出國報告(出國類別:國際會議)

第十二屆流體動力學國際學術研討會
Twelfth International Conference on Flow Dynamics

服務機關: 國立虎尾科技大學

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摘要

流體動力學國際學術研討會(International Conference on Flow Dynamics, ICFD)，自 2004 年首次舉辦以來每年舉辦一次，今年為第 12 屆。本次有一篇論文投稿且通過審查，親自出席參加於 104 年 10 月 27-29 日在仙台舉行的盛會。所發表論文的主要研究內容是，探討三維機匣壁面安裝有凸塊熱源的系統，其散發熱量至外界環境的熱傳特性；以及藉由散熱鰭片與通氣孔的設計，期能改變流場結構，進而提升熱傳效果，降低系統熱點溫度。三天的會議期間，本人除發表論文之外，並特別針對熱管理與散熱性能提升相關主題的場次。本次會議除了能將自己的研發成果發表外，也藉由聆聽其他學者的成果充實自我與了解相關領域的發展趨勢，然而最大的收獲是認識許多來自國內外學者，並相互討論。此次會議，本國的學者參與人數頗多，顯示該會議頗受國內重視。

目次

目的

由日本東北大學主辦的「第十二屆流體動力學國際學術研討會（Twelfth International Conference on Flow Dynamics）」，旨在提供研究人員、科學家及實務科技人員一個交換資訊的論壇，有機會齊聚探討流體流動與傳輸現象，對於工程發展及自然環境的應用，尤其是對於全球能源與環境變遷的關連性，並期促進這些領域研究的國際合作。歷年來，於該研討會所發表之論文，皆具高品質與前瞻性，深受全世界大學、研究機構之學者，以及業界專家的肯定與重視。本次會議於 2015 年 10 月底在日本仙台市舉行，該次研討會其中有一主題-Complex Thermofluid System 係由交大傅武雄教授籌設，此次投稿即是參與該主題。期望藉由論文發表、與各國的學者專家互動交流，提升本人的研究能量，並豐富教學內涵，促進國際交流與合作。

過程

因未能購得台灣直飛日本仙台市的機票，個人與同系老師(共同作者)於 10 月 25 日搭乘長榮航空班機，自松山飛往東京羽田機場。26 日前往日本第一學府東京大學參觀。

10 月 27 日上午，前往設在仙台市國際中心（Sendai International Center）的研討會場辦理註冊報到及領取會議文件，由於資訊設備發達及環保考量，大會僅發給一本手冊及一個隨身碟，該手冊的內容是介紹大會沿革、委員會組織、議程、大會邀請演講與論文發表的場次安排、以及論文名稱與作者等，至於論文的詳細內容則儲存於隨身碟。完成報到手續後，很快速的瀏覽大會手冊內的資料及熟悉場地，之後，前往參加開幕。據統計，此次會議共有 520 篇論文發表，分成 21 個場次。緊接著，聆聽大會的邀請演講。 本屆研討會安排有三場大會演講。第一場是來自美國奧多明尼昂大學（Old Dominion University）的 Colin Britcher 教授，講題為「Highlight from a University / Government Collaboration－Old Dominion University and NASA Langley Research Center」主要內容在說明該大學與美國航空太空總署，於空氣動力學領域的研究合作情形，包括實驗設備之建立及實驗技術之發展。其次是加拿大不列顛哥倫比亞大學（The University of British Columbia）的 James J. Feng 教授，講題為「Drop Dynamics in Complex Fluids ：Partial Coalescence and Self-assembly」，主要內容係藉由實驗觀視及數值模擬的結果，說明複雜流體（Complex Fluids）之液滴與平面，以及液滴之間的介面交互作用。第三位是日本名古屋大學（Nagoya University）的 Noritaka Usami 教授，講題為「Challenges in Photovoltaics」，其主要內容在說明光伏科技未來發展所面臨的挑戰，而材料科學將扮演著重要的關鍵角色。下午進行分組論文發表，則選擇「複雜熱流系統（Complex Thermofluid System）」的主題，前往發表會場進行聆聽與問題討論。

