

第五章 結論與建議

5.1 研究結論

本研究可分成兩個部分。第一部份是透過以 Colorimeter 量測而得的數據來驗證 CCD 取像的可靠性，並分析使用 Colorimeter 量測通電 PLED 實體的量測結果。第二部分則是設計與開發一套可檢測成品 PLED 的瑕疵的自動光學檢測系統，包括了硬體概念與軟體演算法。

硬體部分，除了沿用李氏[2]所使用的硬體架構外，由於其所使用的夾具在檢測封膠瑕疵會影響取像結果，故本研究在檢測封膠瑕疵時，用一改良的夾具固定待測 PLED 樣本。由於本研究的檢測項目均屬於巨觀瑕疵，不需要過細的解析度，故取像方式與結果皆與李氏不同，整理比較如下表 5.1。

表 5.1 本研究與[2]之取像方式比較表

	是否需移動取像機構	取像次數	影像色彩
本研究	否	1	彩色
李孟坤 (2005)	是 (移動兩次)	3	黑白

軟體檢測演算法部分，則包括亮度不均、色度不均與封膠瑕疵檢測三部分。其中亮度不均與色度不均所使用之檢測演算法概念相同，而由於目前業界仍無亮度或色度標準片以利檢測對照，故本研究的演算法設計概念仍以相對比較為主。演算法設計過程則先以實驗討論使用固定大小的待測區是否適合用來檢測發光點不均勻瑕疵，再接著開發檢測演算法，並找出合適的檢測參數；此演算法經由實驗驗證可找出亮度與色度不均勻瑕疵的位置與分佈情形。在封膠瑕疵檢測部分，針對[2]的演算法造成之誤判情形進行改善，並且加入氣泡瑕疵等膠寬不足之外的瑕疵檢測項目。同樣在以實驗驗證檢測法前加入檢測參數的討論，並以封膠瑕疵樣本驗證檢測法的可行性。

本研究所提出的亮度不均勻瑕疵檢測演算法，巨觀的比較整片 PLED 樣本上的發光點亮度，此檢測結果比局部的檢測方式更能貼近真實 PLED 樣本上的瑕疵

分佈。而由於本研究使用彩色影像進行檢測，透過色彩模型的轉換，同樣檢測亮度不均勻瑕疵的巨觀檢測演算法也能運用在色度不均勻檢測項目上，更可進一步的運用在目前業界相當關注的 Mura 瑕疵檢測項目上。在封膠檢測項目演算法中，除了以掃描帶的方式改善逐條掃描方式的缺點，並將轉角處膠寬納入檢測項目中。透過本研究所提出的封膠瑕疵檢測演算法，不但可以找出所有不符膠寬規格的封膠，更能進一步判斷封膠上是否具有氣泡或波浪這些不屬於封膠寬度的瑕疵，克服在封膠檢測上所面臨的問題，提高檢測的正確率。

5.2 後續研究探討與建議

在進行不均勻瑕疵檢測前，將影像由 RGB 色彩空間轉換至 HSL 色彩空間的選擇是否最佳仍有待探討，如使用 CIE Luv 或者 CIE Lab 等色彩空間，除了這些色彩模型也有較接近人類視覺的特性外，並且能用線性的色彩誤差公式計算在這些模型之下，兩種顏色或亮度的差別。



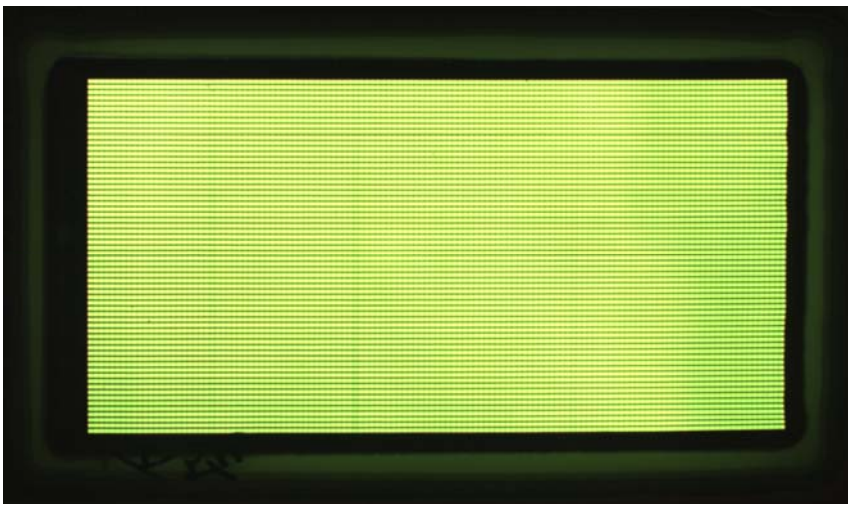
由於 PLED 的亮度與色度仍然沒有標準片的建立，在發光點亮度不均勻檢測方面僅能從所有取得的樣本中，找尋亮度較為均勻的 PLED 樣本作為參考，故在亮度門檻值的訂定與驗證的部分尚有待加強；另一方面，由於色度不均勻樣本取得不易，故在演算法的驗證與門檻值的訂定方面也有不足。未來若能有更多樣本或資訊，對於提升演算法可靠度應有相當助益。

