



GPS/GNSS課程

GPS/GNSS定位應用成果 (GPS/GNSS Applications)

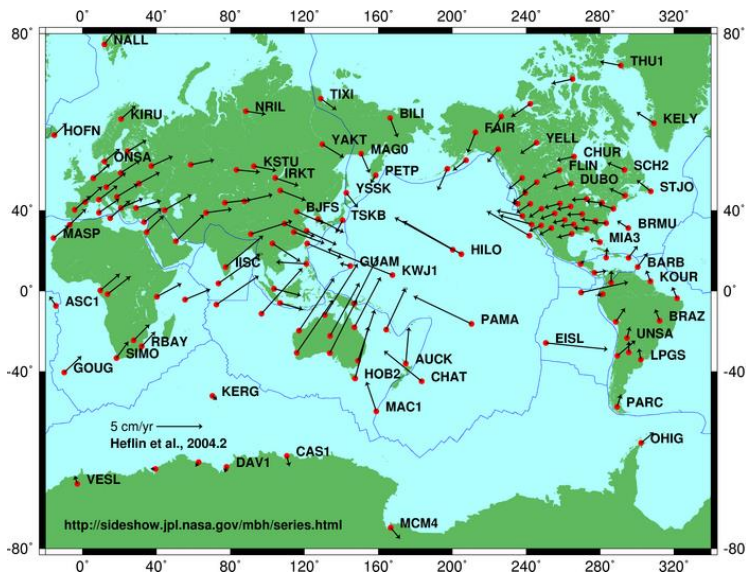
張嘉強

健行科技大學
應用空間資訊系





GPS兩大應用主軸



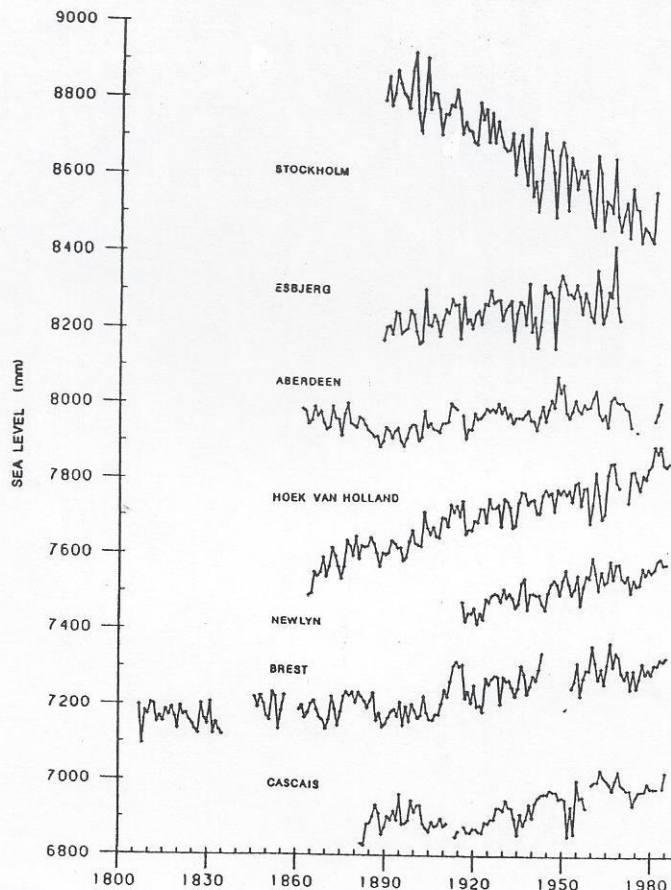
地球表面測繪

行動載具導航

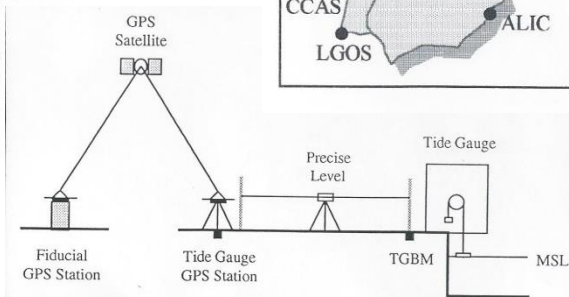
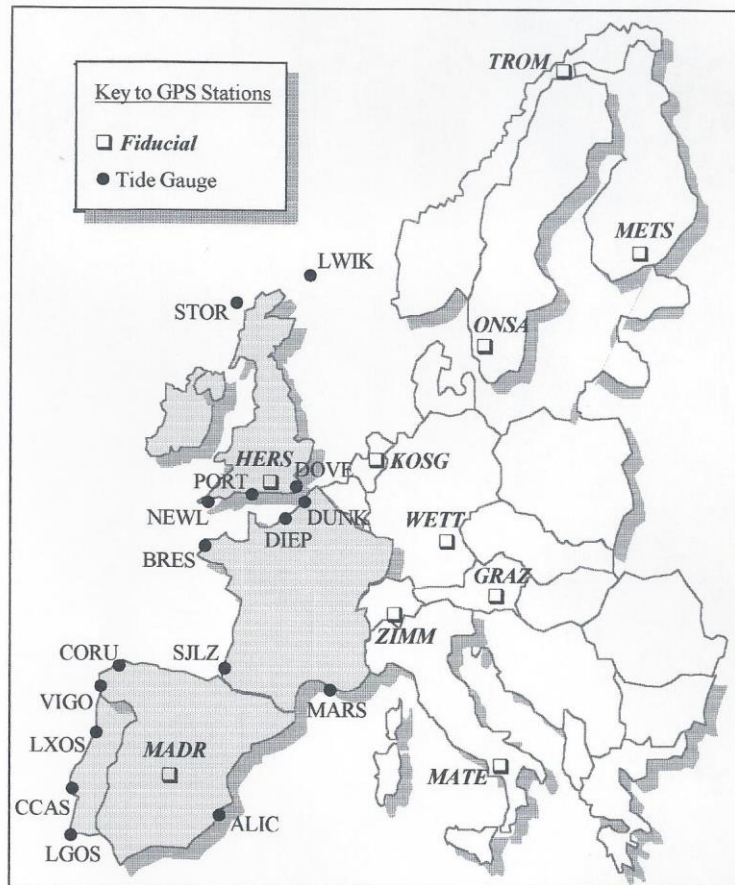




西歐驗潮站GPS監測

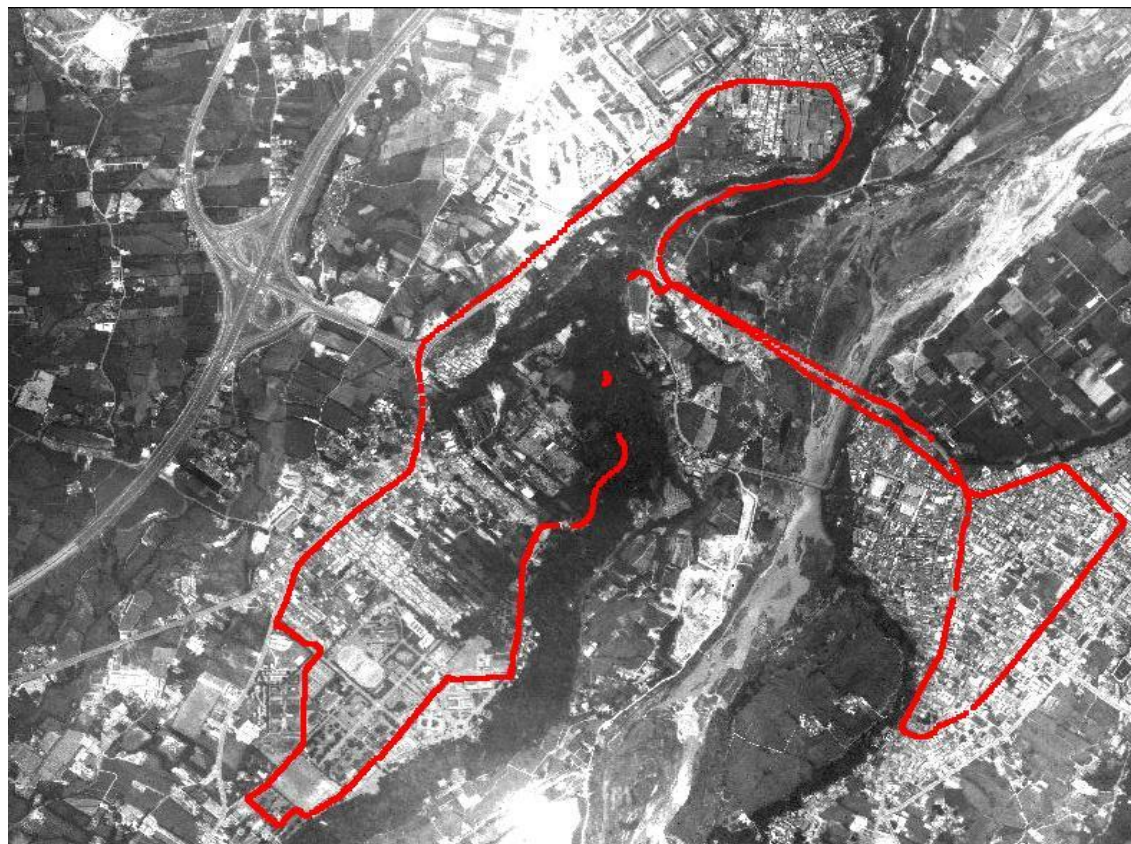


(a)



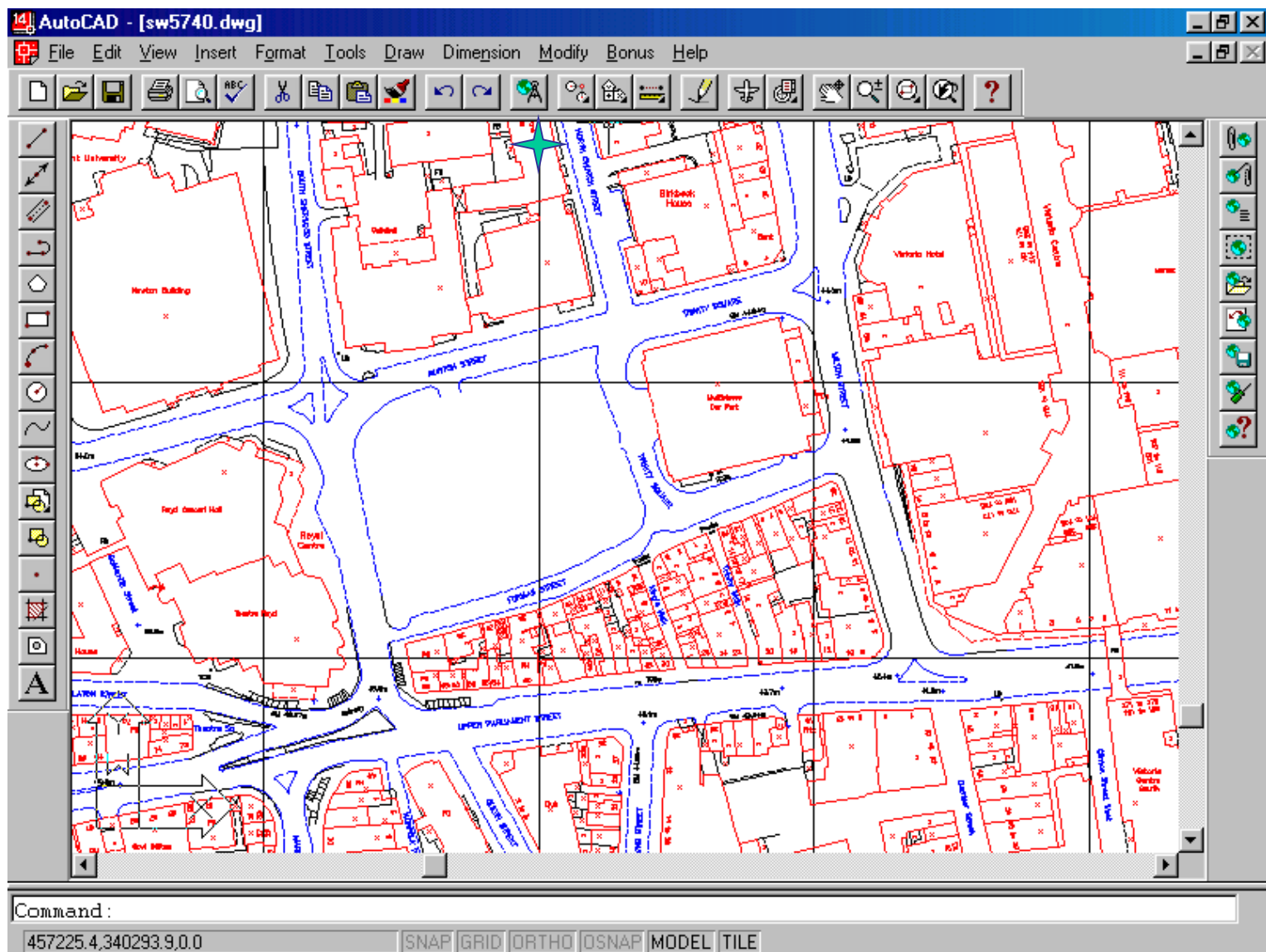


砂石車路徑顯示



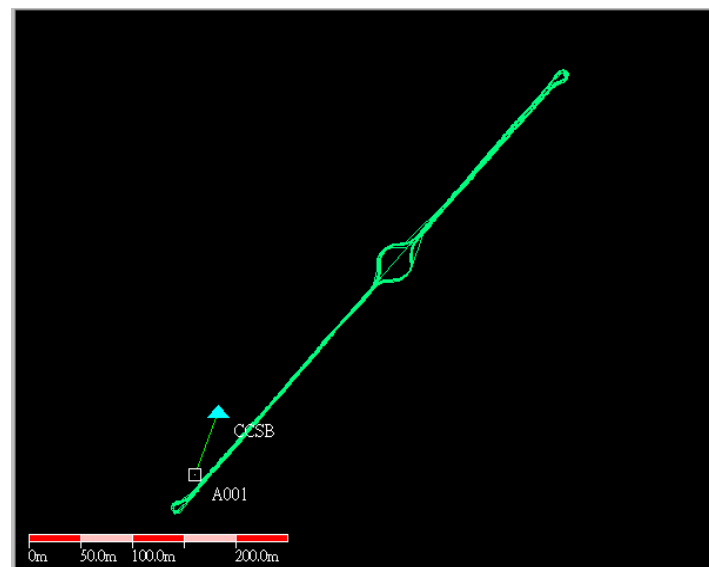
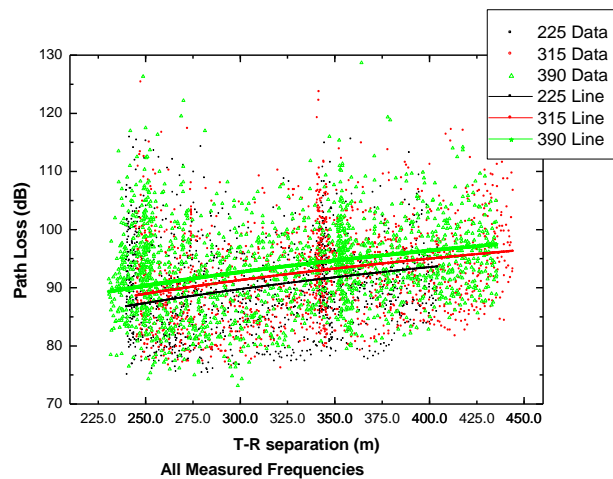
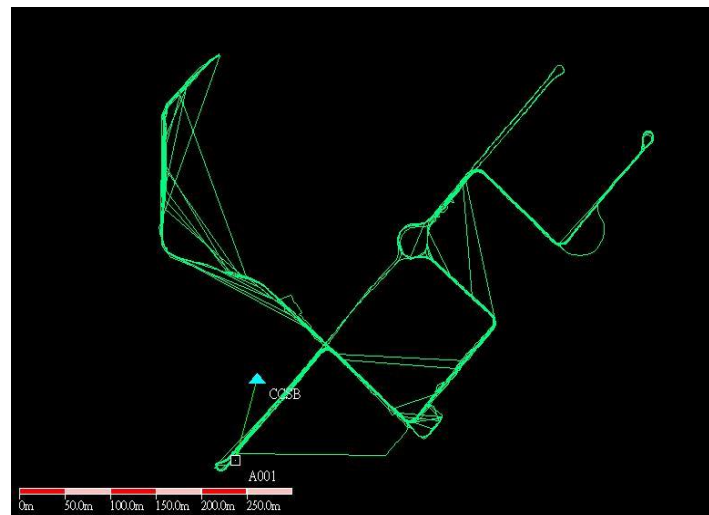


車輛即時監控



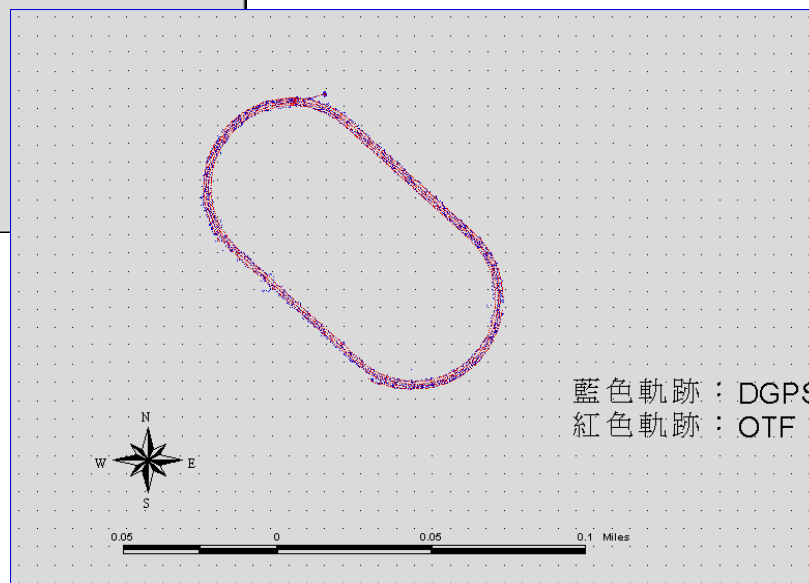
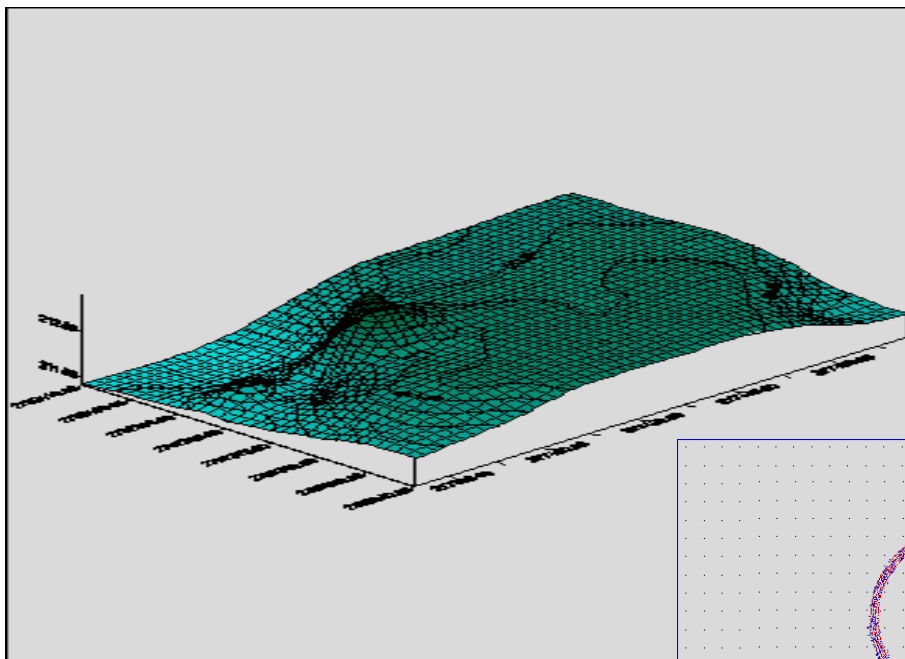


