PCB AOI

Prof. KC Fan
2014

PCB Inspection

PCB 底片檢查機

PCB 內層板檢查機

PCB 錫高檢查機

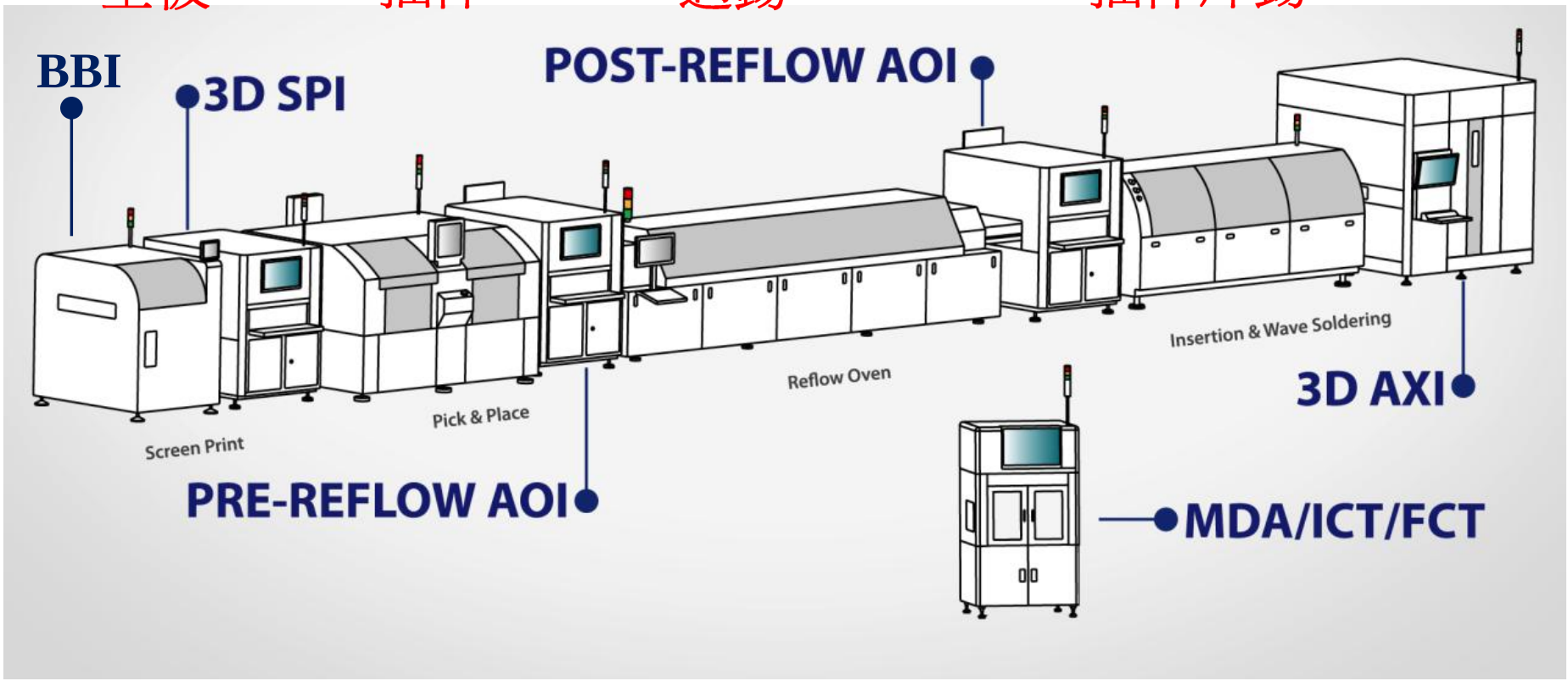
PCB 空板檢查機

PCB 插件板檢查機

PCB 插件板X-ray檢查機

PC板 (PCB)製程檢測

空板　　插件　　過錫　　插件焊錫



PCB 製程能力- 傳統電路板

	2005		2006		2012
	量產	小量產	量產	小量產	
最小線寬/線距	75/75	60/60	60/60	50/50	20/20
最小機械鑽孔直徑	200	150	150	100	50
最大通孔縱深比	8 : 1	12 : 1	12 : 1	15 : 1	
最小 SMT 間距	300	250	250	250	
最小 BGA 間距	500	400	400	400	
最小防焊對位誤差	±37	±37	±37	±30	
最小層間對位	± 110	± 100	± 100	± 100	
阻抗控制	± 10%	± 7%	± 7%	± 5%	
最小板厚 (四層)	400	300	300	300	
最小板厚 (六層)	450	400	400	400	
最小板厚 (八層)	700	550	550	550	

Unit : um or specified

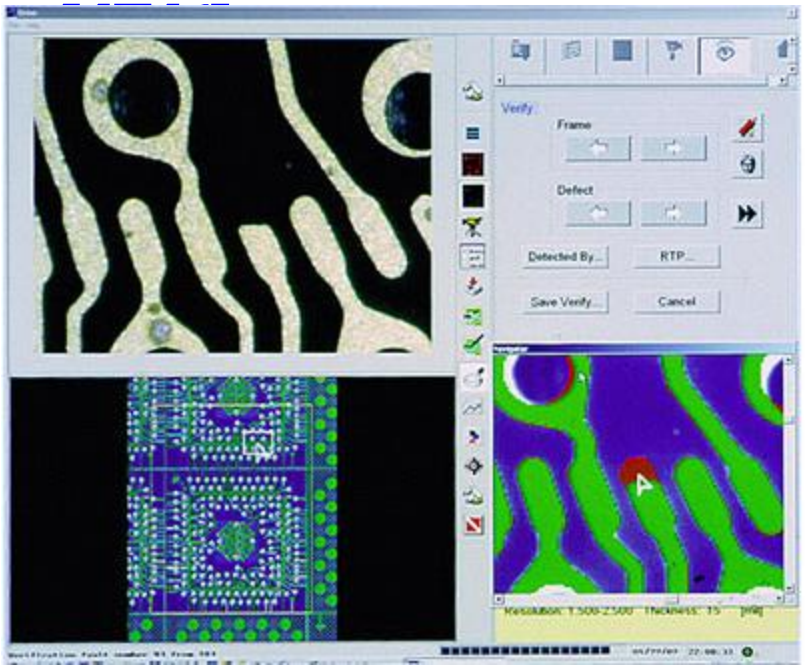
PCB 製程能力- 高密度連結板 (英制)

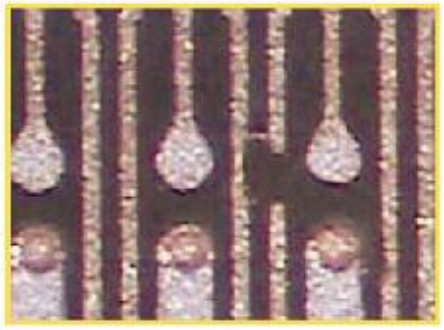
		2005		2006	
		Production	Prototype	Production	Prototype
最小線寬/線距	mil	3.0/3.0	2.5/2.5	2.5/2.5	2.0/2.0
最小微孔直徑	mil	4	3	3	2
最小微孔墊直徑	mil	10	8	8	6
最小機械鑽孔直徑	mil	8	6	6	4
最小機械鑽孔墊直徑(D=鑽孔直徑)	mil	D+8	D+7	D+7	D+6
最大通孔縱深比		8 : 1	12 : 1	10 : 1	15 : 1
最大HD增層數	Layer	3	3以上	3以上	3以上
可量產之HD設計		Every Layer	Every Layer	Every Layer	Every Layer
最小HD層間對位	mil	± 3	± 2.5	± 3	± 2.5
最小防焊對位誤差	mil	± 1.5	± 1.2	± 1.5	± 1.2
阻抗控制	%	± 10	± 7	± 7	± 5

1 mil = 25.4 micron

*-Color camera: 512*512*
-Optical zoom: 13,15,20,25,30,35,50 um/pixel
-Lighting: Florescent red, green and blue
-Two monitor: one for live image, one for host computer

Orbotech Discovery 6/8



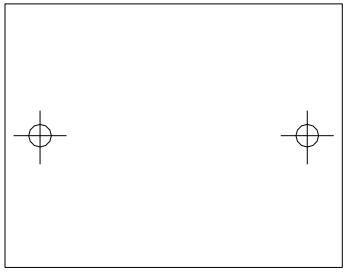


Inspection Algorithm
1) Design Rule Check (DRC)
2) Template Matching
3) Morphologic

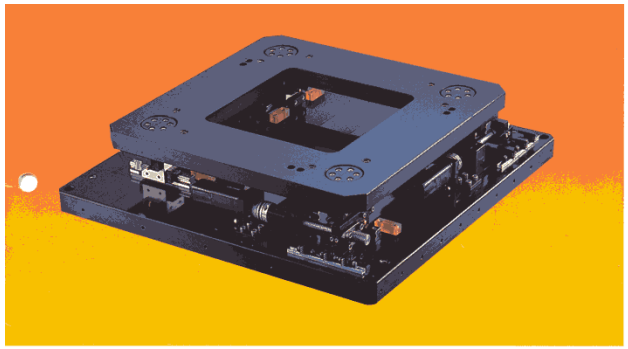
210 sides of 18 x 24”, 75-100 um line / space panels per hour

