Banach space with spectral parameter depending on time is considered. In the case where the initial value of parameter coincides with some isolated point of the spectrum of Fredholm operator the additional conditions of solvability are established.

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Qualitative Dynamics of Periodic Nonlinearities

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I will present part of my work on a type of third-order nonlinear ordinary differential equations that is used to model phenomena in the fields of fluid mechanics, combustion theory, and semiconductor physics. I will show how, armed only with the assumption that the nonlinearity is periodic, it is possible to draw a fairly complete picture of the qualitative dynamics. I will also outline a method for constructing Silnikov homoclinic trajectories for these three-dimensional systems.

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On stochastic fractional relaxation equations

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The presentation deals with stochastic fractional relaxation equations in a Hilbert space.The purpose of this talk is to establish the existence of strong solutions to the stochastic versions of the generalized Basset equation. The Basset equation arises in fluid dynamics concerning the unsteady motion of a particle accelerating in a viscous fluid under the action of the gravity, see e.g. [3]. It corresponds to a fractional relaxation equation and can be interpreted as an integral equation, which is our viewpoint.

This presentation bases on very recent, not yet published deterministic and stochastic results, obtained in [2] and [1], respectively.

References

[1] A. Karczewska, C. Lizama,*Stochastic fractional relaxation equation*, in preparation.

[2] C. Lizama, H. Prado,*Fractional Relaxation on Banach spaces*, submitted.

[3] F. Mainardi,*Fractional calculus: some basic problems in continuum and statistical mechanics*, in "Fractional Calculus in Continuum Mechanics (ed. A. Carpinteri and F. Mainardi), Springer, Wien 1997, 291-348.

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The Issue of Local Solvability for Nonlinear Equations

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The most simple and basic question that one can ask of a differential equation, is whether it admits any solution in any neighborhood of a point. Thus it is surprising to note how little is known concerning this question, for many well-known nonlinear partial differential equations. Motivated by problems from geometry, we will discuss this issue for the class of Monge-Ampere equations. New sufficient conditions for existence, as well as counterexamples, will be presented.

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Stability of linear dynamic equations on time scales

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In this talk we introduce u_∞-quasisimilarity to order to unify (continuous) t_∞-quasisimilarity and (discrete) n_∞-quasisimilarity and then investigate the strong stability for linear dynamic equations on time scales by using the concept of u_∞-quasisimilarity and dynamic inequality.

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Quotient Coupled Systems of ODE's

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A coupled cell network is coupled system of ODE's. Every coupled cell system, when restrict to a flow-invariant subspace defined by equality of certain cell coordinates, is associated with a quotient network. Given a (quotient) network, we describe a general method to construct coupled cell networks admitting it as a quotient. Also, we investigate the impact of a generic codimension-one synchrony-breaking bifurcation from a synchronous equilibrium, occurring in the quotient network, for the different networks having it as a quotient network.

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Classic and fractal geometry of smooth linear oscillations on a finite interval

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Classic and fractal geometry of oscillatory smooth solutions $y \in C(\bar{I}) \cup C^2((0,1])$ of the second-order linear differential equation $y'' + f(x)y = 0$ on the unit interval $I = (0,1)$ contain the following five new problems: the finiteness of the length of the graph $G(y)$ - the so-called *rectifiable* oscillations on I, simultaneous oscillations at $x = 0$ and $x = 1$ - the so-called *two-point* oscillations on I, oscillations in respect to a given nonzero oscillation axis - the so-called *relative* oscillations on I, the infiniteness of the length of the graph $G(y)$ - the so-called *unrectifiable* oscillations on I, and positiveness and finiteness of the s - dimensional upper Minkowski content of $G(y)$ - the so-called *fractal* oscillations on I.

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CHARACTERIZATIONS OF POSITIVE LINEAR VOLTERRA-STIELTJES EQUATIONS

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We first introduce the notion of positive linear Volterra-Stieltjes equations. Then, we give some characterizations of positive equations. An explicit criterion and a Perron-Frobenius theorem for positive linear Volterra- Stieltjes equations are given. Next, we offer a new criterion for uniformly asymptotic stability of positive equations. Finally, we study stability radii of positive linear Volterra-Stieltjes equations. It is proved that complex, real and positive stability radius of positive linear Volterra-Stieltjes equations under structured perturbations coincide and can be computed by an explicit formula. The obtained results include our ones established earlier in only recent time for positive linear Volterra integro-differential equations of convolution type and for positive linear functional differential equations as particular cases.

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About the Stability of Gas Balls

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The presentation is concerned with the question of stability for the spherically symmetric equilibrium of a slowly rotating barotropic fluid under the influence of self gravitation with a free boundary without surface tension. This analysis proceeds by a study of the linearization of the equation. Its solutions do not decay exponentially, which makes it hard to derive nonlinear stability from linear stability. We discuss some of the difficulties and the tools used for overcoming them.

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