行政院國家科學委員會專題研究計畫 成果報告

光資訊儲存系統之微細讀寫機構與控制技術研究(II)
研究成果報告(精簡版)

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行政院國家科學委員會補助專題研究計畫 成果報告

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目錄

摘要

藍光 BD 讀寫系統因其高容量之儲存能力將成為光資訊儲存產品市場主流。但藍光 BD 讀寫系統需與 CD、DVD 碟片兼容，因此不同波長雷射光源裝置造成藍光讀寫頭之體積過於龐大。如何使藍光讀寫系統之讀取寫頭微型化、輕量化便成為當前的研發課題。本文介紹基於單模光纖系統之微光學讀寫機構設計與分析，說明如何藉由單模光纖及其週邊元件，將系統中的雷射光源光學組件及驅動電路由光學讀寫頭分離出來以達到微型化、輕量化的目的。

關鍵詞：單模光纖、物鏡、光纖式光學讀寫頭

Abstract

Blu-ray Disc drive system becomes the mainstream on optical data storage products market because of its high storage capacity. However, the BD optical pickup head is quite bulky because it has to be backward compatible with CD and DVD discs caused the BD optical pickup system needs to equip different laser light sources. So, the important subject for research and development of BD pickup head is how to reduce the size and weight. This article introduces the system structure of micro optical pick up head design and analysis based on single mode optical fiber system to separate the laser diode optics modules and driving circuit board from optical pick up head for reducing the size and weight of traditional optical pick up head.

Keywords: Single mode fiber, object lens, spot size.

一、 前言

目前市面上常見之 CD、DVD 紅光讀寫系統所採用的是紅光雷射：CD 紅光讀寫系統之雷射波長為 780 *nm*，光碟片之 *NA* 值為 0.45、軌距為 1.6 μm、記錄點為 0.83 μm，資料層深度為 1.2 *mm*；DVD 紅光讀寫系統之雷射波長則是 650 *nm*，光碟片之 *NA* 值為 0.6、軌距為 0.74 μm，資料層深度為 0.6 *mm*、記錄點為 0.4 μm。新一代的 BD 藍光讀寫系統之雷射波長為 405nm，光碟片之 *NA* 值為 0.85、軌距為 0.32 μm、記錄點為 0.14 μm，資料層深度為 0.1 *mm*。紅光讀寫系統與藍光讀寫系統兩者間最明顯的差異處在於單位面積內之儲存容量。

藍光光碟片的高容量、高解析度、高相容性、高自由度在高畫質世界當中扮演關鍵性的地位，在光資訊儲存界中勢必成為主流。

二、 研究目的

光資訊儲存系統已逐漸成為大量數位資料存取之重要工具，而光學讀取頭乃是光資訊儲存系統技術發展中之關鍵技術，要求其輕量且體積小巧。為了達到 25GB 高密度藍光碟片的資訊存取且兼容於前期 CD/DVD 光碟片，具有 780/650/405 nm 光波長之光源及光學鏡片模組須同時設計在目前藍光讀取頭中，如此設計之裝置增加光學讀取頭體積及重量。因此如何縮小光學讀取頭尺寸為發展高密度光資訊儲存系統之重要課題。

本研究計畫主要目的在發展微細光學讀取頭的設計方法，研究將 780/650/405 nm 光波長之光源模組、光學鏡片模組及光偵測電路等組件與光學讀取頭分離，而以光纖傳輸雷射光至物鏡，聚焦光點於碟片上，以讀取資料。此設計方式有兩大優點：一、減少光學讀取頭體積及重量，由於光學讀取頭致動件部份只留下物鏡、光纖、線圈與磁鐵，大幅縮減光學讀取頭外型尺寸。二、光源模組、光學鏡片模組及光偵測電路成為在電路板上之固定件，因此其零組件無需特別縮小以能置入光學讀取頭中，使國內相關零組件(尤其在藍光二極體模組)供應商無需受限於各光學讀取頭生產廠規定之尺寸。

本研究計畫分為三年執行，第二年將研究與設計光纖與物鏡整合之光學系統，並分析機構動態特性，以讀取光碟片上之凹點信號。本計畫研究微細光學讀取頭設計方式，縮減傳統光學讀取頭之體積、重量及增加光傳導效率。而計畫執行之成果，可進一步將此微細光學讀取裝置朝向商品化設計應用研究。

三、 文獻探討

SONY 曾於專利 6966707 與 6349082 中提出新型光學讀寫頭的構想：利用光纖使讀寫頭達到小型化的目的。其架構如圖 2.1 與圖 2.2 所示：

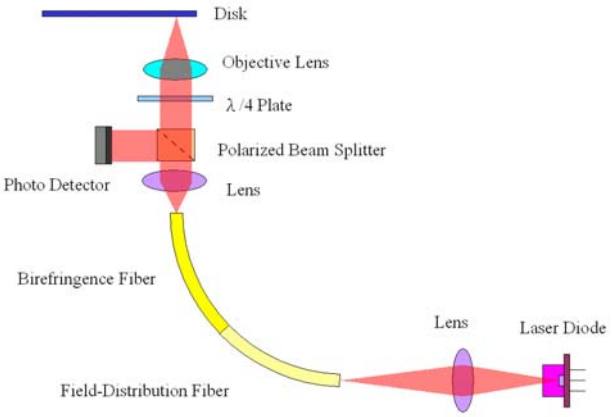

圖 2.1 SONY 專利 6966707 之架構圖

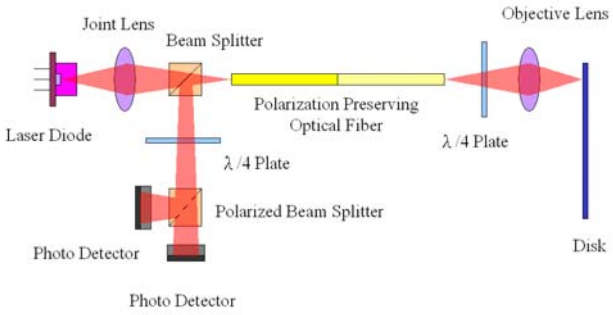

圖 2.2 SONY 專利 6349082 之架構圖

SONY 專利 6966707 中，光由雷射半導體射出，經由透鏡聚焦入射至光纖。藉由場變換光纖(Field-Distribution Converting Fiber)與雙折射光纖(Birefringence Fiber)所結合的光纖系統如圖 2.3 所示。當雷射光通光纖系統時，入射光可在第一段光纖中被整形並於第二段光纖中起偏，使出射光之雷射光成為圓形的線性偏振光。之後藉由透鏡使出射光成為平行光，再經由起偏分光鏡使入射光產生偏振，之後由物鏡聚焦至光碟上讀寫資訊再回傳至光偵測器。

