Schedule, Speakers & Abstracts of Texas Differential Equation Conference 2025

Saturday, March 8, 2025
University of Houston-Downtown
(All talks in STB Fondren Commons Rooms A & B)

9:00–9:10

Welcome

Akif Uzman / Dean Science & Technology, University of Houston-Downtown

9:10–9:30

Convergence of Eigenfunction expansions for Poison type equations

Giles Auchmuty / University of Houston

Abstract

Let Ω be a nonempty bounded connected open set in R^N with N = 2 or 3. Let $\mathcal{G}_\mu$ f be the weak solution in $H_0^1(\Omega)$ of the equation

$$\mu^2 u - \Delta u \;=\; f \quad \text{on}\,\Omega \quad \text{with} \quad f \in L^2(\Omega).$$

This solution is actually in $C_0(\overline{\Omega})$ and a proof that the eigenfunction expansion for the solution converges uniformly to the solution will be outlined.

The proof depends on a little known inequality of Wenzheng Xie for functions in $H_0^1(\Omega)$ with $\Delta u \in L^2(\Omega)$. This leads to a proof that the operator $\mathcal{G}_\mu$ is a compact linear map of $C(\overline{\Omega})$ to $C_0(\overline{\Omega})$ with a very good bound on the norm. This enables a simplification of many results in bifurcation theory of solutions of semilinear Laplacian problems with zero Dirichlet b.c.s

9:35–9:55

A semi-implicit projection scheme for multiphase incompressible flows with thermal convection

An Vu / University of St. Thomas

Abstract

We introduce a semi-implicit time-stepping thermal solver for the incompressible Navier-Stokes equations coupled with temperature equation. This solver handles systems with variable fluid properties such as density and viscosity, as well as thermal properties like heat diffusivity and thermal conductivity. We use a projection method to enforce the incompressiblility, treating momentum (product of density and velocity) and internal energy (product heat capacity, density, and temperature) as primary variables. We show that the scheme is stable and provide the first-order error estimates. Additionally, we present a fully discretized algorithm using finite elements and verify its effectiveness through numerical simulations, including cases with large density differences and fluid interface reversals.

10:00–10:20

Traveling waves for nonlocal Fisher-KPP equations with diffusive delay

William "Kyle" Barker / University of Arkansas at Little Rock

Abstract

We study the existence of traveling waves for nonlocal KPP-Fisher equations with diffusive delay

$$\frac{\partial u(x,t)}{\partial t} = \frac{\partial^2 u(x,t-\tau_1)}{\partial x^2} + u(x,t)\left(1 - \int_{-\infty}^{\infty} d\mu(y) u(x-y,t-\tau_2)\right),$$

where μ is a non-decreasing function with bounded variation. The existence of traveling waves is proved using the method of monotone iteration developed recently for general reaction-diffusion equations with delays in both reaction and diffusion terms. We extend this iteration method to start with very rough upper and lower solutions that we call super and sub solutions. We show that for small delays τ_1 and τ_2 traveling waves connecting 0 and 1 exist.

10:25–10:45 Coffee break

10:45–11:05

Weakly nonlinear investigation of Soret and Lewis number effects on a thermos-solutal convective flow in porous media

Dambaru Bhatta / The University of Texas Rio Grande Valley

Abstract

Here we consider a thermo-solutal convective flow in a horizontal porous layer. The governing system is represented by the Darcy momentum equation, the continuity equation, the heat equation, and the solute transport equation. The convection is driven by buoyancy forces arising from density variations caused by temperature and solute concentration differences. Assuming a vertically varying with no flow basic state system and using weakly nonlinear approach, we derive various order perturbed systems and the amplitude equation. Numerical results are presented to show the effects of the Soret and Lewis numbers.

11:10–11:30

Nonexistence of time almost-periodic solutions of Nonlocal Allen-Cahn Equations

Fengxin Chen / University of Texas at San Antonio

Abstract

We consider nonlocal Allen-Cahn equation $u_t = \alpha\Delta u + \beta(J * u - u) + f(u)$, where $\alpha \geq 0$, and $\beta > 0$; f is a smooth function. Using the energy estimates, we prove that time almost-periodic solutions to the Allen-Cahn equation do not exist.

11:35–11:55

Analysis and Identification of Vibration Spectra for a Horse through and after Its Collision with a Solid Wall

Goong Chen / Texas A&M University, College Station

Abstract

We have performed a case study of a horse colliding with a wall. The horse is assumed to be made of an elastic, muscle-like material the elastodynamic PDE with force-free boundary condition, while the wall is assumed to be rigid. The motion of the horse, after impacting the wall, begins a bouncing-back motion. We have computed the motion sensorial data at several locations on the horse and from the vibration data analysis, we further perform the FFT to identify the vibration frequencies and then compare them with the eigenfrequency data of the horse. The results, with collision or after collision, will be compared and discussed at the talk so one can understand certain aspects of the collision effects.