參考文獻

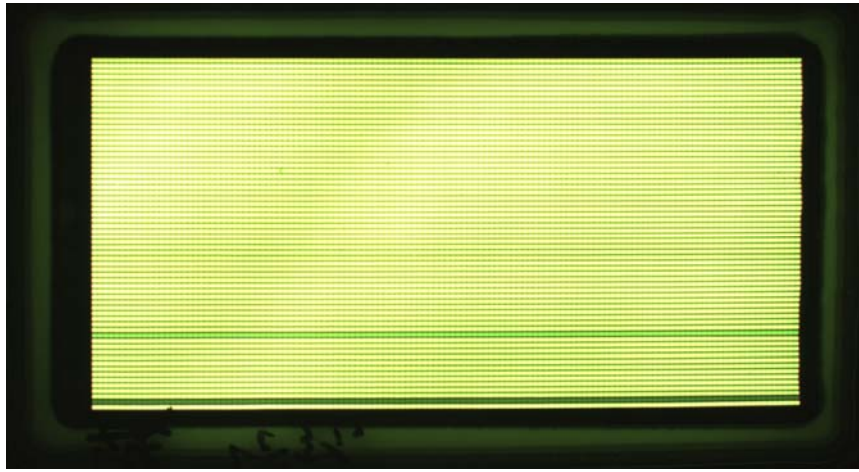
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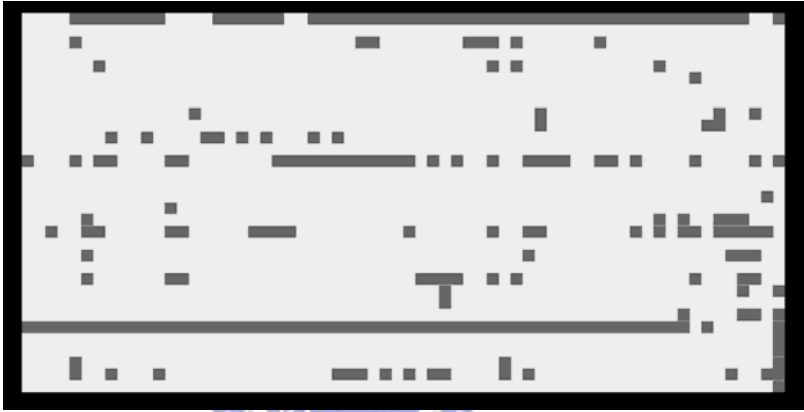
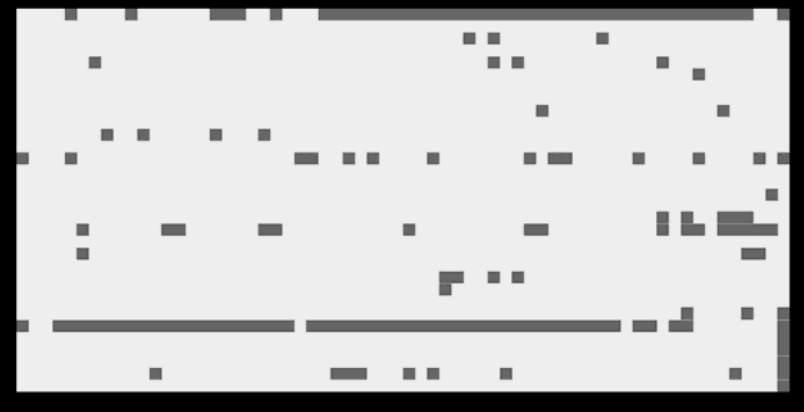
附錄一：發光點亮度不均勻 PLED 實驗樣本之通電影像




