目　　錄

中華民國數學會
The Mathematical Society of the Republic of China

一、特殊貢獻獎

Special Contribution Award

Professor Neil Trudinger

學歷 Education：Ph.D., Stanford University, the United States (1966)；B.Sc., University of New England in Armidale, Australia (1962)。

經歷 Experience：Courant Institute, Macquarie University, University of Queensland, Australian National University.

研究領域 Research interests：
Nonlinear elliptic partial differential equations and applications。

推薦理由

早在 1980 年代中期，Trudinger 教授就開始邀請台灣數學家訪問澳洲國立大學的數學研究中心，給了他們良好的發展機會。他在 1993 年前半第一次訪問了中央研究院數學研究所，訪問期間和很多本地數學家有了進一步的接觸之後，認為台澳數學家之間更密切的交流對雙方在研究上應有正面的效果。從此他積極推動雙方在數學上的交流，於 1993 年在 Brisbane 舉行的數學分析的研討會，除了義大利的數學家之外也邀請了台灣的數學家參加，用以催生已舉行過一次的台澳數學分析研討會成為雙邊經常性的研討會。台澳雙邊的數學分析及其應用的研討會自 1997 年第一次在 Brisbane 開辦，每隔叁年輪流在兩地舉行。2000 年 4 月在台灣舉辦的雙邊研討會，也邀請了義大利的學者參加；自 2003 年開始，遂發展成為台澳義三邊研討會，對三方數學家的交流具有積極的推促力。無論在台澳雙邊或台澳義三邊的數學研究的交流上，Trudinger 教授都盡心盡力，起了非常正面的作用。就更寬廣的意義而言，Trudinger 教授在國際數學的社群文化的提昇是有其貢獻的。

生平介紹 MacTutor biography

(Article by: J J O'Connor and E F Robertson, November 2006,
http://www-history.mcs.st-and.ac.uk/Biographies/Trudinger.html,
School of Mathematics and Statistics, University of St Andrews, Scotland.)

Born: 20 June 1942 in Ballarat, Victoria, Austalia

Neil Trudinger was the son of Air Vice-Marshal L Trudinger. He was educated at Richmond High School, New South Wales, then was an undergraduate at the University of New England in Armidale, New South Wales, Australia. He was awarded a B.Sc. in 1962 and then went to the United States to undertake graduate work at Stanford University.

First he proceeded to a Master's degree and the a doctorate under the supervision of David Gilbarg. He was awarded a Ph.D. in 1966 for his thesis *Quasilinear Elliptical Partial Differential Equations in n Variables*. Several papers, based on the work of his dissertation, appeared in 1967. First there is the paper *On the Dirichlet problem for quasilinear uniformly elliptic equations in n variables* in which he extended previous work by his supervisor David Gilbarg, Olga Ladyzhenskaya and others on the solvability of the classical Dirichlet problem in bounded domains for certain second order quasilinear uniformly elliptic equations. Secondly, in the paper *The Dirichlet problem for nonuniformly elliptic equation* he exploited the maximum principle to formulate general conditions for solvability of the Dirichlet problem for certain nonlinear elliptic equations. In another 1967 paper *On Harnack type inequalities and their application to quasilinear elliptic equations* Trudinger examines weak solutions, subsolutions and supersolutions of certain quasilinear second order differential equations. In our list of his 1967 papers we mention finally *On imbeddings into Orlicz spaces and some applications*.

After the award of his doctorate from Stanford University, Trudinger became a Courant Instructor at the Courant Institute of Mathematical Sciences of New York University during the academic year 1966-67. He then returned to

Australia where he was appointed as a lecturer at Macquarie University in 1967. He was promoted to Senior Lecturer before moving, in 1970, to the University of Queensland where he was first appointed as a Reader, then promoted to Professor. In 1973 he moved to the Australian National University where he was Head of the Department of Pure Mathematics until 1979. In 1977 Trudinger published an important book in collaboration with David Gilbarg. The book *Elliptic Partial Differential Equations of Second Order* aimed to present (in the words of the authors):-

> *... the systematic development of the general theory of second order quasilinear elliptic equations and of the linear theory required in the process.*

O John gives an overview of the book as part of his review:-

> *The book is divided into two parts. The first ... is devoted to the linear theory, the second ... to the theory of quasilinear partial differential equations. These 14 chapters are preceded by an Introduction ... which expounds the main ideas and can serve as a guide to the book. The authors restrict themselves mainly to the theory of the Dirichlet problem. With the exception of the prerequisites of basic real analysis and linear algebra the material of this book is almost entirely self-contained. Almost every chapter is concluded by "Notes" (historical and bibliographical remarks, further results) and "Problems". The authors have succeeded admirably in their aims; the book is a real pleasure to read.*

A second edition of this wonderful book appeared in 1983. It had two new chapters one of which examined strong solutions of linear elliptic equations, and the other was on fully nonlinear elliptic equations. A further edition appeared in 1998. In this the authors write:-

> *The theory of nonlinear elliptic second order equations has continued to flourish during the last fifteen years and, in a brief epilogue to this volume, we signal some of the major advances. Although a proper treatment would necessitate at least another monograph, it is our hope that this book, most of whose text is now more than twenty years old, can continue to serve as*

background for these and future developments.