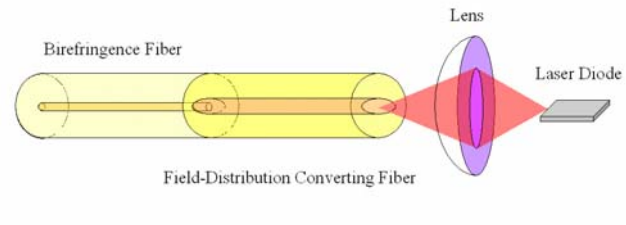

圖 2.3 SONY 專利 6966707 之光纖系統架構圖

SONY 專利 6349082 中，將保偏光纖(polarization preserving optical fiber)應用於多重光碟讀寫系統上。透過兩段保偏光偏之結合如圖 2.4，可用於維持雷射光之偏振態。不論是讀寫凹槽式光碟(pit pattern disc)、相位變換光碟(phase change disc)或是磁光光碟(magneto-optical disc)，此系統皆能完成資料之存取、循軌、聚焦之偵測。

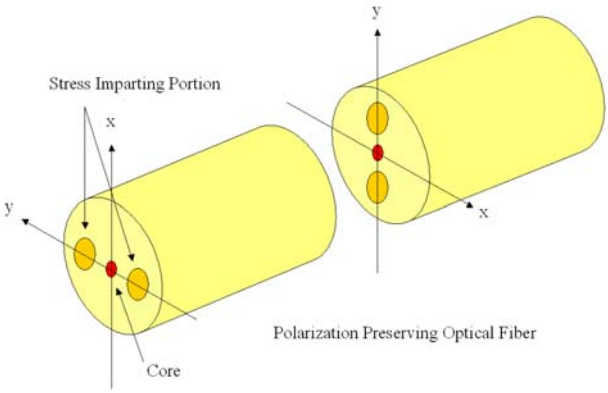

圖 2.4 SONY 專利 6349082 之光纖系統架構圖

上述 SONY 兩篇專利之特點為兩段光纖之結合，作為雷射光整形或偏振態轉換，並可減少光學元件。

設計理念

由於藍光讀寫系統之讀寫頭是由 CD 紅光雷射、DVD 紅光雷射、BD 藍光雷射所組成，因此體積龐大，在控制上及微型化上都會面臨相當的問題。若能將電路板及雷射光之光源由讀寫頭分離出來。減少光學元件即可降低系統負載，使讀寫頭在控制上及微型化上能有效改善。

本研究之設計理念藉由單模光纖之特性，使電路版及雷射光之光源由讀寫頭分離出來，並簡化光學讀寫頭中之光學元件。透過光纖將雷射傳送至讀寫頭讀寫光碟片上之訊號並再次透過光纖回傳，再以偏振分光鏡將雷射光束傳遞至光偵器上。一來便能降低光學讀寫頭上的負載，二來可簡化光學讀寫頭上的元件，使讀寫頭更佳利於控制，在設計上也能朝微型化的方向發展並提高良率。

系統架構

本文之系統架構如圖 2.5 所示：

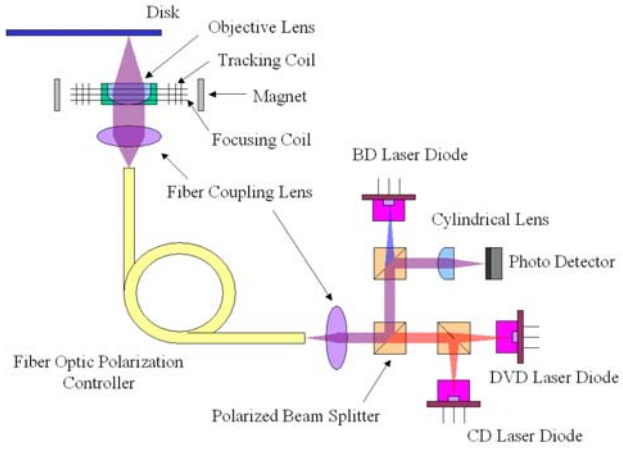

圖 2.5 系統架設示意圖

由單模光纖為核心所構成之光學讀寫頭之架構如圖 2.5 所示。雷射光束由雷射半導體(laser diode)射出，經由偏振分光鏡(polarized beam splitter)由非偏振光轉變為線性偏振光，再由透鏡聚焦入射至單模光纖中。當雷射光通過單模光纖時，因單模光纖受應力彎曲產生四分之一波片之效果，雷射光由單模光纖出射時將改變為圓偏振光。之後藉由透鏡使出射之雷射光束轉變為平行光，再由物鏡(objective lens)將雷射光束聚焦至光碟片上讀寫其資訊。當雷射光由光碟片回傳時，將透過