通訊路徑測試



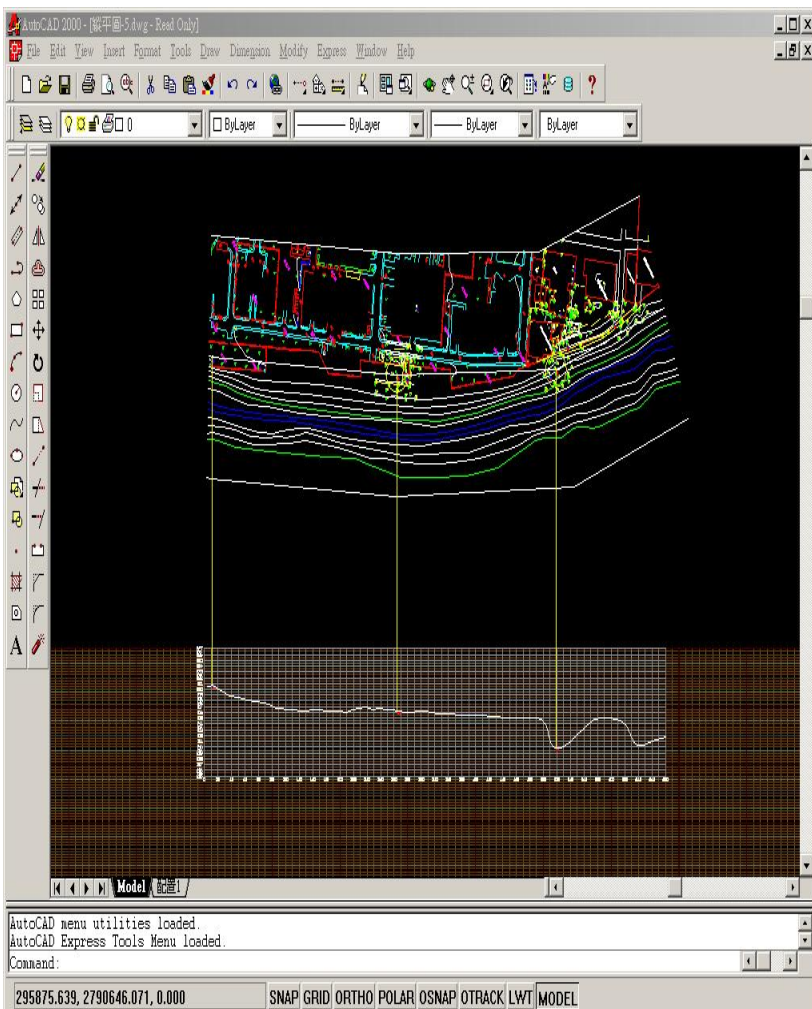


地形及軌跡快速測繪

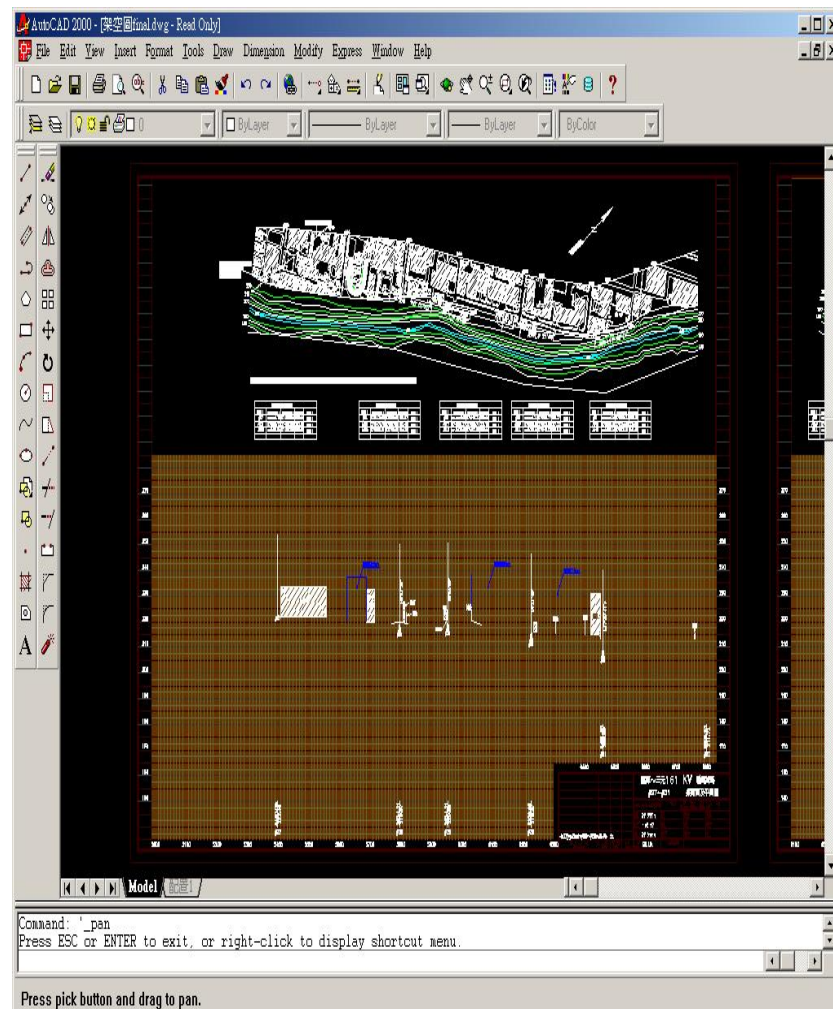




電力管線GIS建置



高壓線路剖面

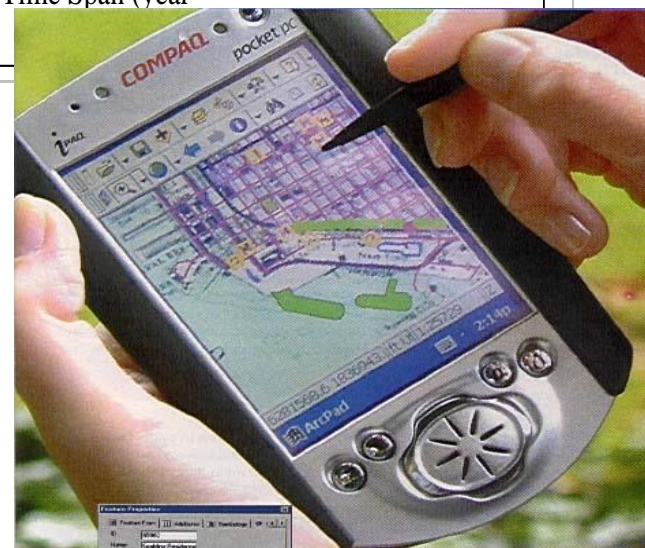
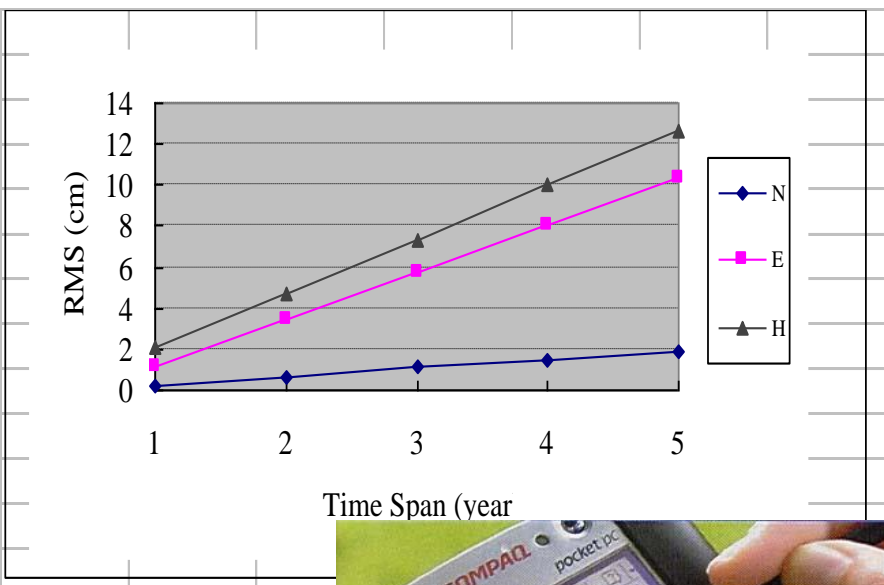
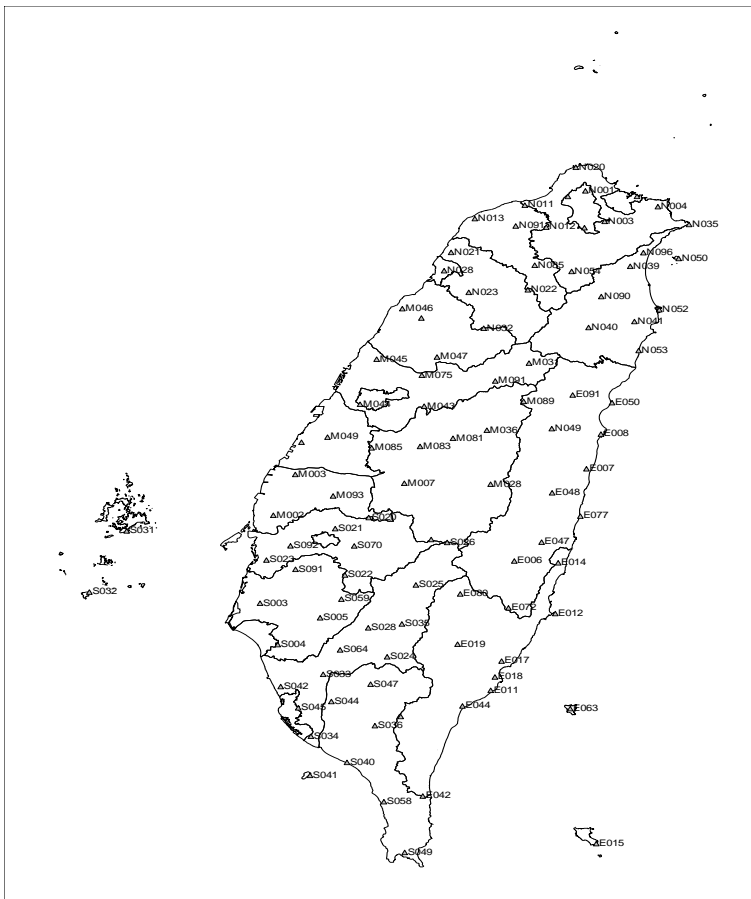


高壓電塔架空路線





修測地圖與坐標維護



TWD97坐標系統





軍圖坐標基準轉換

運用邊緣區

實測地控點



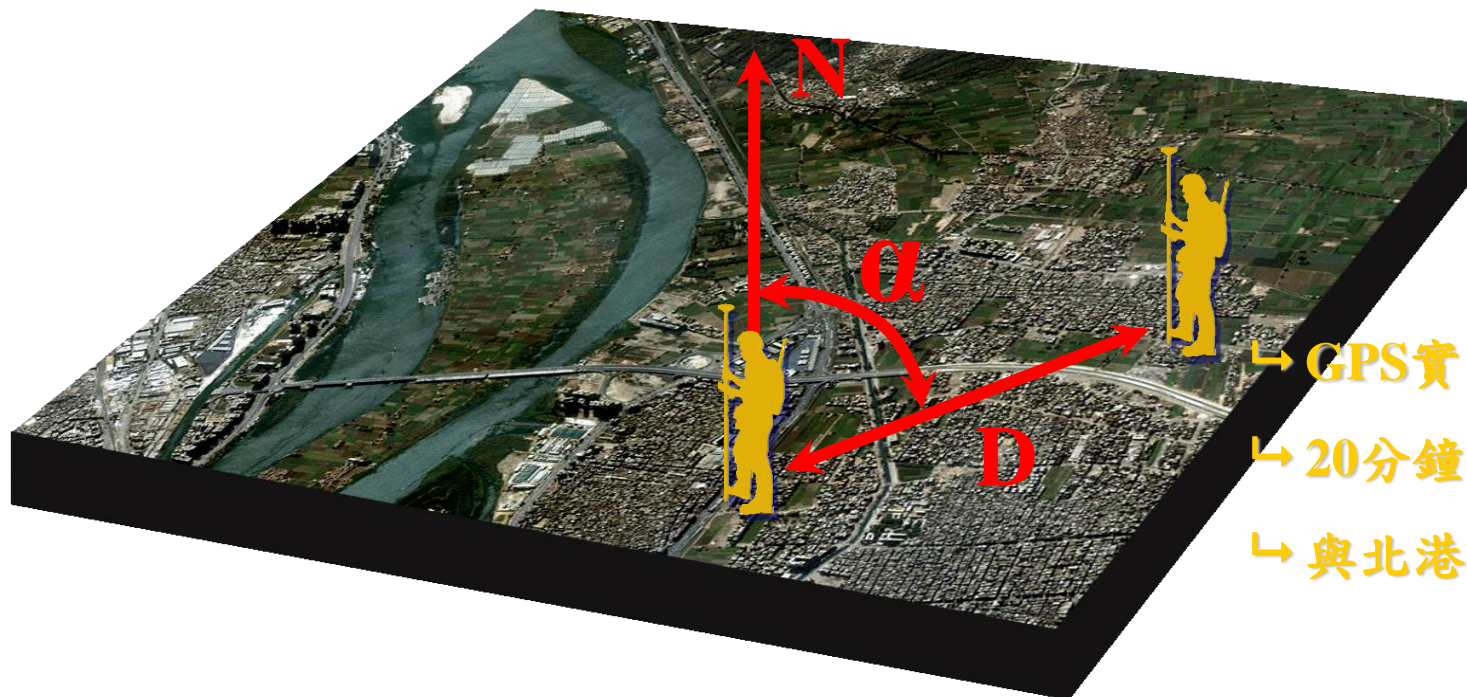
運用製圖區

衛星影像點





衛星影像精度檢核

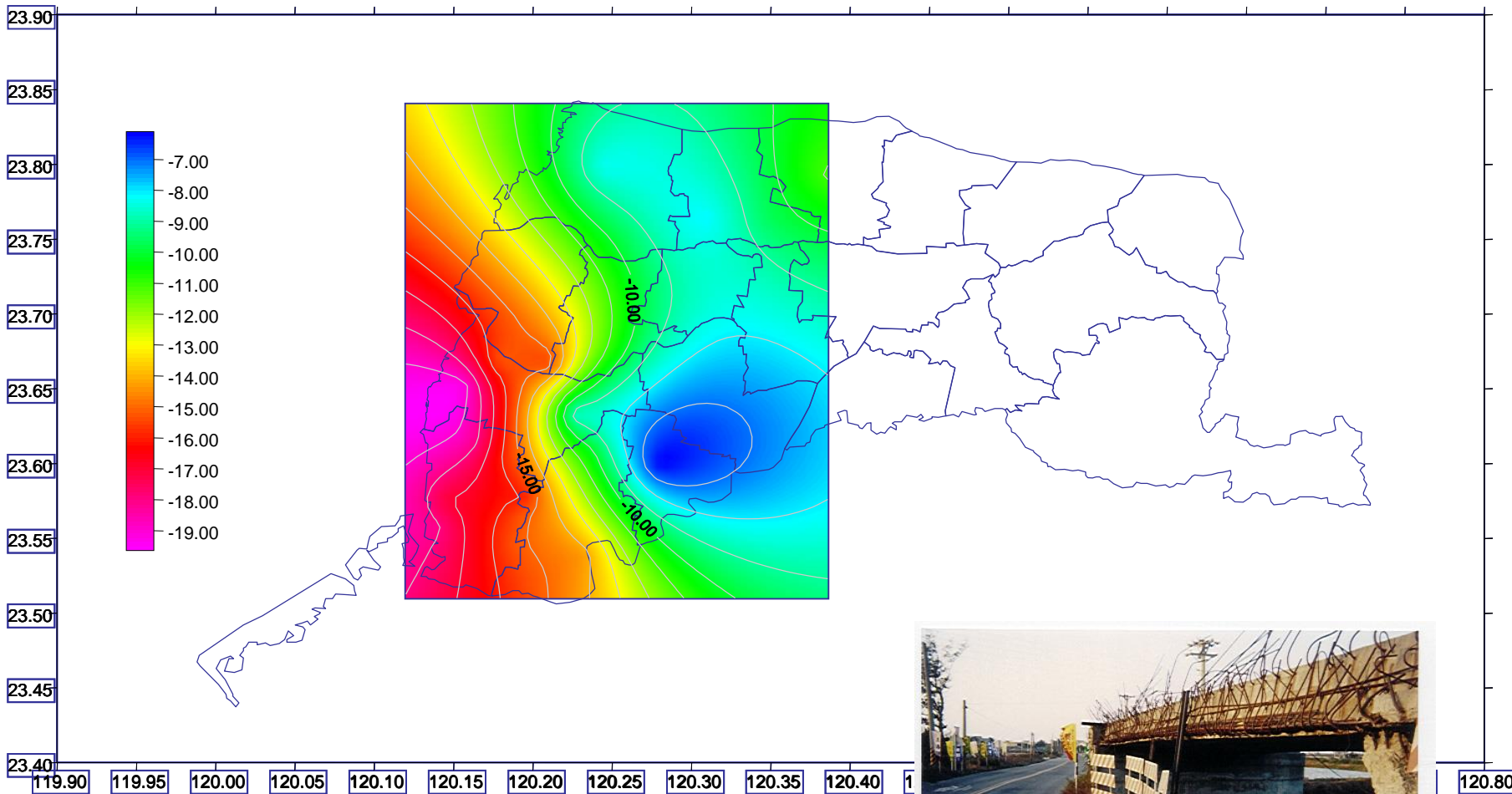


衛星影像點 誤差RMS值	絕對精度 (m) 太空圖像公司宣稱之精度為50m	相對精度	
		距離 (m)	方位角 (°)
三鶯幅	11.0	2.8	0.888
台中幅	56.0	6.3	0.988
社頭幅	92.6	17.9	0.756



