

出國報告（出國類別：其他：國際會議）

## 參加 ICMAME2014 國際學術研討會議報告

服務機關：國立虎尾科技大學飛機系

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派赴國家：英國

出國期間：103 年八月二十一日~八月二十二日

報告日期：103 年十月十六日

## 摘要

本次出國目的為參加於英國倫敦舉辦之“International Conference on Mechanical, Aeronautical and Manufacturing Engineering, ICMAME2014” 研討會，此次研討會計舉辦兩天，四個 sessions、有來自 15 個國家研究學者發表 52 篇機械相關領域論文，個人於會議中發表論文一篇，名稱為 “Application of Double Side Approach Method on Super Elliptical Winkler Plate”，此篇論文為執行科技部專題計畫 “雙側逼近法於工程問題上之應用” (NSC 102-2221-E-150 -029)的部分成果，論文內容主要探討如何以雙側逼近法來求解工程問題，並給與適當估算解的誤差上限值與下限值，以彌補一般數值解在誤差估算能力不足之問題。文中以 Super Elliptical Winkler Plate 受靜態分布力為例，詳細說明方法之步驟與結果，此次論文發表十分順利，會後並與與會學者進行意見交流，獲得許多可做為改進未來研究方向之建議。

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## 壹、目的

本次出國目的為藉由參與國際性研討會，增進與世界各地研究學者之交流溝通，以增進個人視野、了解機械相關領域研究進展，交換研究經驗並尋找研究方向，提升自己之研發能量。參加之研討會為於英國倫敦舉辦之“International Conference on Mechanical, Aeronautical and Manufacturing Engineering, ICMAME2014”研討會，此次研討會是由World Academy of Science, Engineering and Technology (WASET) 組織主辦，主辦地點在英國倫敦的 Holiday Inn London-Wembley。WASET是一個常態性非營利組織，常於世界各地召開有關科學、醫學、自然與理工之各種相關學術會議。而此次會議主要目的在提供一個讓機械、航空與製造方面之研究學者能彼此互相觀摩與討論近期在相關領域之成果、經驗、發展趨勢與挑戰的場合。此次研討會計舉辦兩天，四個議程(sessions)、有來自15個國家研究學者發表52篇機械相關領域論文，個人於此研討會中發表近期研究成果一篇論文，名稱為“Application of Double Side Approach Method on Super Elliptical Winkler Plate”，個人將可透過此次研討會，將就成果就教於各國同好，以了解自己研究不足與盲點之所在。此篇論文為執行科技部專題計畫“雙側逼近法於工程問題上之應用”(NSC 102-2221-E-150 -029)的部分成果。因上述科技部專題計畫出國補助經費僅五萬元，故不足部分動用歷年計畫結餘補助款。

## 貳、過程

“International Conference on Mechanical, Aeronautical and Manufacturing Engineering, ICMAME2014” 由 World Academy of Science, Engineering and Technology (WASET) 組織主辦，主辦地點在英國倫敦的 Holiday Inn London-Wembley。此次研討會計舉辦兩天，四個議程(sessions)、分別由義大利 Catania 大學 Natale 教授、我國逢甲大學之黃錦煌院長、英國 Nottingham Trent 大學 Percy 教授、以及克羅埃西亞 Split 大學 Bulog 教授擔任議程主席。會議議題涵蓋有:

- 1.Acoustics and Noise Control
- 2.Composite and Smart Materials
- 3.Computational Mechanics & Computational Techniques
- 4.Design、
- 5.Micro and Nano Technology
- 6.Turbulence

等多個主題。整個研討會共計發表機械、製造與設計相關領域論文計有 52 篇，雖然篇數不多，但作者分別來自全球 15 個國家，不失為具特色之國際研討會。

### 一、會議議程

會議期間自 8/21 起至 8/22 止共 2 天，詳細議程參考附件一，論文發表分為口頭報告與 e-post 兩種，與一般研討會不同的是 e-post 論文雖然稱為 e-post 形式，但須 5~10 分鐘之口頭報告。個人的論文發表時段為 8/21 日上午第二議程，此時段議程包含間 9 篇口頭報告與 12 篇 e-post，主持人為逢甲大學工學院黃錦煌院長。因報告人數眾多故時間較長，報告學者分別來自阿爾及利亞、日本、韓國、印度、香港、南非與國內多位學者。黃院長於議程結束後評論中指出，多篇報告內容不錯，最佳口頭報告為來自成功大學 Shih-Wen Hsiao, Chu-Hsuan Lee, Rong-Qi Chen 等三位有關利用 3D 雷射成型之客製化程序，為複雜之鞋面造型評估提供系統化與數量化方法。最佳之 e-post 則亦為來自