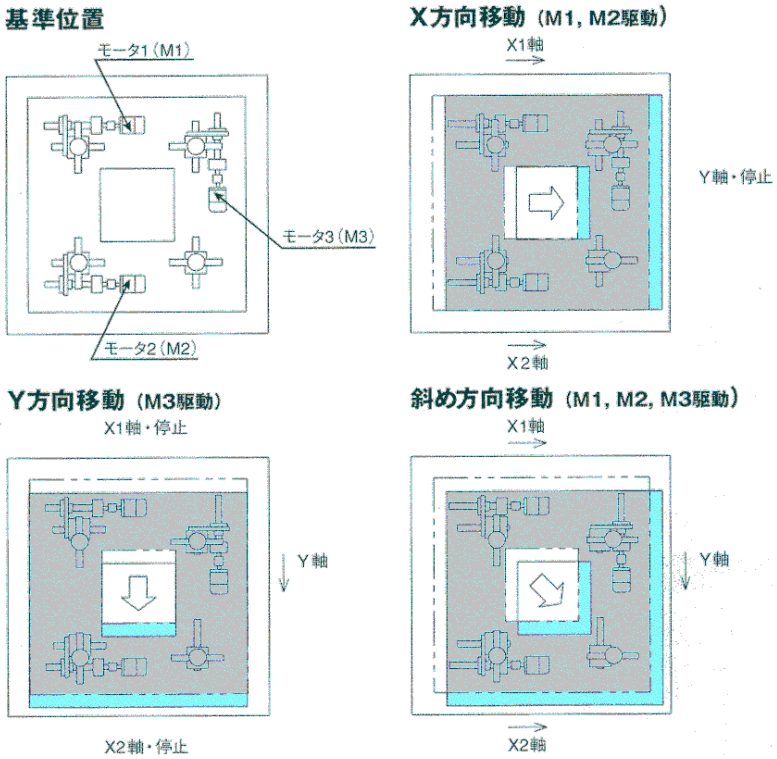
精密對位工作台

Alignment marks

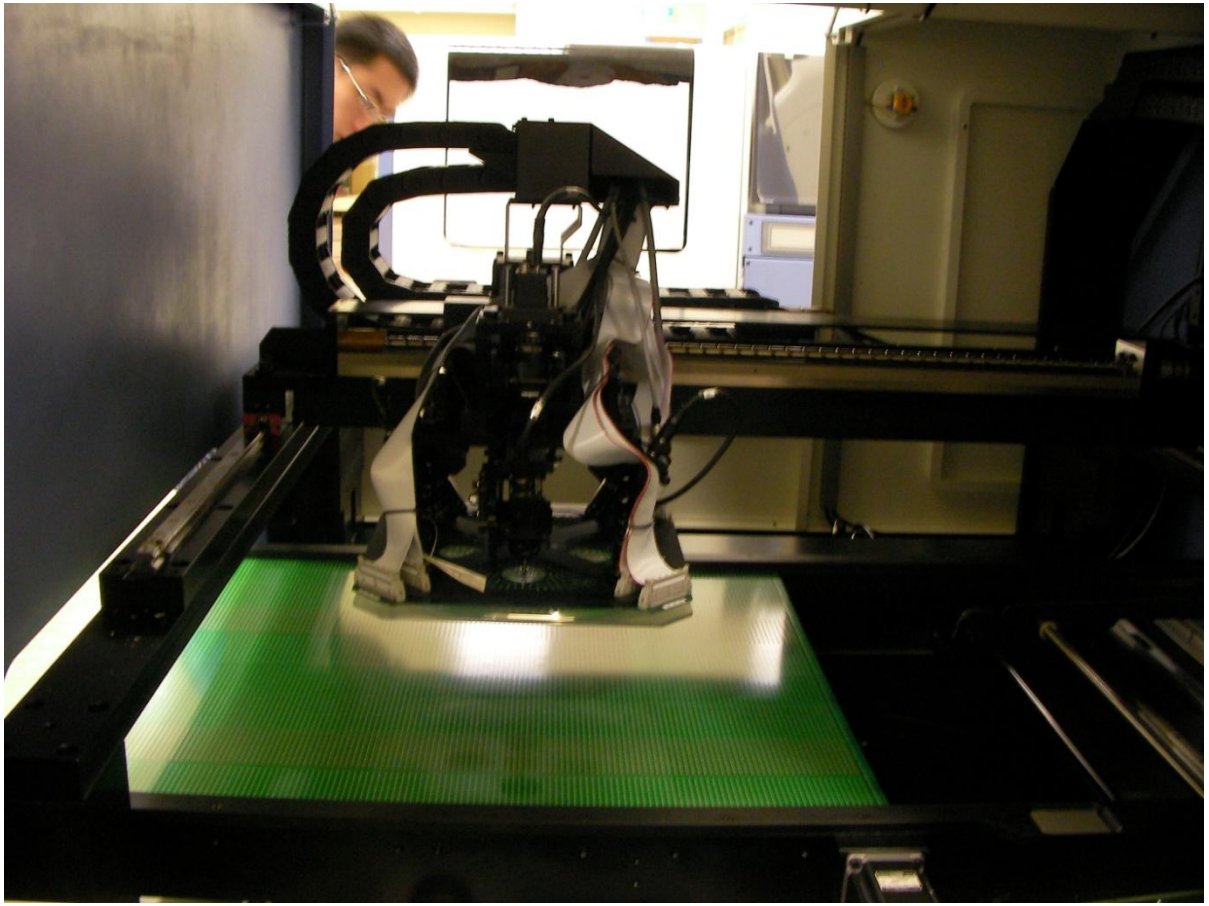


X-Y-θ stage

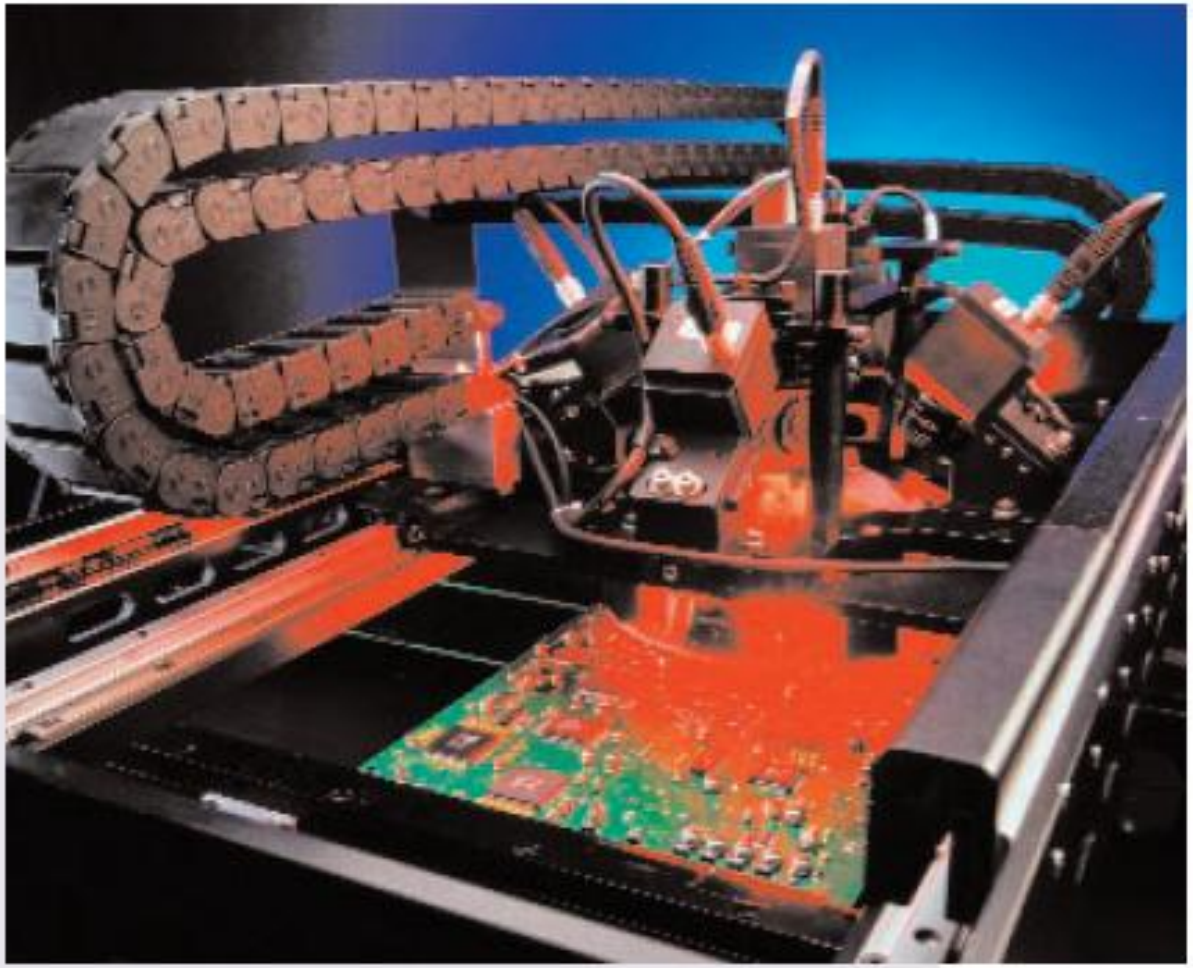




國產之PCB AOI機台: 德律科技



Read on the fly imaging

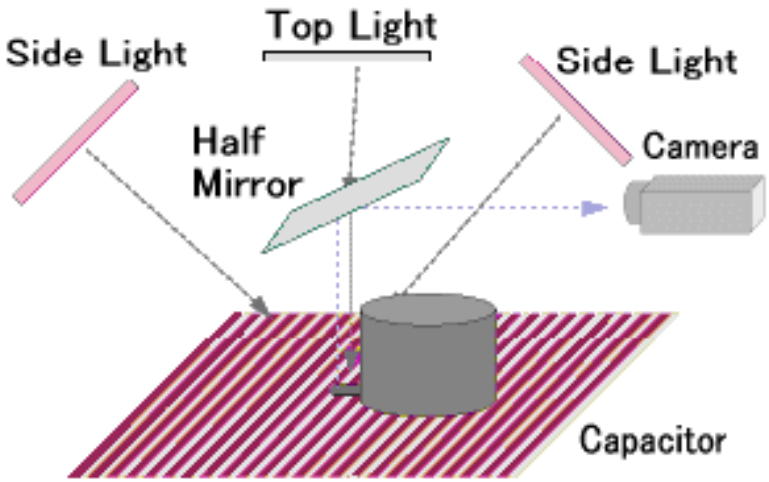


A combination of high-speed cameras, structured LED lighting and sophisticated image-capture architecture allow the Optima 7300 to complete the scan, diagnosis and board-handling cycle at up to 5 square inches per second.