Since our first edition we have become indebted to numerous colleagues, all over the globe. It was particularly pleasant in recent years to make and renew friendships with our Russian colleagues, Olga Ladyzhenskaya, ... who have contributed so much to this area. Sadly, we mourn the passing away in 1996 of Ennio De Giorgi, whose brilliant discovery forty years ago opened the door to higher-dimensional nonlinear theory.

This 1998 edition was reprinted in the "Classics in Mathematics" series by Springer-Verlag in 2001.

In following the editions of the famous text by Gilbarg and Trudinger we have become side-tracked from presenting details of Trudinger's career. In 1981 he was honoured by the Australian Mathematical Society when he became the first recipient of their Australian Mathematical Society Medal:-

... awarded to a member of the Society under the age of 40 years for distinguished research in the mathematical sciences. A significant portion of the research work should have been carried out in Australia.

In 1982 he became Director of the Centre for Mathematical Analysis at ANU, holding this position until 1990. After a short time away from ANU, he returned as Director of the Centre for Mathematics and its Applications in 1991. In 1992 he became Dean of the School of Mathematical Sciences. Trudinger was elected a fellow of the Australian Academy of Science in 1978 and was awarded their Hannan Medal in 1996. He was also honoured with election as a fellow of the Royal Society of London in 1997. On 24 November 1995 three prizes were awarded by the Institut Henri Poincaré and the publisher Gauthier-Villars, with the support of the Centre National de la Recherche Scientifique. Each prize:-

... carries an award of 10 000 FF, [and] recognizes outstanding articles appearing in each of the three sections of the journal Annales de l'Institut Henri Poincaré. In the nonlinear analysis section, the prize goes to N S

Trudinger of the Australian National University for the paper "Isoperimetric inequalities for quermassintegrals".

Today Trudinger coordinates the Applied and Nonlinear Analysis programme at the Australian National University. We end this biography by quoting the "Highlights" from the web page of the programme:-

In recent years, members of the programme have solved major open problems in curvature flow, affine geometry and optimal transportation, using techniques from nonlinear partial differential equations. The first complete proof, for more than two dimensions, of the famous 200 year old Monge problem of mass transfer was found by programme members in 2001.

代表著作三篇 Selected publication

1. Elliptic Partial Differential Equations of Second Order, 1997. (with David Gilbarg)
2. On imbeddings into Orlicz spaces and some applications, J. Math. Mech. 17 (1967): 473–483.
3. The Monge-Ampere equation and its geometric applications, in Lizhen Ji, Peter Li, Richard Schoen, Leon Simon (ed.), Handbook of Geometric Analysis, Volume 1, Higher Education Press, Somerville, USA, 2008 pp. 467-524. (with X-J Wang)

曾獲得之學術獎勵 Honors

1978, elected as a Fellow of the Australian Academy of Science.

1981, first recipient of the Australian Mathematical Society Medal.

1996, awarded the Hannan Medal of the Australian Academy of Science.

1997, elected as a Fellow of the Royal Society of London.

2008, awarded the Leroy P. Steele Prize for Mathematical Exposition by the American Mathematical Society.

2012, elected as a fellow of the American Mathematical Society.

二、學術獎

李瑩英教授

學歷：美國史丹福大學數學系博士(1992)；臺灣大學數學系學士(1985)。

經歷：現任臺灣大學數學系教授(1999-迄今)及系主任(2013/8-迄今)。

曾任臺灣大學數學系副教授(1993-1998)；美國普林斯頓高等研究院(1992-1993)；臺灣大學數學系助教(1985-1988)。

研究領域：辛幾何與黎曼幾何的關係、極小子流形的性質、調和映射的性質。

推薦理由

李瑩英教授是幾何分析的專家，畢業後即回台工作，所有學術研究都是在台灣完成，研究成果在國內外都有極高的評價，因為傑出的研究表現，李瑩英教授得過兩次國科會傑出研究獎，目前也是台大的特聘教授。除了研究以外，李教授對於培育年輕學者也相當付出。學術之餘，也積極參與校內、社會服務工作，對於提升女性科學家的能見度貢獻良多。

研究工作介紹

李瑩英教授的主要研究在於尋找及探討具有特殊性質的自然代表元。結合黎曼結構(Riemannian structure)及辛結構(Symplectic structure)，她探討 Lagrangian 極小子流形，是國際上最早從事這方面研究的學者之一。李瑩英最初開始研究 Lagrangian 極小子流形的動機，是著眼於其具有比一般高餘維極小子流形更好的性質，並與複子流形有一些共通性，因此是所在同調類(homology class)的自然代表元。李瑩英博士畢業後的第一篇論文發表在 Duke Journal [1]，她舉反例說明 Symplectic maps 非常重要的 C0 close 性質，當改考慮其函數圖形，即為