10 月 28 日一早步行前往會場。9 時參加由同系蔡永利老師主持當天第一場次的論文發表，該場次的主題為「複雜熱流系統」，共有 5 篇論文發表，發表者來自台灣、日本及越南，其中台灣的演講者之簡報製作、內容及臨場表現水準皆相當優異；另外，在問題討論方面，大家都很熱絡。接續的場次，由蔡老師報告此次投稿之論文，題目是「三維機匣壁面陣列分佈凸塊熱源的冷卻效能提升之研究（Enhancement of Cooling Performance for Arrays of Block Heat Sources Mounted on the Wall of a 3-D Cabinet）」。本論文旨在針對三維矩形機匣壁面安裝有陣列分佈之間隔凸塊熱源，首先探討散熱鰭片的配置所造成的冷卻效果，其次，於壁面建置通氣孔，探討不同通氣孔的位置對於流體流動之結構、溫度分佈及熱傳特性的影響，最後，探討同時安裝散熱鰭片及建置通氣孔對於冷卻效應的提升。對於相關的統御方程式，是以 QUICK 和 SIMPLE 之數值方法處理，再以嚴謹的數值模擬進行計算，計算區域包括外界環境與機匣內部，而機匣壁面溫度與熱通量並非已知，係於求解過程中獲得。結果顯示，安裝散熱鰭片對於熱傳效果可有效的提升，發熱凸塊的熱點溫度之降低可達 28.47%；建置通氣孔可降低熱點溫度 9.97%；而同時安裝散熱鰭片與建置通氣孔，對於冷卻效應可大幅提升，使得發熱凸塊的熱點溫度降低達 35.4%。下午選擇熱傳效能主題相關場次，前往聆聽論文發表。並前往張貼論文發表會場觀看研究成果發表。容晚上參加大會的晚宴，該晚宴之場地佈置及流程安排差強人意，但有機會與來自美國、日本及台灣的學者進行交流。

10 月 29 日是研討會議的最後一天，一早即前往會場，選擇「流體流動量測與可視化」的相關議題，前往聆聽論文發表及參與討論，中午抽空前往會場附近東北大學分部參觀；於下午 5 點多，此次會議結束所有活動，劃下句點。

心得

本次研討會集結世界各地流體動力、熱質傳及多重領域專家學者齊聚一堂，共同研討工程及應用科學的現況與未來發展，與會者多能提出精闢的論點並發表研究成果，對於本人未來於熱流及其他領域之研究將助益良多。本次會議除了能將自己的研發成果發表外，也藉由聆聽其他學者的成果充實自我與了解相關領域的發展趨勢，然而最大的收獲是認識許多來自國內外學者，並相互討論。此次會議，本國的學者參與人數頗多，顯示該會議頗受國內重視。

建議事項

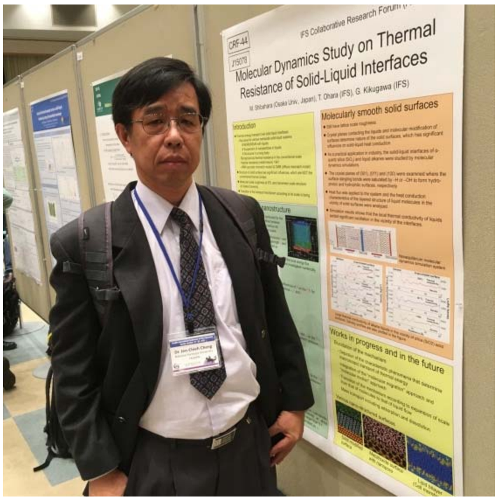
1. 本次會議報名費較其他國際研討會低(21000 日圓約台幣 5500 元)，可以多鼓勵世界各地及當地研究人員及學生參與，可以做為辦理國際研討會參考。
2. 本次研討會其中有一主題國內教授籌設，可以鼓勵國內學者積極參與在研討會中開設論壇，有助於提升我國學術聲望與知名度。

