

PROGRAM
JOINT AUSTRALIA-CHINA MEETING
ON NON-LINEAR PARTIAL
DIFFERENTIAL EQUATIONS

(2 JULY - 6 JULY 2007)

Organized by The University of Queensland
and The Australian National University

The conference has been supported by the Australian Mathematical Sciences Institute, The University of Queensland and The Australian National University.

Joint Australia-China meeting on Non-linear Partial Differential Equations

Monday 2 July

9.30-9.40: Opening address by Professor Neil Trudinger

9.45-10.25: Professor Weiyue Ding - Beijing University

Title: Special solutions of Schrödinger flows

10.30-11 Morning Tea

11-11.40 Professor R. Bartnik - Monash

Title: TBA

11.45-12.25 Professor Ping Zhang - Academy Sinica, China

Title: On the free boundary problem of 3D incompressible Euler equations.

12:30-2:45 Lunch

2.45-3.25 Professor Xiaohua Zhu- Beijing University

Title: Stability related to Calabi's extremal metrics on toric manifolds

3.30-3.55

Dr Bai-Ling Wang - ANU

Title: Boundary value problems for the Seiberg-Witten equation.

4.00-4:25 Dr Seick Kim - ANU

Title: Green's matrix of second order elliptic systems.

Joint Australia-China meeting on Non-linear Partial Differential Equations

Tuesday 3 July

9.00-9.40: Professor Jiaxing Hong - Fudan University, China

Title: TBA

9.45-10.25: Dr J. Urbas - ANU

Title: TBA

10.30-11 Morning Tea

11-11.40 Professor Hua Chen - Wuhan University, China

Title: Asymptotic Behavior of the Trace Displacement for Schrödinger Operators on Irregular Domains

11.45-12.25 Professor Huaiyu Jian - Tsinghua University, China

Title: A mean curvature flow with external force fields

12:30-2:45 Lunch

2.45-3.25

Professor Weimin Sheng - Zhejiang University, China

Title: σ_k Yamabe problem and some related problems

3.30-3.55 Dr Florica Cirstea - ANU

Title: Classification of positive solutions of semilinear elliptic equations near an isolated singularity

Joint Australia-China meeting on Non-linear Partial Differential Equations

Wednesday 4 July

9.00-9.40: Professor Zhou-ping Xin - Chinese University of Hong Kong

Title: On Steady Compressible Flows that may change types

9.45-10.25: Cedric Villani - SNS, Lyon

Title: A synthetic approach to Ricci curvature bounds

10.30-11 Morning Tea

11-11.40 Dr J. McCoy - Univ of Wollongong

The title: Contraction of nonsmooth convex hypersurfaces into spheres.

11.45-5.00 Excursion

6.00- Conference dinner

Joint Australia-China meeting on Non-linear Partial Differential Equations

Thursday 5 July

9.00-9.40: Professor Xi-Ping Zhu - Zhongshan University, China

Title: Uniqueness of Solutions to the Ricci Flow

9.45-10.25: A/Professor J. Chabrowski - UQ

Title: The Hardy inequality and semilinear elliptic equations

10.30-11 Morning Tea

11-11.40 Professor Xiaoping Yang - Nanjing University of Sci. Tech., Nanjing, China

Title: Minimal Surface Equations in the Heisenberg Group

11.45-12.25 A/Prof X. T. Duong - Macquarie University

Title: Recent progress on function spaces associated with operators

12:30-2:45 Lunch

2.45-3.25 Dr N. Chaudhuri - Wollongong

Title: On rigidity estimate and separation of gradient Young measures

3.30-3.55

Dr Sanjaban Santra - Sydney University

Title: The Asymptotic behavior of radial solutions for a semilinear elliptic PDE in an annulus by Morse Index.