Solder paste height measurement

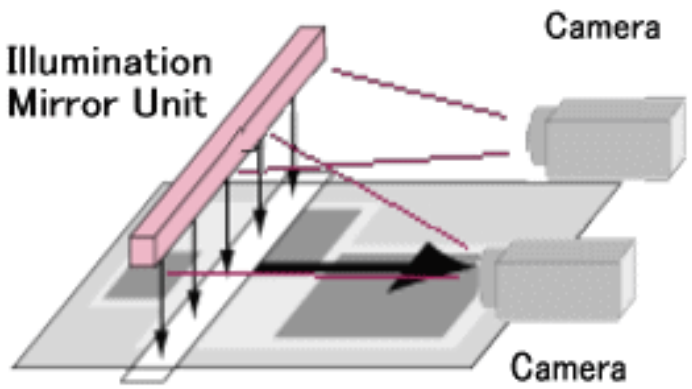
Alternate Scanning System

2 Images by 1 Scan

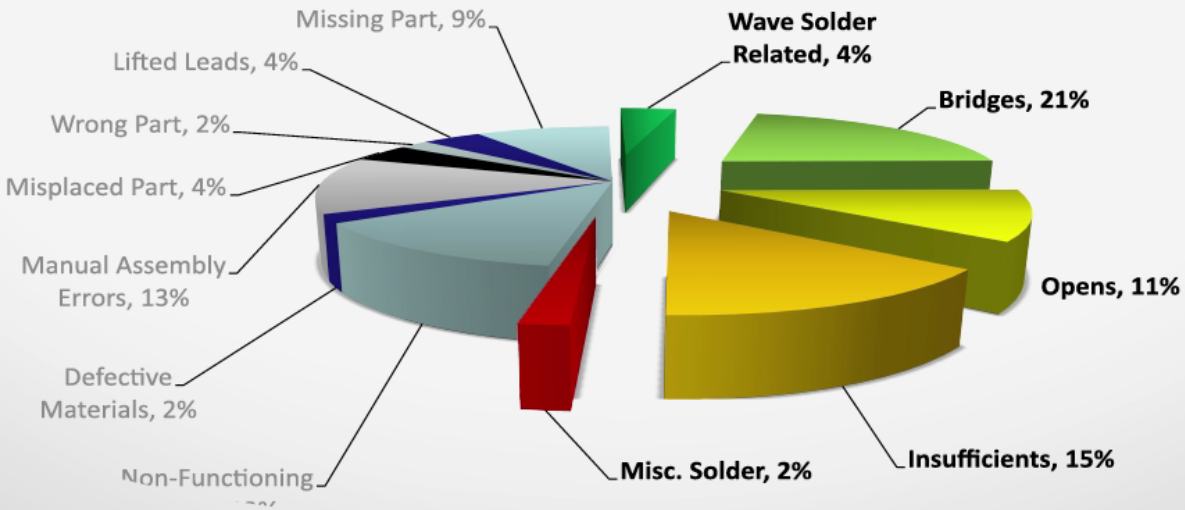


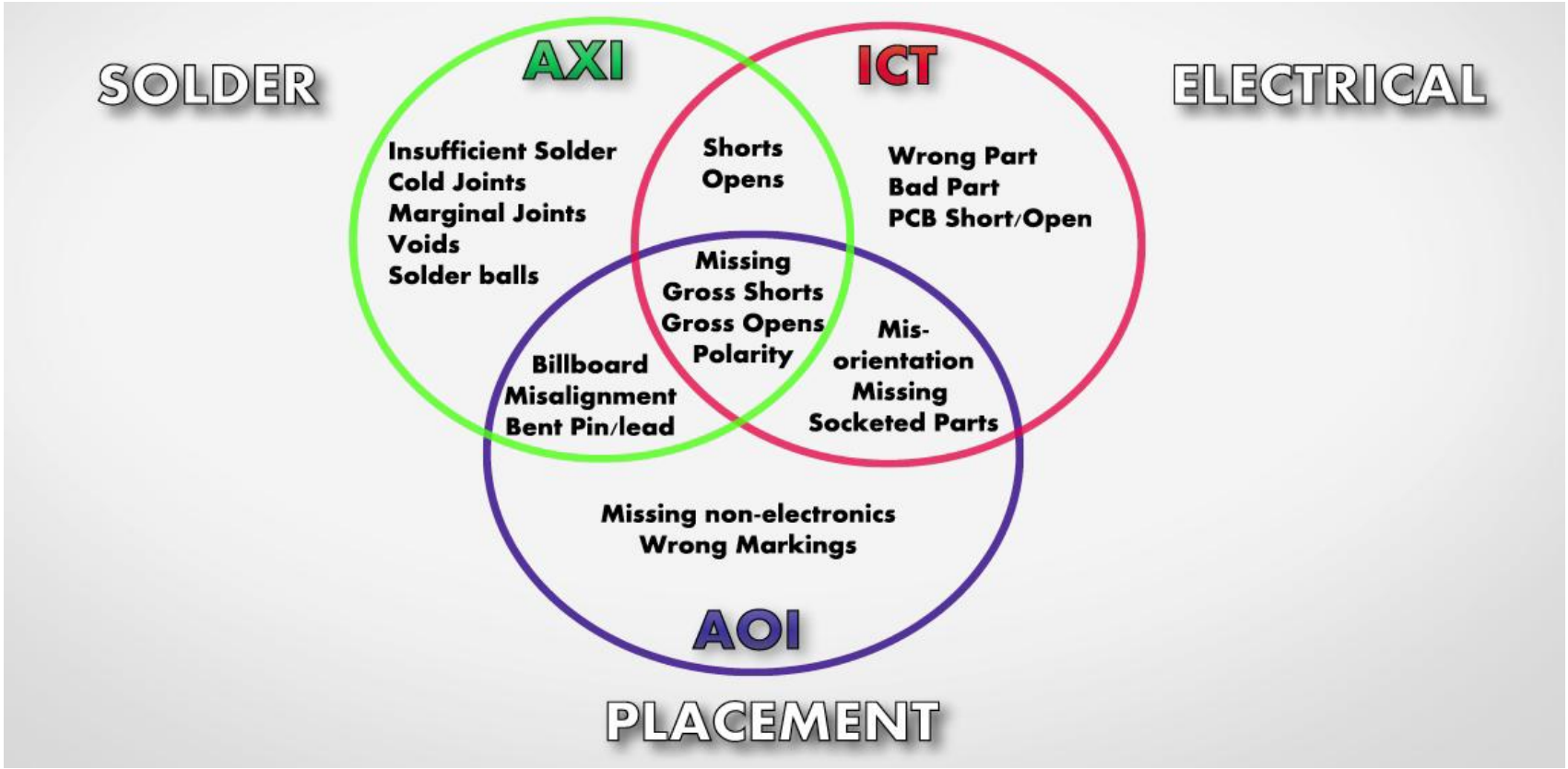
Multi Color Camera System

LL Size with Full Color

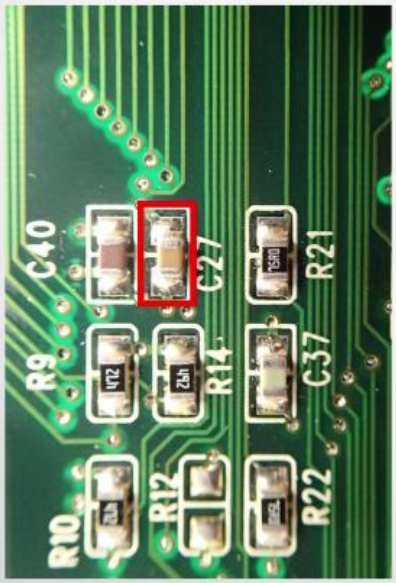


PCBA Defect Spectrum

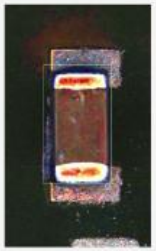



SOLDER
AXI
ICT
ELECTRICAL
Insufficient Solder
Cold Joints
Marginal Joints
Voids
Solder balls
Shorts
Opens
Wrong Part
Bad Part
PCB Short/Open
Missing
Gross Shorts
Gross Opens
Polarity
Billboard
Misalignment
Bent Pin/lead
Mis-
orientation
Missing
Socketed Parts
Missing non-electronics
Wrong Markings
AOI
PLACEMENT

Integrated Inspection

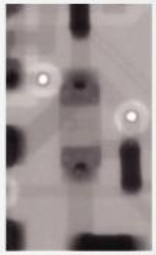


SPI



Pre-reflow AOI

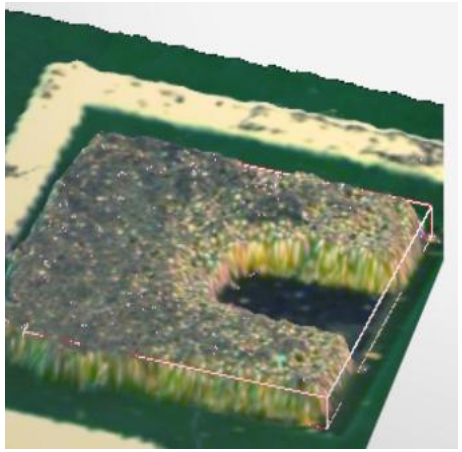
Post-reflow AOI



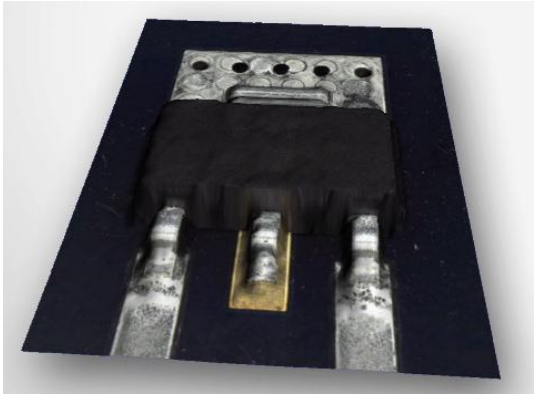
AXI

MEAS

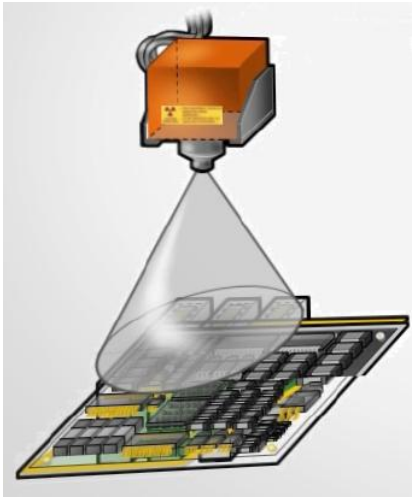
Solder Paste Inspection (SPI)



