目　　錄

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

一、「特殊貢獻獎」姚任之教授

學歷：美國史丹佛大學運籌學博士(1990)。

經歷：現任高雄醫學大學教授。曾任元智大學工業工程系副教授，國立中山大學應用數學系副教授、教授、系主任，國立中山大學理學院院長，國科會數學計畫審議委員會委員。曾任國際數種期刊編輯，例如 Journal of Optimization Theory and Applications。於 2007-2010 間擔任台灣數學雜誌主編。

研究興趣： Generalized convexity and generalized monotonicity, Vector optimization, Optimal control, Fixed point theory, Variational inequalities, Complementarity problems, and Equilibrium problems.

推薦理由：張鎮華教授撰寫

姚任之教授學養俱佳、處事公正，歷年來曾經擔任十餘種國際期刊之編輯及數十種國際期刊之論文審查者。他自二零零七年元月至二零一零年十二月擔任中華民國數學會發行之台灣數學期刊主編，嗣後續擔任執行編輯至今。姚教授在任期間，貢獻良多：首先，為提升論文品質，大幅提高退稿率，使台灣數學期刊的 SCI 影響因子倍增，在 JCR 的排名亦由中下段提昇到中段；其次，將台灣數學期刊由每年發行六期增加到九期，增進期刊能見度；最後，也是十分重要的是，開發台灣數學期刊數位化系統，完成線上投稿建構，達到一流國際期刊的作業方式，吸引國內外學者投稿和引用論文。

再者，姚教授行政經驗豐富，研究成果豐碩，堪為年輕學者表率。其多年來為台灣數學界和台灣數學期刊貢獻心力，繼往開來，將台灣數學期刊推到一個新的立足點，可謂本會後續再提昇台灣數學期刊的典範。本會特頒特殊貢獻獎以表彰其對本會之卓越貢獻。

二、「學術獎」賴明治教授

學歷：中興大學應數系學士（1988 年）、清華大學應數所碩士（1990 年）、紐約大學 Courant Institute of Mathematical Sciences 數學博士（1998 年）。

經歷：杜克大學博士後（1998/09－1999/07 年）、中正大學數學系助理教授（1999/08－2002/07）、交通大學應數系副教授（2002/08－2005/07）、教授（2005/08－迄今），並於 2007 年 8 月至 2009 年 7 月擔任應數系系主任，目前為交通大學理學院數學建模與科學計算研究中心主任。曾獲 Kurt O. Friedrichs 傑出畢業論文獎、國科會傑出獎、國科會傑出學者研究計畫，曾擔任數學推動中心審議委員，目前擔任國科會計畫審議委員、國家理論科學研究中心科學家、及 SIAM 東亞分會副主席。

研究領域：有界面之流體問題模型與計算，橢圓偏微分方程在非直角座標系之快速算法，目前對偏微分方程在三維變動曲面的數值方法及離散曲面幾何量之估計感興趣。

推薦理由：陳宜良教授撰寫

賴明治教授在計算流體力學中的沉浸邊界法與沉浸介面法的改進與應用有深入的研究，成果豐碩。沉浸邊界法是 NYU 教授 Charles Perkin 在 1970-80 年代所發展的流彈藕合的計算方法，用來模擬心臟血流。這個方法被廣泛地用在各種多相流，流固藕合的問題。賴教授在此方法的框架下，進行許多重要改進的工作，包括: 提出在移動界面時維持其上網格點均勻分布的方法；設計移動界面上的傳輸擴散方程的守恆格式；提出界面運動時維持面積不變的計算方法；提出沉浸邊界法在一維情況下的嚴格誤差分析。這些工作對沉浸邊界法均有重要的改進。在應用上，他將沉浸邊界/界面法成功應用到可溶與不可溶的界面活性劑的數值模擬、移動接觸線的問題、不可延展的水泡與流體的交互作用問題，以及二維乾泡沫的數值模擬。而在其中的後者成功的僅以 Navier-Stokes 模型驗證了 Von Neumann 定律，有別於前人驗證此定律時需用 Laplace-Yours 條件與 Plateau 規則。