Lagrangian submanifolds 時，這樣的封閉性質不再成立。之後，透過調和映射技巧，她證明在某些狀況下，極小曲面一定是 Lagrangian，從而得到 Lagrangian 極小曲面最早的存在性結果，由此更推論出該同倫類 (homotopy class) 中極小曲面的唯一性 [2]。李瑩英另外得到以下重要結果 : 如果在一個負曲率的 Kähler-Einstein surface (N, g)，存在 Lagrangian 極小曲面 L (可能具 branch point)，則任何可連續變動到 g 的 Kähler-Einstein 距離 h，必定存在從 L 變動來的 Lagrangian 極小曲面，這也是到目前為止唯一能處理這類型大擾動的結果 [3]。李瑩英的這些工作分別發表在 Comm. Anal. Geom. 及 J. Diff. Geom.，她並先後得到 Alfred P. Sloan Doctoral Dissertation Fellowship 及 1998-2000 的國科會傑出獎的榮譽。

Lagrangian 極小子流形在當大空間是 Calabi-Yau 流形時，被稱為 special Lagrangian，與弦論有很密切的關聯，Strominger-Yau-Zaslow 在 1997 年更提出可以用 Calabi-Yau 流形上面 special Lagrangian tori 的模空間來構造其鏡流形的猜想。這個猜想引起數學家很大的興趣，並激發了許多後續的研究，然而整體而言我們對此的瞭解依然十分有限，這個方向還有許多重要的基礎問題尚待克服及解決。例如對於在非歐氏空間中 special Lagrangian/Lagrangian minimal submanifolds 的存在性，至今還是沒什麼好的例子及定理。李瑩英透過 singular perturbation 的方法得到正則化 special Lagrangian 之 double points 的重要結果 [4]，她證明我們可以得到一簇 imbedded special Lagrangians 光滑收斂到具自交點的 special Lagrangian。這個結果一方面可視為是關於 special Lagrangians 的存在性定理，另一方面可視為對 special Lagrangians 模空間最簡單邊界點的研究。李教授使用各種不同方法及技巧研究這些課題及延伸問題，她一開始主要是利用調和映射理論，後來逐漸轉向偏微分方程的非線性分析及幾何測度論，近年來專注於「均曲率流」及 singular perturbation 這兩個重要方向。

均曲率流是將一個子流形沿著其均曲率方向變動，這是讓子流形面積減少的最有效方式，若是均曲率流的光滑解長時間存在而且收斂，則其極限為極小子流形/variety。當初始子流形是在 Kähler-Einstein 流形中的 Lagrangian 子流形時，均曲率流的光滑解會仍然滿足 Lagrangian 的條件，因此這可能是構造 Lagrangian 極小子流形或 special Lagrangian 的有效方式。透過偏微分方程理論，我們可以得到均曲率流短時間的存在性(光滑解)，但很不幸地，在一段時間後這個解可能會產生奇異點。李瑩英首先嘗試構造均曲率流的 Lagrangia 弱解，弱解若能收斂，則極限雖然有奇異點，依然會是 minimal Lagrangian/special Lagrangian。如果不要求滿足 Lagrangian 條件，均曲流的弱解有幾個不同的構造方式，在餘維為 1 時有

Evan-Spruck 及 Chen-Giga-Goto 用 level set 概念構造 viscosity solution，在任何餘維，則有 Brakke 用幾何測度論構造的 Brakke Flow。然而，李瑩英後來發現若沒有加額外條件，一般情況不可能有 Lagrangian 弱解。這就必須提到 Schoen 及 Wolfson 的工作，他們用幾何測度論的方法來尋找 minimal Lagrangian/ special Lagrangian，在具相同邊界或同調類中的 Lagrangian varieties，找出面積最小的。這個面積最小的 Lagrangian，總是可以找得到，被稱為 Lagragian minimizer，然而由於它是限制在特殊條件下找出來的，因此不見得是對所有變動的極小子流形/variety。Lagrangian minimizer 的正則性是主要關鍵，Schoen 及 Wolfson 花了將近 10 年處理這個問題。他們發現 2 維 Lagrangian minimizer 的奇異點只有 branch point 及 cone point，同時 Einstein 曲面中的 Lagrangian minimizer，若沒有 cone point，則可證得是極小曲面。可惜經過很多努力後，Wolfson 發現 cone point 並無法排除，確實可能發生。對一個具 cone point 的 Lagrangian minimizer，我們不可能定義出均曲率流的 Lagrangian 弱解，因為減少面積及保持 Lagrangian 條件，這兩個目標無法同時滿足。

構造弱解行不通，李瑩英轉為分析均曲率流的奇異點。透過將奇異點附近不斷放大，我們可以得到歐氏空間中均曲率流的自同構解 (self-similar solution)，因此對自同構解的研究，可以說是處理均曲率流解之奇異點的重要鑰匙。李瑩英分別與哥倫比亞大學的王慕道，牛津大學的 Joyce，托雷多大學的崔茂培，以及她的學生李國瑋、呂揚凱，在這方向合作取得很多重要結果，並發表多篇論文在 J. Diff. Geom. 及 Trans. Amer. Math. Soc.。