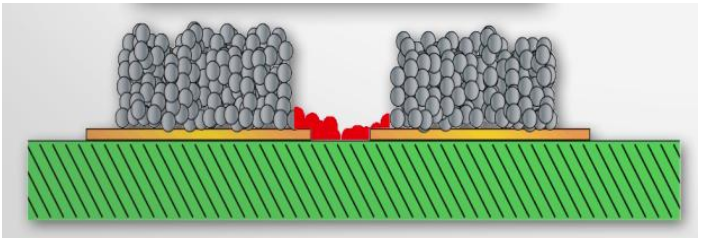
3D AOI



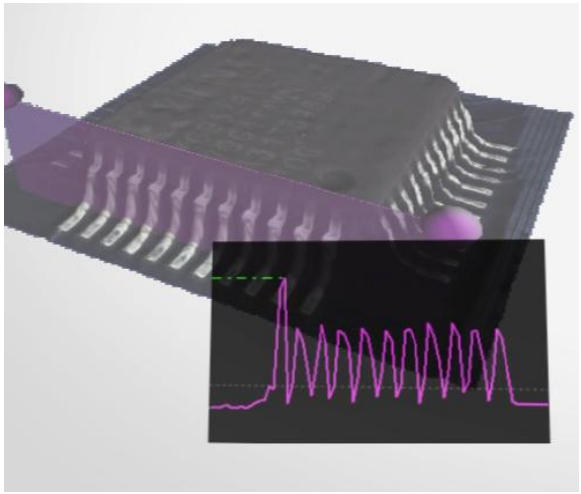
3D AXI



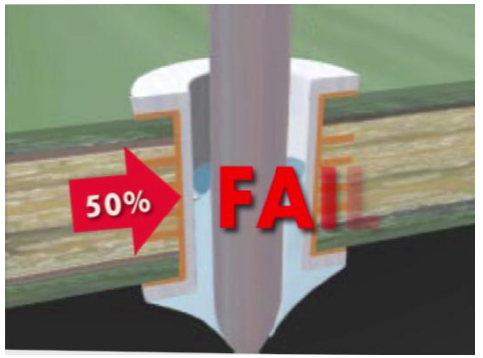
Low Bridge Defect



Pin height



Through hole



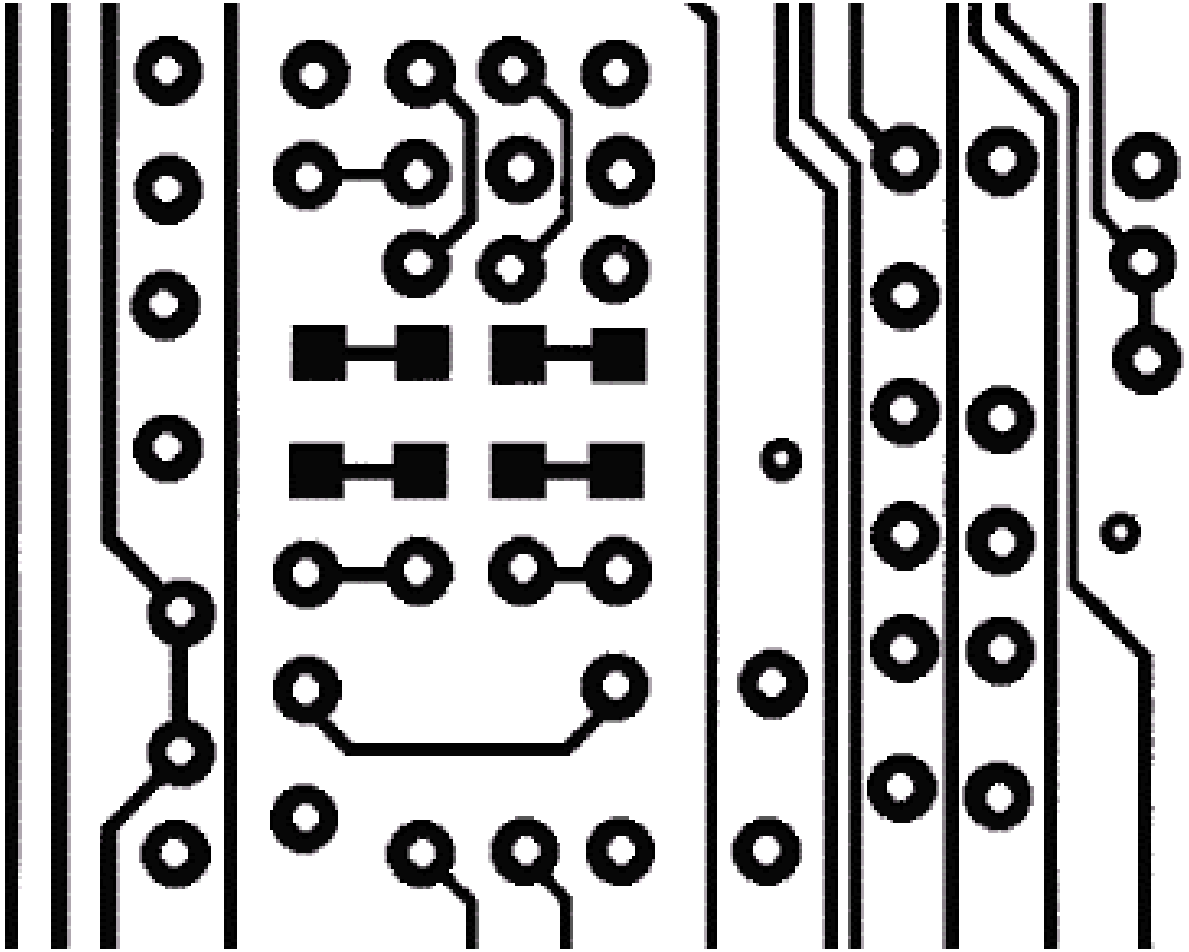
缺陷辨認軟體

辨認軟體為核心所在，PCB底片缺陷辨認可分為兩種主要方法:

1.PCB底片參考影像(reference image)載入電腦,由辨認軟體計算出考影像之特徵 ,再將被測底片與參考影像逐一比對以判定是否有缺陷

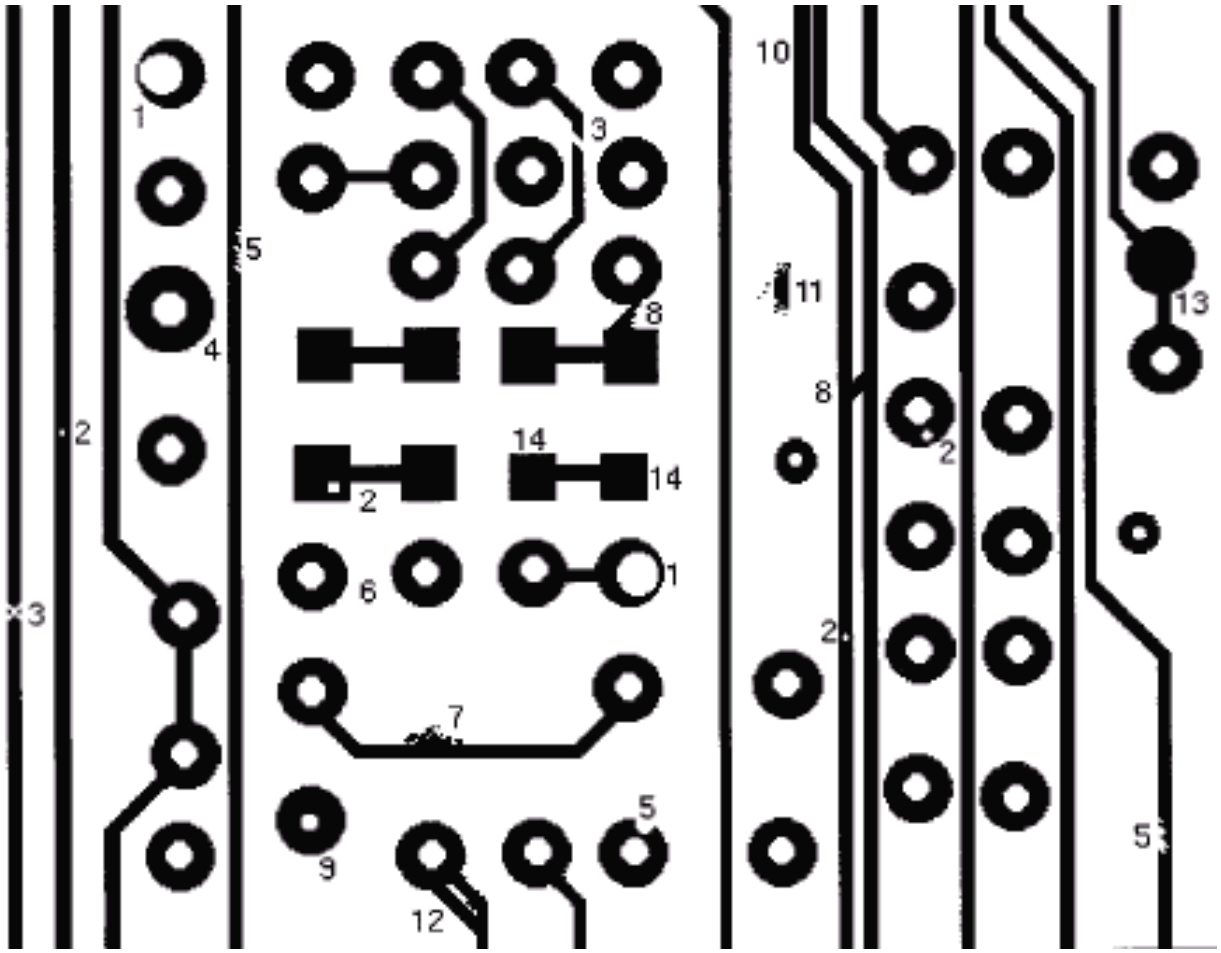
2. 將 PCB底片可能的缺陷內建在辨認軟體內,再逐一比對被測底片以判定是否有缺陷.