The Joint Australia-China meeting on Non-linear Partial Differential Equations

Friday 6 July

9.00-9.40: Professor Daomin Cao - Academy Sinica, China

Title: Infinitely many solutions for an elliptic problem involving critical nonlinearity

9.45-10.25: Dr S. Yan - UNE

Title: Clustered Bubbles for An Elliptic Problem with Critical Growth

10.30-11 Morning Tea

11-11.40 Professor Min Ji - Academy Sinica, China

Title: Scaler Curvature Equations on S^n

11.45-12.25 A/Prof Y. Du - UNE

Title: Convergence and sharp thresholds of propagation in a bistable parabolic problem

12:30-2:45 Lunch and closed

Abstracts of all talks

Professor R. Bartnik - Monash

Title: TBA

Professor Daomin Cao - Academy Sinica, China

Title: Infinitely many solutions for an elliptic problem involving critical nonlinearity

Abstract: Let $N \geq 3$, $2^* = \frac{2N}{N-2}$, and Ω be an open bounded domain in \mathbb{R}^N . We will talk about existence of infinitely many solutions to the following two problems:

$$\begin{aligned} -\operatorname{div}(a(x)\nabla u) &= Q(x)|u|^{2^*-2}u + \lambda u & x \in \Omega, \\ u &= 0 & \text{on } \partial\Omega, \end{aligned}$$

where $a, Q \in C^4(\bar{\Omega})$, $a(x) \geq a_0 > 0$, $Q(x) \geq Q_0 > 0$, and $\lambda > 0$ is a positive constant and

$$\begin{aligned} -\Delta u - \frac{\mu}{|x|^2}u &= |u|^{2^*-2}u + \lambda u & x \in \Omega, \\ u &= 0 & \text{on } \partial\Omega, \end{aligned}$$

where $0 \leq \mu < \bar{\mu} = \frac{(N-2)^2}{4}$.

Joint work with Shusen Yan at University of New England, Australia

A/Professor J. Chabrowski - UQ

Title: The Hardy inequality and semilinear elliptic equations

Abstract: I will discuss a new variant of the Hardy inequality. This will be used to solve the Neumann problem involving the critical Sobolev exponent and the Hardy potential.

Dr N. Chaudhuri - Wollongong

The title: On rigidity estimate and separation of gradient Young measures

Abstract: Gradient Young measures (GYM) are used to analyze oscillations and concentrations in gradients of uniformly bounded sequence of Lipschitz deformations. It is well-known that GYM are probability measures having compact support. We will establish a quantitative estimate proving that gradients of $W^{2,p}$ for $p > 1$ deformations cannot jump between two incompatible phases. As a consequence, we prove that the support of a GYM generated by uniformly bounded sequences in $W^{2,p}$, consists of only compatible phases. We also recover the classical isoperimetric inequality, and Liouville Theorem.

Professor Hua Chen - Wuhan University, China

Title: Asymptotic Behavior of the Trace Displacement for Schrodinger Operators on Irregular Domains

Abstract: We shall study the Dirichlet eigenvalue problems for Schrodinger operators and Laplace operators defined on general domains with irregular boundaries. We shall give the estimate of the second asymptotic term for the trace displacement.

Dr Florica Cirstea - ANU

Title: Classification of positive solutions of semilinear elliptic equations near an isolated singularity

Abstract: We consider the semilinear elliptic equation $\Delta u = h(u)$ in $\Omega \setminus \{0\}$, where Ω is an open subset of \mathbb{R}^N ($N \geq 2$) containing the origin and h is locally Lipschitz continuous on $[0, \infty)$, positive in $(0, \infty)$. We give a complete classification of isolated singularities of positive solutions when h varies regularly at infinity of index $q \in (1, N/(N-2))$ (that is, $\lim_{u \rightarrow \infty} h(\lambda u)/h(u) = \lambda^q$, for every $\lambda > 0$). This generalizes a well-known result of Véron for $h(u) = u^q$.

This is joint work with Yihong Du.

Professor Weiyue Ding - Beijing University

Title: Special solutions of Schrodinger flows

Abstract: We present our recent results on the existence of two different kinds of special solutions for the Schrodinger flows: periodic solutions of solitary wave type and self-similar solutions. These solutions are obtained by reductions to elliptic problems and by elliptic methods.