成功大學航太系 Tzai-Shiung Li, 楊文彬合著之有關風扇葉片之複合材料設計方法。楊教授唱作俱佳之簡報風格令人留下深刻印象。

## 二、報告議題

個人於研討會中發表之論文題目為“Application of Double Side Approach Method on Super Elliptical Winkler Plate”，共同作者為湯祥雯。此篇論文為個人執行 102 年度科技部專題計畫“雙側逼近法於工程問題上之應用”(NSC 102-2221-E-150 -029)的部分成果。論文內容主要探討如何以雙側逼近法來求解工程問題，並給與適當估算解的誤差上限值與下限值，以彌補一般數值解在誤差估算能力不足之問題。雙側逼近法為求解近似解方法中的一種，此方法具有計算量少、程序簡單且可提供高精度解等優點，相較於其他求解近似解之數值方法，其最顯著的優點在於可給出近似解之誤差界，提供近似解之可靠度。計畫對雙側逼近法做了原理上的深入探討，並利用微分方程最大值原理以及加權殘值法建構出數學規劃問題，並進一步結合基因演算法，求解最佳化解，建立完整理論基礎與計算架構，並將之應用至工程問題上。原計畫探討兩種典型工程應用，包含不同截面形狀管流之速度場分析以及不同形狀薄板與文克勒基底薄板之靜態行為分析計畫。此次投稿部分為針對文克勒基底薄板之靜態行為分析，因為雙側逼近法對求解具有複雜邊界形狀之問題特別具有優勢，因此討論在超級橢圓的形狀之橢圓形邊界之文克勒板問題，由於超級橢圓形相較於矩形，於尖角處會避免掉應力集中之現象，因此在實際工程應用上為一相當常見之形狀。其相關研究在過往少有探討，至今僅有極為少數的學者利用 Galerkin 法或 Ritz 法來解決此類問題，然而，藉由引進雙側逼近法，可使求解此類問題過程大為簡化且快速、精確，此次投稿文章所得之分析解果與解析解比對，所求得之結果均相當令人滿意。驗證了此法於邊界值問題之可行性。此次論文發表十分順利，會後並與與會學者進行意見交流，獲得許多可做為改進未來研究方向之建議。參與此次研討會之 e-post 內容請參考附件二。

### 參、心得與建議

- 一、此次研討會是由 WASET 舉辦之國際研討會，雖然發表論文篇數不多，但參與國家數目仍有一定程度，在會議過程中碰到許多國內學者與國外學者，可以盡情交換研究心得與認識新朋友，是一件極為快樂的事。因為是規模不大，理論上可以議程安排可以更加聚焦，但很可惜，主辦單位似乎沒有注意到。雖然第一天議程較偏向機械，第二天較偏向設計，但仍可發現有部分論文議程時段歸類較為混亂，此可做為以後辦理相關研討會可注意之處。
- 二、此次參與研討會，發覺幾位作者的研究題目十分有意思，包含韓國 J.H.Kim 利用等效電路做壓電結構行為預測之方法，Kim 採用之方式十分簡易快速，不失為良好之預測工具以及日本 Masato Nishi 有關碳纖強化編織材料熱塑性行為的有限元素分析方法，因為目前複合材料於汽車與航空器上之使用，已有逐漸趕上金屬材料之趨勢，而在有限元素法分析上，材料性質之處理往往是困難所在，因此在相關分析技巧與方法展上是蠻可以投入的課題。
- 三、個人的論文，雖然已完整觸及兩側逼近法之建構與數理基礎，並且達到誤差值估算之目的，但相較之下，如果運用實例更加貼近實務，應可對此方法於工程上之運用有較佳之說服力，在未來可考慮擴展到振動現象之探討，可預見在數學規劃問題之建立與求解上，均會增加不少難度，但是可以挑戰的議題。
- 四、個人認為逢甲大學黃錦煌院長發表之論文討論如何藉由逆問題方法，求解喇叭參數之文章，為此次研討會最具特色之論文，因個人對逆問題略有涉入，深覺黃院長展現嚴謹之研究態度，將振動時空氣慣性之影響，納入分析模型中，大幅改進喇叭動態模擬與頻率響應上之預測，此分析應可廣泛運用於改進高品質音效喇叭之製作，黃院長對研究課題之深入與主持議程之能力，非常值得我得學習與效法。
- 五、此次為個人第一次到英國倫敦參加研討會，亦有機會對現代工業革命發祥地有初次接觸，對倫敦有了初步認識，也搭了倫敦歷史最久之地鐵，感覺在發展中保有原味，顯示英國人對舊有物件之尊重態度，這是值得我們學習的態度。當然，倫敦的交通