PCB基板瑕疵種類



無瑕疵印刷電路樣本

PCB基板瑕疵種類



有瑕疵的印刷電路板樣(Madhav,96)

1:Breakout

2:Pin Hole

3:Open

4:Underetch

5:Mouse bite

6:Missing Conductor

7:Spur

8:Short

9:Wrong Size Hole

10:Conductor too close

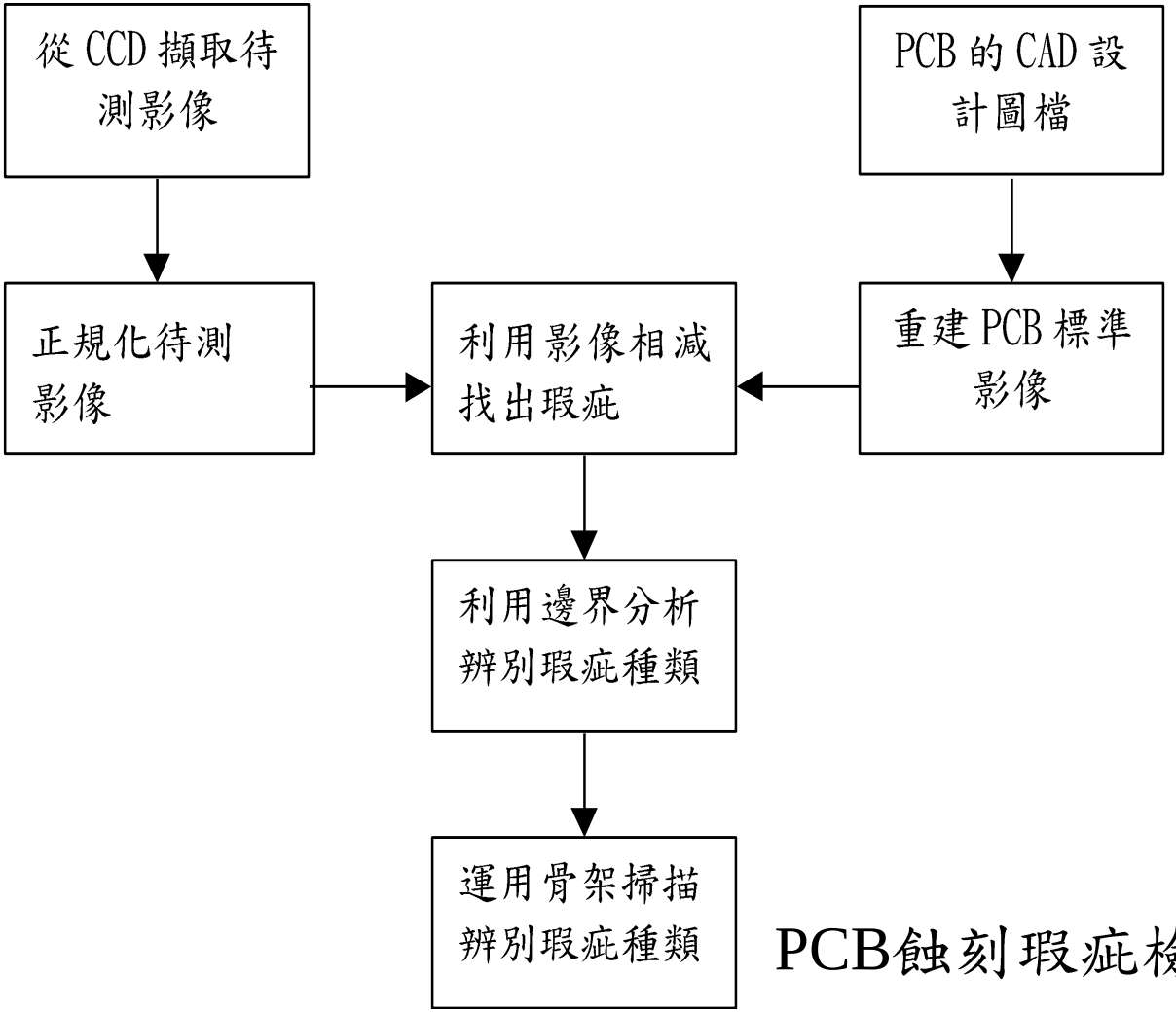
11:Spurious copper

12:Excessive Short

13:Missing Hole

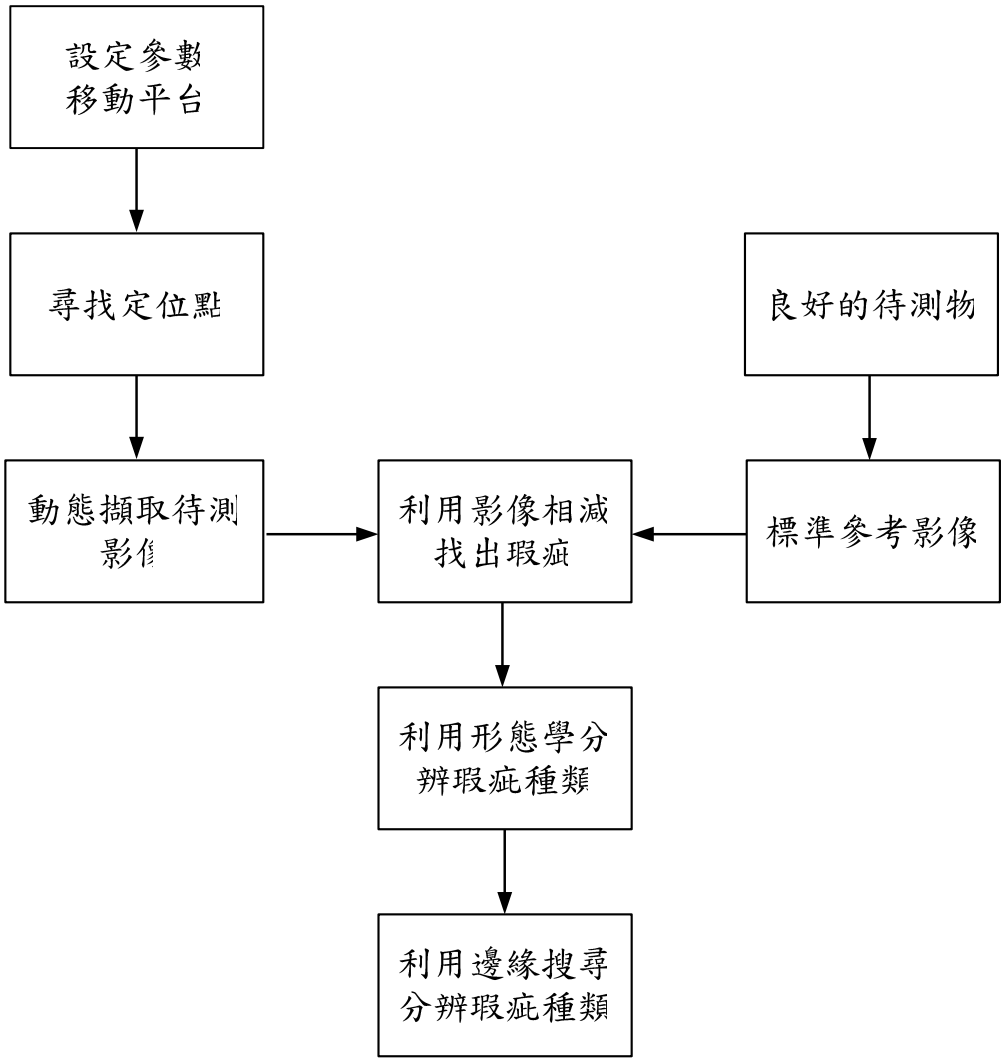
14:Over etch

印刷電路板影像瑕疵檢測法

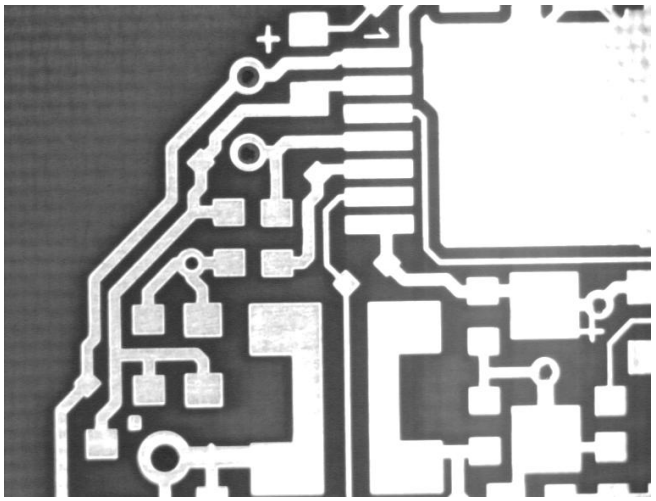


PCB蝕刻瑕疵檢測流程

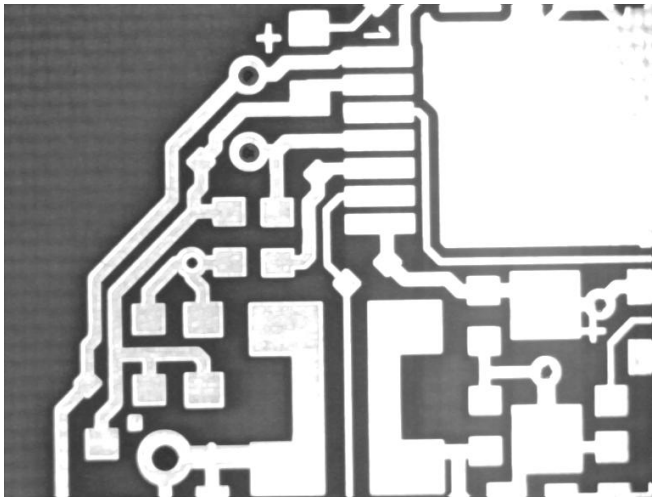
PCB基板檢測流程


設定參數
移動平台
尋找定位點
動態擷取待測
影像
良好的待測物
標準參考影像
利用影像相減
找出瑕疵
利用形態學分
辨瑕疵種類
利用邊緣搜尋
分辨瑕疵種類

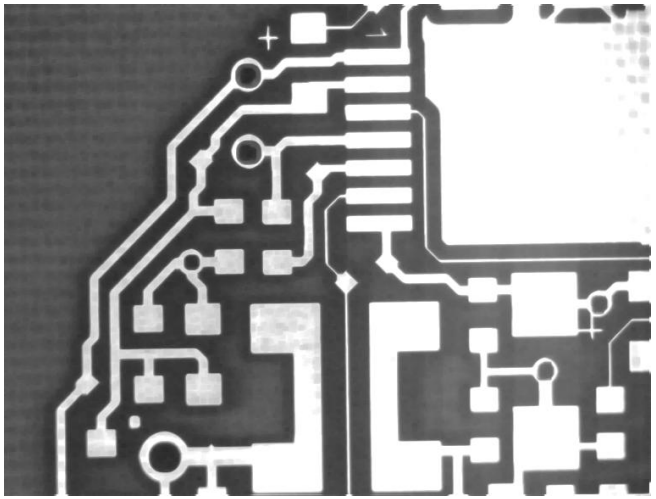
建立參考影像



參考影像



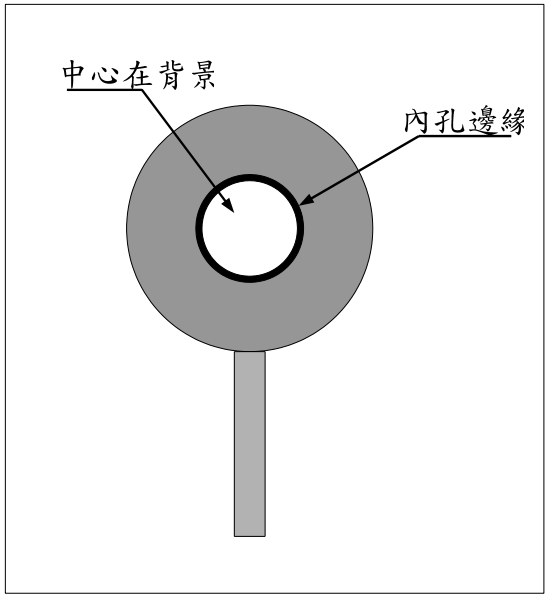
擴張參考影像