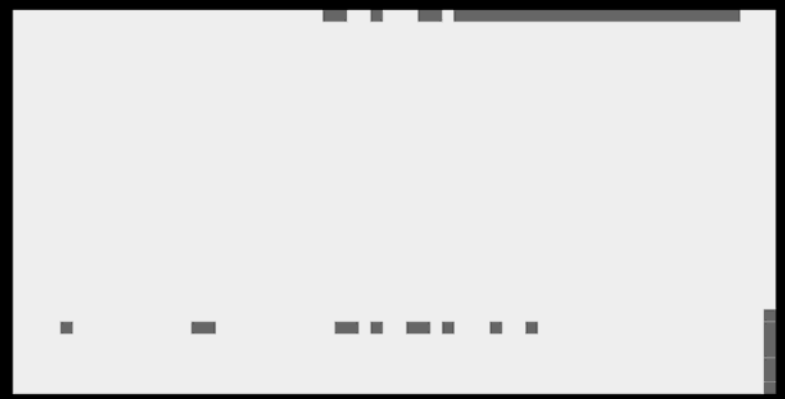
編號	不均勻 PLED 實驗樣本
49b3	
49c1	
49d3	

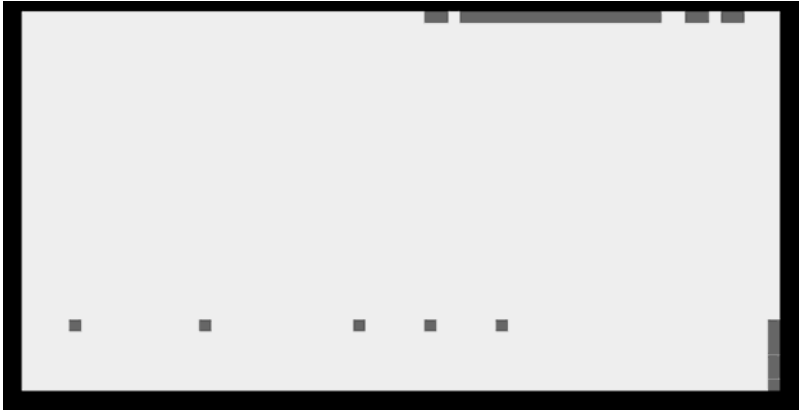
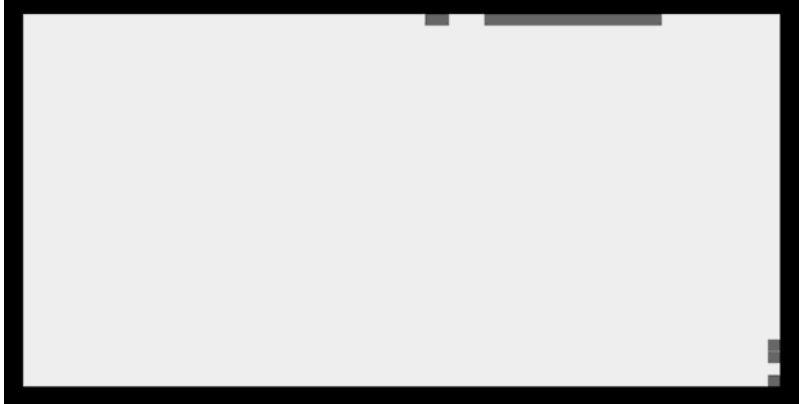
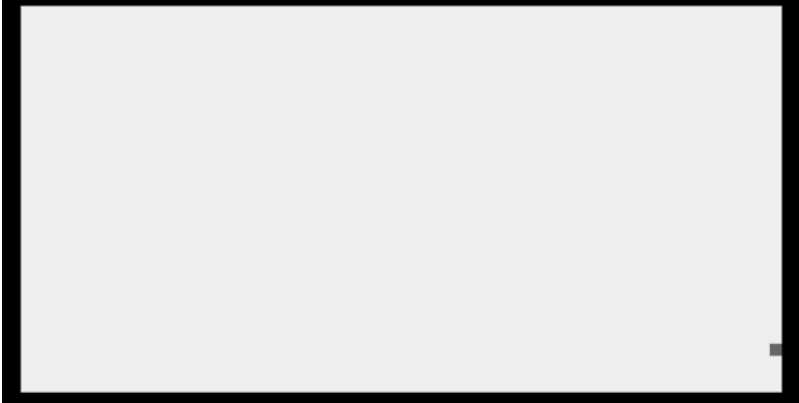
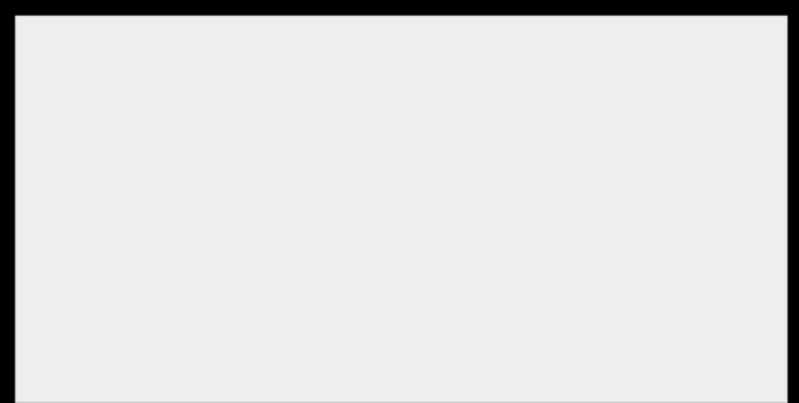
49e1