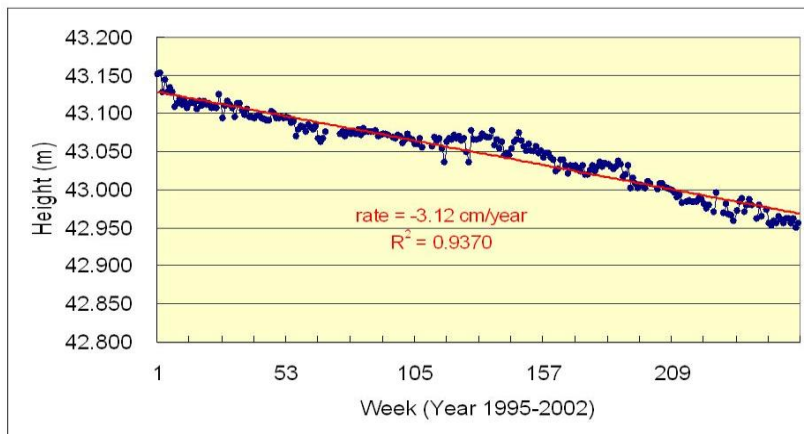


雲林地區地層下陷監測



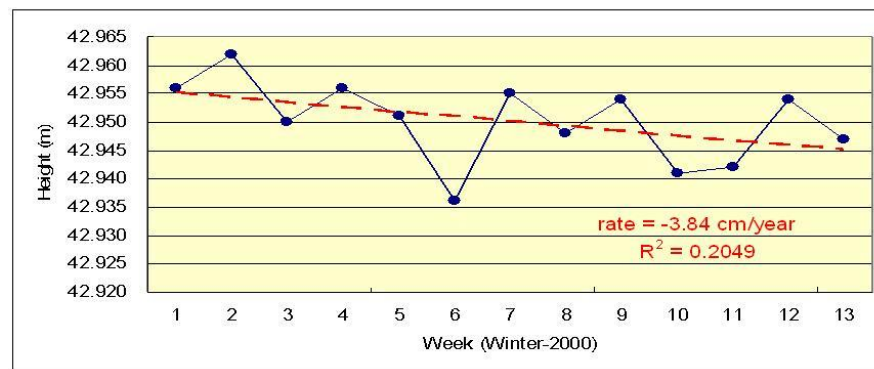
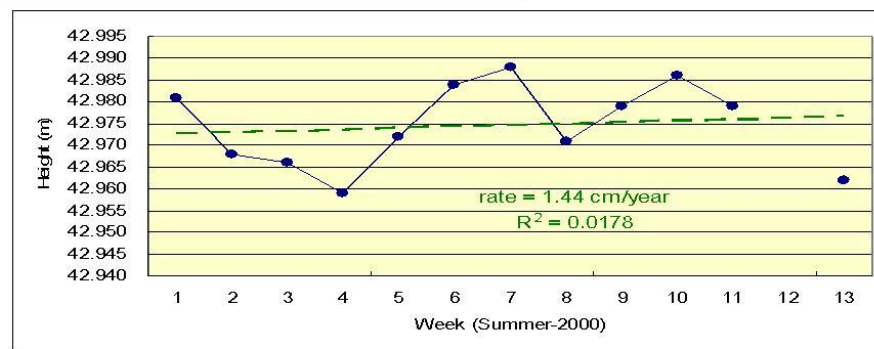


季節性高程變化-高鐵沉陷監測



長期高程變化

單年(夏冬季)
高程變化





類神經網路估計高程變化

Network #1 - Alyuda NeuroIn

File View Data Network Query

Analyze

Raw Data

	(N) Column #1	(N) Column #2
TST	2004.010959	42.807
TST	2004.030137	42.786
TRN	2004.049315	42.788
TRN	2004.068493	42.788
TRN	2004.087671	42.785
TRN	2004.106849	42.772
TRN	2004.126027	42.78
TRN	2004.145205	42.773
TRN	2004.164384	42.767
TRN	2004.183562	42.769
TRN	2004.20274	42.774
TRN	2004.221918	42.759
TRN	2004.241096	42.772
TRN	2004.260274	42.759
TRN	2004.279452	42.76
TRN	2004.29863	42.763
TRN	2004.317808	42.76
TRN	2004.336986	42.758
VLD	2004.356164	42.754

Network #1 - Alyuda NeuroIntelligence

File View Data Network Query Options Help

Analyze Preprocess Design

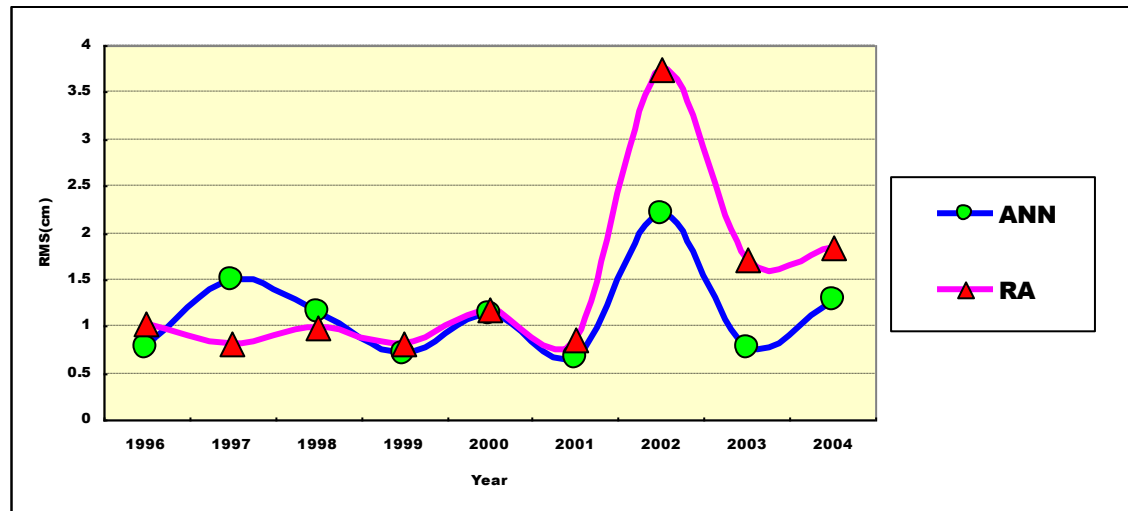
Active Network

Show network image:

1-4-1

Architecture Search

ID	Architecture
1	[1-1-1]
2	[1-7-1]
3	[1-4-1]
4	[1-5-1]
5	[1-2-1]
6	[1-3-1]





林肯大郡坡地滑動監測

災變區

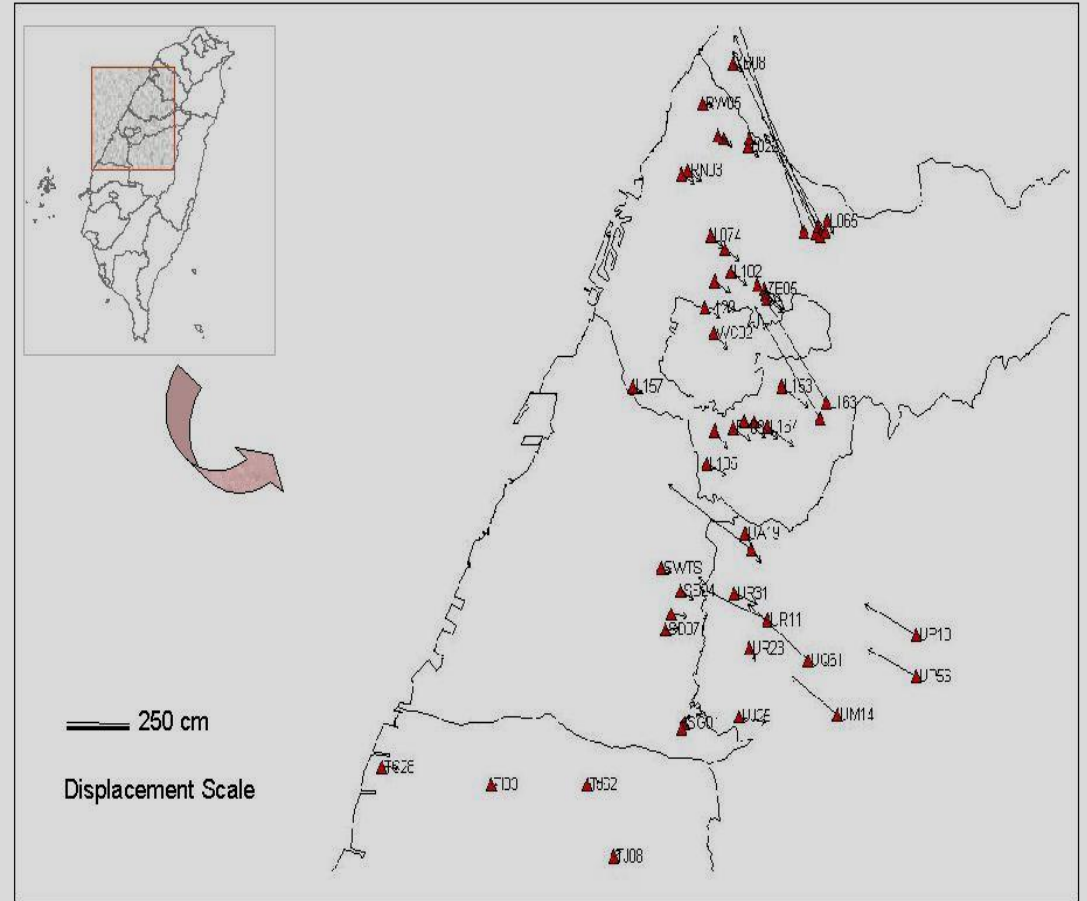


危險區



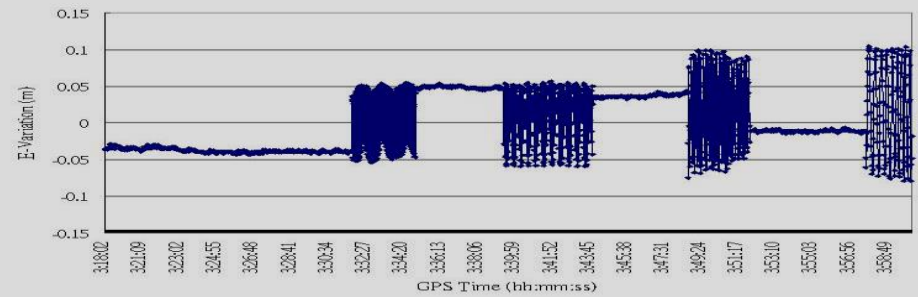
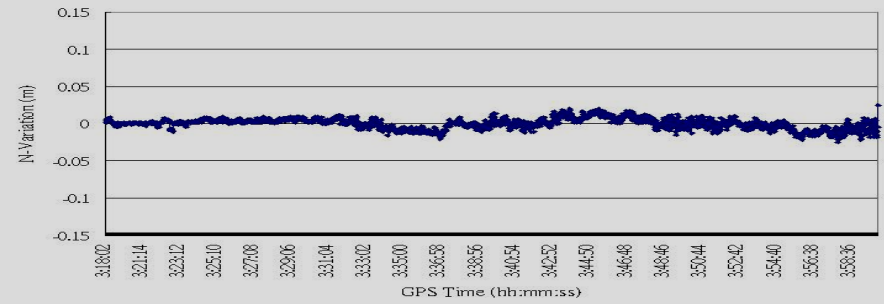


921 大地震檢測控制點



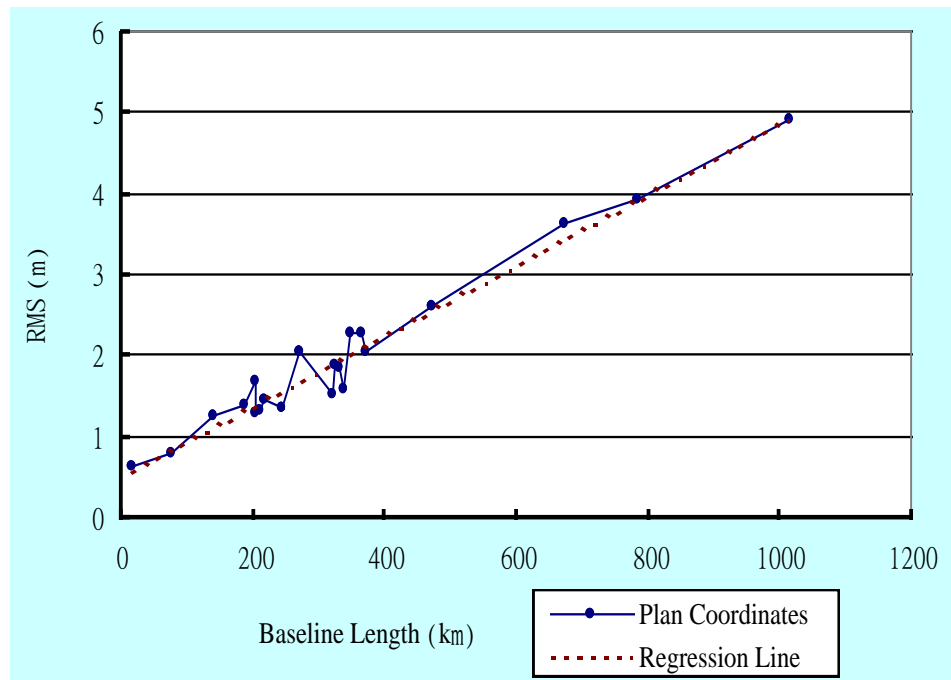
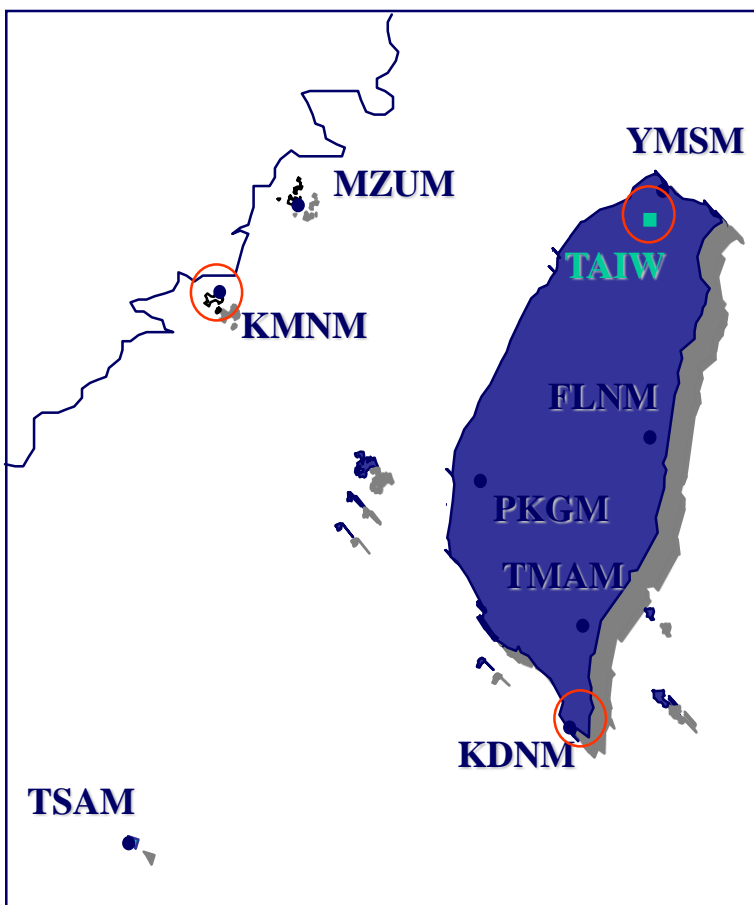


地震震動模擬偵測





區域性DGPS導航

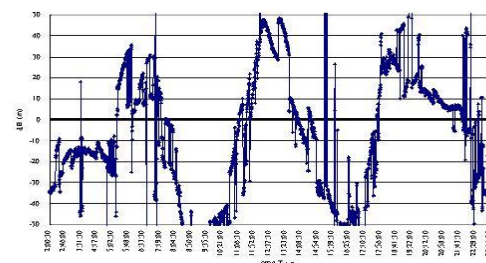
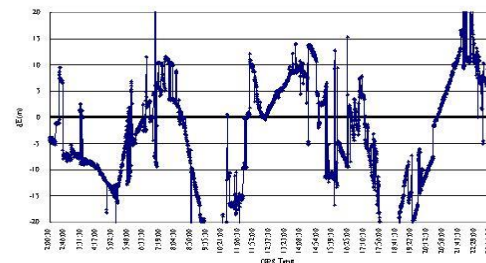
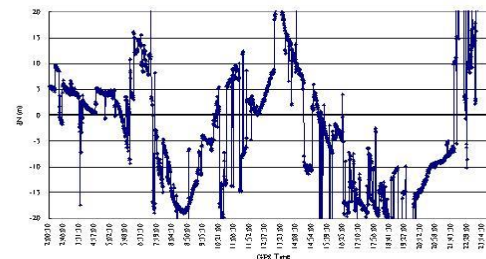
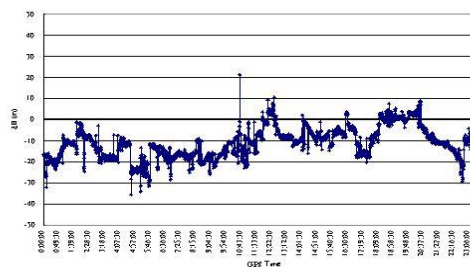
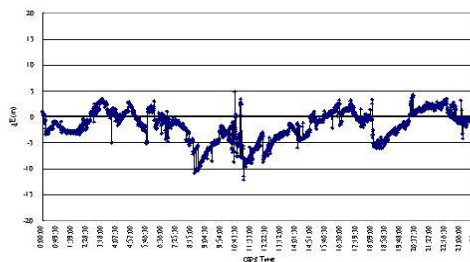
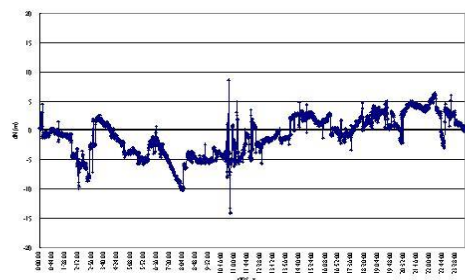
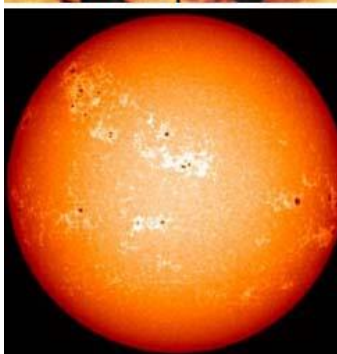
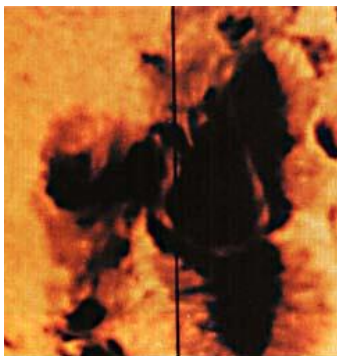