我們對賴明治教授在應用面向的廣度，以及對沉浸邊界法改進的重要貢獻，給予高度的評價。

研究工作介紹

我於 1998 年獲得紐約大學 Courant Institute 之數學博士學位，師承美國國家科學院院士 Charles S. Peskin 教授，主要的研究內容為沉浸邊界法在計算流體力學上面的數值分析與應用。畢業之後，我便到杜克大學擔任博士後，在此期間，我有幸認識了 Tom Beale 及在 NC-State 的 Zhilin Li 教授，後者便成為我的長期合作者，而 Peskin 與 Beale 教授對我日後之教學及研究態度影響最鉅。過去 12 年來，我的研究工作主要涵蓋了流體力學沉浸邊界/界面法之模型與計算，及 Poisson 方程在非直角座標系統之快速算法。下面提到的成果是我認為較有趣或常被他人所引用的工作。

1. 流固耦合的數學模型及數值方法：我們提出把固體界面當成一個奇異力場的來源，此奇異力場為未知，角色如同在界面之 Lagrange multiplier，然若以簡單的 Hook's law 來取代奇異力場，問題便簡化很多，且要計算拖力或升力等物理量，僅要將力場加總便可，大量省去繁複手續，也可處理複雜固體界面，方法簡單且應用性相當廣。上述方法乃屬顯式方法，time step 要求較為嚴苛，2007 年我與清大動機系林昭安教授改善了上述結果，在 projection 之方法過程中改以隱式去求奇異力場，雖要負擔解一小型奇異力場的矩陣方程，卻克服了 time step 太小的困難，其數值結果相當不錯，這篇文章目前為 Computers & Fluids 雜誌的 Most Cited Articles 的 Top 8！

2. 有界面活性劑之兩相流問題：在有界面的兩相流體計算上面，我們將界面摻入活性劑(surfactant)，成功地用參數式導出活性劑分佈在界面的演化方程式，並巧妙地指出他人文獻中可以簡化之處，再應用導出的方程式配合沉浸邊界法去模擬有界面活性劑之兩相流問題，成功地設計一套活性劑在界面之質量的數值守恆方法，並且嚴格證明其守恆性，目前已推廣其結果至可溶性之界面活性劑問題及移動接觸線的問題上面。

3. 二維泡沫問題之數值模擬：在 1952 年，von Neumann 證明了二維單一多邊形（邊長為圓弧）的 gas bubble 的面積變化率僅與其邊的數目有關。在過去的文獻中，對二維 dry foam 的數值模擬皆是在一些必要的假設下進行，如必須滿足 Laplace-Young 條件及 Plateau 規則，使對二維 dry foam 的問題，簡化成僅以壓力為未知變數。最近，我們成功地建立完全以流體力學為數學模型並考慮 gas diffusion 的二維 dry foam 的模擬，就我們所知，這是第一篇完全以 Navier-Stokes 方程為模型的泡沫模擬，我們不僅成功地驗證 von Neumann law，而且也驗證了 foam coarsening 的物理現象。目前，我們正在推廣三維的數值結果，並打算驗證三維的 von Neumann law（已由普林斯頓高等研究院的美國國家科學院院士 Robert MacPherson 與 David Srolovitz 於 2007 年導出，並發表於 Nature 期刊中），並嘗試進行三維 dry foam 的數值模擬。

4. 橢圓偏微分方程在非直角座標系之快速算法：我們針對 Poisson 方程在非直角座標（極座標、圓柱座標、球座標及橢圓座標等）的數值解法提供了一些簡

單且有效率的有限差分技巧。運用解的傅立葉級數展開，我們可以將問題的維度降低一維。巧妙地安排離散網格點及善用傅立葉係數的對稱條件，座標奇異點的困難可以順利被克服，而且導致的線性方程組也可有快速算法運用其上。

最後，在此感謝我的所有合作者及學生，特別是 Charlie Peskin, Tom Beale, Zhilin Li, Huaxiong Huang, Yongsam Kim, 林昭安, 及曾昱豪。

外審報告節錄

“Dr. Lai's research is on biomedical fluids, numerical PDEs, Bose-Einstein condensates, interface problems, and modeling. He is a productive researcher, both qualitatively and quantitatively. Many of his papers are published in reputed journals such as J. Comp. Phys., SIAM's, Phys. Review, etc.”