在 2 維 Lagrangian minimizer 的 cone point 附近不斷放大，其極限是歐氏空間中的一個錐體，我們將其稱為 SW-cone。這些 cone 是在 Lagrangian 擾動下的面積穩定解，所以他們是 Hamiltonian stationary Lagrangian。李瑩英及王慕道構造出以 SW-cone 為模型，包含自縮解及擴張解的自同構解，同時對任何一個 SW-cone，都找到另一個相應的 SW-cone，以及從時間負無窮，到正無窮的均曲率流 Lagrangian 弱解 (Brakke flow sense)，使其在 $t<0$ 時是 Hamiltonian stationary Lagrangian 自縮解，在 $t=0$ 是這兩個 SW-cone，在 $t>0$ 時是 Hamiltonian stationary Lagrangian 擴張解，也就是他們能透過這個方式光滑化具奇異點的兩個 SW-cone [5]。SW-cone 的形式由兩個互質的自然數 $p>q$ 決定，Schoen 及 Wolfson 曾提出以下猜想：只有 (2,1) SW-cone 是 Lagrangian volume minimizing，亦即只有 (2,1) SW-cone 可作為 Lagrangian minimizer cone point 的模型。李瑩英及王慕道證明 Schoen 及 Wolfson 的猜想在微觀的情況是對的，這是數學家第一次能

將 (2,1) SW-cone 與其他 (p,q) SW-cone 區隔。之後，他們又將以上 2 維的結果推廣到任何維度 [6]，同時 Castro-Lerma 證明所有 2 維的 Hamiltonian stationary Lagrangian 自同構解，局部都必須形如李瑩英及王慕道所構造的例子。

另外，李瑩英與 Joyce 及崔茂培合作的工作也非常重要。在所有維度，任何兩個相交於原點且滿足一個必要條件的兩個 Lagrangian 平面，他們都可以構造出漸近於這兩個平面的 Lagrangian 擴張解，其中還包括 Lagrangian 角度任意小，可以任意接近 special Lagrangian (Lagrangian 角度為 0) 的例子[7]，這些可以做為對 Lagrangian 均曲率流之自交點作 surgery 的模型，Lotay-Neves 後來進一步證明具有相同漸近行為的 Lagrangian 擴張解，基本上一定必須是李瑩英他們所構造的例子。由以上的 Lagrangian 擴張解，李瑩英及其合作者還構造 Lagrangian 角度可以任意小的 translating solution。Translating solution 是均曲率流另一個重要的孤粒子解，它在均曲率流之下只是沿著一個方向平移，形狀不會改變。這些例子大出數學家意料之外，原先 Neves 一直嘗試證明在 2 維 Lagrangian 角度小的 translating solution 必定是平面。李瑩英他們構造的 translating solution，和瑞奇流中的 Cigar solution 類似，數學家急欲排除它們可以做為均曲率流(瑞奇流)奇異點附近 blow-up 的可能性，否則我們將很難對解的行為有所掌控。在瑞奇流，這個可能性是直到 Perelman 解決 Poincare conjecture 的證明時才被排除。在同篇文章中，李瑩英、Joyce 及崔茂培還 建構許多其它例子及性質，可說統整及推廣了這方面所有已知的結果。在均曲率流方面，李瑩英還和其學生李國瑋，推廣了王慕道及王慕道和崔茂培的工作，證明在某些條件下，均曲率流的長時間存在性及收斂性 [8]。另外，她和她的另一位學生呂楊凱，則推廣 Colding-Minicozzi 在餘維 1 對自縮解的穩定性研究到高餘維的情況 [9]。

當限制在 Lagrangian 子流形時，Hamiltonian 變動下的面積穩定解，稱為 Hamiltonian stationary Lagrangian，它們是 special Lagrangian/minimal Lagrangian 的推廣，也是 Schoen-Wolfson 用幾何測度論方法時必須處理的對象，另外二維不可壓縮之彈性力學模型亦與此相關。然而，除了在歐氏空間或某些特別的均勻空間，在一般 Kähler 流形我們並不知道 Hamiltonian stationary Lagrangian 的光滑例子。前述 Lagrangian minimizer 是 Hamiltonian stationary Lagrangian，但是它們有奇異點。李瑩英、Joyce 及 Schoen 不只在任何緊緻的 Kähler 流形，證得許多光滑 Hamiltonian stationary Lagrangian 的存在性，甚至對緊緻辛流形上任何一個自恰 (compatible) 距離，也都得到相同的結果 [10]。他們使用的是 singular perturbation 的技巧，並且很具巧思地將一個無限維的問題化簡成有限維的情況。

但雖然找到廣泛的存在性，我們並不知道這些例子發生在何處。在一篇後續的文章，李瑩英更進一步找到一個在 Kähler 流形中的條件，保證在該點附近及指定標架，我們可以找到一簇彼此不相交的 imbedded Hamiltonian stationary Lagrangian tori [11]。這幾年的傑出表現，讓李瑩英再次獲得國科會傑出研究獎 (2011~2014)，以及獲聘為台灣大學的特聘教授 (2012~2015)。

除了以上工作，李瑩英和王慕道還合作研究 minimal graph 的穩定性，這在餘維是 1 的情況總是對的，但在高餘維則有反例，他們在高餘維找到能保證穩定性的條件，而且這條件能完全涵蓋餘維為 1 的情況。早期她亦與吳德琪及王藹農合作多篇關於極小流形及調和映射的文章。

李瑩英教授的部分著作

[1] Y.I. Lee, The Limit of Lagrangian Surfaces in R^4 , Duke Math. Journal, vol.71 (1993), p.629-631.