物鏡、透鏡等元件回到單模光纖中，由單模光纖出射時將透過偏振分光鏡，將光傳遞至光偵測器(photo detector)上接收訊號，並做循軌與聚焦之伺服動作。

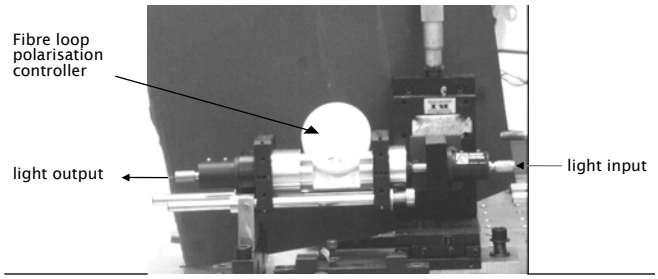

圖 2.6 光纖干涉儀中之光纖環偏振控制器

系統參數

由圖 2.5 之系統架構，其中單模光纖部分如圖 2.7、圖 2.8、圖 2.9 所示：

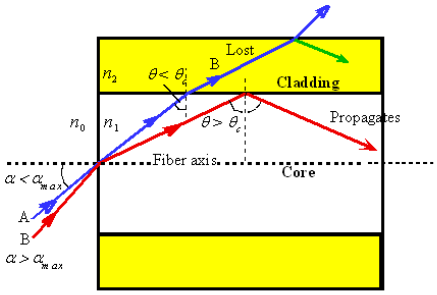

圖 2.7 雷射入射至光纖之示意圖

NA：光纖之數值孔徑

n_0：入射光所在介質之折射率

n_1：光纖核心之折射率

n_2：光纖包層之折射率

α：雷射光入射至光纖核心之角度

α_{max}：雷射光入射至光纖核心且能發生全內反射之角度

θ：雷射光於光纖核心入射至包層之角度

θ_C：雷射光能在光纖中發生全內反射之角度

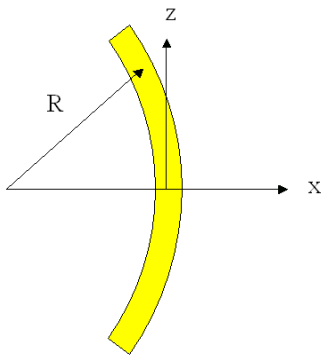

圖 2.8 單模光纖受應力產生形變之示意圖

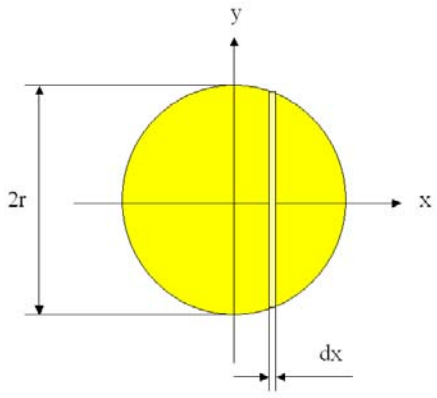

圖 2.9 單模光纖受應力產生折射率改變之區塊

σ_x：光纖延 x 方向之應力分量

σ_z：光纖延 z 方向之應力分量

E：楊氏係數

n：光纖之折射率

v：卜瓦松常數

p_{ij}：光彈係數

$\kappa=\frac{1}{R}$：光纖彎曲之曲率

$2r$：光纖之外徑

β_b：雙折射率

k_x：在 HE_{11} 之模態下，延 x 軸偏振之傳遞常數

k_y：在 HE_{11} 之模態下，延 y 軸偏振之傳遞常數

至於能否讀寫光碟片上的資訊還有一個相當重要的因素，即物鏡取焦後的光點大小及工作距離，如圖 2.10 所示：

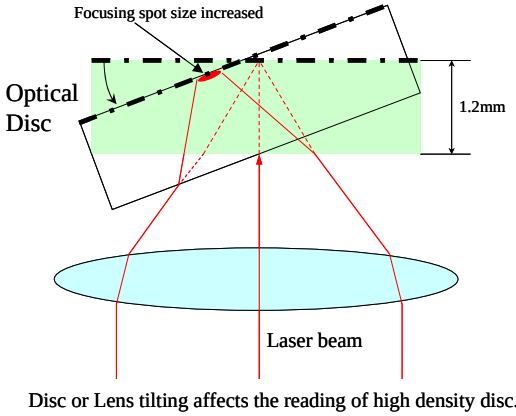

圖 2.10 光碟片的擾動對光點大小之影響

D_{Airy}：雷射光聚焦後之光點直徑

λ：雷射光之波長

f：焦距

k：f 數

ϕ_{EP}：自由空間之直徑

數學推導

由圖 2.7 可知：

$$n_0 \sin\alpha = n_1 \cos\theta \quad (1)$$

$$n_1 \sin\theta = n_2 \sin\theta_C \quad (2)$$

雷射光能在光纖中產生全反射之條件為 $\theta_C = 90^o$，故可得：

$$\cos\theta = \frac{\sqrt{n_1^2 - n_2^2}}{n_1} \quad (3)$$

$$\sin\alpha = \frac{\sqrt{n_1^2 - n_2^2}}{n_0} \quad (4)$$

其中，入射光所在之介質為空氣，光纖核心之折射率為 1.468，光纖核心之折射率為 1.467，即：

$$n_0 = 1 \quad (5)$$

$$n_1 = 1.468 \quad (6)$$

$$n_2 = 1.467 \quad (7)$$

故可得：

$$\alpha = \sin^{-1}\left(\frac{\sqrt{n_1^2 - n_2^2}}{n_0}\right) = 3.11^o \quad (8)$$

由式(8)可知：

當雷射光入射至光纖之入角角為 3.11°時，雷射光可透過光纖傳遞至出射端。

在彎曲的光纖中：

$$\sigma_z = \kappa E x \quad (9)$$

其中 $x > 0$ 時，σ_z 為張力；$x < 0$ 時 σ_z 為壓力

設 $\kappa r \ll 1$，當光纖如圖 2.8 彎曲時，$|\sigma_x| \ll |\sigma_z|$，則張力 $\sigma_x(x)$ 可表示為：

$$\sigma_x(x+dx) - \sigma_x(x) = (R+x)^{-1}\sigma_z(x)dx \quad (10)$$

$$\frac{\partial\sigma_x}{\partial x} = \kappa^2 E x \quad (11)$$

$$\sigma_x(x) = \kappa^2 \frac{E}{2}\left(x^2 - r^2\right) \quad (12)$$

$$\beta_b = k_x - k_y \approx k\left(\Delta n_x - \Delta n_y\right)，\ k = \frac{2\pi}{\lambda} \quad (13)$$

$$\Delta n_i = -\left(\frac{n^3}{2}\right)\sum p_{ij}\varepsilon_j \quad (14)$$

$$\Delta n_x = \frac{n^3}{4}\left(p_{11} - 2\nu p_{12}\right)\left(\frac{r}{R}\right)^2 \quad (15)$$

$$\Delta n_y = \frac{n^3}{4}\left(p_{11} - \nu p_{12} - \nu p_{11}\right)\left(\frac{r}{R}\right)^2 \quad (16)$$

$$\Delta n = \Delta n_x - \Delta n_y = -0.133 \cdot \left(\frac{r}{R}\right)^2 \quad (17)$$

$$\beta = k_x - k_y \approx \frac{2\pi}{\lambda}\Delta n = \frac{2\pi}{\lambda}\left(\Delta n_x - \Delta n_y\right) \quad (18)$$