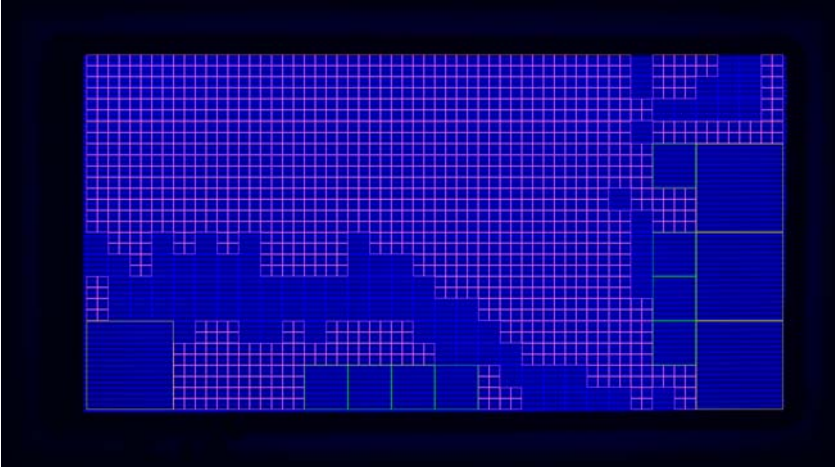
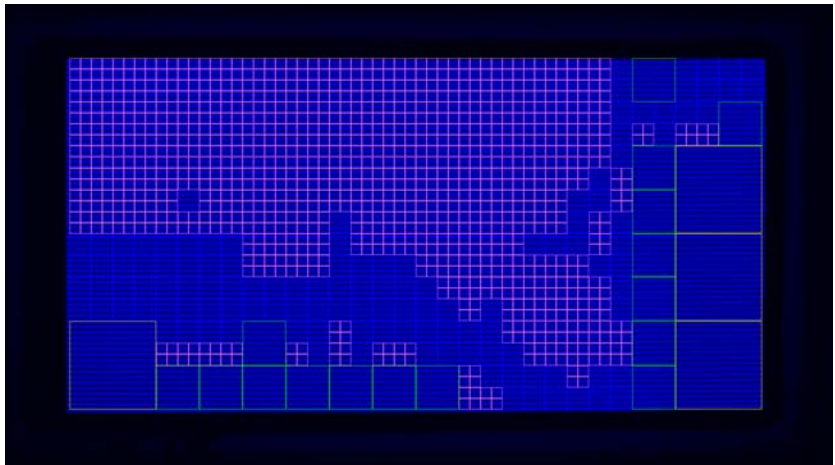
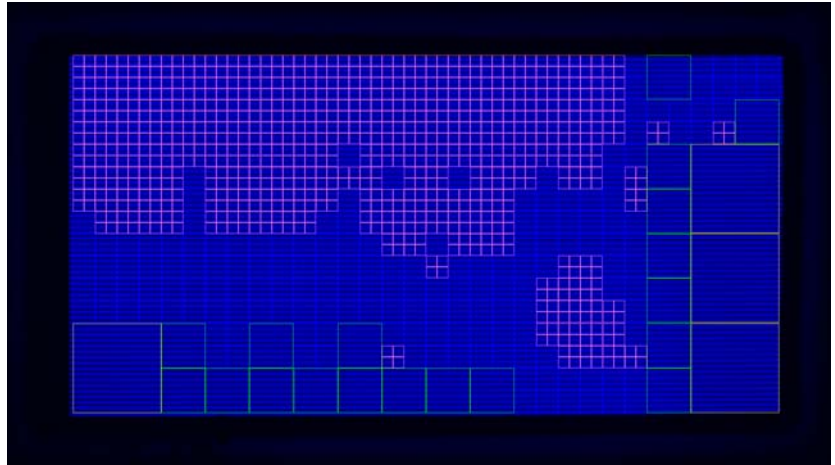
附錄二：亮度平均值門檻實驗結果

β	實驗結果
8	 <p>The image shows a thresholded binary representation of a document page. The text is mostly black on a white background, with some noise and artifacts. The thresholding is relatively coarse, resulting in thick, blocky characters and some loss of fine detail.</p>
9	 <p>The image shows a thresholded binary representation of a document page. The text is mostly black on a white background, with some noise and artifacts. The thresholding is slightly finer than for beta=8, but still shows some blockiness and noise.</p>
10	 <p>The image shows a thresholded binary representation of a document page. The text is mostly black on a white background, with some noise and artifacts. The thresholding is the finest of the three, resulting in thinner, more defined characters and less noise, though some artifacts remain.</p>