[2] Y.I. Lee, Lagrangian Minimal Surfaces in Kahler-Einstein Surfaces of Negative Scalar Curvature, Comm. Anal. Geom., vol.2 (1994), p.579-592.

[3] Y.I. Lee, The Deformation of Lagrangian Minimal Surfaces in Kahler-Einstein Surfaces, J. Diff. Geom., vol.50 (1998), p.299-330.

[4] Y.I. Lee, Embedded Special Lagrangian Submanifolds in Calabi-Yau Manifolds, Comm. Anal. Geom., vol.11 (2003), p.391-423.

[5] Y.I. Lee and M.T. Wang, Hamiltonian Stationary Shrinkers and Expanders for Lagrangian Mean Curvature Flow, J. Diff. Geom., vol.83 (2009), p.27-42.

[6] Y.I. Lee and M.T. Wang, Hamiltonian Stationary Cones and Self-similar Solutions in Higher Dimension, Trans. Amer. Math. Soc., vol.362 (2010), p. 1491-1503.

[7] D. Joyce, Y.I. Lee and M.P. Tsui, Self-similar Solutions and Translating Solutions for Lagrangian Mean Curvature Flow, J. Diff. Geom., vol.84 (2010), p.127-161.

[8] K.W. Lee and Y.I. Lee, Mean Curvature Flow of the Graphs of Maps Between Compact Manifolds, Trans. Amer. Math. Soc., vol.363 (2011), p.5745-5759.

[9] Y.I. Lee and Y.K. Lue, The Stability of Self-shrinkers of Mean Curvature Flow in Higher Co-dimension, to appear in Trans. Amer. Math. Soc.

(2013).
[10] D. Joyce, Y.I. Lee and R. Schoen, On the Existence of Hamiltonian Stationary Lagrangian Submanifolds in Symplectic Manifolds, Amer. J. Math., vol.133 (2011), p.1067-1092.
[11] Y.I. Lee, The Existence of Hamiltonian Stationary Lagrangian Tori in Kahler Manifolds of Any Dimension, Calc. Var., vol.45 (2012), p.231-251.

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2. Y.I. Lee and M.T. Wang, Hamiltonian Stationary Shrinkers and Expanders for Lagrangian Mean Curvature flow, J. Diff. Geom., vol.83 (2009), p.27-42.
3. Y.I. Lee, The Deformation of Lagrangian Minimal Surfaces in Kahler-Einstein Surfaces, J. Diff. Geom., vol.50 (1998), p.299-330.

曾獲得之學術獎勵

2012- 2015	國立臺灣大學特聘教授
2011- 2014	行政院國科會傑出研究獎
2013	行政院國科會數學學門共同召集人
2012	行政院國科會數學學門審議委員
2011 及 2012	教育部學術審議會委員
2008- 2009	北區理論科學研究中心榮譽研究員
1998- 2000	行政院國科會傑出研究獎
1999- 2000	國立臺灣大學理學院青年學人獎
1991- 1992	美國 Alfred P. Sloan 博士論文獎

其他

2012-2013	中華民國數學學會學術委員
2010-2013	國家理論中心數學組學術委員
2006- 2009	台大數學科學中心執行委員
2004- 2008	國家理論中心數學組學術委員

外審報告節錄

『Yng-Ing Lee has been extremely productive in the last five or more year. The series of work [17], [22], [23] provide rich classes of existences of Hamiltonian Stationary Lagrangia Submanifolds in Symplectic and Kahler Manifolds. Her recent series of papers [24], [25], [26], [27] (joint with different coauthors) made a penetrating study of constant mean curvature hypersurfaces. Her works are characterized by constructions of concrete examples which indicates deep understanding of hard core topics which are at the frontier of research …』