對圈數 N 、曲率半徑 R 之光纖而言，其相位延遲為：

$$\left|\Delta n\right| \cdot 2\pi NR = \frac{\lambda}{m} \quad (19)$$

其中 $m : 2, 4, 8, \ldots for \frac{\lambda}{2}, \frac{\lambda}{4}, \frac{\lambda}{8}, \ldots$

$$\left|\Delta n_x - \Delta n_y\right| \cdot 2\pi NR = \frac{\lambda}{m} \quad (20)$$

$$2\pi NR\left|0.02736\left(\frac{r}{R}\right)^2 - 0.1641\left(\frac{r}{R}\right)^2\right| = \frac{\lambda}{m} \quad (21)$$

$$R = 0.13674 \cdot \frac{2\pi r^2}{\lambda} Nm \quad (22)$$

由式(22)可知：

當光纖彎曲至適當的曲率後，配合圈數等參數可將單模光纖用以取代四分之一波片。

由圖 2.10 可知：

$$D_{Airy} = 2.44\lambda k \quad (23)$$

$$k = \frac{f}{\phi_{EP}} \quad (24)$$

因此，光碟片上之聚焦角度為

$$\sigma = \tan^{-1}\frac{\phi_{EP}}{2f} = \tan^{-1}\frac{1.22\lambda}{D_{Airy}} \quad (25)$$

若能配合光纖並設計出適當的物鏡等再配合週邊元件，之後透過機構設計追跡、聚焦，即可使讀寫頭與電路板分離讀寫光碟片上的資料。

四、 研究方法

系統設計

在微光纖讀寫頭中，光碟片聚焦之物鏡的設計亦伴演著重要的角色。透過光學軟體 Code V 的功能，可以用來設計非球面物鏡並分析其聚焦後之波前像差與 Sterhl ratio。

模擬結果

物鏡為讀寫光碟片資料之光學讀寫頭中的重要光學元件之一，因此在設計上需滿足光學系統之規格。BD 碟片之 *NA* 為 0.85、DVD 碟片之 *NA* 為 0.6、CD 碟片之 *NA* 為 0.45。且設計非球面透鏡時還需滿足雷射光之波長(BD 波長 405 *nm* 、DVD 波長 650 *nm* 、CD 波長 780 *nm*)。經由光學軟體 Code V 系統之設計分析結果如下所示。

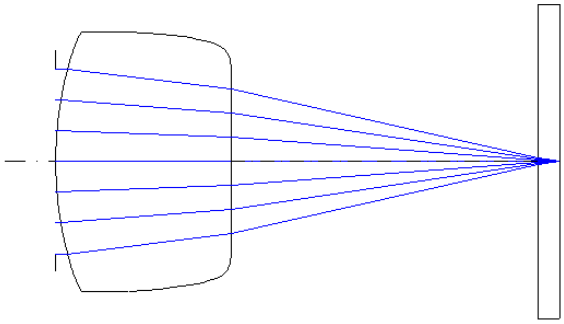

圖 3.1 由 Code V 設計之物鏡光路圖(BD)

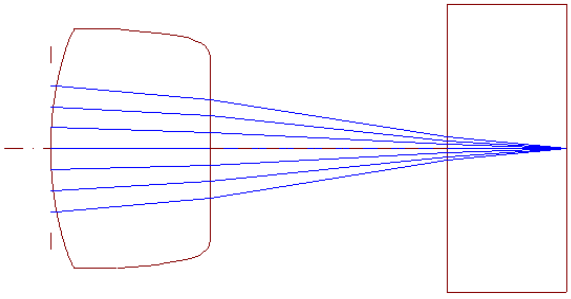

圖 3.2 由 Code V 設計之物鏡光路圖(DVD)

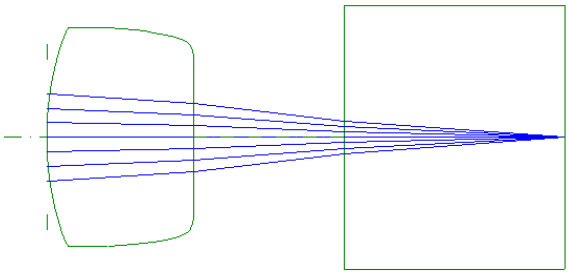

圖 3.3 由 Code V 設計之物鏡光路圖(CD)

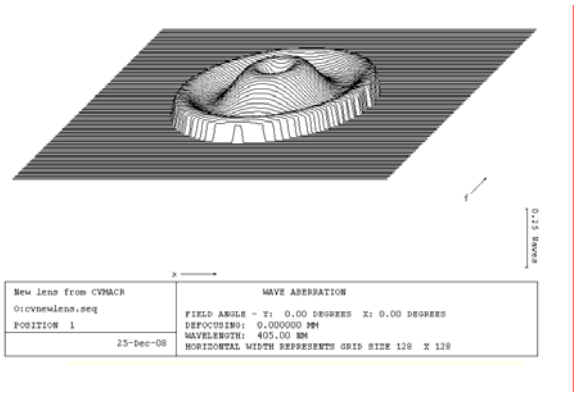

圖 3.4 由 Code V 分析之物鏡聚焦波前圖(BD)

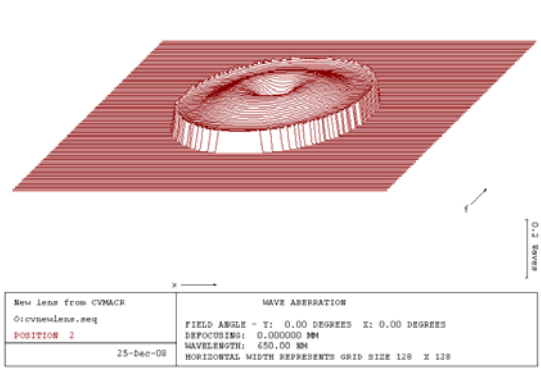

圖 3.5 由 Code V 分析之物鏡聚焦波前圖(DVD)

