

NCTS 2015 Analysis and PDE Young Scholars Summer Symposium

Tuesday, June 23, 2015

R408, Dept. of Applied Mathematics, NUK

Speakers

Yan-Yu Chen 陳彥宇 (Tamkang University)

Yi-hsin Cheng 鄭益新 (National University of Kaohsiung)

Shih-Wei Chou 周世偉 (National Central University)

Bo-Chih Huang 黃博峙 (National Central University)

Hsin-Yuan Huang 黃信元 (National Sun Yat-sen University)

Yin-Liang Huang 黃印良 (National University of Tainan)

Ying-Chieh Lin 林英杰 (National University of Kaohsiung)

Yu-Yu Liu 劉育佑 (National Cheng Kung University)

Tien-Tsan Shieh 謝天長 (National Central University)

Hsi-Wei Shih 史習偉 (National Cheng Kung University)

Kuan-Hsiang Wang 王冠祥 (National Cheng Kung University)

Chang-Hong Wu 吳昌鴻 (National University of Tainan)

Organizers

Jenn-Nan Wang (National Taiwan University)

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Program

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	On a free boundary problem for the curvature flow with driving force	
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	The Error Analysis of Spatially Compatible Finite Difference Schemes for Navier-Stokes Equations	
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	The minimal speed of traveling wave solutions for a Lotka-Volterra type diffusive predator-prey model	
12:00 – 14:00	Lunch Break (Room 407)	
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	The Hydrodynamic Escape Phenomenon in Planetary Atmospheres	
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	Delayed Flame Quenching in Time Periodic Cellular Flows Modeled by Strain G-equation	
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18:00 –	Dinner	

The existence of vortex sheets for the lake equations

Ying-Chieh Lin
National University of Kaohsiung

Abstract

Lake equations arise to leading order in a low aspect ratio, low Froude number and very small wave amplitude expansion of the three-dimensional incompressible Euler equations in a basin with a free upper surface and a spatially varying bottom topography. This topic is one of my ongoing project. In this talk, I will first give some background and present the steps to solve this problem. Finally, I will describe the difficulties that I meet in this work.

On the skew-symmetric Chern-Simons system

Hsin-Yuan Huang
National Sun Yat-sen University

Abstract

In this talk, I will survey the recent developments of the system arising from the Chern-Simons Model with two Higgs Particles. Mathematically, the system is a typical skew-symmetric system. Thus, the action functional of this system is indefinite, which makes it difficult to study from the variational method. Among others, I will present my recent works on this system, including the uniqueness of the topological solutions and the radial non-topological solutions, and existence of bubbling solutions on a torus (joint work with X. Han and C.S. Lin and Y.Lee).

On a free boundary problem for the curvature flow with driving force

Chang-Hong Wu
National Tainan University

Abstract

In this talk, We shall focus on a free boundary problem associated with the curvature dependent motion of planar curves in the upper half plane whose two endpoints slide along the horizontal axis with prescribed fixed contact angles. The dynamics of this problem is investigated completely. Moreover, we introduce “the extended intersection number principle”, which plays an important role in our analysis. This is a joint work with Jong-Shenq Guo, Hiroshi Matano and Masahiko Shimojo.

The Error Analysis of Spatially Compatible Finite Difference Schemes for Navier-Stokes Equations

Yin-Liang Huang
National Tainan University

Abstract

We use the nonlinear stability, stream functions, discrete Fourier analysis and the inf-sup condition to analyze the error in the simulation of the time dependent Navier-Stokes Equations. In particular, the numerical schemes under consideration are based on the stagger grids and ensure that the discretization of the involving differential operators are spatially compatible to one another.

The minimal speed of traveling wave solutions for a Lotka-Volterra type diffusive predator-prey model

Yan-Yu, Chen
Tamkang University

Abstract

We study the traveling wave solutions of a diffusive predator-prey model of Lotka-Volterra type functional response. Both species obey the logistic growth such that the carrying capacity of the predator is proportional to the prey. Our aim is to see whether both species can survive eventually if we introduce an alien invading predator to the habitat of an existing prey. Applying Schauder's fixed point theory with the help of suitable upper and lower solutions, we prove the existence of traveling wave solutions for this model. By deriving the non-existence of traveling waves, we also determine the minimal speed of traveling waves for this model. This research is the joint work with Jong-Sheng Guo and Chih-Hong Yao.