“He is able to provide leadership in Taiwan's mathematical modeling research by establishing the Institute for Mathematical Modeling and Scientific Computation at NCTU. He has also interacted with and directed many master-degree graduate students. Though there may not seem to be grandiose results, his papers contain many interesting problems with ingenious insights, ideas and solutions. Overall, both the quality and quantity of his research are high. His leadership in mathematical modeling and scientific computation have tangible impact to Taiwan's mathematical and scientific communities. He merits the Academic Excellence Award of the Mathematical Society of the R.O.C.”

三、「青年數學家獎」夏俊雄教授

學歷：台灣大學數學系學士及碩士、美國印第安那大學數學博士(2006)。
經歷：伊利諾大學芝加哥校區博士後研究員(2006-2008)、台灣大學數學系助理教授 (2008-目前)。曾獲建大文教基金會年輕金玉學者(2008)。
研究興趣：偏微分方程式、分歧與相變理論、地球物理中的流體問題。

推薦理由：陳俊全教授撰寫

夏教授的研究方向非常廣，也有許多重要的成果。他主要的研究領域簡述如下：

1. 地球物理中流體的動態行為: 研究 doubly diffusive convection 模型(海水、溫度、鹽等的共同對流) 及 rotating Boussinesq 方程的分歧行為與週期解， 探討層流(stratification)作用及旋轉(rotation)作用在其中扮演的機制。對這些分歧行為進一步分析其穩定性，獲得實際物理參數上可明確計算的判定準則，以及推導出 critical Rayleigh numbers 的公式。
2. 不可壓縮的對稱流體: 探討其結構穩定性(structure stability)並給出判定準則。
3. 雙成分物質的相變: 證明在 Cahn-Hilliard 模型中，雙成分物質從均質狀態到分離狀態不僅取決於溫度和成分濃度，也和其幾何構造有關。同時，也研究 Onsager mobility 作用下的分歧行為及穩定性。
4. 橢圓方程: 探討有邊界奇點及臨界非線性的橢圓方程，證明解的存在性及相應的 Caffarelli-Kohn-Nirenberg 不等式，並證明解在奇點附近有漸進對稱性。

夏教授的研究在質跟量上都令人激賞，是台灣數學界年輕一輩重要的分析學者，他的得獎是實至名歸。

研究工作介紹

My main research interests include phase transition problems, asymptotic analysis and transitions of geophysical fluid flows and nonlinear PDEs. Materials consisting of two components A and B are called binary systems. In quenching process, a binary system can undergo changes from spatially homogeneous to heterogeneous with the two components A and B separated. Our mathematical analysis shows that such phase transition depends not only on the temperature and the concentration of the homogeneous state, but also on the underlying geometry.

In geophysical fluid dynamics point of view, stratification and rotation are two important ingredients of oceanic flows. We have analyzed these two important ingredients by considering the onsets of steady state bifurcation and Hopf bifurcation for doubly-diffusive convection model and rotating Boussinesq equations. We obtained the criterions according to physical parameters that dictates the stabilities of these bifurcations. Meanwhile, we also give the precise formulae of the critical Rayleigh numbers.

In the study of properties of two-dimensional divergence-free flows, we obtained the criterion for the structure stabilities of two-dimensional symmetric flows. Recently, we give a characterization of asymptotic behaviors of solutions of three-dimensional Primitive equation with small forcing terms. This result also applies to two-dimensional Navier-Stokes equations.

外審報告節錄

“Since receiving PhD in 2006, Professor Hsia has had 10 papers published and another paper accepted. All of these papers appeared in highly respectable journals. There are 4 additional papers under preparation. With 6 papers published or accepted after 2010, Professor Hsia is very productive with an upward momentum.

In his research statement, he lists 4 topics of his research:

1. Geophysical fluid dynamics

2. Structural stability of symmetric flows

3. Binary systems

4. Elliptic differential equations

Topic 1 has been his main research line since PhD and consists of 5 papers. These papers consider bifurcation problems in geophysical fluid dynamics, modeled by coupled differential systems of a fluid, its temperature, and either a material convected by the fluid, or an additional term corresponding to rotation. These problems are non-symmetric and thus much harder and richer than the Rayleigh-Benard convection model. The analysis reduces the problems to the center manifold in the first unstable eigen-directions, based on an approximation up to certain order for the center manifold.