『Professor Lee is a leading expert on Riemannian geometry and submanifold theory. Her thesis ``The deformation of Lagrangian minimal surfaces in Kähler-Einstein surfaces" proved that a Lagrangian minimal surface persists under the deformation of Kähler-Einstein metrics. This is one of the most important results on the existence of minimal Lagrangians. In the past few years, she has been working on Lagrangian mean curvature flows. Her joint work with Mu-Tao Wang entitled ``Hamiltonian stationary shrinkers and expanders for Lagrangian mean curvature flows" produced the first example of eternal weak solutions of Lagrangian mean curvature flows and gave the strongest evidence why a well-known conjecture of Schoen-Wolfson on Lagrangian minimizer should hold. Her joint work with Dominic Joyce and Mao-Pei Tsui generalized the constructions in the previous work and constructed many higher-dimensional self-similar solutions and translating soliton of the Lagrangian mean curvature flow. These results play an indispensible role in the eventual characterizing the singularity profile of the flow. In conclusion, Professor Lee’s works in special Lagrangian submanifolds and mean curvature flows are pioneering and well-recognized by experts in the field. She is certainly one of the very top differential geometers in Taiwan …』

三、青年數學家獎

班榮超教授

學歷：交通大學應用數學系博士(2001)、碩士(1999)；清華大學數學系學士(1997)。

經歷：現任東華大學應用數學系副教授(2010-迄今)。
曾任東華大學應用數學系助理教授(2005-2010)；台大數學科學中心合作訪問學者(2008-2009)；國家理論科學研究中心數學組博士後研究員 (2001-2005)。

研究領域：遍歷理論、微分方程、隨機微分方程、網格動態系統。

推薦理由

班教授這幾年在動態系統上的研究非常傑出，許多文章已發表在國際頂尖數學期刊，包括 Memoirs of the American Mathematical Society, Transaction of American Mathematical Society 以及 Journal of Differential Equations 等著名雜誌。他的研究工作獲得國科會理論中心的肯定授予『年輕理論學者獎』以及東華大學『99 年度特聘教授』等榮譽，這些都可以證明班教授是國內動態系統領域的頂尖人才。值得一提的是，國內這幾年的動態系統研討會中，班教授都擔任主辦人以及大會講員，可看出他在國內動態系統領域有著一定的影響力和貢獻。

研究工作介紹

2-dimensional dynamical zeta function ([2]): 網格動態系統的研究中其中最重要的莫過於 dynamical zeta function 的相關探討。以動態系統的眼光來說，此類函數不僅可以深刻刻畫系統中週期點的分配狀況，更重要的是它是兩類系統是否會強等價的一個重要指標。以數論眼光來說，它是眾所皆知黎曼猜想的主要核心。我們成功的建立二維 zeta function 的形式化概念並引進大量代數、數論及線性代數的技巧，最後完成了二維 dynamical zeta function 的正式定義，並且利用了 D. Lind

在數論及代數的工具證明了此函數是有理函數的無窮乘積，解決了著名的 Lind 猜想。這一類的工具和技巧已經悄悄為二維的網格動態系統開啟了一扇窗，許多以前無法考慮的問題，這幾年已經紛紛解決。

Multi-Layers Cellular Neural Networks ([1], [5]): 2006 年展開了對於 MCNN 的研究，其中最令人興奮的是結合了兩個截然不同的領域，微分方程及符號動力學來進行此類研究。利用符號動態學的觀點來研究此類方程的解結構，成功的分類了所有的 MCNN 方程解結構，用分類定理、有限平移等價、強平移等價和平移等價等等價系統把 MCNN 解做最完整的分類，這類方法相信是目前相關研究的最新研究和結果。並且這項研究中所建立的技巧也在今年發現可以用來研究多層網格方程耦合的問題，就目前的了解，用符號動態學的觀點來研究這類方程的相關方法仍非常少見。

Hausdorff dimension non-conformal repellers ([3], [4]): 考慮 Averaged conformal repeller 及其 Hausdorff dimension 的估計，利用熱力學數學原理技巧來研究關於此 non-repeller 的碎型維度並探討維度公式隨著隨機擾動的穩定性。成功的推廣 D. Ruelle 於 1976 年對 conformal repellers 的維度公式並證明此公式穩定於隨機擾動。另外對於 Sofic 系統我們研究對於拓撲壓的稠密性，可以得到此系統的拓撲壓會稠密於一個有限實數區間，並且對任一 Sofic 系統，都可以找到一個子系統，使得子系統所產生的拓撲壓可以無窮靠近此區間的某一實數值，成功推廣了早期對於 Markov 系統中拓撲熵的等價定理。

1. J. -C. Ban, C. -H. Chang and S.-S. Lin, On the structure of multi-layer cellular neural networks, J. Differential Equations (2012) vol.252, no.8, 4563-4597.
2. J. -C. Ban, W. -G. Hu, S. -S. Lin, and Y. -H. Lin, Zeta functions for two-dimensional shifts of finite type, Memoirs of the American Mathematical Society (2013) vol.221, no 1037.
3. J. -C. Ban, Y. -L. Cao and H. -Y. Hu, Hausdorff dimension and variational principle for repellers, Trans. Amer. Math. Soc.(2010) vol.362, no.2, 727-751.
4. J. -C. Ban, Y. -L. Cao and Y. Zhao, The Hausdorff dimension of averaged conformal repellers under random perturbations, Nonlinearity (2009) vol.22, 2405-2416.
5. J. -C. Ban, C. -H. Chang, S. -S. Lin and Y. -H. Lin, Spatial complicity in

multi-layer cellular neural networks, J. Differential Equations (2008) vol.246 No 2, 552-580.