● GPS衛星追蹤站





太陽活動干擾導航精度



三天後





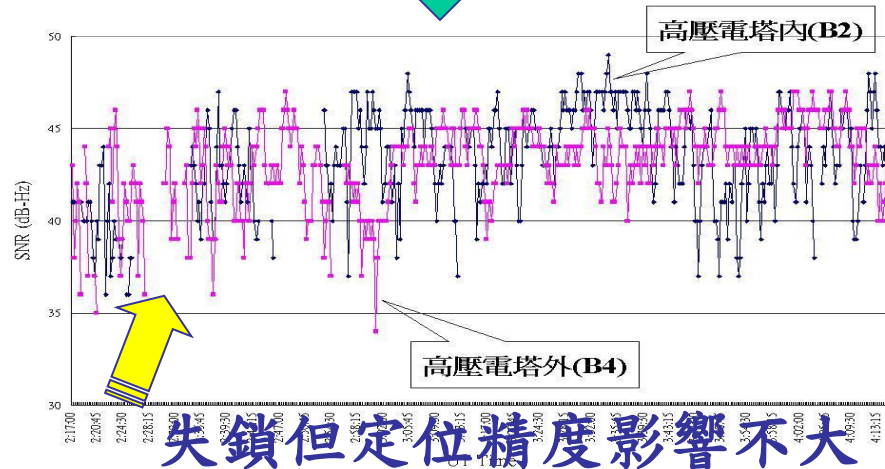
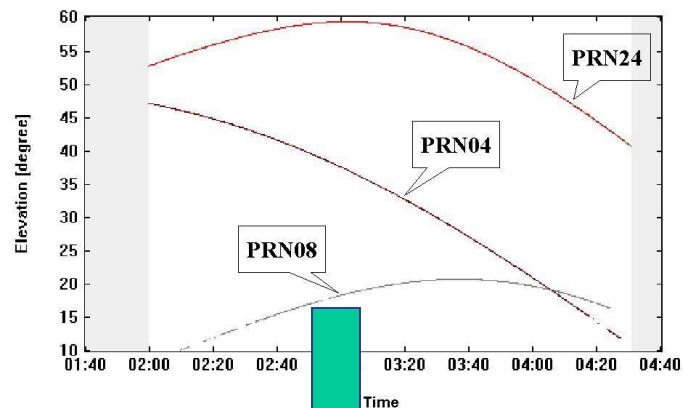
高壓電場之定位干擾測試



161KV



345KV

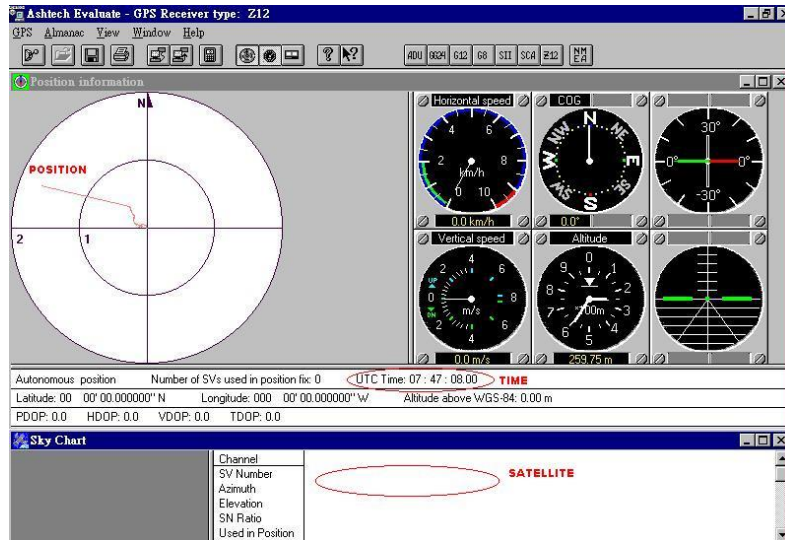
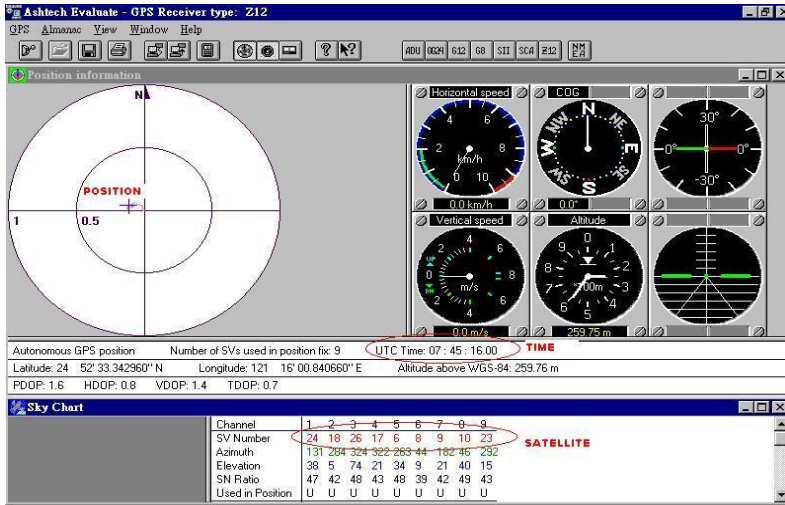


失鎖但定位精度影響不大



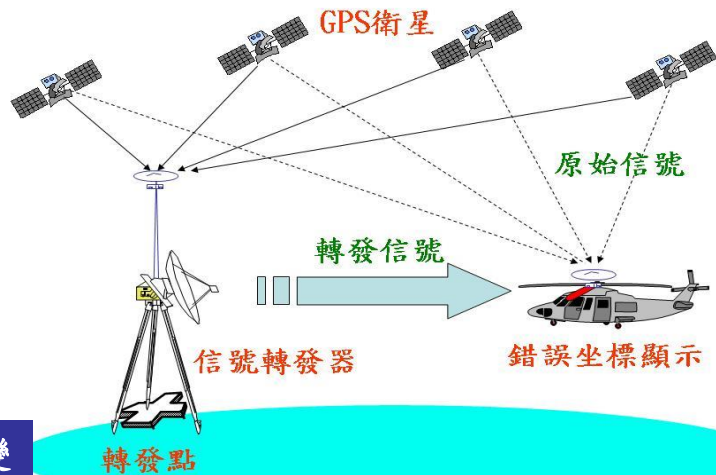


GPS雜波干擾測試





GPS轉發信號干擾測試



Ashtech Evaluate - View logging from GG24

GPS Almanac View Window Help

Position information

Sky Chart

Channel	1	2	3	4	5	6	7
SV Number	26	10	2	29	56	55	33
Azimuth	208	338	70	207	233	212	328
Elevation	45	51	62	66	45	49	38
SN Ratio	30	31	25	31	37	47	44
Used in Position	U	U	S	U	U	U	U

Ant1 SV Number
SN Ratio

Ant2 SV Number
SN Ratio

Ant3 SV Number
SN Ratio

Ant4 SV Number
SN Ratio

坐標改變

時間過2秒

Autonomous GPS+GLONASS position Number of SVs used in position fix: 6 UTC Time: 02:17:59.00

Latitude: 24 52' 31.864380" N Longitude: 121 16' 02.486040" E Altitude above WGS-84: 130.17 m

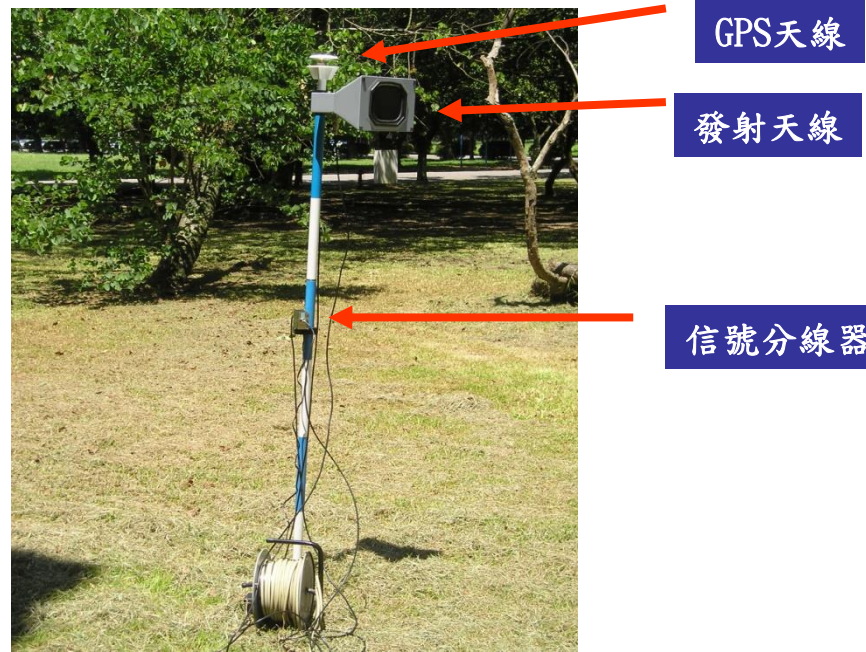
PDOP: 7.7 HDOP: 3.9 VDOP: 6.7 TDOP: 5.6

ADU Double differences: Vector 1-2: 0 Vector 1-3: 0

定位坐標改變2.3" (約70m)

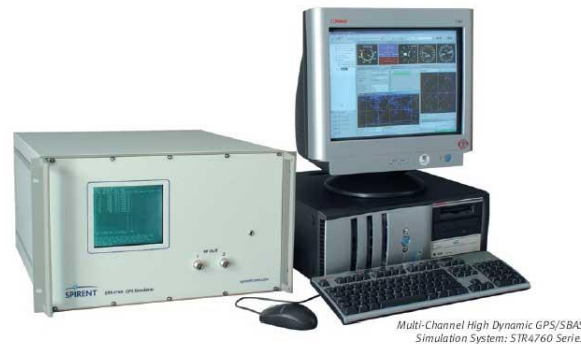
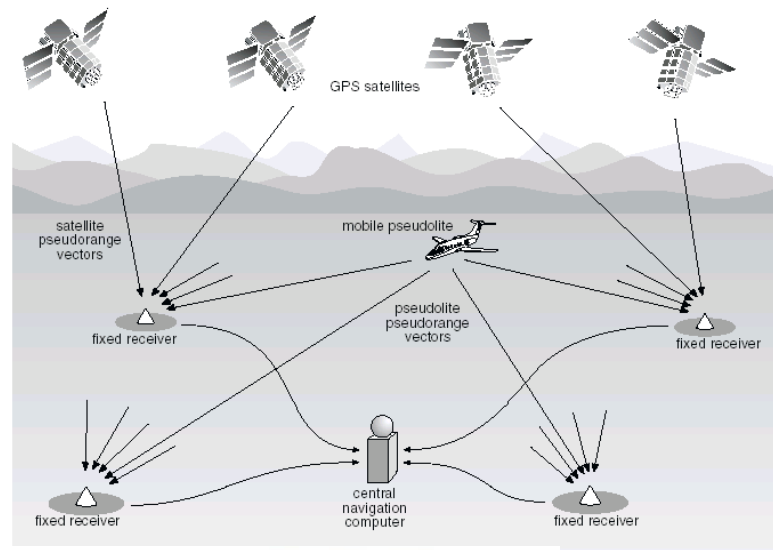
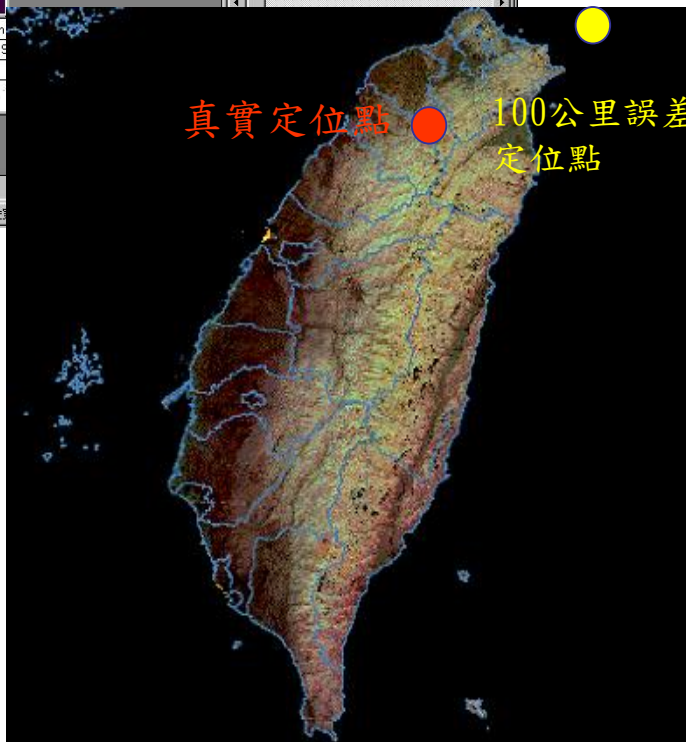
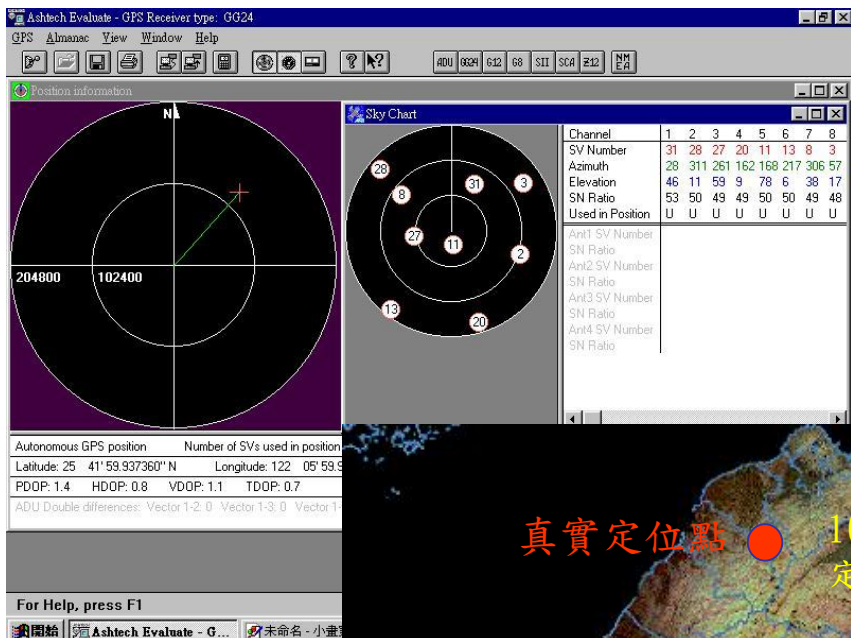
D:m A:m H:km/h V:m/s 06 Jun 2005 11:27

開始 Ashtech Evaluate - Vi... 01.bmp - 小畫家





GPS 虛擬信號干擾測試





GPS干擾基站布設模擬器

PL導航定位模擬器

開啓檔案 輸出檔案 坐標解算 關閉程式

1.定位點 (ROVER) 起始坐標及高度
經度: ° ' " 緯度: ° ' " 高度: m

2.虛擬衛星 (PL) 布設坐標及高度

PL1 - 經度:	<input type="text" value="126"/> ° <input type="text" value="0"/> ' <input type="text" value="0.000"/> "	緯度:	<input type="text" value="22"/> ° <input type="text" value="0"/> ' <input type="text" value="0.000"/> "	高度:	<input type="text" value="500.000"/> m
PL2 - 經度:	<input type="text" value="125"/> ° <input type="text" value="0"/> ' <input type="text" value="0.000"/> "	緯度:	<input type="text" value="26"/> ° <input type="text" value="0"/> ' <input type="text" value="0.000"/> "	高度:	<input type="text" value="500.000"/> m
PL3 - 經度:	<input type="text" value="120"/> ° <input type="text" value="0"/> ' <input type="text" value="0.000"/> "	緯度:	<input type="text" value="26"/> ° <input type="text" value="0"/> ' <input type="text" value="0.000"/> "	高度:	<input type="text" value="500.000"/> m
PL4 - 經度:	<input type="text" value="120"/> ° <input type="text" value="0"/> ' <input type="text" value="0.000"/> "	緯度:	<input type="text" value="21"/> ° <input type="text" value="0"/> ' <input type="text" value="0.000"/> "	高度:	<input type="text" value="500.000"/> m

3.虛擬衛星坐標誤差量 (3D等量)
PL1 - m PL2 - m PL3 - m PL4 - m

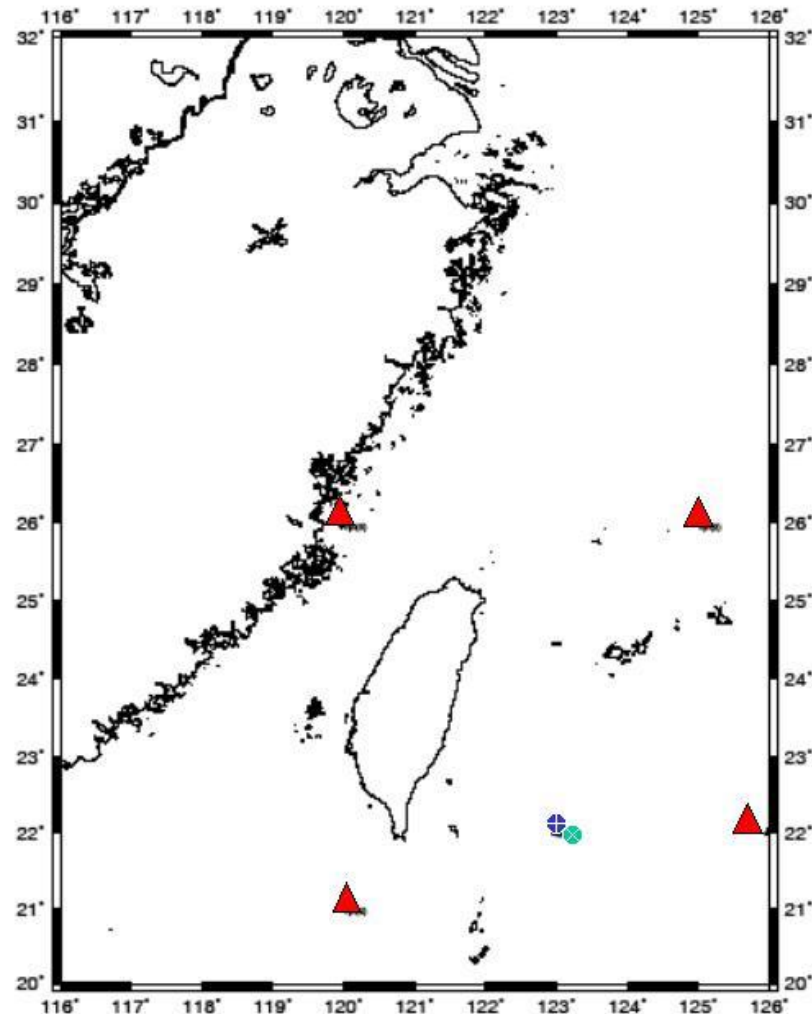
4.測距誤差量 (PL-ROVER)
PL1 - m PL2 - m PL3 - m PL4 - m