Topic 2 consists of one paper and considers the stability of the symmetry of fluids.

Topic 3 consists of two papers and shows two types of transition from homogeneity to heterogeneity of certain configuration of materials with two components described by nonlinear Cahn-Hilliard models, and also its stability under the Onsager mobility.

Topic 4 consists of two papers on elliptic PDE: One on the existence of solutions of elliptic partial differential equations (PDE) with two nonlinear terms of critical growth and singular coefficient near a boundary point, using variational methods. The other studies the asymptotic symmetry near an essential singularity of positive solutions of the Euler-Lagrange equation of the Caffarelli-Kohn-Nirenberg inequality, by sophisticated application of the methods of moving plane and generalized Kelvin transform."

"It is evident that Professor Hsia has worked on many different problems on fluid dynamics and PDE, and has used very different techniques. Note that he started working on topics 3 and 4 after he returned to Taiwan in 2008, while he continued his research on topic 1."

"Topic 3 probably uses techniques similar to those for topic 1, but topic 4 definitely needs completely different machinery. This shows that he has broadened his scope, as well as his circle of collaborators.

To summarize, I think Professor Hsia has been doing extremely well and is very promising. I strongly recommend him for the TMS Young Mathematician Award."

三、「青年數學家獎」陳冠宇教授

學歷：2006 康乃爾大學數學系、交通大學應用數學系博士。

經歷：理論中心訪問學者，交通大學應用數學系助理教授。

研究興趣：Stochastic processes and their applications.

推薦理由：黃啟瑞教授撰寫

陳冠宇研究馬氏過程的收斂行為，在 cutoff 現象及 logarithmic Sobolev 常數的估計這兩個基本且困難的問題上獲得很好的結果。

粗略來說 cutoff 現象是一族馬氏過程在 cutoff 時間後突然收斂到平穩分佈的行為。1986 年 Aldous 和 Diaconis 觀察到洗牌具 cutoff 的現象，開啟此方向的研究。這是一個相當困難的問題，陳冠宇刻畫出 cutoff 現象等價條件一般性理論和 cutoff 時間的估計；並應用到有限的馬氏鏈的例子和布朗運動，證明這些系統確有 cutoff 的現象。他這些基礎性的工作應可促使相關理論及應用的發展。

有限的馬氏鏈 logarithmic Sobolev 常數的估計及其與譜距的關係是一仍在發展的課題。這些常數與馬氏鏈趨近平衡的速度有關。陳冠宇研究這兩個常數間的關係，對一些例子計算出它們的 logarithmic Sobolev 常數。這些計算相當不容易，但卻是理論發展的基礎工作。

在金融數學方面，陳冠宇針對具交易費的 Boyle-Vorst 模型計算選擇權的定價。具交易費的模型會讓市場不完備，選擇權的定價計算不易尚無一般性結果。

研究工作介紹

In the past few years, my research topic focuses on the mixing time of Markov chains. This subject is about the quantitative estimate of convergence of ergodic Markov chains, while the classical analysis deeply explored the qualitative behavior since Markov introduced his philosophy in early 1900s. From the perspective of Markov chain Monte Carlo method, a Markov chain with desired stationary probability is performed and one has to decide a time to stop the simulation and then select the random sample. Such a problem arises in many fields including statistic physics, computer science, biology and more. The choice of the time, either random or deterministic, is closely related to the mixing time of Markov chain and very sensitive to the measurement of convergence.

A remarkable phase-transit phenomenon, the cutoff, was a concept introduced by Aldous and Diaconis in 1980s to capture the rapid convergence of Markov chains to their stationarity. Many heuristic ideas were introduced to estimate the mixing time and further to determine the cutoff phenomenon in the past three decades. Due to the variety of measurements of convergence, the frequently used techniques consist of the coupling, spectral decomposition, group representation, conductance profile, Poincaré inequality, logarithmic Sobolev inequality and related constants. In 2004, Peres conjectured: The cutoff is completely determined by the mixing time and the spectral gap. This was currently the only available criterion on cutoffs.