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1. J. -C. Ban, Zeta functions for two-dimensional shifts of finite type, Memoirs of the Amer. Math. Soc. (2013) vol.221, no.1037. (with W. –G. Hu, S. –S. Lin and Y. –H. Lin)
2. J. –C. Ban, On the structure of multi-layer cellular neural networks, J. Differential Equations. (2012) vol.252, no.8, 4563-4597. (with C. -H. Chang and S. –S. Lin)
3. J. –C. Ban, Hausdorff dimension and variational principle for repellers, Trans. Amer. Math. Soc. (2010) vol.362, no.2, 727-751. (with Y. –L. Cao and H. Hu)

曾獲得之學術獎勵

2013　獲頒「東華學術獎」
2013　國科會理論科學研究中心頒授「中心科學家」
2010　國科會特殊優秀人才獎勵
2011　國科會特殊優秀人才獎勵
2012　國科會特殊優秀人才獎勵
2010　國立東華大學特聘教授
2010~2011　99 年度理論中心年輕理論學者獎
2009　98 年度國立東華大學新進教師學術獎

外審報告節錄

『... 評述其中的三篇代表作(他的工作很多，這裡只限於三篇)。關於 2D Shifts 的 Zeta function 的文章，是一個大型的工作。我知道一些與此有關的比如 Williams 的早期工作，是很難，很硬的。班榮超教授的工作引進了大量代數、數論、線性代數的技巧，解決了著名的 Lind 猜想，我認為是一個很有份量的工作。關於 Neural Network 的文章，班榮超就受將符號動力學運用到微分方程，解決了 MCNN 的完全分類問題，也是一個很重要的工作。第三個關於 Non-conformal repellers 的 Hausdorff 維數的工作則是領域很不相同、距離很遠的一個工作。班榮超教授利用熱力學的原理，得到了 Non-conformal repellers 的 Hausdorff 維數和 box 維數的

上界，結果很重要很漂亮，顯示了很好的分析功底。短短幾年，連續做出這麼多不同的、重要的工作，是很不尋常的。我很驚訝班榮超教授表現出來的多方面超群的能力和才華 …』

『… Subshifts of finite type is one of the most classic and important examples of symbolic dynamical systems, and has been extensively studied using dynamical zeta function. However, not much has been done for multi-dimensional subshifts of finite type. Dr. Jung-Chao Ban and his collaborators provided an in-depth analysis for such systems. It is a very solid work on a very meaningful model, and has been published on a top journal Memoirs of Amer. Math. Soc.

.... In one of his representative works, published on J. Diff. Equations, he and his collaborators study the solution space for multi-layer cellular neural networks and projected subspaces corresponding to different patterns. They discovered that relations between these subspaces can be formulated in terms of a mechanism in symbolic dynamics called sofic shift. This is an original and insightful discovery that is quite useful in the study of multi-dimensional cellular neural networks.

... Dr. Jung-Chao Ban and his collaborators studied Hausdorff dimensions of repellers for a quite general class of maps. They obtained pretty good estimates that generalize or coincide prior works, some of which are considerably well-known. Their results were published on Trans. Amer. Math. Soc. and Nonlinearity, and have received recognition from leading experts in the field.

In sum, Dr. Jung-Chao Ban has published several quality papers on prestigious journals in the field of dynamical systems. He has a broad range of interests, and has provided insightful contributions to several problems related to pattern generations, multi-fractals, neural networks, cellular automata, among others. He not only collaborates with many well-established scholars in the world, but also with younger generations in Taiwan. He actively engages in local and international research activities, organizes several dynamical systems workshops and young dynamics days at NCTS in recent years ...』

四、傑出博士論文獎

銀牌獎

關汝琳 博士

論文：利用邊界測量重建彈性物體中的未知物

Reconstruction of Unknown Inclusions in an Elastic Medium by Boundary Measurements.

論文指導教授：王振男教授。

學歷：臺灣大學數學所博士(2008/9-2013/6)、碩士(2005/9-2008/6)；國立台北教育大學數學暨資訊教育學系學士(2001/9-2005/6)。

經歷：Post doctor, National Taiwan University (2013-now)；Junior Specialist, Department of Mathematics, University of California, Irvine, USA.(2012/6-2013/3) (under the Graduate Student Study Aboard Program supported by National Science Council)。

Visits：Winter school of Institute for Mathematical Sciences' program at National University of Singapore, Singapore (2011/12/14–2012/1/13) ；Summer school of Fields Institute for Research in Mathematical Sciences, Toronto, Canada (2012/7/16-25)；Visitor, University of Washington, USA (2012/12/2-8)

研究興趣：Inverse problems for partial differential equations.