定位點解算坐標
經度: ° ' " 緯度: ° ' " 高度: m

定位點坐標誤差 (2D、3D)

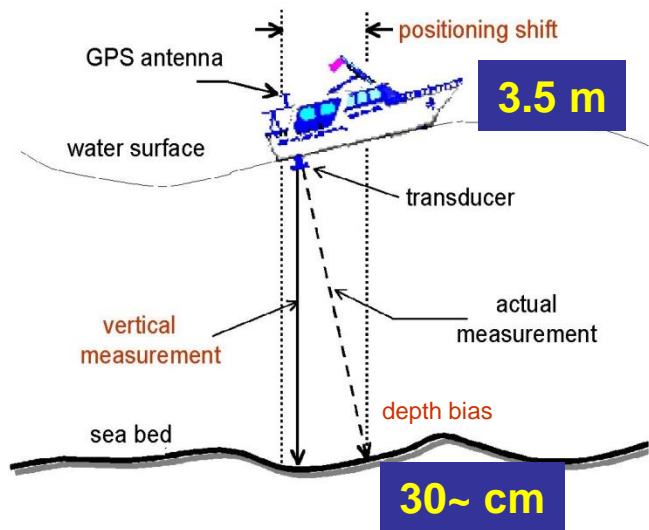
X:	<input type="text" value="39151.0655"/> m	Y:	<input type="text" value="-62696.8276"/> m	Z:	<input type="text" value="-35169.1871"/> m
2D:	<input type="text" value="73916.8325"/> m	3D:	<input type="text" value="81857.0085"/> m		

點位繪製

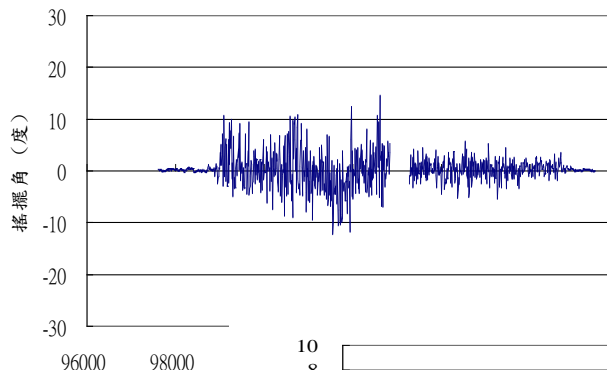
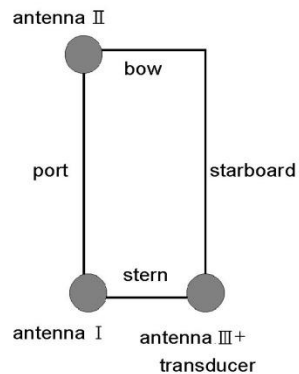




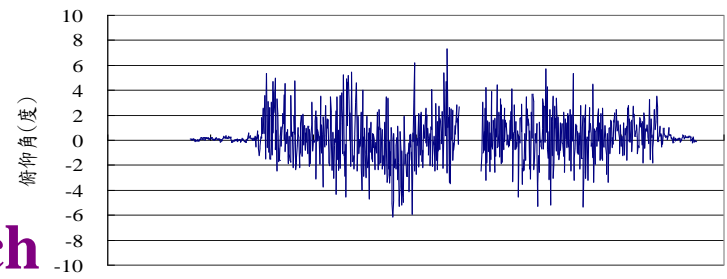
海測船姿態角測量



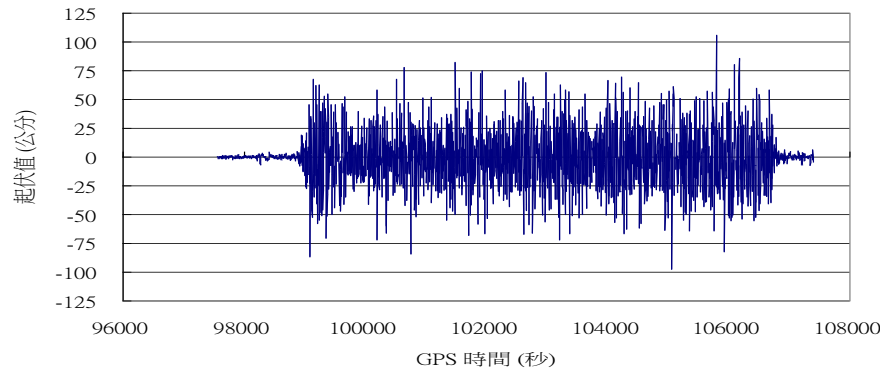
+ attitude corrections



roll



pitch

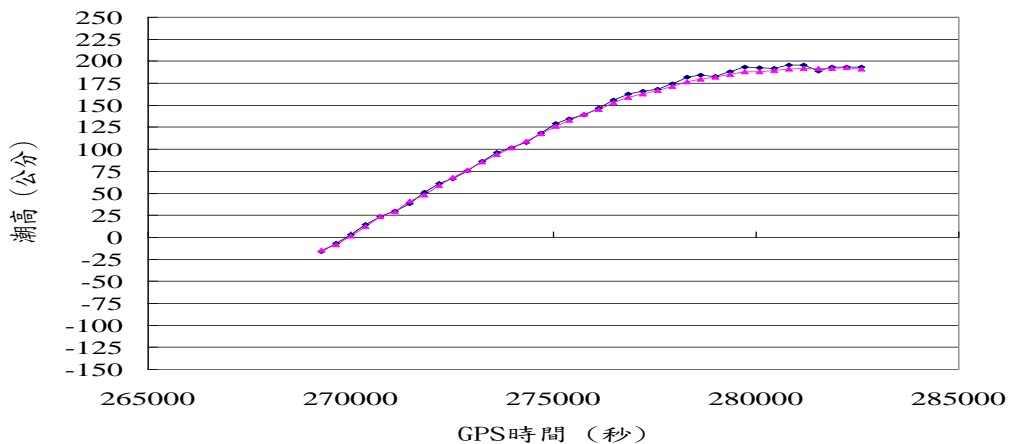


heave



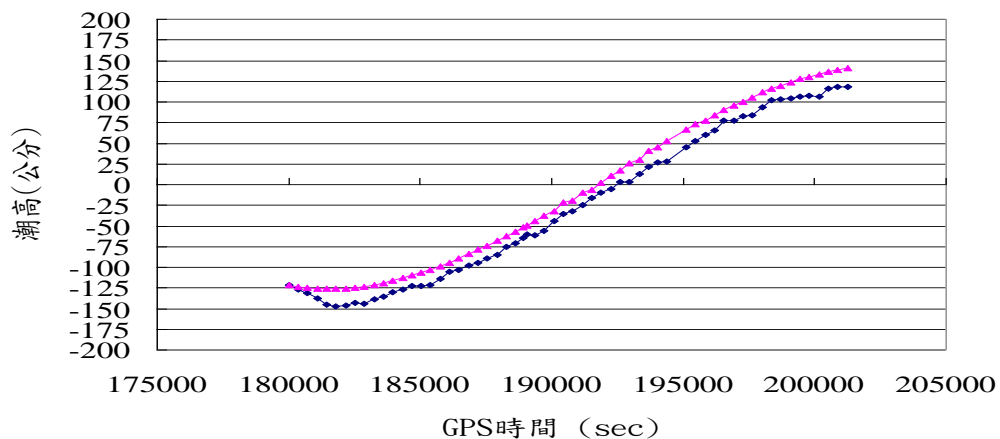
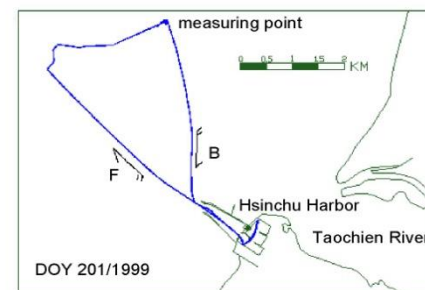


離岸驗潮



港內
差異: 2-4 cm

船測潮高
岸測潮高



港外
差異: 10-25 cm

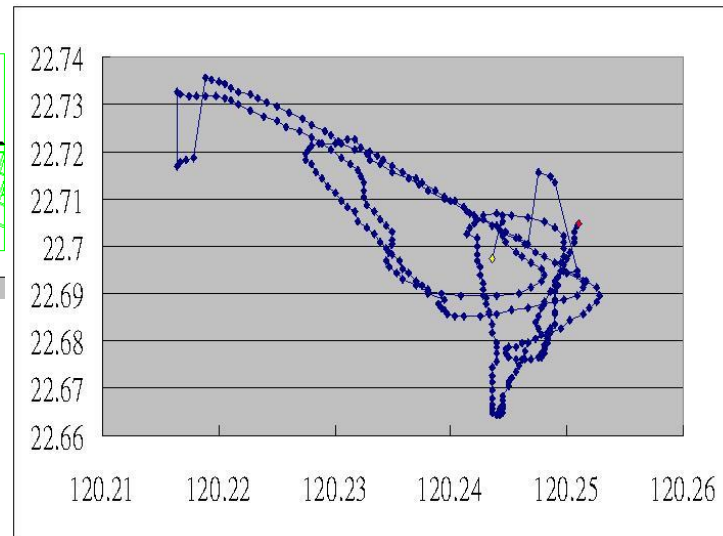
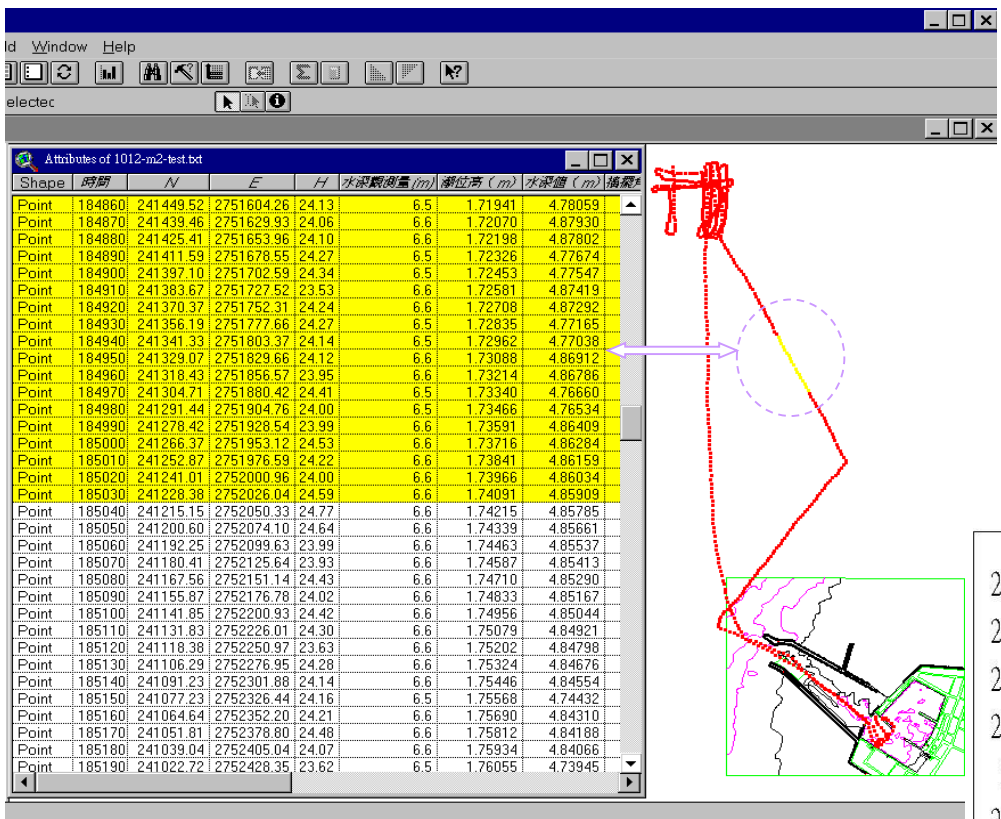
船測潮高
岸測潮高

原因:
動態吃水/潮差



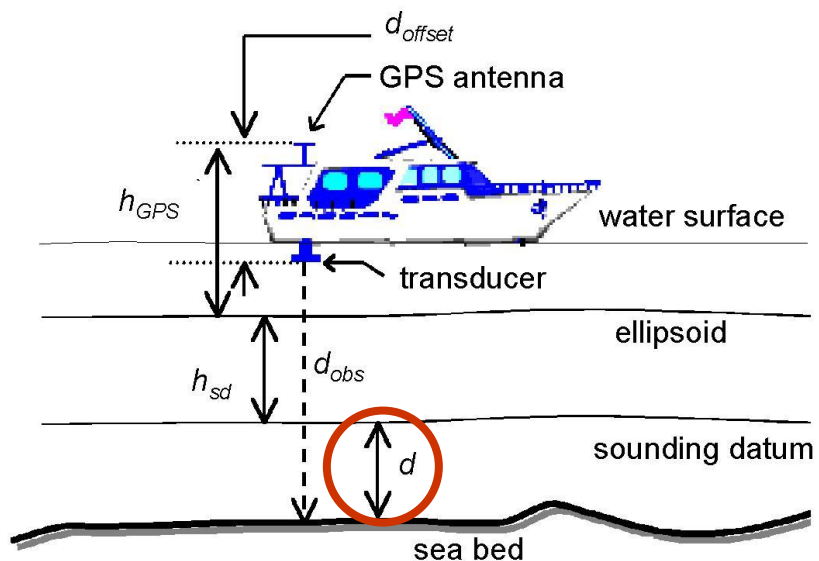


船跡資訊

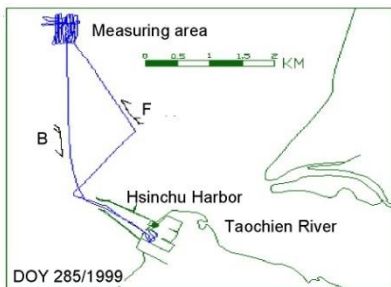




無驗潮水深測量



$$d = d_{obs} + d_{offset} - h_{GPS} - h_{SD}$$



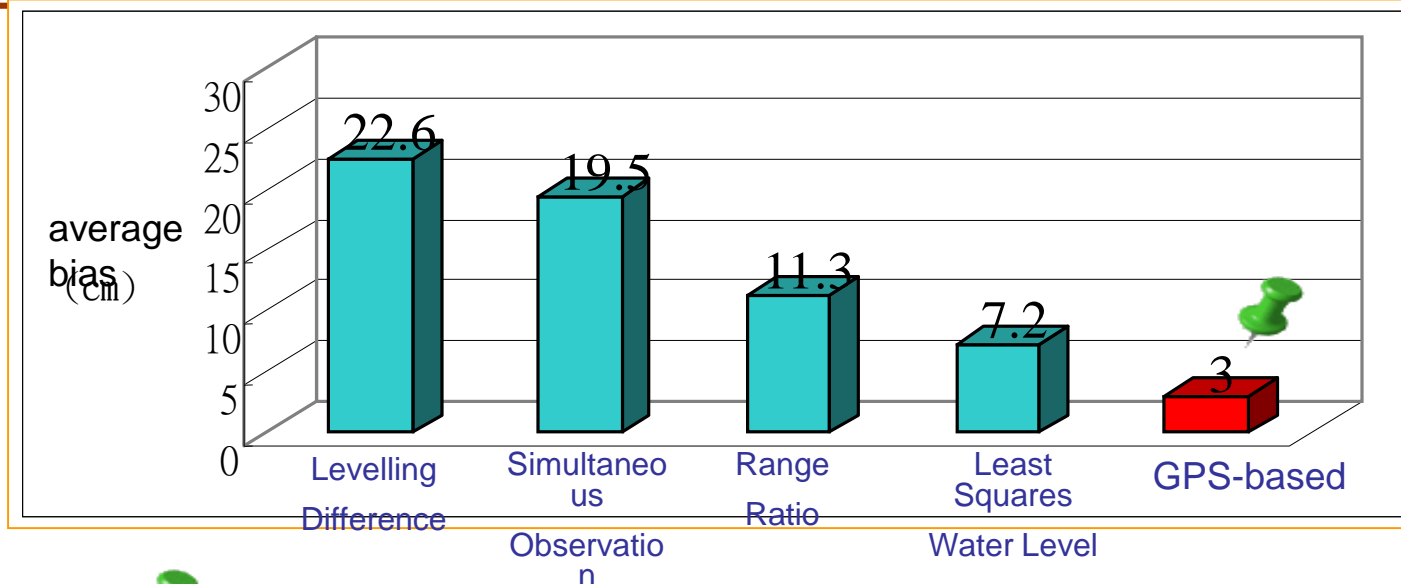
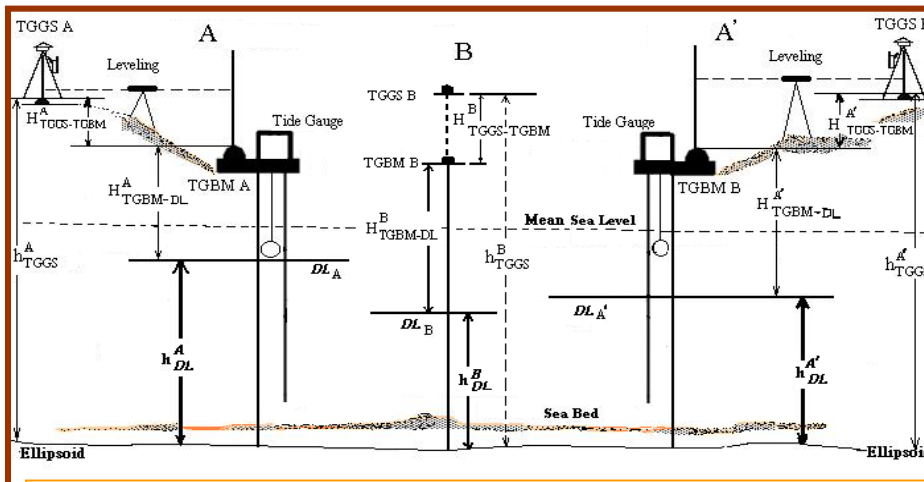
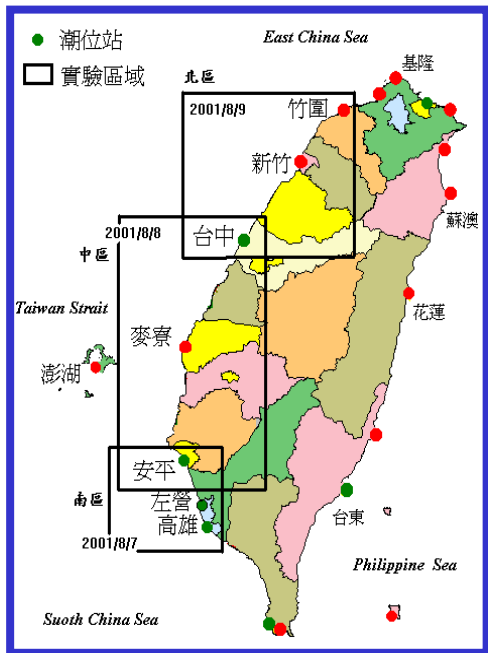
Mode	Average Absolute Difference (cm)	Improvement to Mode 1 (%)	Satisfied to Specification (ratio)
1	51	N/A	5/7
2	37	28	6/7
3	41	20	4/7
4	29	43	6/7
5	38	26	5/7
6	27	47	7/7