實在有點擁擠，到處都是單行道，也因為有此親身經歷，回國見到電影雷神索爾 2 中，以倫敦交通為背景之對話，更有深切的感覺。

六、此次參加之研討會在規模上不大，但亦吸引不少不同國家的學者聚集一處，舉辦此類研討會的方式，可值得借鏡。



**ICMAME 2014 : International Conference on Mechanical, Aeronautical and Manufacturing Engineering**



**Conference Program**

REMARKS: Presenters of particular session should be ready in the meeting room at least 10 minutes before the beginning of the session. Also, Presenters should introduce themselves to the session chair and upload their papers to the computer.

Session I - Aug 21, 2014 Room : A 09:00-10:00

**Chair: Raffaele Di Natale**

Mathematical and Numerical Analysis of a Nonlinear Cross Diffusion System	Hassan Al Salman King Faisal University, Saudi Arabia	
A Web-Based Self-Learning Grammar for Spoken Language Understanding	S. Biondi, V. Catania, R. Di Natale, A.R. Intilsano, D. Panno University of Catania, Italy	
Ultra-Low Loss Dielectric Properties of (Mg <sub>1-x</sub> Nix) <sub>2</sub> (Ti <sub>0.95</sub> Sn <sub>0.05</sub> )O <sub>4</sub> Microwave Ceramics	Bing-Jing Li, Sih-Yin Wang, Tse-Chun Yeh, Yuan-Bin Chen National Cheng Kung University,	
Prediction of the Performance of a Bar-Type Piezoelectric Vibration Actuator Depending on the Frequency Using an Equivalent Circuit Analysis	J. H. Kim, J. H. Kwon, J. S. Park, K. J. Lim Chungbuk National University, Korea, Republic Of	e-Poster
Insulation Properties of Rod-Plane Electrode Covered with ATH/SIR Nanocomposite in Dry-Air	Jae-Yong Sim, Jung-Hun Kwon, Ji-Sung Park, Kee-Joe Lim Chungbuk National University, Korea, Republic Of	e-Poster
Spatial Audio Player Using Musical Genre Classification	Jun-Yong Lee, Hyoung-Gook Kim Kwangwoon University, Korea, Republic Of	e-Poster

Coffee Break: 10:00 - 10:15 Session II - Aug 21, 2014 Room : A 10:15-12:00 Lunch Break: 12:00

**Chair: Jin H. Huang, Chu-Hsuan Lee**

A Comparative Study between Displacement and Strain based Formulated Finite Elements Applied to the Analysis of Thin Shell Structures	Djamal Hamadi, Oussama Temami, Abdallah Zatar, Sifeddine Abderrahman Biskra University, Algeria	
Efficiency of the Strain Based Approach Formulation for Plate Bending Analysis	Djamal Hamadi, Sifeddine Abderrahmani, Toufik Maalem, Oussama Temami Faculty of Sciences and Technology, Biskra University, Algeria	
Forming Simulation of Thermoplastic Pre-impregnated Textile Composite	Masato Nishi, Tetsushi Kaburagi, Masashi Kurose, Tei Hirashima, Tetsusei Kurasaki JSOL Corporation, Japan	
A Comparison Study of Fabric Objective Measurement (FOM) Using RES-FB and PhabrOmeter System on Warp Knitted Fabrics Handle – Smoothness, Stiffness and Softness	Ka-Yan Yim, Chi-Wai Kan The Hong Kong Polytechnic University, Hong Kong	e-Poster
Response Surface Modeling of Lactic Acid Extraction by Emulsion Liquid Membrane: Box-Behnken Experimental Design	A. Thakur, P. S. Panesar, M. S. Saini SLET Longowal (Deemed University) , India	
Application of Neural Network on the Loading of Copper onto Clinoptilolite	John Kabuba Vaal University of Technology, South Africa	
Dissolution of Zeolite as a Sorbent in Flue Gas Desulphurization Process Using a pH Stat Apparatus	Hilary Rutto, John Kabuba Vaal University of Technology, South Africa	
Parameters Affecting the Removal of Copper and Cobalt from Aqueous Solution onto Clinoptilolite by Ion-Exchange Process	John Kabuba, Hilary Rutto Vaal University of Technology, South Africa	