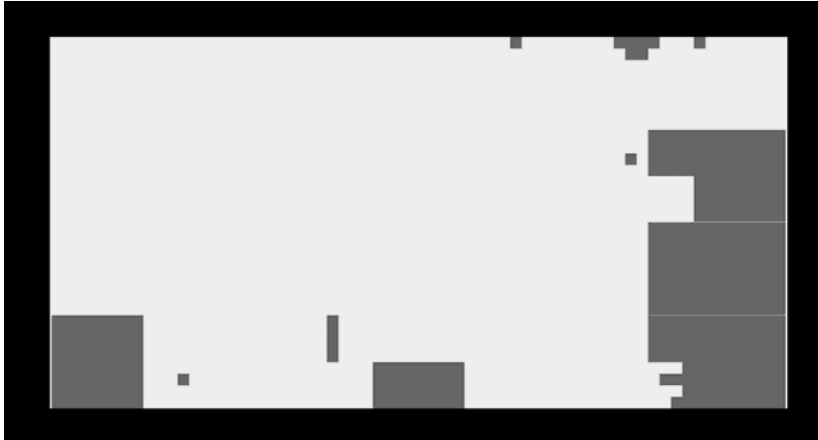


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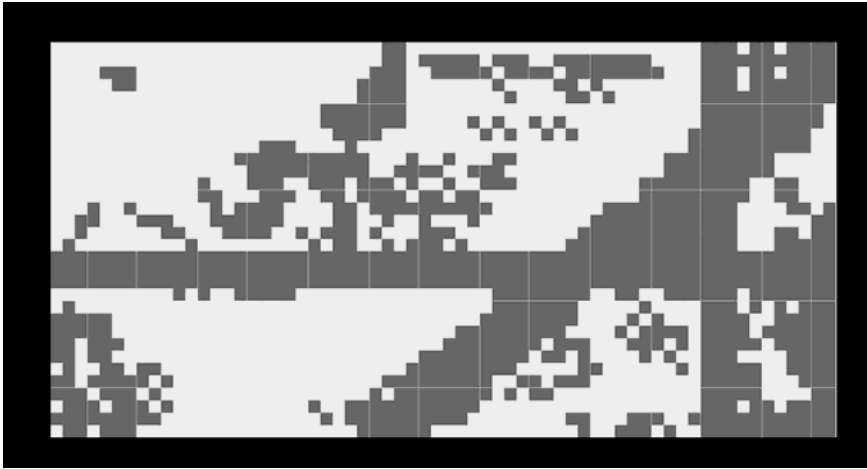
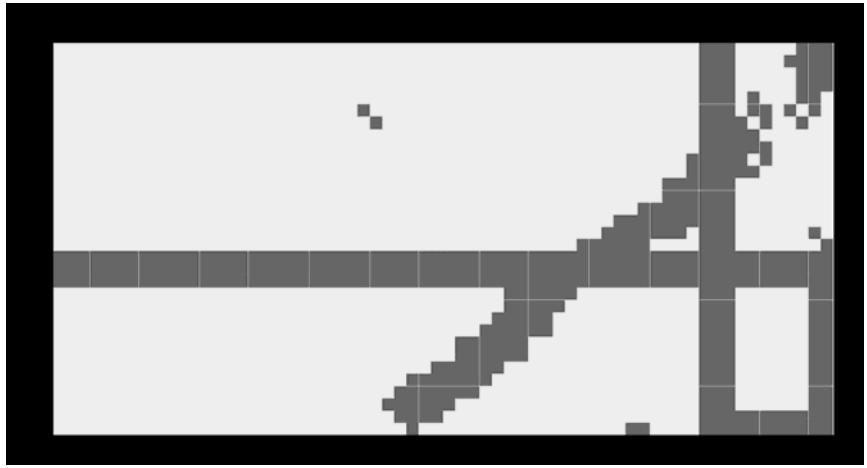
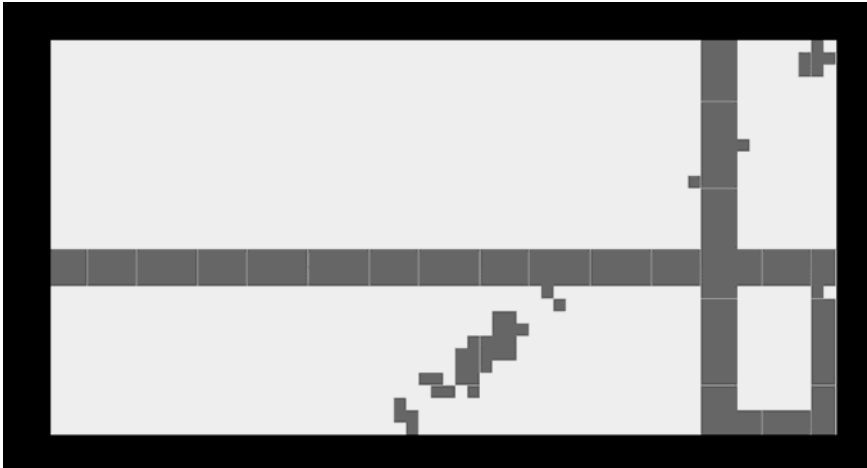
附錄三：亮度均勻度演算法其他樣本實驗結果