In 2008, we proved Peres' conjecture for cutoffs in Lp-distance and have a detailed discussion on the windows of cutoffs. In 2010, we successfully obtained a formula on the L2-mixing time assuming the reversibility and confirmed Peres' conjecture with a modified spectral gap. This was the first time the cutoff was systemically studied and the mixing time was determined. Concerning the exact computation of spectral gap and log-Sobolev constant, our proposal is to generate an algorithm with exponential convergence rate. The idea has been implemented for spectral gaps of birth and death chains with a rigorous mathematical proof, whereas the reasoning for the log-Sobolev constant is under construction. In the near future, we will focus on the total variation cutoff, which is mostly interesting but lacks of results.

外審報告節錄

"Professor Chen has made rather significant contributions regarding to the

cutoff phenomenon and the logarithmic Sobolev constant for Markov chains and Markov processes."

"Professor Chen has a very impressive record of research work. There are many first rate young probabilists in Taiwan. I would rank Professor Chen as the best one among them. I most strongly recommend him for a Young Mathematician Award of the Taiwan Mathematical Society."

"陳冠宇教授的研究工作可分為如下三個部分,(1)為馬可夫過程 cutoff 的研究,(2)Logarithmic Sobolev Constant 的估計問題,(3)為具交易費模型的選擇權的訂價問題。陳教授的研究(1)是很重要的工作,這是一個新進發展的研究課題,探討馬可夫過程在短時間達到平穩態的現象,陳教授在該方面的研究始於文章 5,在該文章中討論洗牌的相關機率問題,得到相當深刻的結果,洗牌的問題研究室馬可夫過程 cutoff 現象的研究的經典的例子之一 。文章 1、2 為兩篇長篇論文,在論文中一方面建立了馬可夫過程 cutoff 現象的基礎的數學理論,尤其討論 Lp 及 L2 的 cutoff 現象的理論,討論與 eigenvalue、spectral measure 的關係,這些都是從無到有原創性的基礎工作,在論文中一方面也討論幾個特別的例子,利用其建立的數學理論得到 cutoff 現象,這是很重要的貢獻。"

"關於研究(2),探討 Logarithmic Sobolev Constant 與 Spectral gap 的關係,Spectral gap 與馬可夫過程趨近平衡的速度有關。關於研究(3)具交易費模型不完備市場一個重要的例子,不完備市場的選擇權的定價的計算相當不容易,尚沒有一般性的結果,這些都是有趣的研究工作。**"**

四、「傑出碩士論文獎」金牌獎 吳允中

現為中研院統計所研究助理，今年七月畢業於台大數學所，大學就讀於台大社會系。大學時興趣在於有關人口學及社會網絡方面的研究，退伍後曾於社會系擔任研究助理，參與大型社會調查相關工作。進入數學所後則專注於統計領域，接觸統計分類理論、特別是以 ROC 分析為基礎的指標區辨力評估，而後碩士論文便是 ROC 分析在多類別分類問題上的一般理論架構及推廣。

論文工作介紹

Theories about binary classification have been well-developed and widely applied; how to assess the discriminability of binary classification markers is also at issue, and receiver operating characteristic (ROC) analysis would be a classical methodology. The past decade has seen the rapid development of multi-classification in various areas of science. To evaluate overall discrimination capacity of a marker for multi- classification tasks, some foregoing works has been struggling to extend ROC curves to ROC surfaces or manifolds to deal with ternary or arbitrary K classification tasks respectively in recent years. However, these developed methods are really limited—they rely on strong assumptions on models or are only able to cope with univariate markers.

Indeed, so-called ROC manifolds in literatures are treated as arbitrary subsets in Euclidian space rather than actually manifolds in terminology of geometry. This causes difficulty in statistical estimation and inference. Hence, we employed the performance function and utility-maximization criterion to connect a ROC space with a decision space spanned by likelihood ratio scores. We indicated that performance of a classification marker can be represented as a convex body in ROC space. We illustrate the relation between linear classifiers in a decision space and boundary sets of the convex bodies in a ROC space. Geometric features of optimal ROC manifolds explain, ternary and further give that simplicity in estimation and

ensure that even a naïve empirical estimator of optimal ROC manifolds enjoys uniform consistency and is with the asymptotic Gaussian process.
Furthermore, as the number of categories increases, optimal ROC manifolds could be hard to be interpreted in practice. We investigated whether the area under the ROC curves (AUC), a commonly-used summary index, can be extended to the hypervolume under the optimal ROC manifolds (HUM). We figure out that the HUM does not exist in general but is well-defined in some ROC subspaces of practical interest. Moreover, we provided a rigorous proof for the equality of HUM and its alternative form, the correctness probability, which is directly related to an explicit U-estimator. Parametric model-based estimators under weaker assumptions can be shown to preserve the same statistical characteristics. Then, related application of the results in this work is handy and operational for working-scientists.