Loudspeaker Parameters Inverse Problem for Improving Sound Frequency Response Simulation	Y. T. Tsai, Jun H. Huang Feng Chia University, Taiwan	
The Customization of 3D Last Form Design Based On Weighted Blending	Shih-Wen Hsiao, Chu-Hsuan Lee, Rong-Qi Chen National Cheng Kung University, Taiwan	
Robust Design of a Ball Joint Considering Uncertainties	Bong-Su Sin, Jong-Kyu Kim, Se-Il Song, Kwon-Hee Lee Dong-A University, Korea, Republic Of	e-Poster
Second-Order Slip Flow and Heat Transfer in a Long Isoflux Microchannel	Huei Chu Weng Chung Yuan Christian University, Taiwan	e-Poster
Application of Double Side Approach Method on Super Elliptical Winkler Plate	Hsiang-Wen Tang, Cheng-Ying Lo National Formosa University, Taiwan	e-Poster
Design of the Fiber Lay-up for the Composite Wind Turbine Blade in VARTM	Tzai-Shung Li, Wen-Bin Young National Cheng Kung University, Taiwan	e-Poster
Natural Convection in Wavy-Wall Cavities Filled with Power-Law Fluid	Cha'o-Kuang Chen, Ching-Chang Cho National Cheng Kung University, Taiwan	e-Poster
Impact Deformation and Fracture Behaviour of Cobalt-Based Haynes 188 Superalloy	Woei-Shyan Lee, Hao-Chien Kao National Cheng Kung University, Taiwan	e-Poster
Study on Roll Marks of Stainless Steel in Rolling Mill	Cai-Wan Chang-Jian, Han-Ting Tsai I-Shou University, Taiwan	e-Poster
A New Analytic Solution for the Heat Conduction with Time-Dependent Heat Transfer Coefficient	Te Wen Tu, Sen Yung Lee Mechanical Engineering, Taiwan	e-Poster
Estimation of Natural Convection Heat Transfer from Plate-Fin Heat Sinks in a Closed Enclosure	Han-Taw Chen, Chung-Hou Lai, Tzu-Hsiang Lin, Ge-Jang He National Cheng Kung University, Taiwan	e-Poster
Numerical Optimization of Trapezoidal Microchannel Heat Sinks	Yue-Tzu Yang, Shu-Ching Liao National Cheng Kung University, Taiwan	e-Poster
Surface Flattening Assisted with 3D Mannequin Based On Minimum Energy	Shih-Wen Hsiao, Rong-Qi Chen, Chien-Yu Lin National Cheng Kung University, Taiwan	e-Poster
Development of Automatic Laser Scanning Measurement Instrument	Chien-Hung Liu, Yu-Fen Chen National Chung Hsing University, Taiwan	e-Poster
Performance Variation of the TEES According to the Changes in Cold-Side Storage Temperature	Young-Jin Baik, Minsung Kim, Junhyun Cho, Ho-Sang Ra, Young-Soo Lee, Ki-Chang Chang Korea Institute of Energy Research, Korea, Republic Of	e-Poster