The Hydrodynamic Escape Phenomenon in Planetary Atmospheres

Bo-Chih Huang
National Central University

Abstract

The hydrodynamic escape problem (HEP) is significant on the study of the evolution of planetary atmospheres. In this talk, I would like to introduction the physical phenomenon of this problem, and explain the reason why the three comparable size and mass planets, Venus, Earth, and Mars, in our solar system have different composition of atmosphere. Meanwhile, I will briefly explain our mathematical work on this problem, and introduce some future work relating to it.

Global spacetime bounds for the energy-critical nonlinear wave equation in high spatial dimensions

His-Wei Shih
National Cheng Kung University

Abstract

I will present the result on global spacetime bounds for the energy-critical nonlinear wave equation in all space dimensions $d \geq 3$. This extends the work in the case $d = 3$ of Tao, who proved a certain global Strichartz norm has an explicit double-exponential bound in the energy,

$$\|u\|_{L_t^4 L_x^{12}(\mathbb{R} \times \mathbb{R}^3)} \leq C(1 + E)^{CE^{105/2}}$$

for some absolute constant $C > 0$. The work uses Tao's argument extensively, but differs in important points too. Besides applying also in high dimensions, we get a sharper bound (though still double-exponential) in the case $d = 3$.

These explicit bounds are interesting not only for the intrinsic value, but also through their connection with regularity problem for slightly energy-supercritical nonlinear wave equations.

Delayed Flame Quenching in Time Periodic Cellular Flows

Modeled by Strain G-equation

Yu-Yu Liu

National Cheng Kung University

Abstract

We study the numerical schemes of the G-equation models and used them to compute the turbulent flame speeds in cellular flows. The turbulent flame speed is enhanced by the cellular flow, while the curvature term causes bending on the growth rate, and the strain term causes quenching when the flow intensity is large. If the cellular flow is time periodic, then the growth rate function becomes piecewise constant, and the quenching effect is delayed until much larger flow intensity.

Bilinear space-time estimates for homogenous wave equations

Kuan-Hsiang Wang
National Cheng Kung University

Abstract

In this talk we introduce the bilinear space-time estimates for homogeneous wave equation in $n+1$ dimension. We discuss necessary and sufficient conditions for the validity of bilinear estimates, based on L^2 norm in space and time.

A local minimizer of a generalized minimal interface problem involving a boundary contact energy

Tien-Tsan Shieh
National Central University

Abstract

We consider a variational problem

$$\inf_{u \in \mathcal{A}(m)} \int_{\Omega} \frac{\varepsilon^2}{2} |\nabla u|^2 + \frac{V(x)}{2} u^2 + \frac{1}{4} u^4 dx$$

where the admissible class $\mathcal{A}(m, f) = \{u \in W^{1,2}(\Omega) : \int_{\Omega} u^2 dx = m, u = f \text{ on } \partial\Omega\}$. The establishment of the Γ – limit of the energy functional helps us construct a sequence of local minimizers $\{v_{\varepsilon}\}_{\varepsilon>0}$ of the perturbed problem. With a given Dirichlet boundary condition, the limiting problem demonstrate phase separation behaviors which are different from one with a Neumann boundary condition.

Combined Fanno Rayleigh heat transfer and friction effects through the variable nozzles

Shih-Wei Chou
National Central University

Abstract

In this talk, we study the thermal fluid in the nozzle and the influence of the wall friction according to the shape of the nozzle. We construct the global transonic solutions to the Fanno-Rayleigh equations, which is one of the most important models in the study of the smaller engines where the heating and friction cannot be ignored.

On the indefinite Kirchhoff type problems with local sublinearity and linearity

Yi-hsin Cheng
National University of Kaohsiung

Abstract

We study the indefinite Kirchhoff type problem:

$$\begin{cases} M \left(\int_{R^N} (|\nabla u|^2 + u^2) dx \right) [-\Delta u + u] = f(x, u) \text{ in } R^N, \\ 0 \leq u \in H^1(R^N), \end{cases}$$

where $N \geq 1$, $M(t) = at + b$, $a, b \in \mathbb{R}$ and $f \in C(R^N \times R^+, \mathbb{R})$. We require that f is "local" sublinear at the origin and "local" linear at infinite. Using the mountain pass theorem and Ekeland variational principle, the existence and multiplicity of nontrivial solutions are obtained. In particular, the criterion of existence of three nontrivial solutions is established. Furthermore, the non-existence of nontrivial solutions is considered as well.