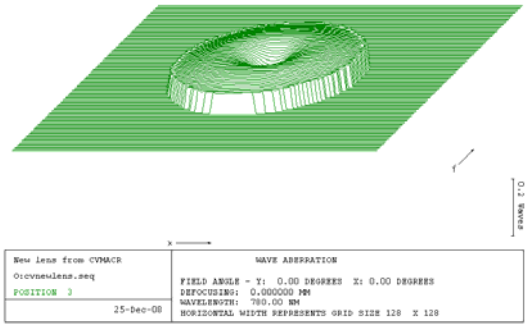

圖 3.6 由 Code V 分析之物鏡聚焦波前圖(CD)

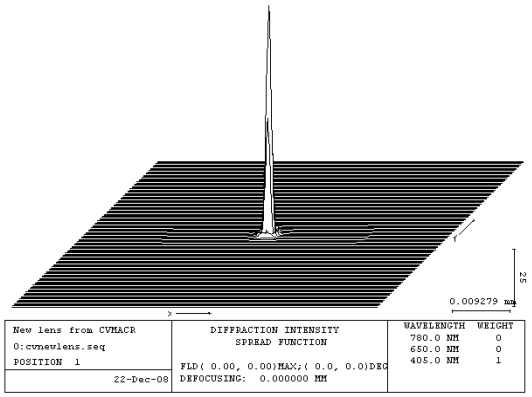

圖 3.7 由 Code V 分析之點擴散函數圖(BD)

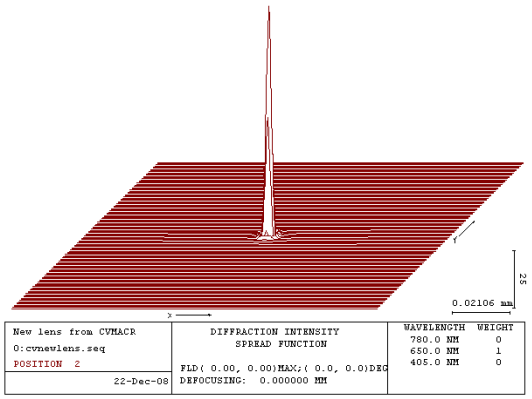

圖 3.8 由 Code V 分析之點擴散函數圖(DVD)

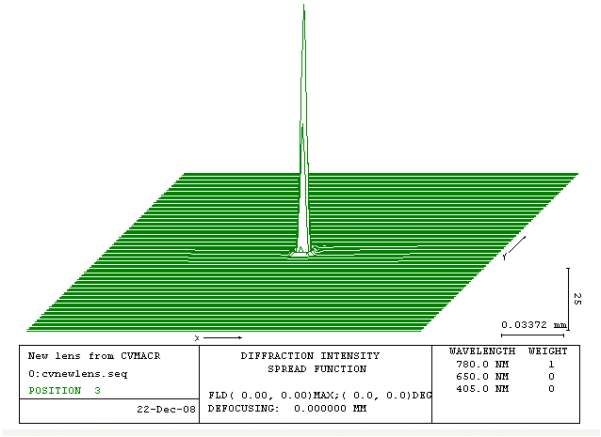

圖 3.9 由 Code V 分析之點擴散函數圖(CD)

經 Code V 之波前分析可得此物鏡之效能。BD 之波前像差為 0.0347、Sterhl ratio 為 0.953；DVD 之波前像差為 0.0117、Sterhl ratio 為 0.995；BD 之波前像差為 0.0108、Sterhl ratio 為 0.995。經過適當的聚焦微調後，此物鏡即可讀寫光碟片儲存之資訊。

實驗架構

完成光纖讀寫系統之設計、模擬與分析後，藉由實驗平台驗証軟體之模擬結果是相當重要的一環。在光學桌上以綠光雷射(波長 530 nm)為光源再加上偏振分光鏡、光纖耦合器等光學元件架設出光纖讀寫系統，並以平面鏡取代光碟片架設出整體系統如圖 4.1 所示。

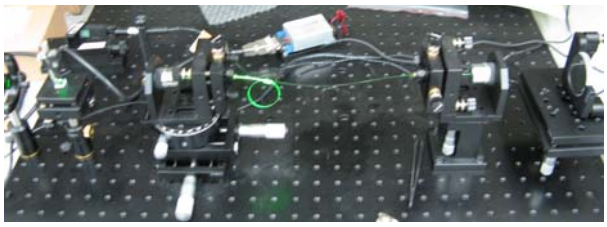

圖 4.1 整體系統架構圖

圖 4.2 光強度偵測器讀取之數值

由上列圖片可知，雷射光束可由雷射半導體射出，經由偏振分光鏡由非偏振光轉變為線性偏振光，再由光纖耦合器聚焦入射至單模光纖中。當雷射光通過單模光纖時，因單模光纖受應力彎曲產生四分之一波片之效果，雷射光由單模光纖出射時將改變為圓偏振光。之後藉由光纖耦合器使出射之雷射光束轉變為平行光，再傳遞至平面鏡上。當雷射光由平面鏡回傳時，將透過顯微物鏡等元件回傳至單模光纖中，由單模光纖出射時將透過偏振分光鏡，將光傳遞至光偵測器上接收訊號，由圖 4.2 可知，回傳之光強度約為 0.05mW 。此光強度仍屬偏低，如何提升效能為本系統設計之努力方向之一。

五、 結果與討論

藍光讀寫系統之讀寫頭是由 CD 紅光雷射、DVD 紅光雷射、BD 藍光雷射所組成，因此體積龐大，在控制上及微型化上都會面臨相當的問題。藉由單模光纖之特性，使電路版及雷射光之光

源由讀寫頭分離出來，再透過光纖將雷射傳送至讀寫頭讀寫光碟片上之訊號並再次透過光纖回傳至光偵器。

由軟體模擬與實驗結果可知，微光纖讀寫頭之構想是可行的。雷射光束可由雷射半導體射出，經由偏振分光鏡由非偏振光轉變為線性偏振光，再由顯微物鏡聚焦入射至單模光纖中。當雷射光通過單模光纖時，因單模光纖受應力彎曲產生四分之一波片之效果，雷射光由單模光纖出射時將改變為圓偏振光。之後藉由顯微物鏡使出射之雷射光束轉變為平行光，再由物鏡傳遞至光碟片上。當雷射光由光碟片回傳時，將透過顯微物鏡等元件回傳至單模光纖中，由單模光纖出射時將透過偏振分光鏡，將光傳遞至光偵測器上接收訊號。