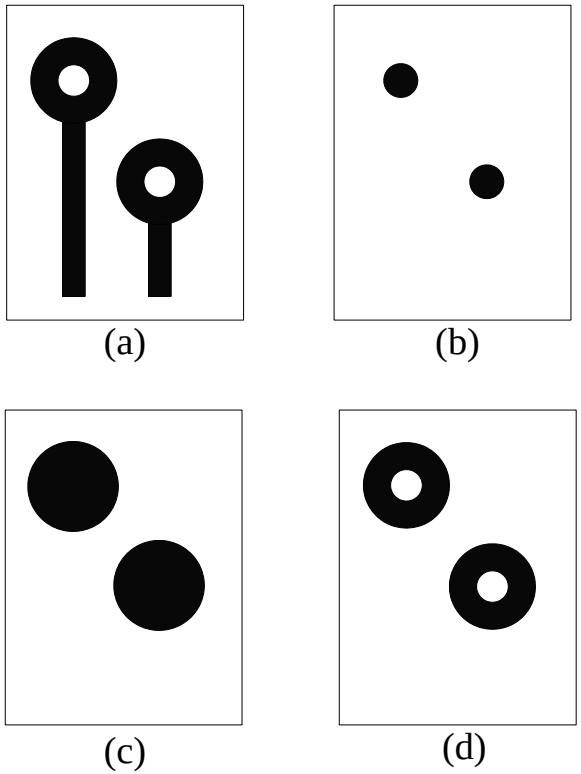
收縮參考影像

標記物體

PCB基板上的物體一般定義有三種，即線路(Track)、銲墊(Pad)和孔洞(Hole) 加以標記。



尋找PCB基板中的孔洞



(a)原始影像

(b)孔洞位置

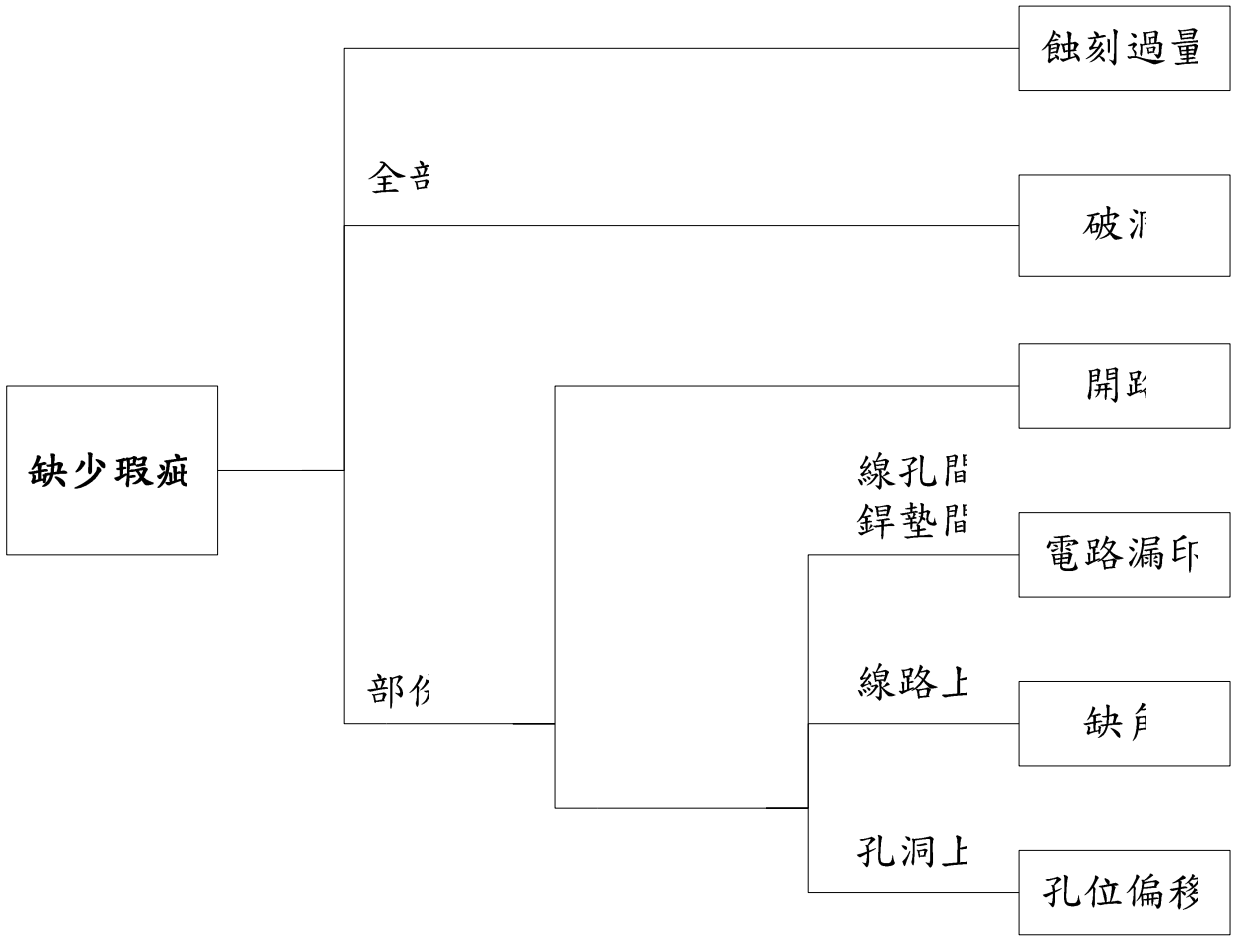
(c)孔洞膨脹後

(d)銲墊位置

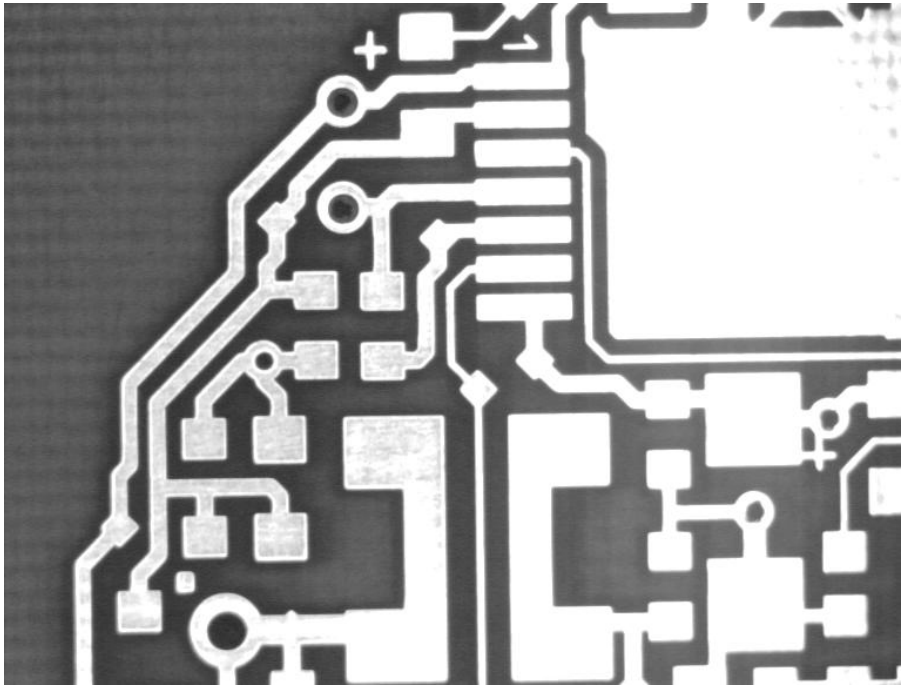
瑕疵分類


多餘瑕疵
全音
部份
背景上
銅泊
銲墊上
蝕刻不足
瑕疵內
孔徑不合
瑕疵外
缺孑
短路
重複短路
有瑕疵
間距不足
無瑕疵
毛邊

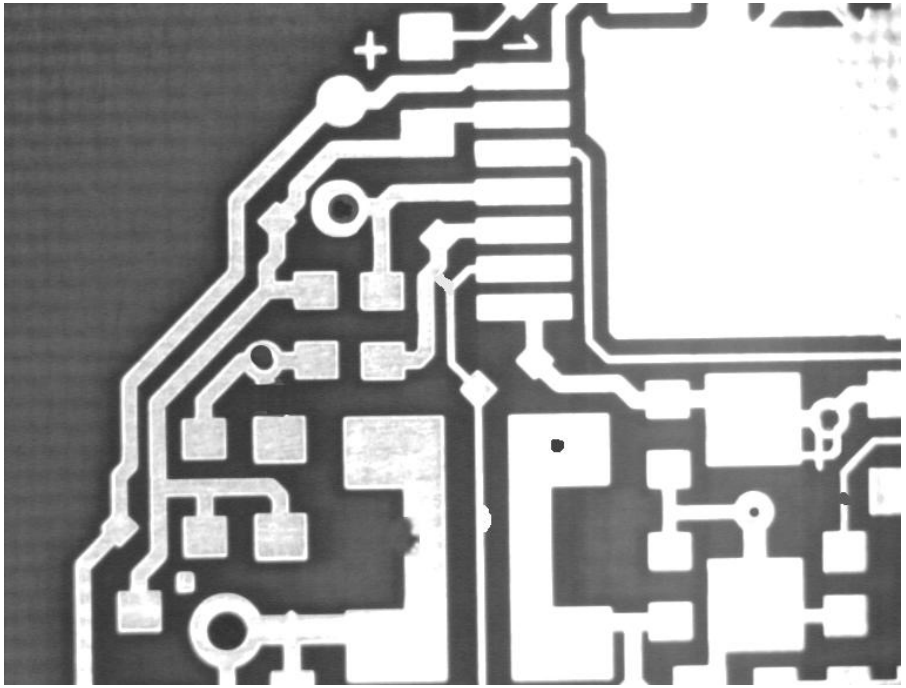
瑕疵分類



PCB基板檢測結果

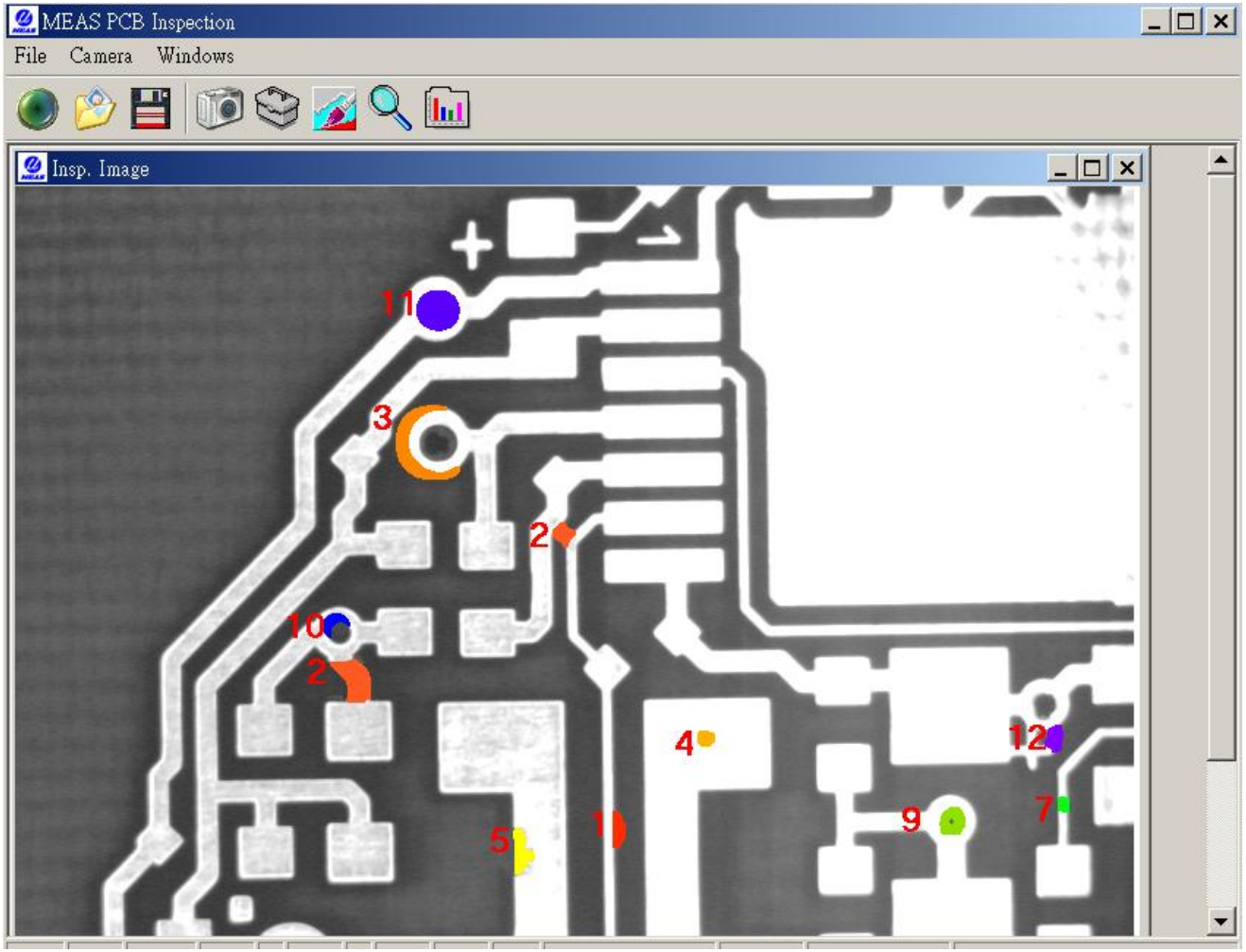


參考影像

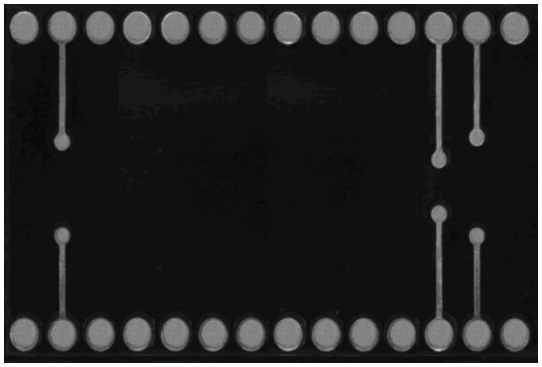


瑕疵影像

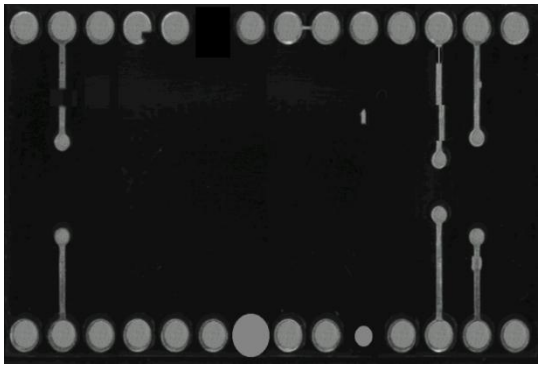
PCB基板檢測結果


MEAS PCB Inspection
File Camera Windows
Insp. Image
11
3
2
10
2
4
12
9
7
5
1

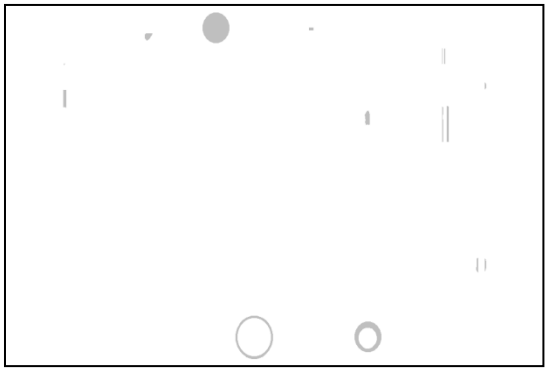
印刷電路板影像瑕疵檢測法應用例