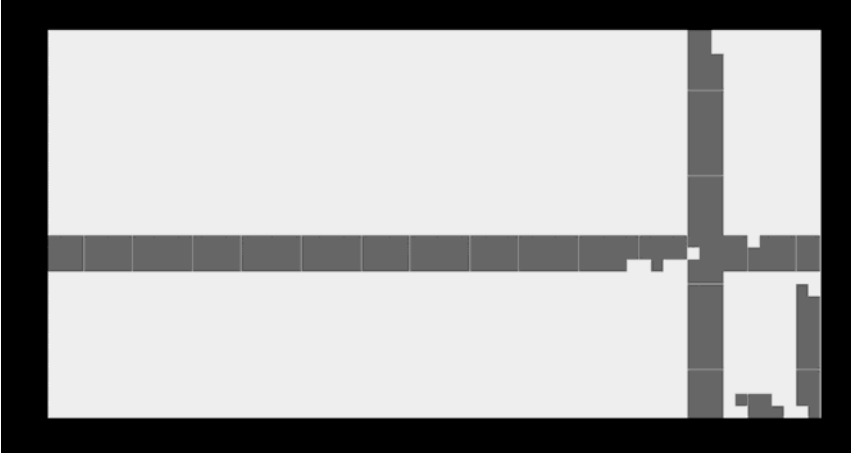
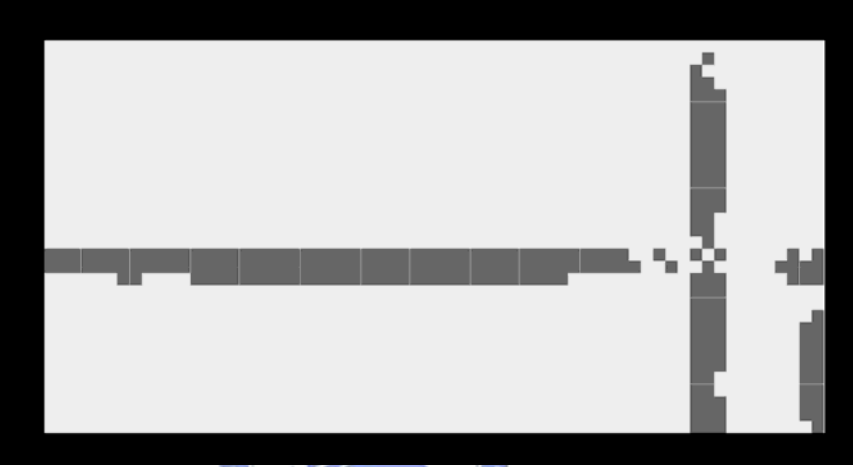

α	實驗結果
2	
3	
4	


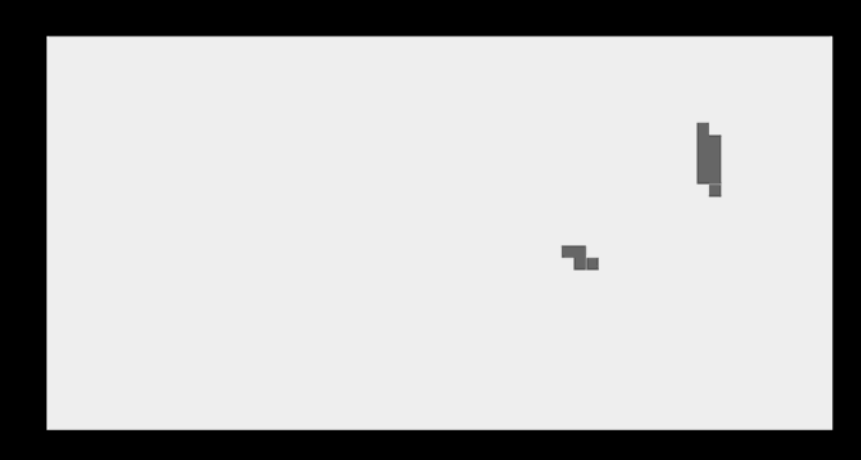
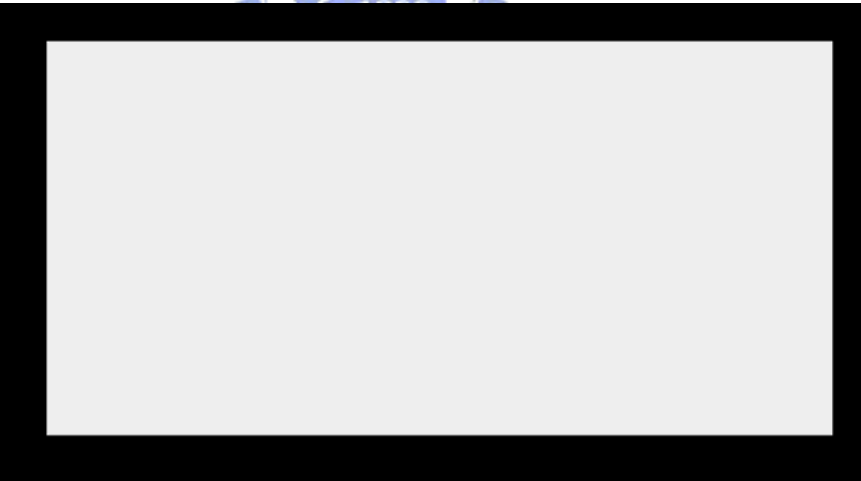
附錄四：亮度檢測演算法其他樣本實驗結果