外審報告節錄

"This thesis is concerned with a suitable measure of discrimination capability of a marker in the multi-classification setting involving K classes. For the binary classification case (K=2), the measure AUC (Area Under the receiver operating characteristic Curve) has been extensively studied and is known to be equal to the CP (Correctness Probability), the probability that an optimal classifier will rank a randomly chosen positive instance higher than a randomly chosen negative one. For the ternary classification case (K=3), Scurfield (1996) showed that the HUM (Hypervolume Under the receiver operating characteristic Manifold) is equal to CP. By making use of spanning trees in graph theory, the present thesis proves that this is true for general K. With this remarkable result available, statistical estimation of HUM becomes much easier. This estimation issue has been well studied in the thesis.

In my opinion, this is an exceptionally good thesis."

五、「傑出碩士論文獎」銀牌獎 鄭 堯

學歷：清大數學系學士、台大數學研究所碩士。

經歷：目前在服役中。

論文工作介紹

在這篇論文中,我們明確的構作西群上偉依表現 (Weil Representation) 的特徵函數當其局部體 (Local Field) 的剩餘體 (Residue Field) 有偶數特徵值時.我們是根據楊同海 [Yan 98] 的作法,在 Lattice model 中構作這些特徵函數.

楊同海解決了特徵值為奇數的情形,並且利用這些特徵函數證明某些 CM 橢圓曲線的 central L-values 不為 0 .特別的,我們似乎能夠拿掉一些在[Yan99,Main Theorem]裡判別式 (Discriminant) 的限制藉由利用這篇論文中的主要結果.

換言之,我們在這篇論文中證明了在特徵值為偶數時,若加上適當的限制條件,則西群上的偉依表現存在有好的分解 (Splitting) 使得我們能清楚構作其上的特徵函數,並且我們還能證明每一個西群上的 Eigencharacter 若不是不會出現,否則就出現一次.

我就讀於桃園縣的中壢高中,並以推薦甄試的方式考上了清華大學數學系,會選擇數學系就讀是因為受到國中數學老師的影響,她使我喜歡數學,而會選擇清華大學數學系就讀則是因為清華大學的理工學系很出名.還記得當時我們微積分以及高等微積分的任課教授就是目前的中華民國數學理事長許世壁教授,在這裡我要謝謝他的指導!

清大畢業後又很幸運的推甄上了台灣大學數學研究所,並接受台灣大學數學系謝銘倫教授的指導,我很感謝他的教導.這篇論文能夠完成有很大一部分是因為謝銘倫教授的幫助.

役畢後我打算攻讀博士,無論在國外或是國內,都希望能朝數學這條路走下去.

外審報告節錄

“I have advised several master students myself and sat in the oral examinations for many other master students. I must say that Mr. Cheng’s master thesis is *by far* the best master thesis I have ever seen. In the thesis, Mr. Chen considered explicit constructions of eigenfunctions in a certain model of the Weil representation of the unitary group U(1) over dyadic local fields. Such cases are more complicated than the cases of odd residue characteristic treated by Tonghai Yang earlier. So far, Mr. Cheng has only settled some restricted cases. (In most cases, he required the field extensions involved are all unramified.) If he can work out the remaining cases, I would say it will warrant a publication on a journal comparable with the Transactions of the American Mathematical Society, where Tonghai Yang’s work appeared.”

“Representation theory itself is a difficult subject, usually requiring several years of study before one can make a significant contribution to the theory. Within his two years of study, not only does Mr. Cheng manage to get a good understanding of this subject, but he also started to make important contribution. This shows that Mr. Cheng must have worked very hard in the last two years. Therefore, I recommend enthusiastically that Mr. Cheng be awarded the *best master thesis* prize.”