透過這種微型化的過程，BD 讀寫頭可望達成小型化、輕量化，此做法在藍光讀寫機構的發展上，可說是種新設計方式。

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七、 計畫成果自評部份

本研究內容與原計畫規劃之進度相符、達成預期目標。研究成果之學術或應用價值適合在學術期刊發表。

- **國內會議論文發表**: 江柏融 鄭泗東,“基於單模光纖系統之微光學讀寫機構設計與分析” 2009 奈米工程暨微系統技術研討會，新竹市，98 年 7 月 9-11 日。
- **國際會議論文發表 最佳論文獎**(決選): Po-jung Chiang, Stone Cheng, “Micro Optic Pickup Head Design and Analysis Based on Single Mode Optical Fiber System,” The 10th International Conference on Automation Technology (Automation 2009), Tainan/Taiwan, June 27-29, 2009.
- **期刊論文 submitted**: Stone Cheng, Po-jung Chiang, "New Optical Pickup Head Design and Analysis Based on Single Mode Optical Fiber System," **Optical Engineering**.

出席國際學術會議心得報告

計畫編號	NSC 97-2221-E-009-026
計畫名稱	**光資訊儲存系統之微細讀寫機構與控制技術研究(II)**
出國人員姓名 服務機關及職稱	**鄭泗東 國立交通大學 機械工程學系 助理教授**
會議時間地點	*Edinburgh/Scotland, August 6-8, 2008*
會議名稱	*The ECSIS Symposium on Learning and Adaptive Behavior in Robotic Systems, LAB-RS 2008,*
發表論文題目	**AC Servo drive with Dual Robust Controller Design**

一、參加會議經過

97/8/05　搭機出國至英國愛丁堡

97/8/06~08　參加研討會，會場即在愛丁堡大學會議廳，本次的會議為期總共三天，第一天先在報到處簽到並領取會議資料，之後參加早晨的 Keynote speech 及上下午的其他學者 presentation 會議。隔天，聆聽其他學者 presentation 會議及參加壁報論文展示。個人論文報告的時間排在 8/06 的下午。在全體參加會議之報告後，由全體與會學者作討論，至此三天的會議行程圓滿結束。

二、與會心得

參與國際會議除發表個人近期研究成果外，不外乎瞭解目前其他研究單位最新的發展情況、尋求具潛力的研究方向以及語言上的溝通與交流。每個作者的報告大約為 20 分鐘，可以讓其他學者有初步的認識，對當今國際上研究的趨勢、進度、方法都有基本的認識，這對我們的研究是很大的幫助。會場中，認識包括來自美國、英國、中國、義大

利及加拿大的許多學者。除了認識各國文化外，我們亦相互分享彼此的研究內容與經驗。

本屆會議收錄論文數量 40 篇，其中許多有關 Robotic 及 Adaptive algorithm 主題的論文。由於曾在工研院參與類似的研究計畫，個人認為此方面之主題較台灣相關的研究成果深入且完整。國內學者自行研究投稿的論文，主要在 mixed signal 主題的範圍。個人在會議中之口頭報告主題為: AC Servo drive with Dual Robust Controller Design.

國際學術會議 簡介

The ECSIS Symposium on Learning and Adaptive Behavior in Robotic Systems, LAB-RS 2008, will be held in Edinburgh, Scotland from August 6-8, 2008. The Proceedings will be published by the IEEE Computer Society Press. This Symposium is being held in conjunction with the ECSIS Symposium on Bio-inspired Learning and Intelligent Systems for Security (BLISS-2008) to be held in Edinburgh on Aug 4-6, 2008.

Scope: Learning and adaptive behaviors are key to robotics system operation in real world environments. While there have been important developments at the theoretical level and in simulations or laboratory environments, the transfer of these methods onto realworld platforms has been limited. This symposium will bring together researchers from academia and industry to report on new concepts, laboratory demonstrations, and fielded robotic systems that exhibit learning and adaptive behaviors. The goal of the symposium is to roadmap future directions for development of robotic systems with capabilities comparable to those of biological systems.

Topics to be covered include, but are not limited to:

Technologies:

- Robot learning
- Dynamics of learning
- Learning in real environments
- Adaptive behaviours
- Nano robotics
- Adaptive sensing
- Bio-inspired algorithms and technologies
- Neural networks
- Evolutionary algorithms
- Adaptive information processing
- Collaborative learning
- Soft computing techniques
- Dynamic and reinforcement learning
- Legged locomotion
- Adaptive formation flying
- Hybrid and adaptive architectures
- Adaptive multi-robot

Application areas

- Autonomous ground vehicles
- Unmanned Aerial Vehicles
- Unmanned Underwater
- Vehicles
- Industrial Robots
- Construction Robots
- Humanoids and Actroids

- Human-centric systems
- Security robots
- Training systems (modelling, simulation,
- virtual environments)
- Cooperative and collaborative robotics

國際學術會議 議程

BLISS 2008
4-6 August, Edinburgh, Scotland, UK
LAB-RS 2008
6-8 August, Edinburgh, Scotland, UK