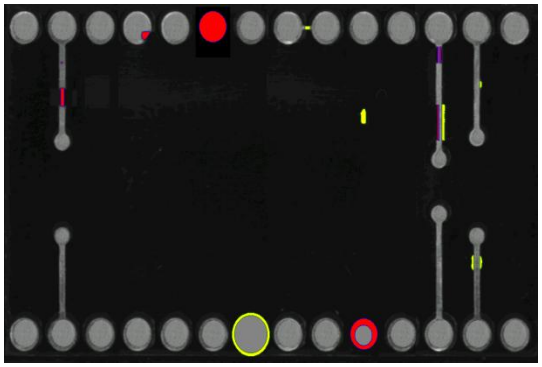
(a) 標準影像



(b) 待測瑕疵影像



(c) 影像相減結果



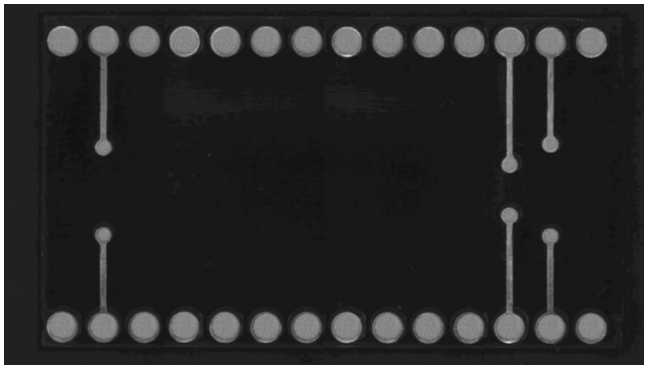
(d) 檢測結果影像

蝕刻瑕疵樣本檢測結果：

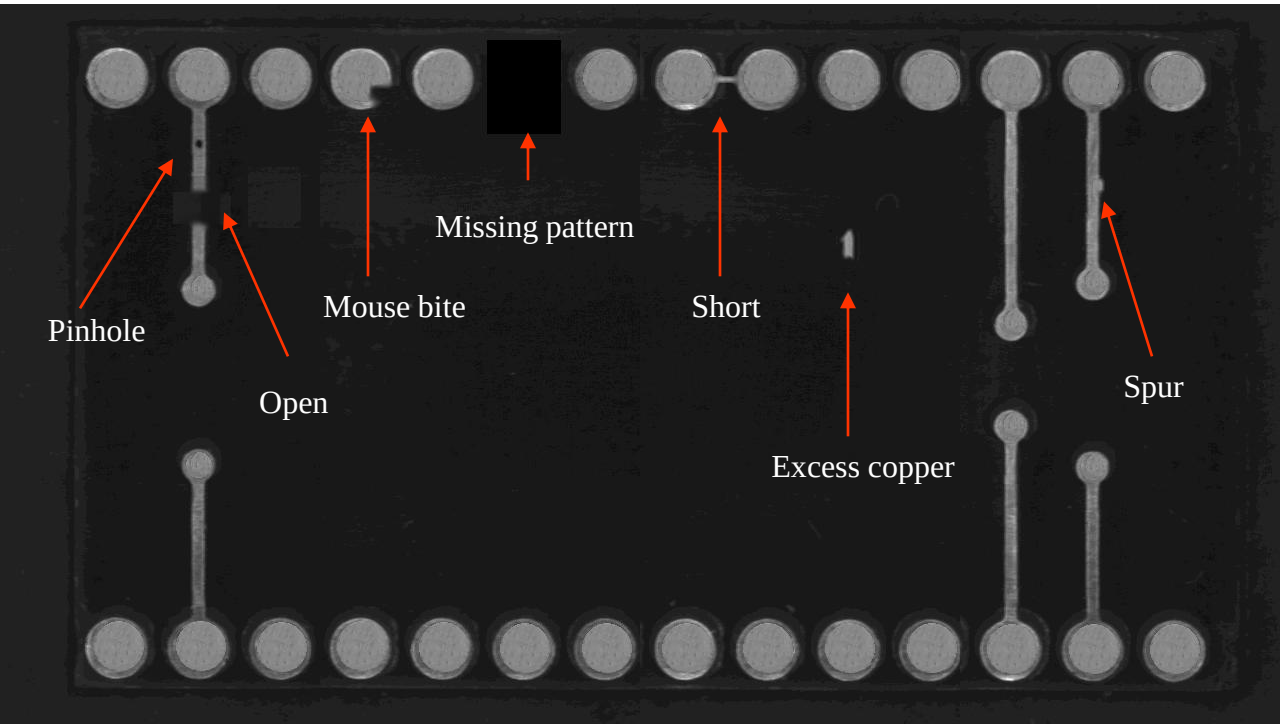
(a) 標準影像、(b) 待測瑕疵影像、(c) 影像相減結果及(d) 檢測結果影像

PCB Inspection Sample

- Effective Pixels per Frame
  - 320×240 pixels
- Inspection Field
  - 3×4 frames (1280×720 pixels,38.4×21.6 mm^2)



Standard Sample

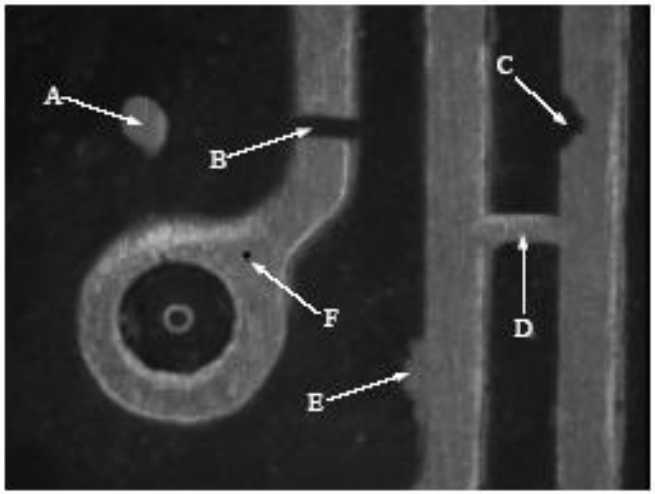


Inspection Sample

PCB基板檢測結果

ID	X	Y	Type
11	273	70	Missing Hole
3	259	148	Under etch
2	366	228	Short
12	702	366	Excessive Short
9	630	422	Wrong Size Hole
1	407	425	Spur
10	209	290	Breakout
2	214	321	Short
4	465	370	Pin Hole
7	711	415	Open
5	339	436	Mouse bite