12:00–12:20

Utilizing Steklov Expansion Techniques for Analyzing Physical Capacitances in Electrostatics

Manki Cho / University of HoustonClear Lake

Abstract

This presentation introduces the Steklov expansion method for addressing mixed boundary value problems. By solving specific Steklov eigenvalue problems, we obtain approximations for solutions to the Laplace equation under various boundary conditions. These approximations, constructed using Steklov eigenfunctions, are then applied to evaluate physical capacitances with high accuracy. In addition to providing reliable capacitance approximations, the Steklov expansion method offers error analysis based on Steklov eigenvalues. The talk will also feature numerical experiments to demonstrate the effectiveness of the approach.

12:30–13:45 Lunch Break

13:50–14:10

A Transient$^{[X]}$ / Transient$^{(k,K)}$ /1 Queue with Reneging and Setup Time for Service

Aliakbar Montazer Haghighi[1] and Dimitar P. Mishev / Prairie View A&M University

Abstract

In this paper, we analyse a transient queuing model, in which tasks arrival in bulks of varying sizes with compound Poisson process. There is a single server serving batches of tasks with limited sizes with a minimum and a maximum, according with exponential distribution. Also, there are setup times for service with also exponential distribution. There is a possibility that impatient tasks renege while the server is busy with also exponential distribution. The transient probability generating function for the number in the system, special cases to verify it, and some performance measures have been found.

14:15–14:35

Anisotropic Forchheimer flows in porous media

Luan Thach Hoang / Texas Tech University

Abstract

We study the anisotropic Forchheimer-typed flows for compressible fluids in porous media. We first investigate the nonlinear structure of the anisotropic momentum equations. Unlike the isotropic flows, the important monotonicity properties are not automatically satisfied in this case. Therefore, various sufficient conditions for them are derived and applied to the experimental data. Next, we prove the existence and uniqueness of the steady state flows subject to a nonhomogeneous Dirichlet boundary condition. It is also established that these steady states, in appropriate functional spaces, have local Hölder continuous dependence on the forcing function and the boundary data. This is a joint work with Thinh Kieu (University of North Georgia, Gainesville Campus)

[1]Speaker

14:40–15:00

Asymptotic stability of solitary waves for the 1D cubic NLS under even perturbations

Yongming Li / Texas A&M University

Abstract

I will present an overview for our proof of the asymptotic stability of solitary waves for the 1D cubic NLS under even perturbations, which is based on a combination of modulation techniques and a space-time resonances approach. The main challenges are the threshold resonances of the linearized operator and the resulting slow local decay of the Schrodinger waves. Remarkable null structures in the evolution equation for the radiation term as well as in the modulation equations play an important role in the proof. This is joint work with Jonas Luhrmann (Texas A&M University).

15:05–15:25

On Blow-Up and Explicit Soliton Solutions for Coupled Variable Coefficient Nonlinear Schrödinger Equations

Erwin Suazo[2] / The University of Texas Rio Grande Valley
and Jose Escorcia / EAFIT, Colombia

Abstract

This work is concerned with the study of explicit solutions for a generalized coupled nonlinear Schrdinger equations (NLS) system with variable coefficients. Indeed, by employing similarity transformations, we show the existence of rogue wave and darkbright soliton-like solutions for such a generalized NLS system, provided the coefficients satisfy a Riccati system. As a result of the multiparameter solution of the Riccati system, the nonlinear dynamics of the solution can be controlled. Finite-time singular solutions in the L8 norm for the generalized coupled NLS system are presented explicitly. Finally, an n-dimensional transformation between a variable coefficient NLS coupled system and a constant coupled system coefficient is presented. Soliton and rogue wave solutions for this high-dimensional system are presented as well.

15:30–15:50 Coffee break

[2]Speaker

15:50–16:10

Symmetric and asymmetric floating drops

Ray Treinen / Texas State University

Abstract

A drop of liquid rests on a supporting bath of a different liquid, and the entire configuration is contained in a vertical tube. Symmetric and asymmetric configurations are numerically computed, and the resulting potential energies are compared. We present a variety of parameter studies that show examples where the symmetric configuration has lower energy, and also where it does not. This is joint work with Mason Mault.

16:15–16:35

On singular and degenerate elliptic equations arising from sharp geometric inequalities

John Villavert / The University of Texas Rio Grande Valley
Shanghai Jiao Tong University

Abstract

In this talk, we focus on the non-negative regular solutions to a broad class of nonlinear elliptic problems in either entire space or in bounded star-shaped domains. These problems may involve both singular and degenerate operators and whose lower order terms may contain radial weights. The type of equations and systems within this class include classical ones arising in finding the best constant in functional inequalities and curvature problems from conformal geometry. In particular, under certain growth and structural conditions on the weights and nonlinearities, we can establish various (at times sharp) existence and non-existence results, including Liouville-type theorems as well as proportionality and classification results.

16:40–17:00

AI Technology and Modal Analysis in Motion Imitation of Dinosaurs

Yuetong Wu / Texas A&M University

Abstract

Understanding and replicating the motion of extinct species, such as dinosaurs, presents a unique challenge due to the lack of direct observational data. In this talk, we introduce a novel framework that integrates Artificial Intelligence (AI) techniques combined with modal analysis to achieve realistic motion imitation of dinosaurs. Our approach leverages multiple AI techniques such as Long Short-Term Memory (LSTM) networks, random forest classifiers to learn motion patterns from existing biomechanical simulations and applies modal analysis to refine skeletal movement based on physical constraints and dynamic stability.