α	實驗結果
2	 <p>The image shows a grayscale scene with a thick black border. The scene contains several dark, rectangular shapes of varying sizes and orientations, set against a light gray background. The shapes are distributed across the frame, with a notable cluster of larger, darker shapes on the right side.</p>
3	 <p>The image shows a grayscale scene with a thick black border, similar to the one for alpha=2. The dark shapes are present, but their boundaries appear slightly more blurred or smoothed compared to the alpha=2 result, particularly in the smaller shapes.</p>
4	 <p>The image shows a grayscale scene with a thick black border, similar to the previous results. The dark shapes are present, and their boundaries appear even more smoothed or blurred compared to the alpha=3 result, with some loss of fine detail in the smaller shapes.</p>


附錄五：色度平均值門檻實驗結果

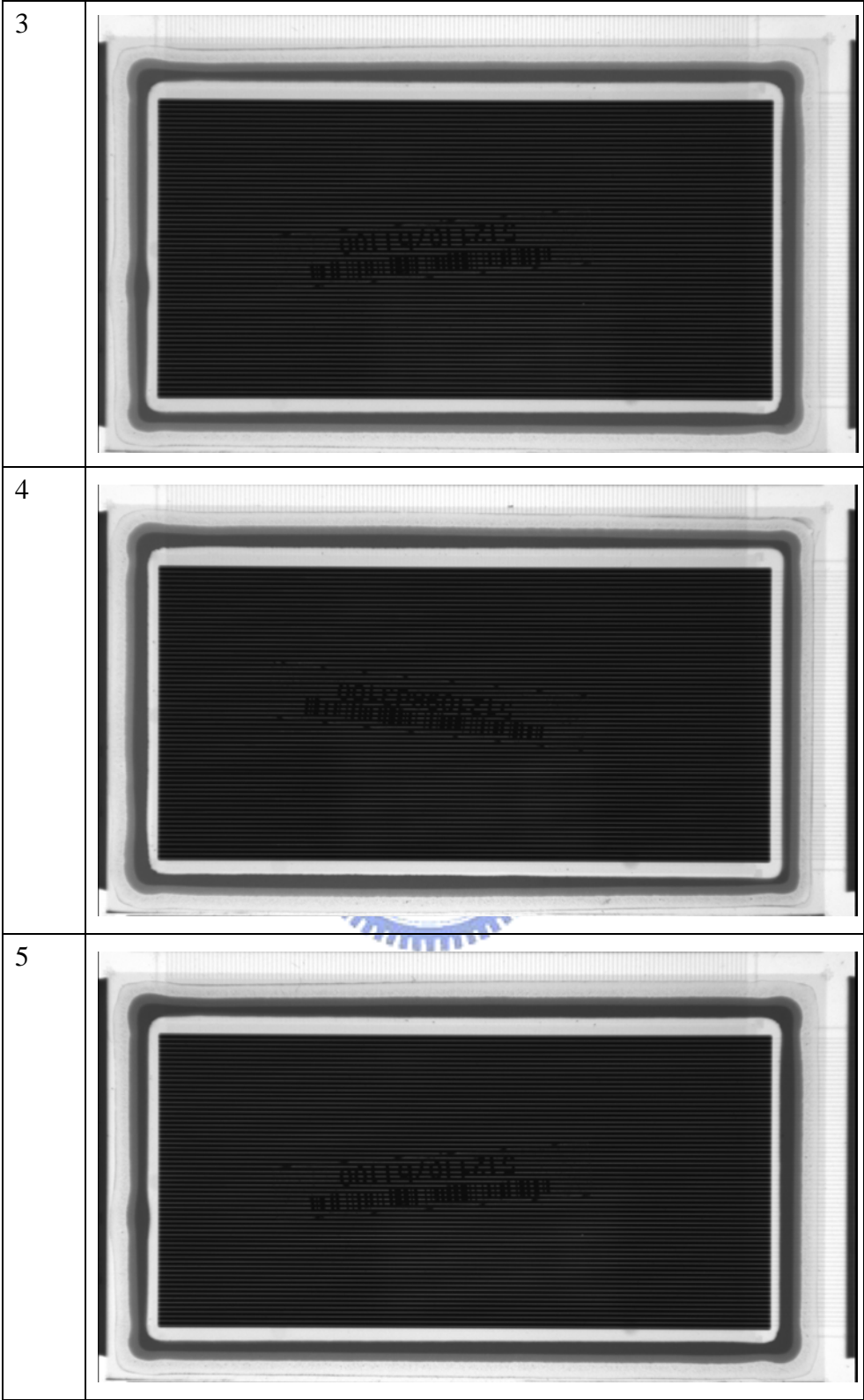
β	實驗結果
1	
2	
3	

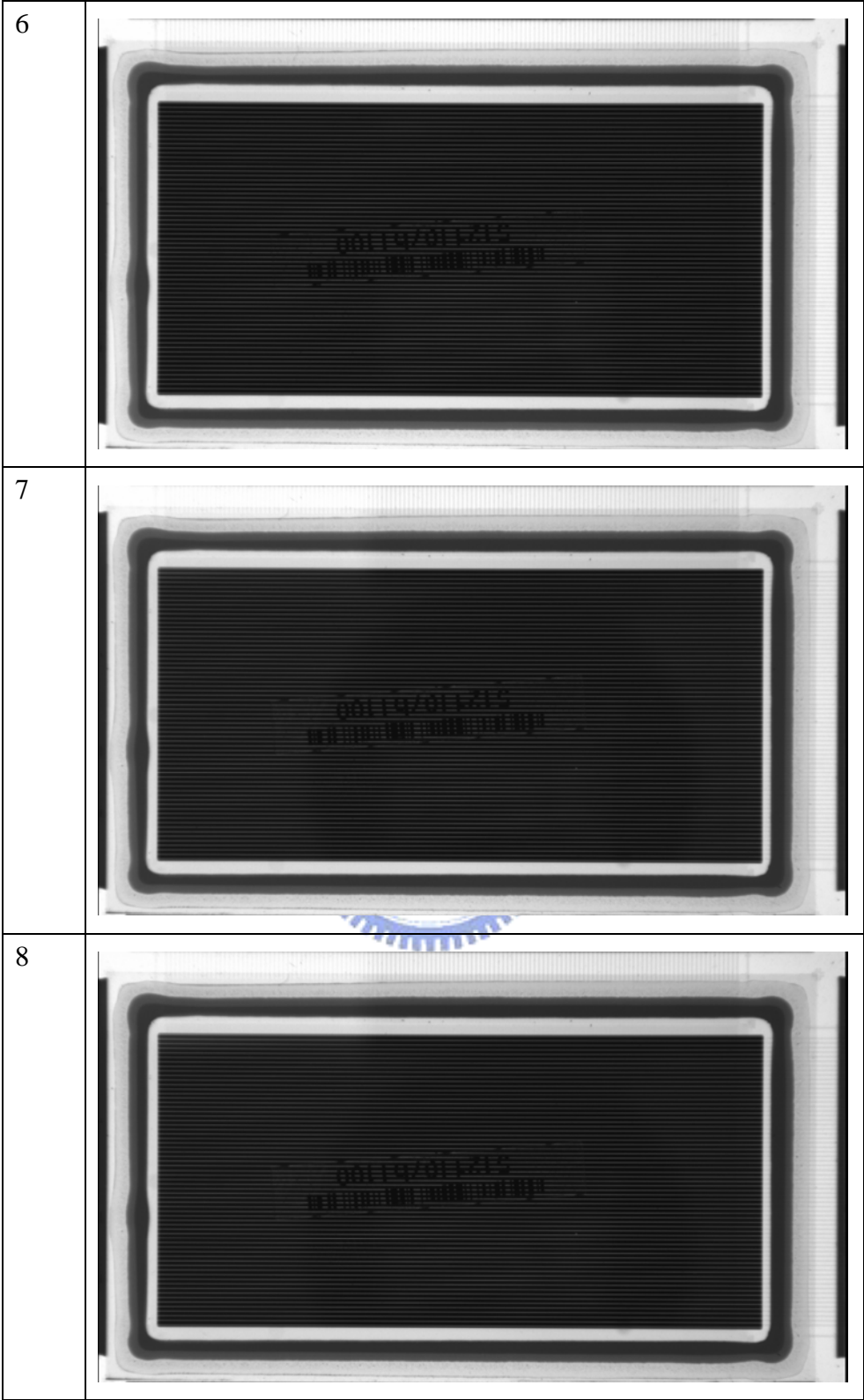
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7	
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附錄六：封膠檢測硬體設計實驗樣本影像



距離 (cm)	樣本編號：07b1
0	
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2	





9	
10	
距離 (cm)	<p>樣本編號：46a3</p>
0	

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4		
5		
6	