Session III - Aug 22, 2014 Room : A 09:00-10:00

**Chair: Nicole Pearcy, Reda Abdel-Aziz, Aiman Elragig**

Hypergraph Models of Metabolism	Nicole Pearcy, Jonathan J. Crofts, Nadia Chuzhanova Nottingham Trent University, United Kingdom	
Impact of Compost Application with Different Rates of Chemical Fertilizers on Corn Growth and Production	Reda Abdel-Aziz National Research Center, Egypt	
On a Negative Relation between Bacterial Taxis and Turing Pattern Formation	A. Elragig, S. Townley, H. Dreiwil Department of Mathematics, Faculty of Science, University of Benghazi, Libya	
Profile of Viral Hepatitis in Saudi Arabia	Abdulmajeed Abdulrahman Alshabanat, Rashed Backer Albacker, Ali Abdullah Basalama, Abdullah Abdulrahman Bin Salamah, Abdulrahman SalehAlfayh King Saud University, Saudi Arabia	
Perceptibility of Tactile Symbols	T. Nishimura, K. Doi, H. Fujimoto, T. Wada National Institute of Special Needs Education, Japan	e-Poster
Development of Sound Tactile Interface by Use of Human Sensation of Stiffness	K. Doi, T. Nishimura, M. Umeda National Institute of Special Needs Education, Japan	e-Poster
Development of a Method to Prepare in-School Tactile Guide Maps for Visually Impaired School Children	K. Doi, T. Nishimura, M. Kawano, H. Fujimoto, Y. Tanaka, M. Sawada, S. Oouchi, T. Kaneko, K. Kanamori National Institute of Special Needs Education, Japan	e-Poster
Corelation between DCPT and Other Tests - A Critical Review	Parampreet Kaur, K. S. Gill, Rohin Kaushik S.B.S.T.C., Ferozepur, Punjab, India	
The Application of Dynamic Network Process to Environment Planning Support Systems	Wann-Ming Wey National Taipei University, Taiwan	

Coffee Break: 10:00 - 10:15 Session IV - Aug 22, 2014 Room : A 10:15-12:00 Lunch Break: 12:00

**Chair: Ivana Bulog, Chackrit Duangphastra**

The Development of XML Resume System in Thailand	Jarumon Nookhong, Thanakorn Uiphanit Suan Sunandha Rajabhat University, Thailand
The Algorithm of Semi-Automatic Thai Spoonerism Words for Bi-Syllable	Nutthapat Kaewrattanapat, Wannarat Bunchongkien Suan Sunandha Rajabhat University, Thailand
Strategic Decision Making Practice in Croatia – Which Decision Making Style is More Effective?	Ivana Bulog Faculty of Economics, Croatia
The Effects of Consumer Inertia and Emotions on New Technology Acceptance	Chyi Jaw National Yunlin University of Science & Technology, Taiwan
Comparative Study of Multimodal Transport Issues of GMS CBTA and ASEAN Agreement	Chackrit Duangphastra Chulalongkorn Business School, Thailand
Human Resource Development Strategy in Automotive Industry (Eco-Car) for Asean Hub	Phichak Phutrakhuil Suan Sunandha Rajabhat University, Thailand
Correction of Frequent English Writing Errors by Using Coded Indirect Corrective Feedback and Error Treatment	Chaiwat Tantarangsee Suan Sunandha Rajabhat University, Thailand
Teaching Speaking Skills to Adult English Language Learners through ALM	Wichuda Kunnu, Aungkana Sukwises Suan Sunandha Rajabhat University, Thailand
The Study of Idiom Translation in Fiction from English into Thai	Chinchira Bunchutrakun Suan Sunandha Rajabhat University, Thailand
An Error Analysis of English Communication of Suan Sunandha Rajabhat University Students	Chantima Wangsomchok Suan Sunandha Rajabhat University, Thailand
Cultural Capital for Promoting Tourism in Cultural Resources of a University: A Case Study of SSRU	Siriman Wattana Suan Sunandha Rajabhat University, Thailand
Brand Placement Strategies in Turkey: The Case of Yalan Dünya	Burçe Boyraz Baskent University, Turkey
Representation of “Gezi Parkı Actions” in Media and Resistance	Sibel Özkan Selcuk University, Turkey
Kurdish Issue and Peace Journalism in Turkey	Mustafa Aksoy Ankara University, Turkey

PROGRAM LAST UPDATED: August, 26 2014 12:07

REMARK FOR e-POSTER PRESENTATION

We kindly ask the presenters to prepare a short electronic presentation (NO PRINT OUT) for their e-POSTERs as scheduled with the oral presentations. The e-POSTER presentations will last in 5 min including discussions.

Laptop Computer, Projector, USB Flash Drive(No CD Drive), MS. PowerPoint/AcrobatReader

SYSTEM SECURITY ALERT

As many delegates insert their USB devices into the laptop computer provided for presentation we can not avoid Cyber/Computer viruses. Therefore, you are kindly advised to bring a USB Flash Drive containing only your .ppt, .ptx or .pdf presentation file in it. Otherwise, your files may become corrupted or inaccessible permanently.