測深基準面傳遞

Department of Applied Geomatics, Chien-Hsin University, Taiwan

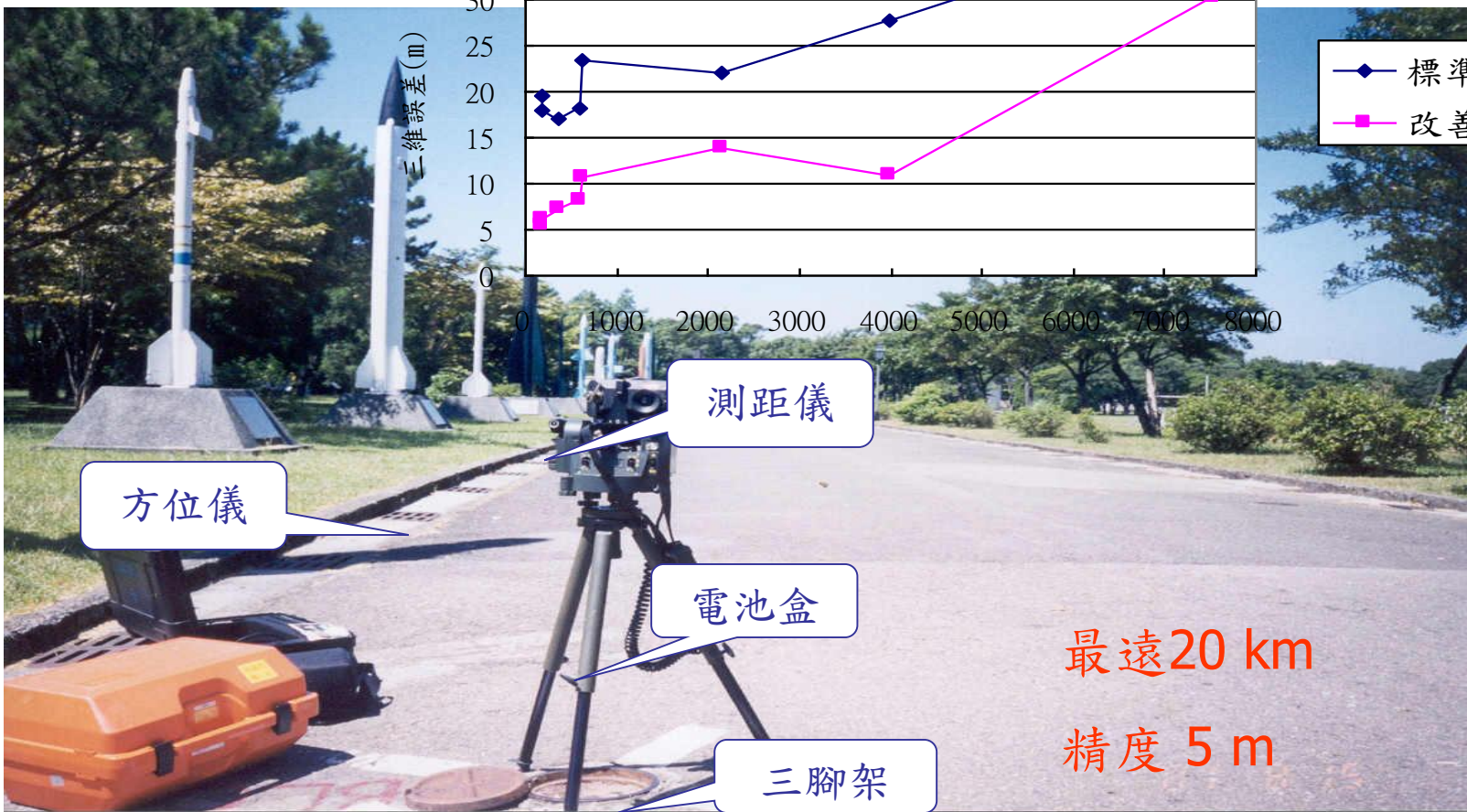


IHO specification : Special Order < +/- 5 cm



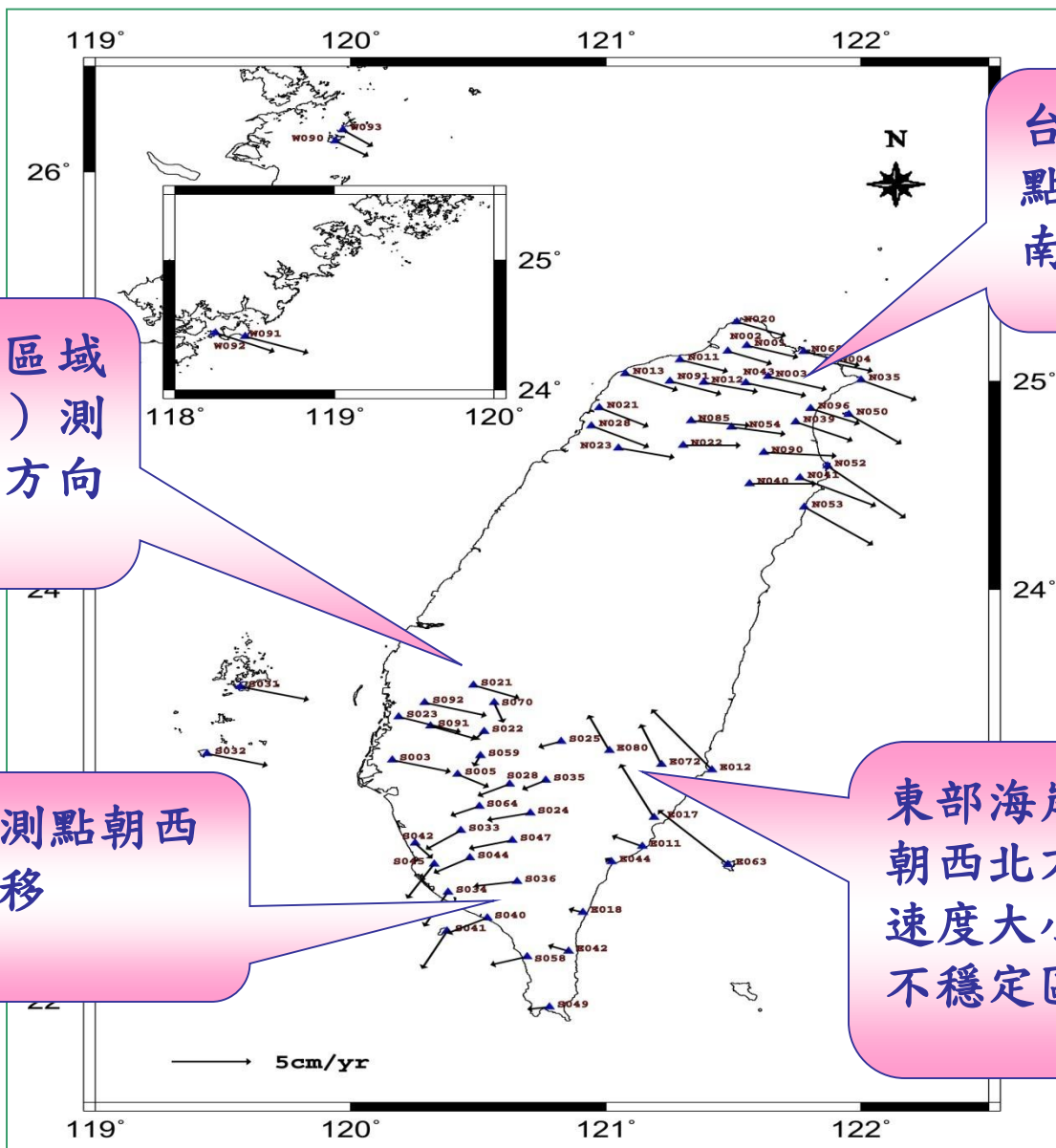


遠距定位





水平位移速度場(97-00)



台灣西部區域
(含澎湖)測
點朝東南方向
位移

台灣北部測
點一致朝東
南方向位移

台灣南部測點朝西
南方向位移

東部海岸山脈測點多
朝西北方向位移，但
速度大小不一，屬於
不穩定區域

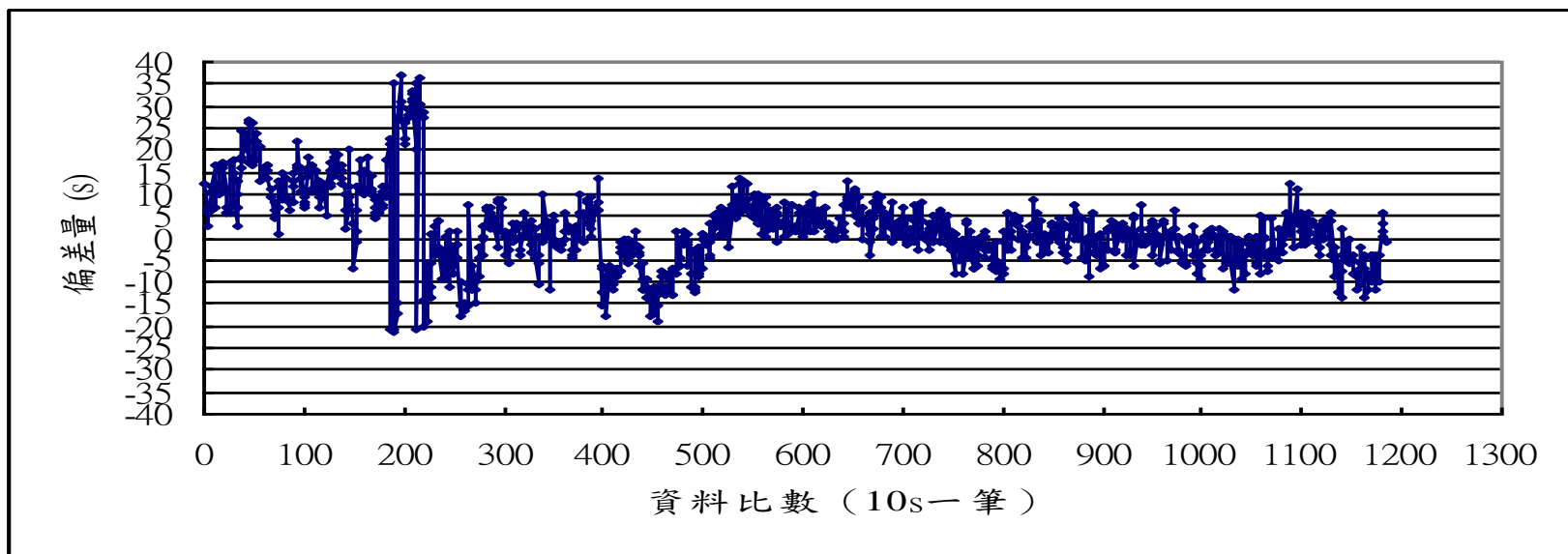




即時方位測算

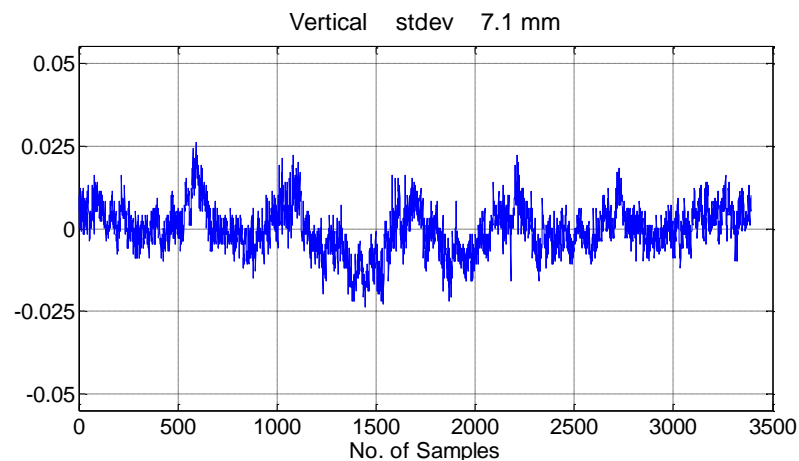
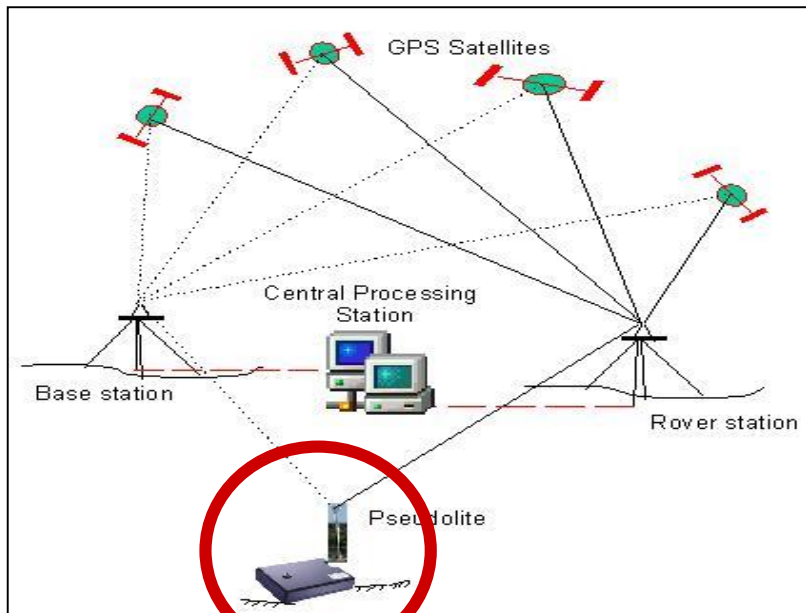
偏差量	出現百分比(%)	累積百分比(%)
±1.5s	20.2%	20.2%
±3s	16.8%	37.0%
±5s	18.4%	55.4%
±10s	24.5%	79.9%
±20s	16.1%	96.0%
±35s	3.0%	99.0%
±40s	1.0%	100%

統計量	差異量絕對值(秒)
最大值	36.970
最小值	0.018
平均值	6.199
RMS	8.693

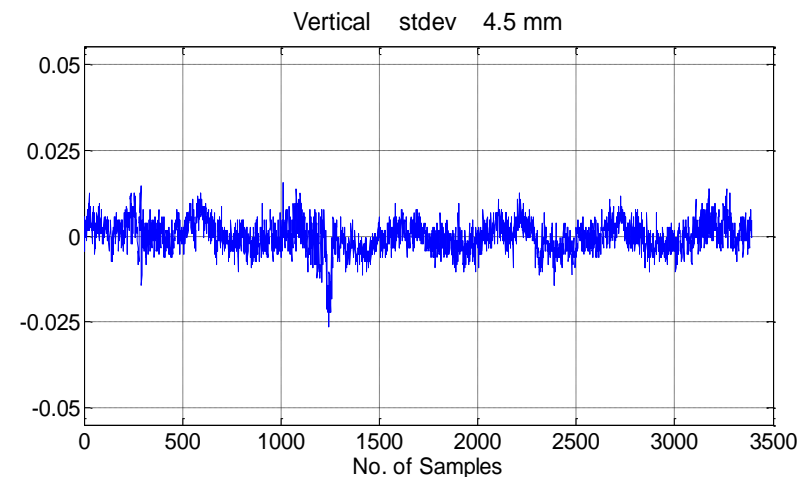




虛擬衛星運作-精度增益



GPS

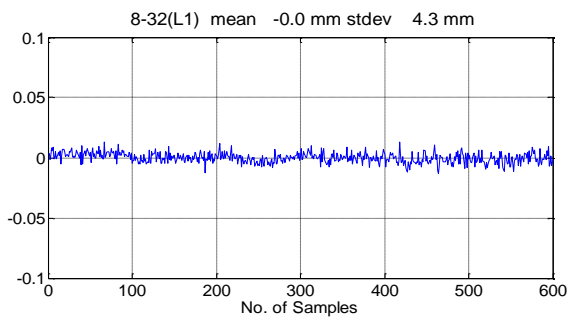
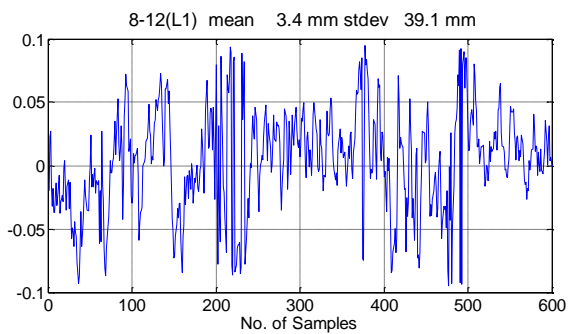
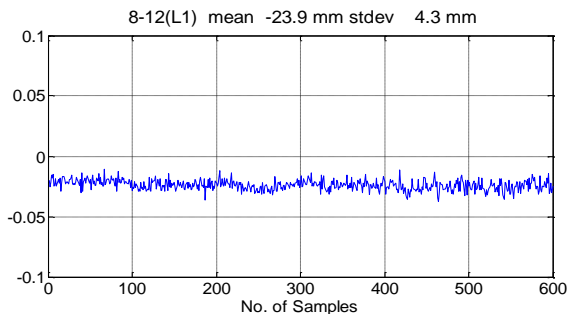