論文工作介紹

My research interest is on inverse problems for partial differential equations, especially non-invasive methods of gaining information within subjects. In my paper, the inverse problem of determining the shapes of inclusions in an elastic body is considered. We use Ikehata's enclosure method to reconstruct penetrable unknown inclusions in a plane elastic body in time-harmonic waves. Complex geometrical optics solutions with complex polynomial phases are adopted as the probing utility. In a situation similar to ours, due to the presence of a zeroth order term in the equation, some technical assumptions need to be assumed in early researches. In a recent work of Sini and Yoshida, they succeeded in abandoning these assumptions by using a different idea to obtain a crucial estimate. In particular the boundaries of the inclusions need only to be Lipschitz. In this work we apply the same idea to our model. It's interesting that, with more careful treatment, we find the boundaries of the inclusions can in fact be assumed to be only continuous.

外審報告節錄

『關汝琳之博士論文是研究用邊界測量重建彈性物體中的未知物 (Reconstruction of Unknown Inclusions in an Elastic Medium by Boundary Measurements) 是屬於偏微分方程的反問題。論文的主要想法是建立在 Ikehata 於 1998 所提的 enclosure-type method，從她所整理的論文中可見她對於這方法已經掌握的非常熟練。在論文最後提到應用這方法到anisotropic 材質的Maxwell方程，這是一個實際且重要的問題，吾人將樂見其成功。關汝琳之博士論文能夠以單一作者發表在 Journal of Differential Equations 是難能可貴。』

『The main point of this dissertation is to apply the method in the recent paper by Yoshida-Sini to yield a simple proof. It requires some efforts to make this work and it is a good dissertation. It also has been emphasized that this is a single-authored paper and published in a reputable journal. ...』

五、傑出碩士論文獎

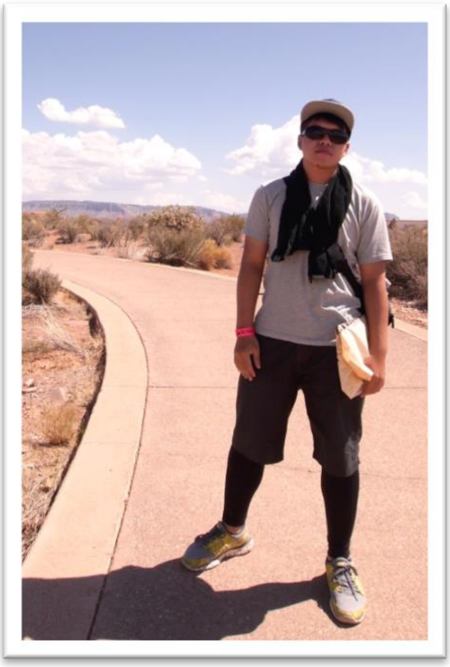
銀牌獎

吳卓翰 碩士

論文：時空有限元素法解在曲面上之傳遞方程式之應用

Space-time Finite Element for Transport Equation on Surface Using Conformal Parameterization.

論文指導教授：吳金典教授。



學歷：交通大學應用數學所碩士(2011/9-2013/7)；逢甲大學應用數學系(2006/9-2007/7) 轉學高雄大學應用數學系學士(2007/9-2010/7)。

經歷：今年七月從研究所畢業後，目前服役中。

研究興趣：科學計算, 組合數學。

論文工作介紹

我們對於傳遞方程式提出了一個無反射邊界條件之數值處理，並使用時空有限元素法離散之，使其波可以順利的離開計算空間。並且將其方法應用在淺水波方程上，更進一步的我們使用了共行參數化的技術，使得此方法可以使用在解曲面上之淺水波方程，也得到了很不錯的效果，並且模擬了水在紅血球上流動的情況，以及人臉上眼淚的流動。

外審報告節錄

『In the first part of his thesis (Sections 1-4), Mr. Wu gave a survey of the equations and existing methods. In particular, he briefly derived the Transport Equations (TE) and Shallow Water Equations (SWE), which were followed by a brief introduction to finite element methods and space-time finite element methods for TE and SWE. In geometric computation, he outlined some basic ideas about conformal parameterization.

In the second part of his thesis (Sections 5 and 6), Mr. Wu proposed a Non-Reflective Bound Condition (NRBC) treatment for one- and two-dimensional TE by introducing artificial ghost points on the extended virtual domain with extrapolations. He then conducted numerical experiments to test the NRBC on three TE problems with one-dimensional and two-dimensional square and disk domain for convergence rates. Mr. Wu then tested the NRBC on two-dimensional SWE over a disk domain and found that no artificial scatters and wiggles in the computations. Finally, by parameterizing a surface (e.g. blood cell and human face) by conformal mapping, he solved the SWE over these surfaces on the parameterized domains to simulate a droplet on a blood cell and tear shedding.

This is an interesting work completed by applying various numerical techniques. Mr. Wu has done a good job. ...』

『... (1) The topic itself, by using differential geometric ideas of nonlinear diffusion for conformal mapping and then compute the PDEs on a plane or sphere, is interesting.

(2) The student, Mr. Wu, has done a substantial amount of work in developing a spatio-temporal finite-element package to compute some sample PDEs such as the transport equation and a shallow water equation. The amount, quality and caliber of the work has substantially exceeded the norm of an ordinary master's thesis. ...』