附錄

照片 1: 東京大學校園

照片 2: 東北大學校園

照片 3: 研討會場之一



照片 4: 研討會場之二

照片 5: 晚宴會場之二

照片 6: 研討會手冊及隨身碟

Enhancement of Cooling Performance for Arrays of Block Heat Sources Mounted on the Wall of a 3–D Cabinet

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ABSTRACT

This study aims to investigate the cooling performance enhancement of block heat sources by installing fins and constructing vents on 3-D cabinet walls. Results show that, for the fin number F_N=23, the hot spot temperature of the blocks can be reduced up to 28.47%. The hot spot temperature of the blocks can be reduced by 9.97% when cabinet walls are constructed air vents with S_D=0.04 and S_N=16. The difference of hot spot temperature of the blocks is about 35.42% when the fins are installed and air vents are constructed simultaneously.

1. Introduction

The conjugate conduction–natural convection heat transfer for block heat sources mounted on the wall of a 3-D cabinet is widely encountered in engineering applications, such as cooling of electronic equipment, photovoltaic cells and products of light emitting diode [1,2]. This study aims to investigate the cooling performance enhancement of block heat sources by installing fins and constructing vents on cabinet walls. Attention is given to the enhancement of cooling performance by installing fin and constructing air vents. The numerical simulation is rigorously performed in this study. The numerical computation domain covers the cabinet and its surrounding area. The boundary conditions of the temperature and heat flux for cabinet wall are not previously known and have to be found in the solution processes.

2. Numerical Method

The physical system under consideration, as shown in Fig.1, is a 3-D cabinet with arrays of block heat sources mounted on left vertical wall of the cabinet. To enhance the heat transfer characteristics, the cabinet walls are constructed with air vents and installed with fins. The block heat sources dissipate heat to the cabinet surrounding through the thermal interaction between the interior and surrounding of cabinet. The numerical computation domain covers the cabinet and its surrounding area. The boundary conditions of the temperature and heat flux for cabinet wall are not previously known and have to be found in the solution processes. In this study the ESI CFD–ACE is employed to carry out the numerical simulation. The effects of grid arrangement and computation domain of the surrounding area are carefully tested. Furthermore the results of limiting cases are verified with relevant articles [3].

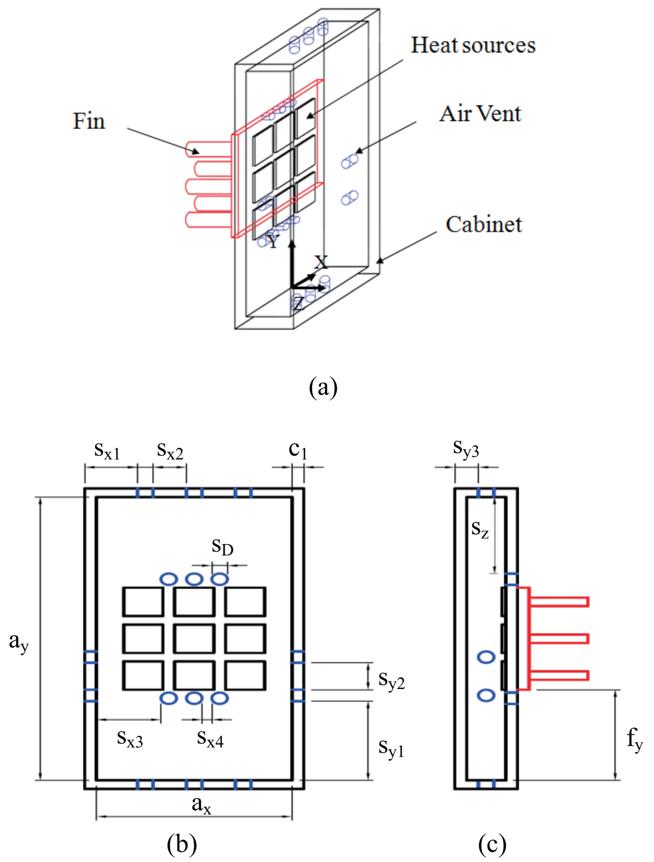

Fig. 1 Schematic diagram of physical system, (a) 3-D cabinet containing heat sources, and with air vents and fins, (b) X-Y plan sectional view, (c) Y-Z plan sectional view.