A/Prof Y. Du - UNE

Title: Convergence and sharp thresholds of propagation in a bistable parabolic problem

Abstract: We study the Cauchy problem $u_t = u_{xx} + f(u)$, $u(0, x) = u_0(x)$, where u_0 is a nonnegative L^∞ function with compact support, and f is a bistable nonlinear function. We show that the solution always has a limit as $t \rightarrow \infty$. If the initial data $u_0 = \phi_\lambda$ depends on a parameter $\lambda > 0$ monotonically, we prove the existence of a critical value λ^* such that the longtime asymptotic behavior changes sharply according to whether $\lambda < \lambda^*$, $\lambda = \lambda^*$ or $\lambda > \lambda^*$. This is joint work with Hiroshi Matano of Tokyo Univ.

A/Prof X. T. Duong - Macquarie University

Title: Recent progress on function spaces associated with operators.

Abstract: Classical function spaces such as Hardy spaces, BMO spaces, Morrey-Campanato spaces, and Besov spaces on R^n can be characterized by the Laplace operator. Hence these spaces are associated with the Laplacian. In this talk, we will discuss some recent progress on function spaces when the Laplacian is replaced by a generator of an analytic semigroup.

Professor Jiaying Hong - Fudan University, China

Title: TBA

Professor Min Ji - Academy Sinica, China

the title is Scaler Curvature Equations on S^n

ABSTRACT: we will adopt the degree-theoretic approach to give a topological condition to ensure the solvability of the prescribing scalar curvature problem on the standard sphere of any dimension. And we will give explicit analytic conditions on the scalar curvature function which verify the topological condition.

Professor Huaiyu Jian - Tsinghua University, China

Title: A mean curvature flow with external force fields Department of Mathematical Sciences Tsinghua University, Beijing 100084, P. R. China

Abstract: We study the evolution of submanifold moving by mean curvature minus a external force field. This flow comes from the vortex dynamics of Ginzburg-Landau equations. We show that even if the initial manifolds are closed, the flow has a long-time smooth solution for all time, which is a different phenomena from the usual mean curvature flow. We find almost optimal conditions for the long-time existence. Those conditions are that the second fundamental form on the initial submanifolds is not too large, the external force field, with its any order derivatives, is bounded, and the field is convex with its eigenvalues satisfying a pinch inequality.

Dr Seick Kim - ANU

Title: Green's matrix of second order elliptic systems.

Abstract: We establish existence and pointwise estimates of Green's matrices for divergence form, second order strongly elliptic systems in a domain $\Omega \subseteq \mathbb{R}^n$, $n \geq 2$. We present a unified approach valid for both the scalar and vectorial cases.

Dr J. McCoy - Univ of Wollongong

The title: Contraction of nonsmooth convex hypersurfaces into spheres.

Abstract: We consider a class of fully nonlinear curvature flows of convex hypersurfaces in Euclidean space for which we obtain smooth convergence under suitable rescaling to spheres. Our new estimates on displacement, speed and curvature under the evolution, independent of initial data, allow nonsmooth convex initial hypersurfaces via an approximation argument. This is joint work with Ben Andrews and Yu Zheng.

Dr Sanjaban Santra - USyd

Title: The Asymptotic behavior of radial solutions for a semilinear elliptic PDE in an annulus by Morse Index.

Abstract: We discuss the asymptotic behavior of radial solutions for semilinear elliptic PDE with Dirichlet boundary conditions in an annulus. We are able to show that Morse Index information on such solutions provide the complete blow up behavior. In particular, in many situations we obtain that the radial ground state solutions blow up and concentrates at the inner boundary of the annulus.

This is joint work with P. Esposito, G. Mancini and P. Srikanth.

Professor Weimin Sheng - Zhejiang University, China

Title: σ_k Yamabe problem and some related problems

Abstract: In this talk, I will introduce the σ_k Yamabe problem and some existence and regularity results. I will talk about its admissibility of this equation. Some other related fully nonlinear equations and their regularity and existence will be discussed.