GPS+PL

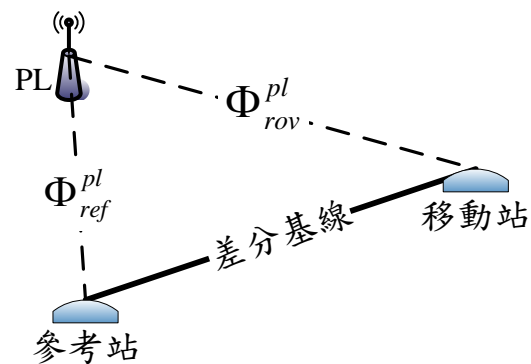




GPS 虛擬信號複製



設點複製

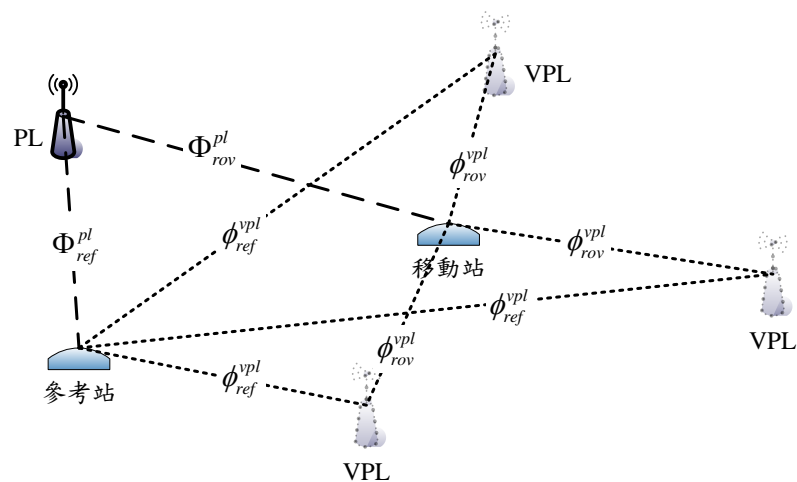


時點複製



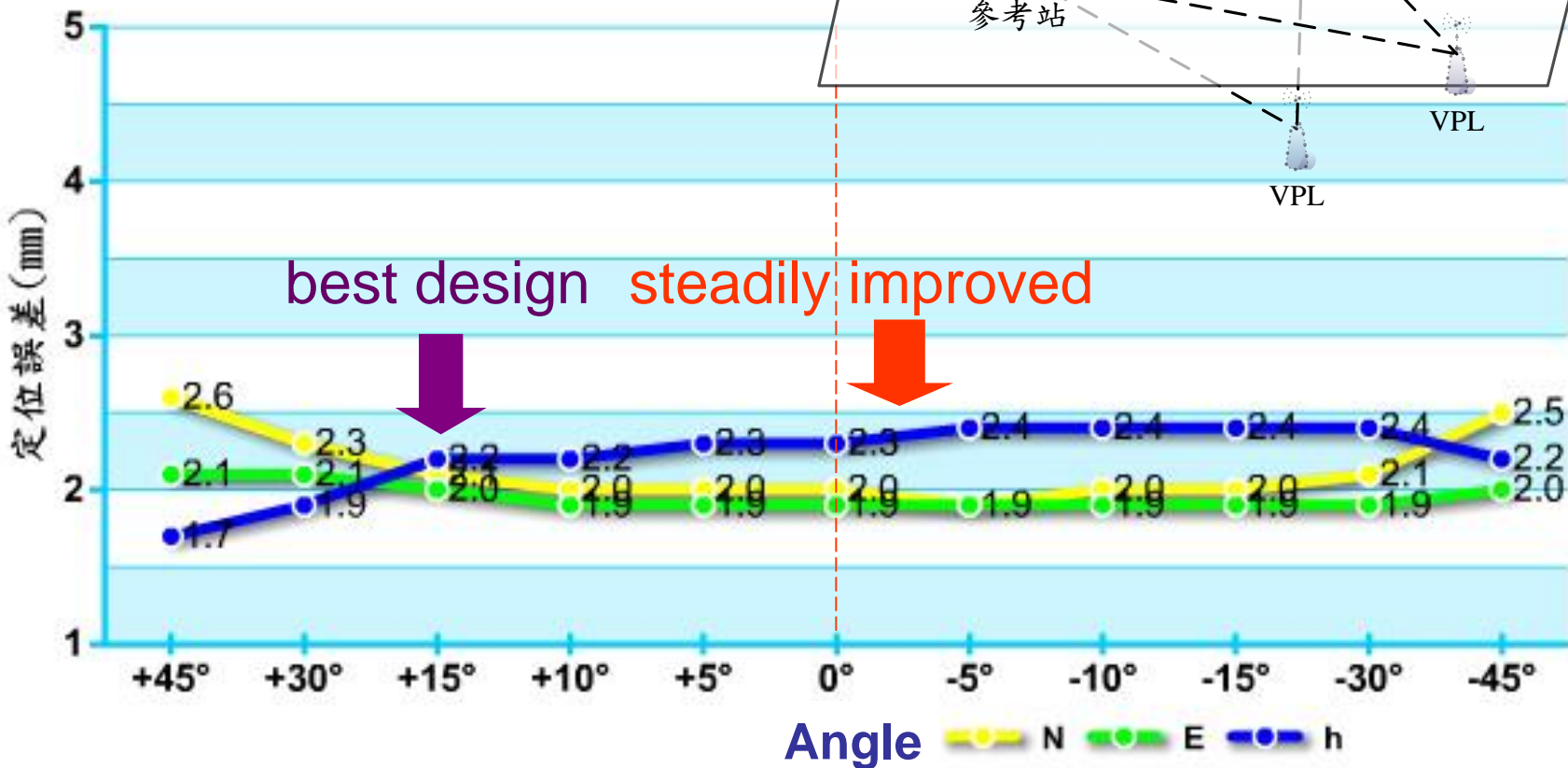
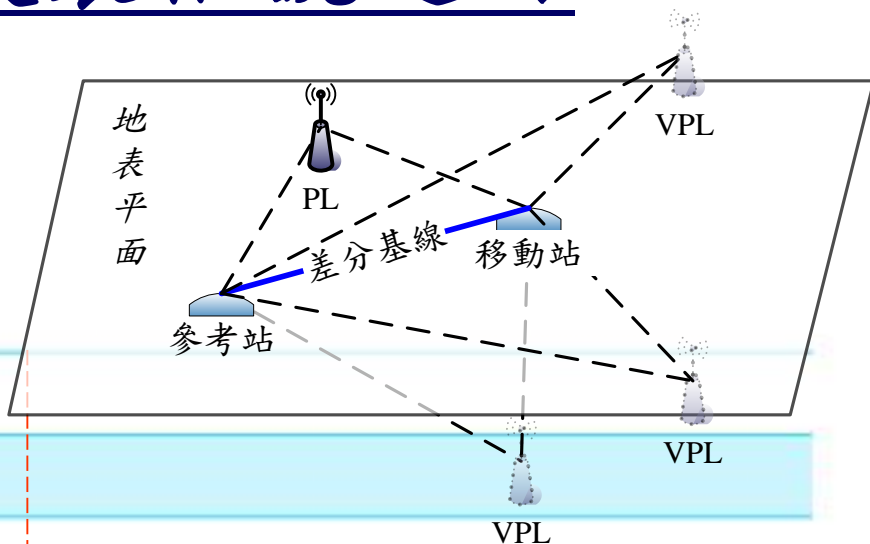
複製成網

同量複製



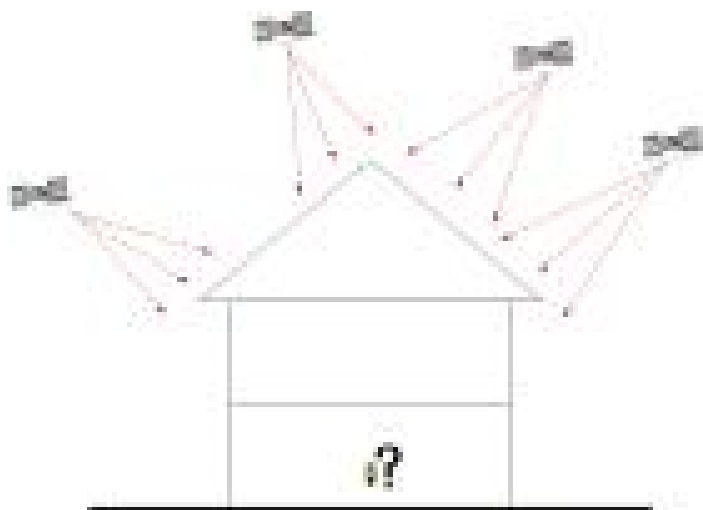


GPS 虛擬複製信號運用





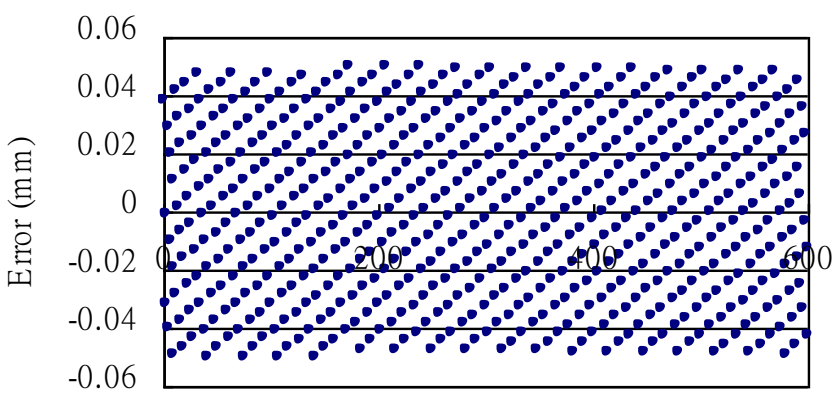
虛擬衛星室內定位



PL pseudo-range

GPS pseudo-range

	8	C1	L1	D1	S1	P2	L2	D2	S2
	1.000								
2003	08	02	13	13	56.0000000				GPS
2003	08	02	14	10	30.0000000				GPS
	13								
	03	08	02	13	13	56.0000000	0	8G32G10G	8G24G27G13G17G26
	67108863.97746		348496466.14156					-349.12546	42
	20750515.73449		111293873.63349				1360.81249		50
	84868635.86746		1060.18846				42.000		
	20468785.19549		109813368.81249				1349.87549		50
	83715005.44946		1051.68846				43.000		
	22989496.93047		123059797.68447				-2999.00047		45
	94036896.72744		-2337.06244				38.000		
	21056752.43849		112903160.41849				-862.00049		49
	86122634.19146		-671.87546				42.000		
	23527714.84446		123638982.13346				-3192.93846		42
	96342086.23441		-2488.18841				26.000		
	23080835.97746		121290609.53146				2132.87546		43
	94512185.35943		1661.81243				35.000		
	24331968.76644		127865356.24244				3560.25044		38
	99635353.09841		2774.06241				26.000		
	03	08	02	13	13	57.0000000	0	8G32G10G	8G24G27G13G17G26
	67108863.97746		348496815.19546					-348.87546	42
	20750256.85949		111292513.24249				1360.12549		50
	84867575.82446		1059.68846				42.000		



Epoch (1 sec interval)

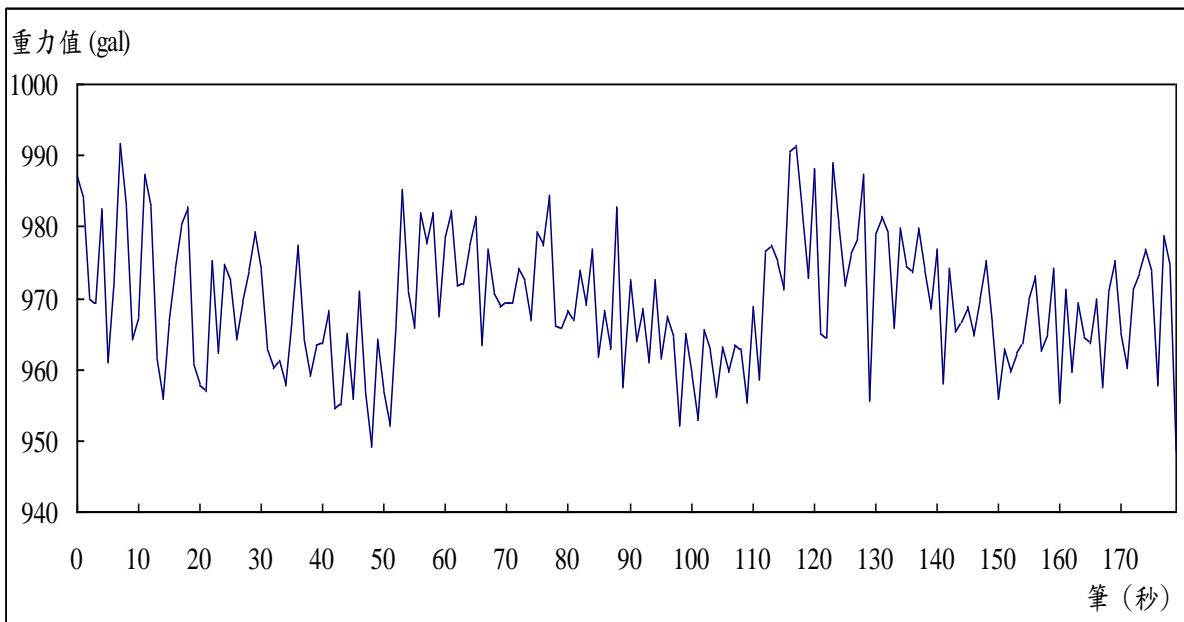
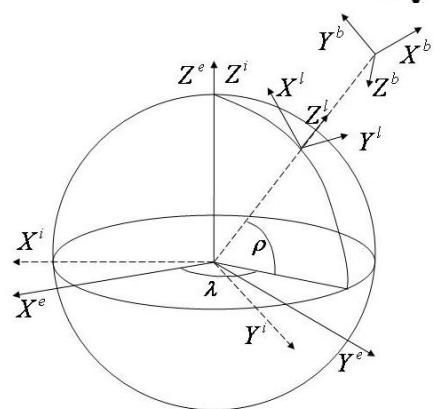
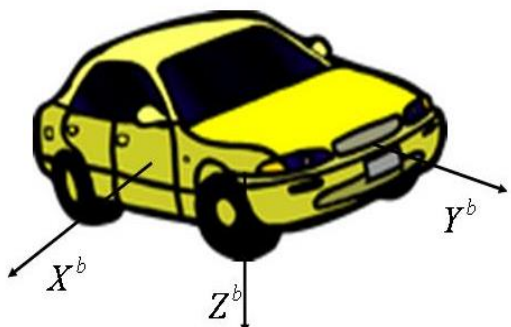
$$\Delta p_{rov}^{vpl,pl} = \rho_{rov}^{vpl} - \frac{x^{vpl} - x_{rov}}{\rho_{rov}^{vpl}} \Delta x_{rov} - \frac{y^{vpl} - y_{rov}}{\rho_{rov}^{vpl}} \Delta y_{rov} - \frac{z^{vpl} - \tilde{z}_{rov}}{\rho_{rov}^{vpl}} \Delta z_{rov}$$

$$\Delta p_{rov}^{vpl,pl} = -\rho_{rov}^{pl} + \frac{x^{pl} - x_{rov}}{\rho_{rov}^{pl}} \Delta x_{rov} + \frac{y^{pl} - y_{rov}}{\rho_{rov}^{pl}} \Delta y_{rov} + \frac{z^{pl} - \tilde{z}_{rov}}{\rho_{rov}^{pl}} \Delta z_{rov}$$





INS/GPS 重力測量

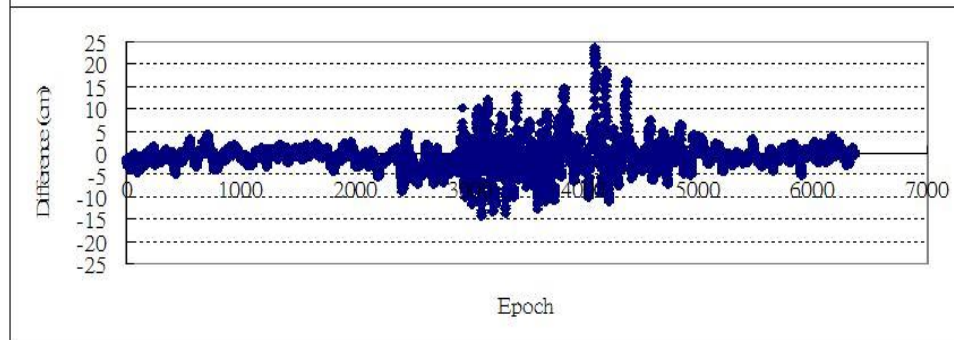
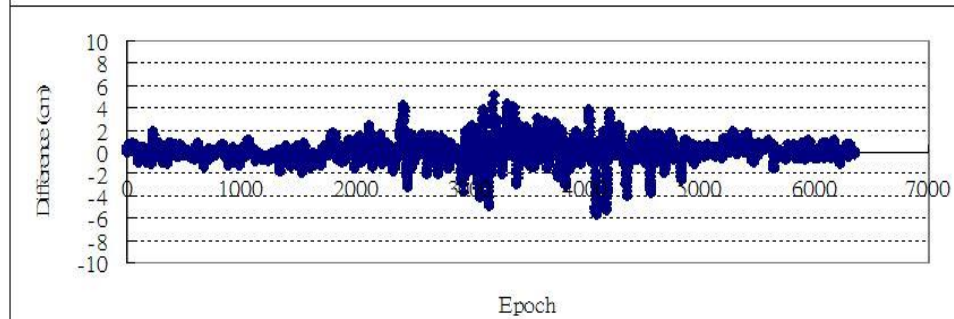
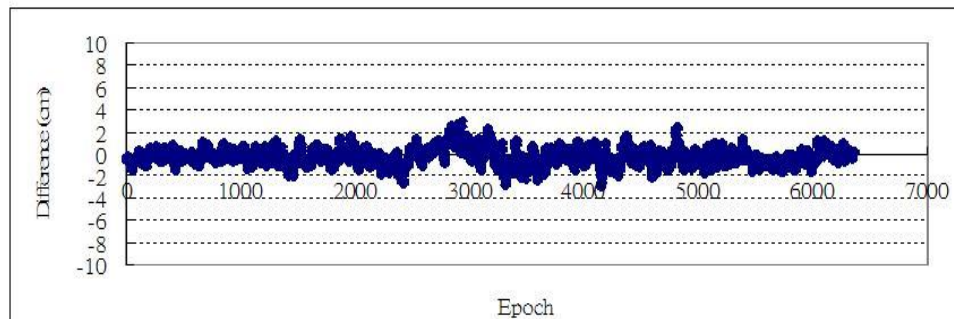
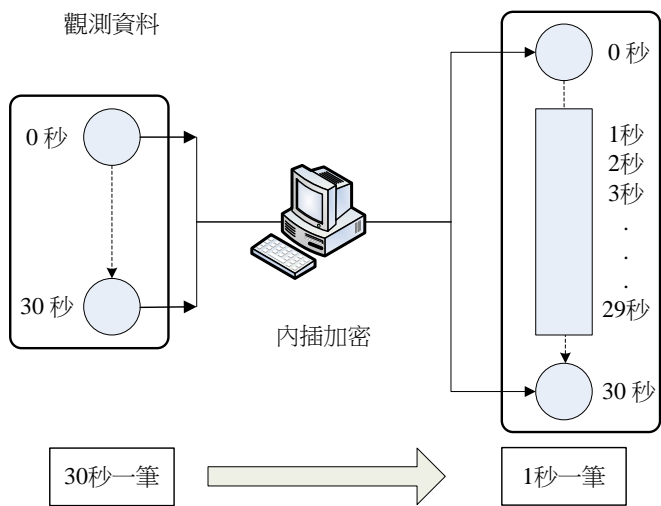
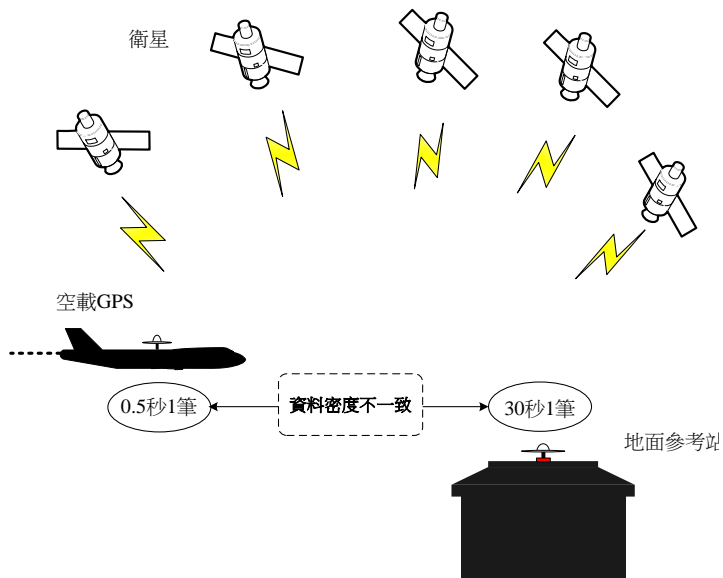