International Conference on Mechanical, Aeronautical and Manufacturing Engineering  
ICMAME 2014 August, 21-22, 2014 at London, United Kingdom

**Application of Double Side Approach Method  
on Super Elliptical Winkler Plate**

*Hsiang-Wen Tang, Cheng-Ying Lo*

**Abstract:**

*The static behavior of super elliptical Winkler plate with clamped boundary is analyzed by applying the double side approach method. We use the double side approach method to solve this problem because of its superior ability on efficiently treating problems with complex boundary shape. The double side approach method has the advantages of high accuracy, easy calculation procedure and less calculation load required. Most important of all, it can give the error bound of the approximate solution. The numerical results in the given example show that the double side approach method works well on this problem*



成功大學

National Cheng Kung University



國立虎尾科技大學

NATIONAL FORMOSA UNIVERSITY

**International Conference on Mechanical, Aeronautical and Manufacturing Engineering  
ICMAME 2014 August, 21-22, 2014 at London, United Kingdom**

**Introduction:**

For some engineering problems, the analytic solutions are impossible to be found, only their approximate solutions can be obtained

**The Method of Weighted Residuals (MWR):**

- Assume trial functions with some undetermined coefficients as the approximate solution
- Substitute this trial function into governing differential equation-->Residuals will come into existence
- Force residuals to be zero in some average sense
- Attain the desired approximate solution which makes the residuals smallest or even zero

*However, traditional MWR does not allow the accurate error analysis so the reliable and accurate solutions can't be guaranteed*

**Basic concept of Double Side Approach Method:**

**Monotonic relation:** When the residuals satisfies the inequality, the corresponding approximate solutions will have the same relation

$$\begin{aligned} & R\tilde{u} \leq Ru \leq R\hat{u} \\ \Rightarrow & \tilde{u} \leq u \leq \hat{u} \end{aligned}$$

*We can utilize the residuals of approximate solutions to establish the constraints, then upper and lower bounds of the solution can be obtain*

**Outline:**

**When**  $R\hat{u} \geq 0 \rightarrow \text{find } \min \hat{u}$   
 $R\tilde{u} \leq 0 \rightarrow \text{find } \max \tilde{u}$   
**The best approximate solution:**  $\tilde{u} = \frac{\hat{u} + \tilde{u}}{2}$

**Problem Formulation:**

Elliptical or super elliptical plates on Winkler-type foundation (the supporting medium is isotropic, homogeneous, and linear elastic).

**Shape function of super ellipse:**

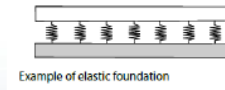
$$\frac{x^{2n}}{a^{2n}} + \frac{y^{2n}}{b^{2n}} = 1$$

ellipse (n=1) and rectangle (n=∞)

**Governing equation:**

$$\frac{\partial^4 w}{\partial x^4} + 2 \frac{\partial^4 w}{\partial x^2 \partial y^2} + \frac{\partial^4 w}{\partial y^4} + \frac{k w}{D} = \frac{q}{D}$$

$$\nabla^4 w + \frac{k w - q}{D} = 0$$



Example of elastic foundation

**Clamped boundary condition:**

$$w_s = 0, \quad \frac{\partial w_s}{\partial n_i} = w_x \times \cos \theta + w_y \times \sin \theta = 0$$

w: deflection                      k: foundation stiffness  
 D: bending stiffness            q: external load on surface  
 For convenience  $b=q=D=k=1$



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**Double Side Approach Method:**

**Procedure:**

1. Check monotonic relation of the problem
2. Transfer the problem into a mathematical programming problem using the submethods in MWR. (*Submethods: Subdomain Method*)
3. Find the optimal solutions of the established mathematical programming problem by optimization method. (*Optimization method: Genetic Algorithms, GA*)

**Basic concept of Double Side Approach Method:**

**Monotonicity check:**

$$\frac{\partial R[w]}{\partial w} > 0$$

Residual :  $Rw = \nabla^4 w + \frac{k w - q}{D}$   
 satisfy

The monotonicity of the biharmonic operator has been successfully proved (Enache, 2010; Mareno, 2011)

$$\frac{\partial}{\partial w} \left( \frac{k w - q}{D} \right) = \frac{k}{D} > 0$$

*Monotonicity holds → The double side approach method can be applied*

**Mathematical Programming Problem:**

(Based on Subdomain Method)