3. Results and Discussions

Figure 2 represents the temperature distributions for the cases without and with fins or vents. It is seen that the installation of fins and construction of vents can significantly reduce the temperatures of block heat sources. In addition the results show that, for the fin number F_N=23, the hot spot temperature of the blocks can be reduced up to 28.47% as A_x = 0.5, A_z = 0.1, B_x = B_y = 0.1, B_z=0.01, Ra =5 × 106, K_{ba}=5000, K_{ca}=600 and K_{fa} = 8000. The hot spot temperature of the blocks can be reduced by 9.97% when cabinet walls are constructed air vents with S_D=0.04 and S_N=16. The difference of hot spot temperature of the blocks is about 35.42% for K_{ca}=600, and K_{fa}=8000, FN=23, S_D=0.04 and S_N=6 when the fins are installed and air vents are constructed simultaneously.

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4. Conclusions

This study proposes a model to investigate the conjugate conduction and natural convection for block heat sources mounted on one of the walls of a 3-D cabinet filled and surrounded by air. Attention is given to the enhancement of cooling performance by installing fin and constructing air vents. The numerical simulation is rigorously performed in this study. The numerical computation domain covers the cabinet and its surrounding area. The boundary conditions of the temperature and heat flux for cabinet wall are not previously known and have to be found in the solution processes. Results show that, for the fin number F_N=23, the hot spot temperature of the blocks can be reduced up to 28.47%. The hot spot temperature of the blocks can be reduced by 9.97% when cabinet walls are constructed air vents with S_D=0.04 and S_N=16. The difference of hot spot temperature of the blocks is about 35.42% when the fins are installed and air vents are constructed simultaneously.

Acknowledgements

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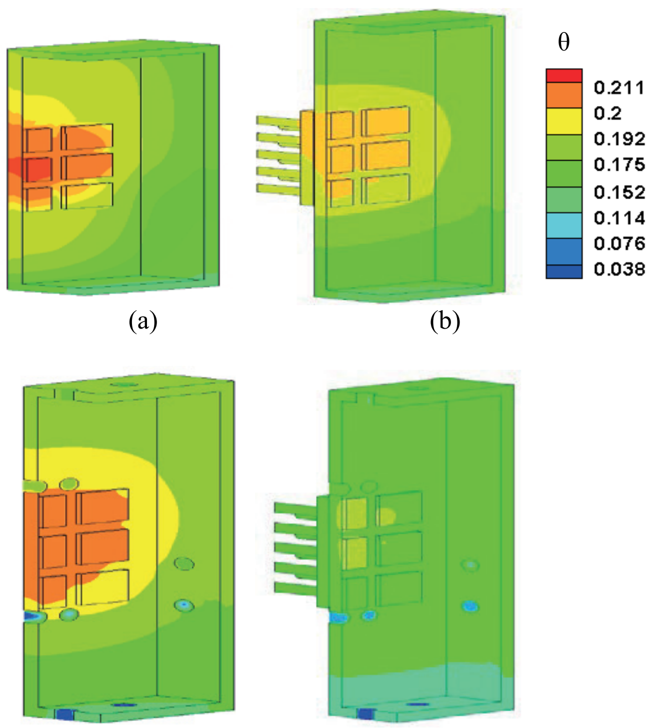

Fig. 2 Temperature distributions in the half cabinet, block heat sources and fins, (a)without fins and air vents ; (b) with fins and without air vents ; (c)with air vents and without fins ; (d)with fins and air vents.

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