Systems, Man, & Cybernetics Society

IEEE computer society

Monday August 4, 2008

DAY 1	BLISS (Playfair Library Hall - Old College)	
08:00	Registration	BLISS Registration
09:00	Opening	Organizational remarks
09:10	Keynote 1	**Security v Business: A Balancing Act** *Nigel Stinton, Howden Group Ltd*
09:55	Break 1	***Coffee Break (Playfair Library Hall)***
		Session A: Biometrics
10:15	A1	Effecting an improvement to the fitness function. How to evolve to a more identifiable face *Charlie Frowd, Joanne Park, Alex McIntyre, Vicki Bruce, Melanie Pitchford, Steve Fields, Mary Keniron and Peter J.B. Hancock, University of (Central Lancashiren, Stirling, Edinburgh, Leicester), UK*
10:40	A2	Biometric-Based Decision Support Assistance in Physical Access Control Systems *S. Chague, B. Droit, France, O. Boulanov, S. N. Yanushkevich, V. P. Shmerko, Canada and A. Stoica, USA*
11:05	A3	Evaluating Biometric Encryption Key Generation using Handwritten Signatures *Samaul Haque, Michael Fairhurst, Gareth Howell, University of Kent, UK*
11:30	Keynote 2	**CHLAC Approach to Flexible and Intelligent Vision Systems** *Nobuyuki Otsu, AIST/University of Tsukuba, Japan*
12:15	Lunch	***Lunch provided (Playfair Library Hall)***
		Session B: CHLAC Pattern Recognition *(Invited)*
13:15	B1	Development of Software for Real-time Unusual Motions Detection by Using CHLAC *Kenji Iwata, Yutaka Satoh, Katsuhiko Sakaue, Takumi Kobayashi and Nobuyuki Otsu, AIST, Japan*
13:40	B2	HLAC Approach to Automatic Object Counting *Takumi Kobayashi, Tadaaki Hasaka Shu Mimura, Takashi Hayashi Nobuyuki Otsu, AIST, UTI, NARC, Japan*
14:05	B3	Object Detection by Selective Integration of HLAC Mask Features *Akinori Hidaka, University of Tsukuba, Takio Kurita, Nobuyuki Otsu, AIST, Japan*
14:30	B4	Motion Recognition by Higher Order Local Auto Correlation Features of Motion History Images *Kenji WATANABE, University of Tsukuba, and Takio KURITA AIST, Japan*
14:55	Break 2	***Coffee Break (Playfair Library Hall)***
15:10	B5	The Cow Gait Recognition using CHLAC *Shu Mimura and Keichi Itoh, United Technology Institute, and Takumi Kobayashi and Nobuyuki Otsu, AIST, Tomohiro Takigawa and Atsushi Tajima, University of Tsukuba, Atsushi Sawamura, National Institute of Livestock and Grassland Science, Japan*
		Session G: Models, Algorithms (I)
15:35	G1	Stochastic Interpolation: A Probabilistic View *Joseph Kolibal, University of Southern Mississippi, USA, Daniel Howard, QinetiQ, UK*

16:00	G2	A Securable Autonomous Generalised Document Model (SAGENT) *Gareth Howells, Hossam Selim, Michael Fairhurst, Farzin Deravi, Sanaul Hoque, University of Kent, UK*
16:25	G3	Granular Association Analysis *Yun Shen and Trevor Martin, University of Bristol, UK*
16:50	G6	Bioinspired Constructive Simulation *(Invited)* *Daniel Howard, QinetiQ, UK*
17:15	Close	End of Day 1

		Tuesday August 5, 2008
DAY 2		**BLISS** **(Playfair Library Hall)**
09:00	Opening	**Organizational remarks**
09:10	Keynote 3	**Computational Intelligence in Cyber Security** *Dipankar Dasgupta, The University of Memphis, USA*
09:55	Break 1	***Coffee Break (Playfair Library Hall)***
		Session C: Cyber security
10:10	C1	Using A Cognitive Architecture to Automate Cyberdefense Reasoning *D. Paul Benjamin, Pace University, Partha Pal, Franklin Webber, Paul Rubel and Mike Atigetchi, BBN Technologies, USA*
10:35	C2	Network Intrusion Detection by Using Cellular Neural Network with Tabu Search *Zhongxue Yang and Ning Yang, Nanjing Xiaozhuang University, China, Adem Karahoca, Ning Yang, Nizamettin Aydina, Bahcesehir University, Turkey*
		Session D : Device and Embedded Systems Security
11:00	D1	Fuzzy Vault Fingerprint Smartcard Implementation Using an Orientation-Based Feature Vector *K. Harmer, W. Sheng, G. Howells, M. Fairhurst & F. Deravi, University of Kent, UK*
11:25	D2	Detecting Voltage Glitch Attacks on Secure Devices *Asier GOIKOETXEA YANCI, ISLI, Stephen PICKLES, Atmel, Tughrul ARSLAN, University of Edinburgh, UK*
11:50	D3	Towards Embedded Artificial Intelligence Based Security for Computer Systems *A.B.T. Hopkins, P. Sartain, K.D. McDonald-Maier, University of Essex, and W.G.J. Howells, University of KENT UK*
12:15	Lunch	***Lunch provided (Playfair Library Hall)***
13:15	D4	Effects of Feature Trimming on Encryption Key Stability for an ICmetric System *Evangelos Papoutsis, Gareth Howells, University of Kent, and Andrew Hopkins and Klaus McDonald-Maier, University of Essex, UK*
13:40	D5	Tamper Protection for Security Ddevices *Philip Paul and Simon Moore, University of Cambridge, and Simon Tam, TAM consulting, UK*
		Session G: Models, Algorithms (II)
14:05	G4	Clone-Resistant DNA-Like Dynamic Secured Identity *Wael Adi, Technical University of Braunschweig, Germany*
14:30	G5	The Re-emission Side Channel *Andrew Burnside, ISLI, Ahmet Erdogan and Tughrul Arslan, The University of Edinburgh, UK*
14:55	Break 2	***Coffee Break (Playfair Library Hall)***
		Session E: Sensing Systems
15:10	E1	Analytical Modelling: An Investigation into the use of Smart Biosensors as Stealth Countermeasures *H J Kadim, LIMU, UK*
15:35	E2	Partially Observable Markov Decision Process for Transmitter Power Control in Wireless Sensor Networks *Adrian Udenze and Klaus McDonald-Maier, University of Essex, UK*
16:00	E3	High-level functional architecture for sensor management system *Isabella Panella, Thales, UK*
16:25	Panel	**Panel Discussion**
16:50	Closing	**End of Day 2**