**Try Function:**  $Z(x, y, c) = \sum_{j=1}^i C_j \left( \frac{x^{2n}}{a^{2n}} + \frac{y^{2n}}{b^{2n}} - 1 \right)^{2j}$

**Upper bound Constrains**

$$\begin{cases} \int_0^{1/i+2} R[Z] dy \Big|_{x=0} \geq 0 \\ \int_{1/i+2}^{2/i+2} R[Z] dy \Big|_{x=0} \geq 0 \\ \vdots \\ \int_{i+1/i+2}^1 R[Z] dy \Big|_{x=0} \geq 0 \end{cases}$$

**Lower bound Constrains**

$$\begin{cases} \int_0^{1/i+2} R[Z] dy \Big|_{x=0} \leq 0 \\ \int_{1/i+2}^{2/i+2} R[Z] dy \Big|_{x=0} \leq 0 \\ \vdots \\ \int_{i+1/i+2}^1 R[Z] dy \Big|_{x=0} \leq 0 \end{cases}$$

**Optimization Problem:**

**Upper bound:** user GA to find minimal larger objective function  $Z(0,0,C_j)$  with upper bound constrains

**Lower bound:** Use GA to find maximal smaller objective function  $Z(0,0,C_j)$  with lower bound constrains



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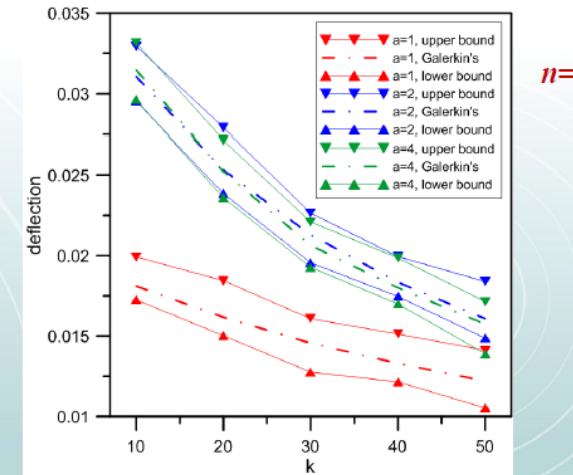
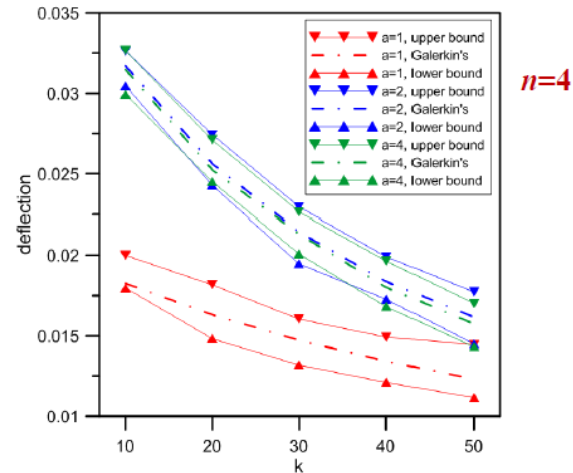
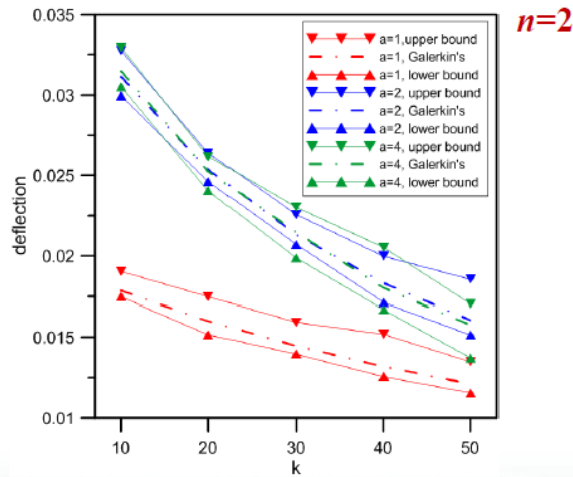
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**Results and Discussions:**



**Conclusions:**

Galerkin's method and the double side approach method are used and their numerical results support each other. The advantage of the double side approach method on dealing with boundary value problems is presented and the detailed information of static behavior of clamped super elliptical plates are given. The double side approach method has high efficiency and gives the upper and lower bounds of the approximate solution and this is what other numerical methods are hard to do.



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簡報室內