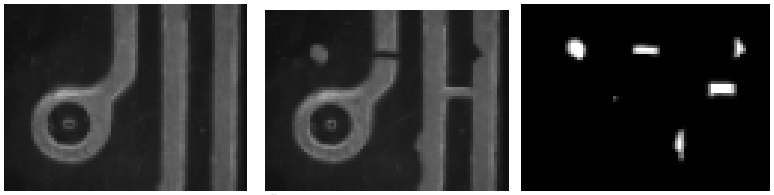
PCB底片檢測

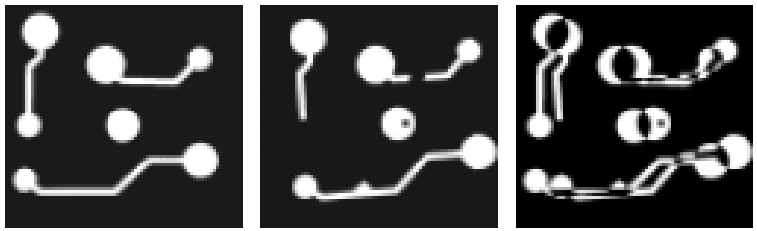


PCB 底片常見之瑕疵，其中A 至F 分別代表污染、斷路、凹口、短路、突出、及針孔。

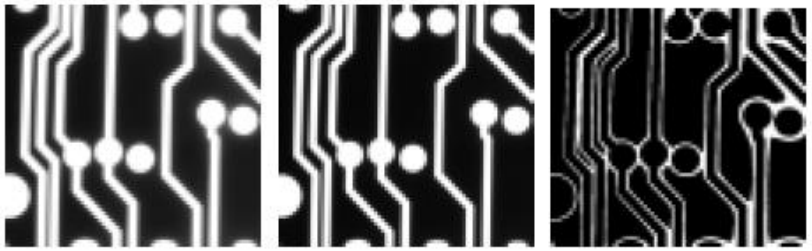
原理：標準影像及待檢測影像相減（XOR邏輯演算）

$$H(x,y) = f(x,y) - g(x,y)$$





由於兩影像之位置有偏移，因此XOR 並無法正確的將瑕疵找出來

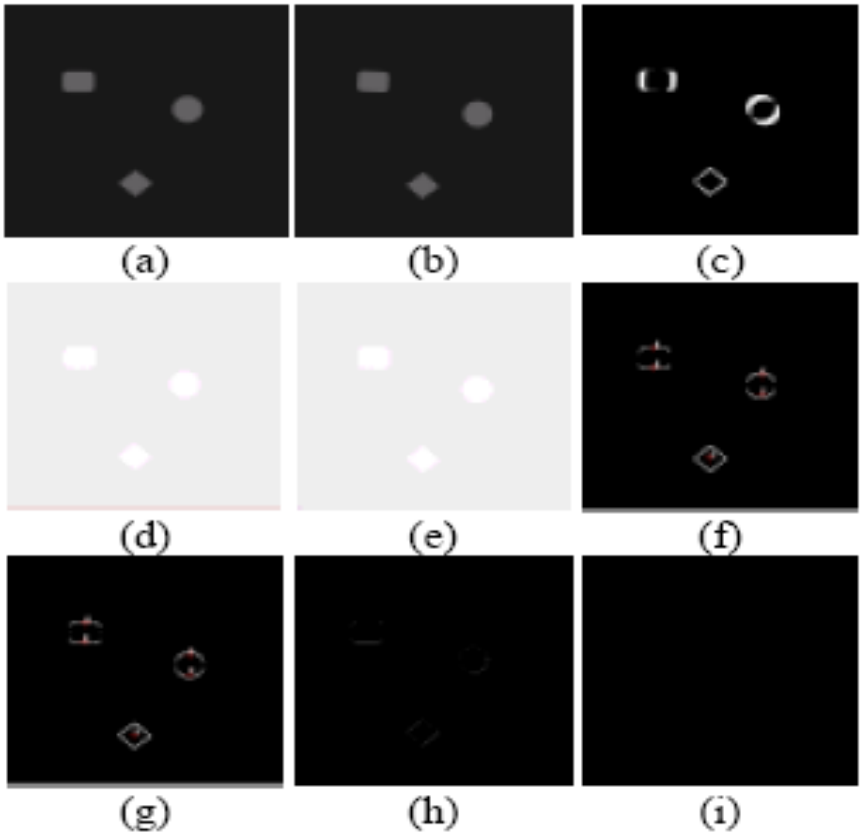


由於兩影像之光源亮度有所不同，XOR 也無法得到預期的結果

影像註記(Image Registration)

在影像相減前，除了必需針對光源的變異進行補償外，還必需針對待檢測影像及標準影像兩者之間的相對偏移量和旋轉量進行修正。

所謂的特徵抽取就是將用於匹配的特徵，分別從標準影像及待檢測影像中抽取出來。利用邊緣偵測運算子(Edge Detector)找出物體邊緣。



瑕疵檢測流程說明例。

(a)為參考影像；

(b)為待檢測影像；

(c)為a 圖與b 圖直接XOR之結果；

(d)為 a 圖直方圖均值化之結果；

(e)為b 圖直方圖均值化之結果；

(f)為d 圖尋邊、二值化、及標號後之結果；

(g)為e 圖尋邊、二值化、及標號後之結果；

(h)為f 圖與g 圖XOR之結果；(i)為h 圖斷開一次之結果。