Wednesday August 6, 2008		
DAY 3	**BLISS and LAB-RS Joined Sessions (Playfair Library Hall)**	
08:00	**Registration**	**LABRS Registration**
09:00	**Opening**	**Organizational remarks**
		Session F: From Biometrics to Space and Airborne Security
09:10	**1A**	Mixture Model Segmentation for Gait Recognition *Matthew Field, David Stirling, Fazel Naghdy, Zengxi Pan, University of Wollongong, Australia*
09:35	**F1**	Toward Recognition of Humans and their Behaviors from Space/Airborne Platforms *Adrian Stoica, Jet Propulsion Laboratory, USA*
10:00	**F2**	Artificial intelligence methodologies applicable to support the decision-making capability on board Unmanned Aerial Vehicles *Isabella Panella, Thales, UK*
10:25	**F3**	WLAN for Earth Observation Satellite Formations in LEO *Tanya Vladimirova and Kawsu Sidibeh, University of Surrey, UK*
10:50	**Break 1**	***Coffee Break (Playfair Library Hall)***
11:10	**Keynote A**	**Space Robotics: Challenges to Learning and Adaptive Systems** *Paul S. Schenker, Jet Propulsion Laboratory, California Institute of Technology, USA*
12:00	**Lunch**	***Lunch provided (Playfair Library Hall)***
		Session 1: Human-Robot Interaction (LAB-RS)
13:15	**1B**	What is an Appropriate Theory of Imitation for a Robot Learner? *(Invited)* *Joe Saunders, Chrystopher L. Nehaniv and Kerstin Dautenhahn, University of Hertfordshire, UK*
13:40	**1C**	Drumming with a Humanoid Robot: Results from Human-Robot Interaction Studies *(Invited)* *Hatice Kose-Bagci, Kerstin Dautenhahn, and Chrystopher L. Nehaniv, University of Hertfordshire, UK*
14:05	**1D**	Movement Times in Inter- and Intrapersonal Human Coordination *Cordula Vesper, Sonja Stork and Anna Schubö, Ludwig-Maximilians-University, Germany*
14:30	**Panel 1**	Human-robot interaction in education: learning with robots Panel led by *Jinpeng Jiang and Qing Huo, P.R. China and A. Stoica, USA*
14:55	**Break 2**	***Coffee Break (Playfair Library Hall)***
15:10	**Video**	Video Competition
17:00	**Closing**	**End of Day 3 Sessions**
19:00	**Banquet**	**Symposia Dinner (South Hall - Pollock Halls)** **BLISS Best paper and LAB-RS Best Video Awards**

Thursday August 7, 2008		
DAY 4	**LAB-RS (Raeburn Room)**	
09:00	**Opening**	**Organizational remarks**
09:05	**Keynote B**	**How to Evolve Controllers for Truly Cooperative Robots** *Dario Floreano, ,Ecole Polytechnique Federale de Lausanne, Switzerland*
09:50	**Break 1**	***Coffee Break (Carstares Room)***
		Session 2: Neuro-Robotics
10:10	**2A**	Improving Robotic System Robustness via a Generalised Formal Artificial Neural System *Gareth Howells, Konstantinos Sirlantzis, University of Kent, UK*
10:35	**2B**	Scalable Biologically Inspired Neural Networks with Spike Time Based Learning *Lyle N. Long, The Pennsylvania State University and The California Institute of Technology, USA*
11:00	**2C**	Recurrent neural autoassociative learning of forward and inverse kinematics for movement generation of the redundant PA-10 robot *R. Felix Reinhart and Jochen J. Steil, Bielefeld University, Germany*

11:25	2D	Evolvability of Neuromodulated Learning for Robots *Peter Dürr, Claudio Mattiussi and Andrea Soltoggioo, University of Birmingham, UK and Dario Floreano, EPFL, Switzerland*
		Session 3: Learning
11:50	3A	Learning Vision Algorithms for Real Mobile Robots with Genetic Programming *Renaud Barate and Antoine Manzanera, ENSTA – UEI, France*
12:15	Lunch	***Lunch provided (Carstares Room)***
13:15	3B	Towards Object Classification using 3D Sensor Data *S ören Schwertfeger, Jann Poppinga, Max Pfingsthorn and Andreas Birk, Jacobs University, Germany*
13:40	3C	Learning Robot Dynamics for Computed Torque Control using Local Gaussian Processes Regression *Duy Nguyen-Tuong and Jan Peters, Max Planck Institute for Biological Cybernetics, Germany*
14:05	3D	Surprise-Based Learning for Developmental Robotics *Nadeesha Ranasinghe and Wei-Min Shene, University of Southern California, USA*
14:30	3F	Continuous Adaptation in Robotic Systems by Indirect Online Evolution *Marcus Furuholmen, Mats Hovin, Jim Torresen and Kyrre Glette, University of Oslo, Norway*
14:55	Break 2	***Coffee Break (Carstares Room)***
		Session 4: Behavior Design and Integration
15:10	4A	Using Cognitive Semantics to Integrate Perception and Motion in a Behavior-based Robot *D. Paul Benjamin Deryle Lonsdale, Brigham Young University, and Damian Lyons, Fordham University and Siddtharth Patel, Pace University, USA*
15:35	4B	A Constraint-Based Behavior Fusion Mechanism on Mobile Manipulator *Shu Huang, Erwin Aertbeliien, Hendrik Van Brussel, Katholieke Universiteit Leuvene, Belgium*
16:00	Closing	**End of Day 4**

		Friday August 8, 2008
DAY 5		**LAB-RS (Raeburn Room)**
09:00	Opening	**Organizational remarks**
09:10	Panel 2	**Learning and adaptation: Robots Vs Biological systems**
11:05	Break 1	***Coffee Break (Carstares Room)***
		Session 5: Adaptive Designs
11:25	5A	Adaptive communication promotes sub-system formation in a multi agent system with limited resources *Di Prodi Paoloi and Bernd Porr, University of Glasgow, UK, and Florentin Wörgötter, University of Göttingenf, Germany*
11:50	5B	Dual Robust Controller Design for High Power AC Servo drive *Stone Cheng, Yuan-Yong Huang, Hsin-Hung Chou, National Chiao-Tung University and MSL/ITRI, Taiwan, ROC*
12:15	Lunch+Awards	***Lunch provided (Carstares Room) + LABRS Best Paper Award***
		Session 6: Autonomous Mobile Platforms
13:15	6A	Simultaneous Localization And Mapping Based On PF-MDS *Hongmo Je and Daijin Kim, Pohang University of Science and Technology, South Korea*
13:40	6B	Autonomous Navigation of an Unmanned Ground Vehicle in Unstructured Forest Terrain *Joel Alberts, Dean Edwards, Terence Soule, Mike Anderson, Michael O'Rourkeu, University of Idaho, USA*
14:05		**Open Discussion and Conclusion**
15:00	Closing	**Symposium Conclusion**

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LAB-RS: *Learning and Adaptive Behavior in Robotic Systems*

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