Dr J. Urbas- ANU

Title: TBA

Cedric Villani - SNS, Lyon

Title: A synthetic approach to Ricci curvature bounds

Abstract: There has been recently a lot of activity around the relations between the geometry of optimal transport in curved geometries, and the Ricci curvature. I will explain how optimal transport can be used to give a synthetic definition of lower Ricci curvature bounds, thus yielding a solution to a problem studied by Gromov, Cheeger and Colding. This is joint work with John Lott.

Dr Bai-Ling Wang - ANU

Title: Boundary value problems for the Seiberg-Witten equation.

The abstract: Problems in low dimensional topology and gauge theory can be studied using certain non-linear differential equations on manifolds with boundary. I will discuss the boundary value problem for the Seiberg-Witten equation and its applications

Professor Zhou-ping Xin - Chinese University of Hong Kong

Title: On Steady Compressible Flows that may change types

Abstract: In this talk, I will discuss some recent results on steady compressible ideal flows in a general nozzle with variable sections. The emphasize will be on the global subsonic, global subsonic-sonic flows in a 2-dimensional infinite long nozzle or 3-dimensional axi-symmetric nozzle, and transonic shock waves in a finite multi-dimensional nozzle with physical boundary conditions. Both existence and nonexistence results will be presented.

Dr S. Yan - UNE

Title: Clustered Bubbles for An Elliptic Problem with Critical Growth

Abstract: We consider the following nonlinear Schrödinger equation in R^3

$$\begin{aligned} -\Delta u + \lambda V(|y|)u &= u^5, \quad u > 0 \text{ in } B_R \\ u &= 0, \text{ on } \partial B_R, \end{aligned}$$

where λ is large. Ambrosetti, Malchiodi and Ni established the existence of one layered solution if $M(r) = r^2V(r)$ has a nondegenerate critical point $r = r_0 > 0$. Brezis and Peletier asked if there are more and more (radial or nonradial) solutions as λ increases. We partially solve this question by constructing solutions with clustered bubbles at the origin and a layer at $r = r_0$, provided that λ is large and is away from certain resonant number.

Professor Xiaoping Yang - Nanjing University of Sci. Tech., Nanjing,, China

Title: Minimal Surface Equations in the Heisenberg Group

Abstract: In this talk, we will discuss minimal surface equations in the Heisenberg group, which is a simplest metric space differing from a Euclidean space. We will talk about some recent results related, which mainly include a Backlund type transformation for the solutions of minimal surface equations in the first Heisenberg group, an existence theorem and interesting properties of minimal surfaces in the Heisenberg group.

Professor Ping Zhang - Academy Sinica, China

My topic title is: On the free boundary problem of 3D incompressible Euler equations.

Abstract: We consider in 3D the motion of a general inviscid, incompressible fluid with a free interface which separates the fluid region and the vacuum. Under some stability condition, we prove the local wellposedness of this problem in Sobolev space.

Professor Xiaohua Zhu- Beijing University

Title: Stability related to Calabi's extremal metrics on toric manifolds

Abstract: In this talk, I will discuss a relationship between the K -stability and the Calabi's extremal metrics on toric manifolds. We prove that on a polarized toric manifold the relative K -stability is a necessary condition for the existence of Calabi's extremal metrics, and also we show that the modified K -energy is proper in the space of G_0 -invariant Kähler metrics for the case of toric surfaces which admit the extremal metrics. If possible for time I would also like to talk about an existence theorem for the weak extremal metrics on toric manifolds.

Professor Xi-Ping Zhu- Zhongshan, China

Title: Uniqueness of Solutions to the Ricci Flow

Abstract: The Ricci flow is an evolution system on metrics. For a given metric as initial data, its local existence and uniqueness on compact manifolds were first established by Hamilton. Later on, De Turck gave a simplified proof. In the later of 80's, Shi generalized the local existence result to complete noncompact manifolds. The uniqueness of the solutions to the Ricci flow on complete noncompact manifolds was only recently proved by Chen and the speaker. In this talk, I will sketch the proof to the uniqueness theorem.