裝置	INS/GPS	GPS	INS
標準偏差 (gal)	9.148	0.711	9.177



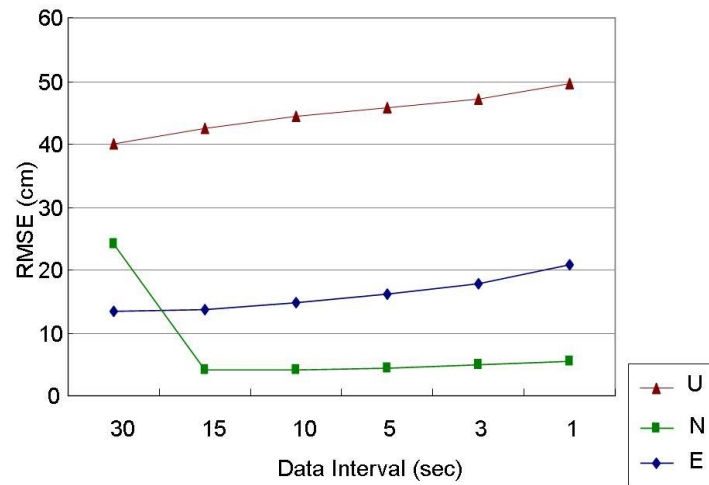
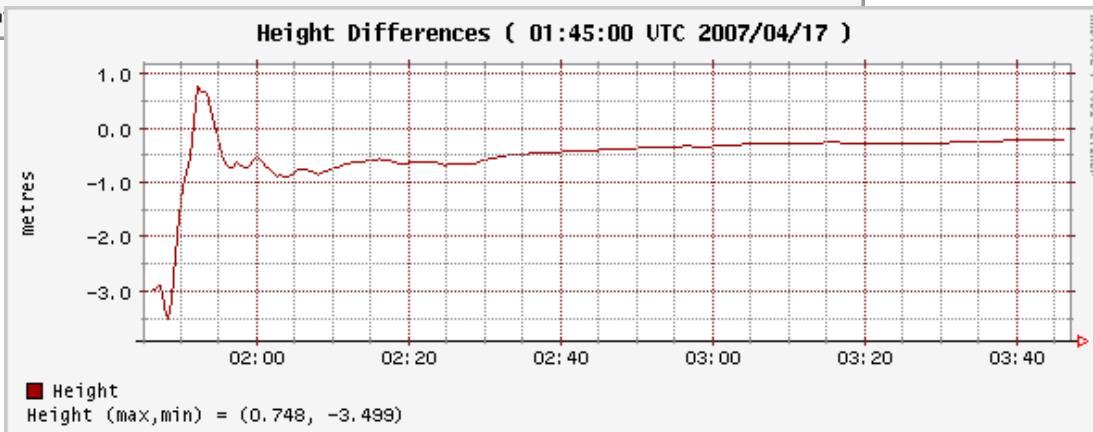
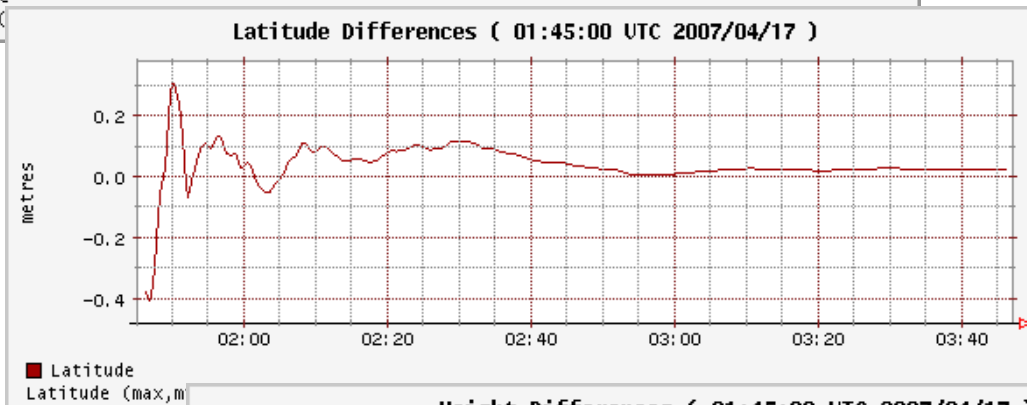
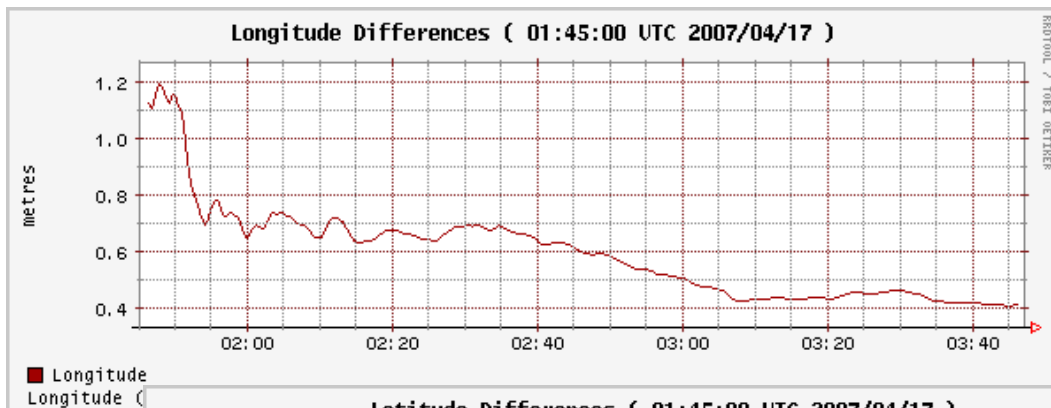


高速率動態觀測量加密



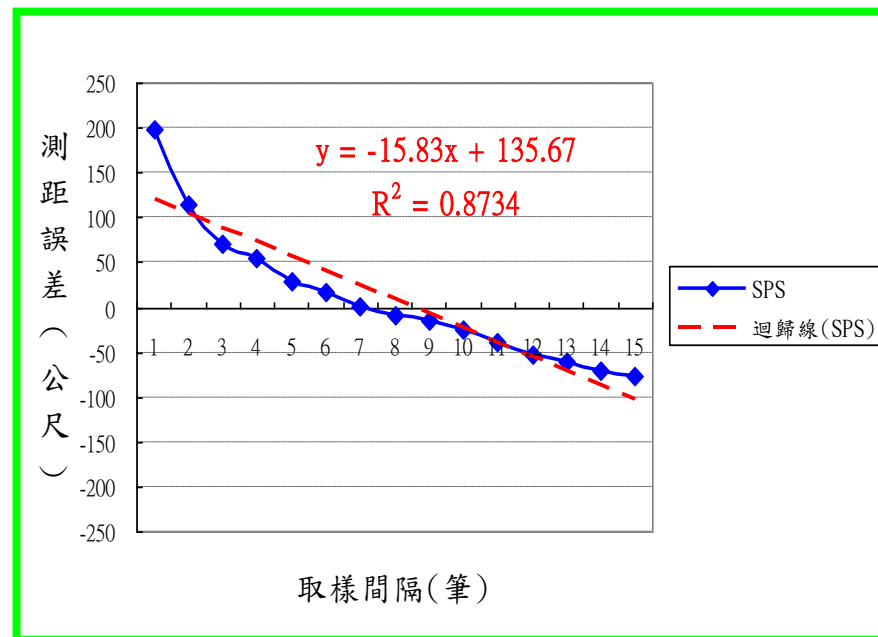
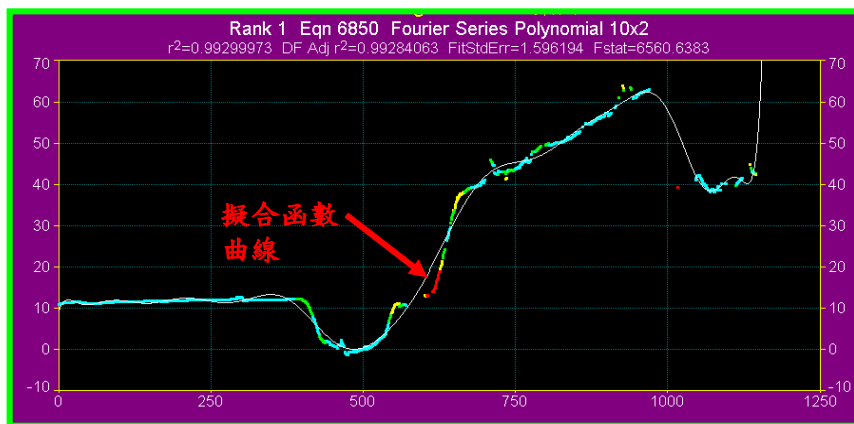
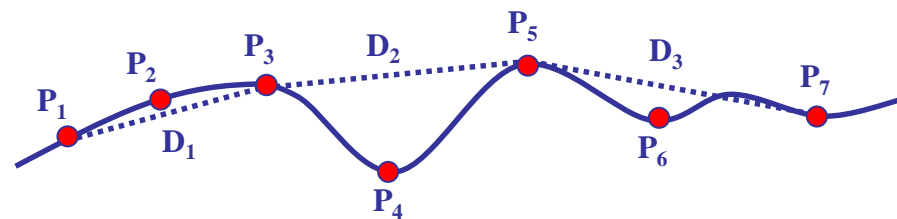
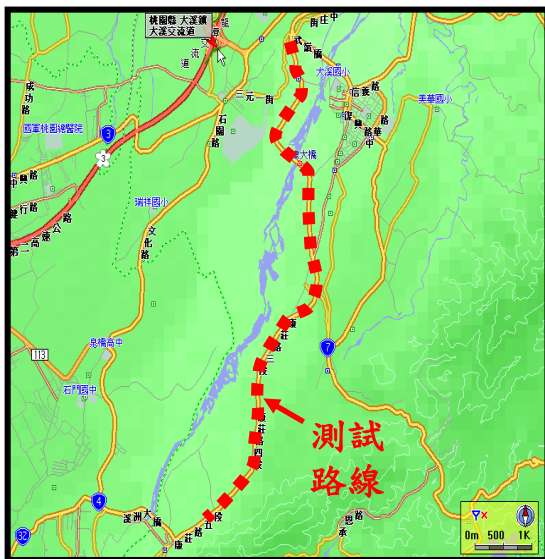


加密觀測量精密單點定位



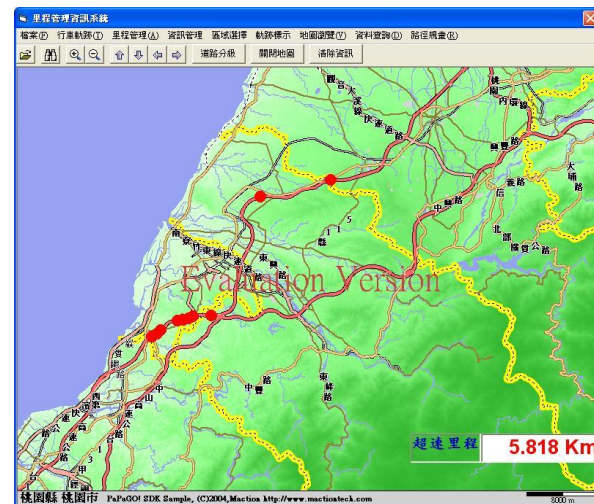
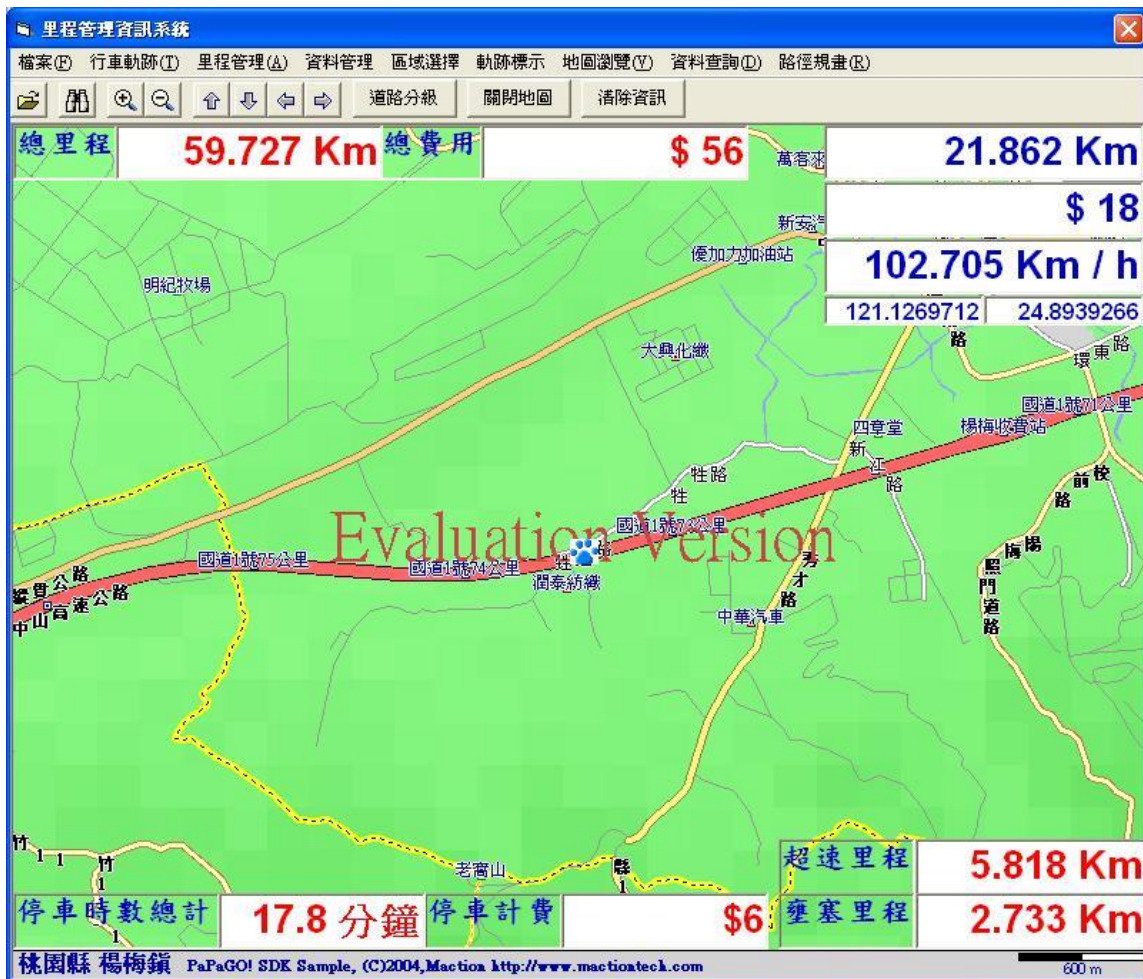


行車距離測定



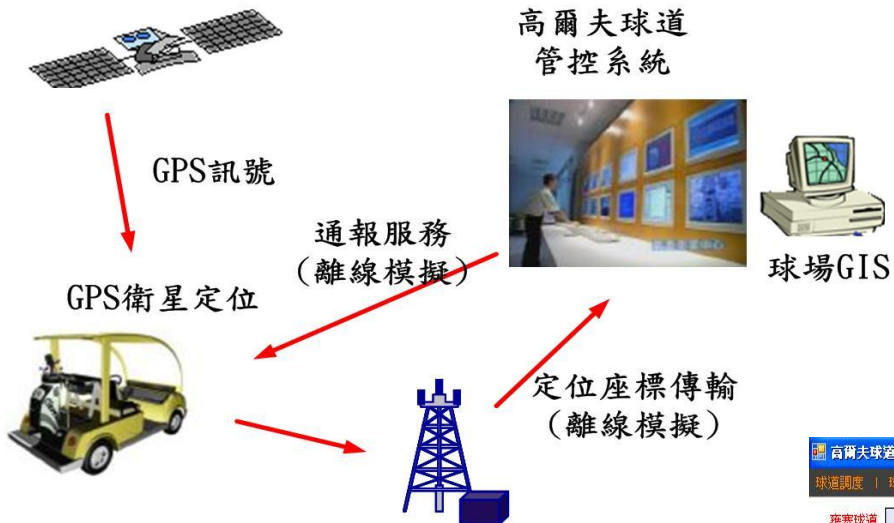


行車資訊管理





高爾夫球車管理



紀錄日期	球車編號	球道警示訊息
2007/5/30 下午 09:51	4	第4車打球太慢,請加快速度,管控時間
2007/5/30 下午 09:50	2	第五洞壅塞,第2車請前往第六洞開球
2007/5/30 下午 09:47	3	第五洞壅塞,第3車請前往第六洞開球
2007/5/30 下午 09:47	4	第五洞壅塞,第4車請前往第六洞開球
2007/5/30 下午 09:45	2	第一洞壅塞,第2車請前往第二洞開球
2007/5/30 下午 08:43	3	第一洞壅塞,第3車請前往第二洞開球
2007/5/30 下午 08:32	4	第一洞壅塞,第4車請前往第二洞開球

高爾夫球道管控系統

球道調度 | 球友資料

壅塞球道: 閒置球道:

需調度球車: 出動球車:

程式演練: 2007/5/13 下午 12:40:01

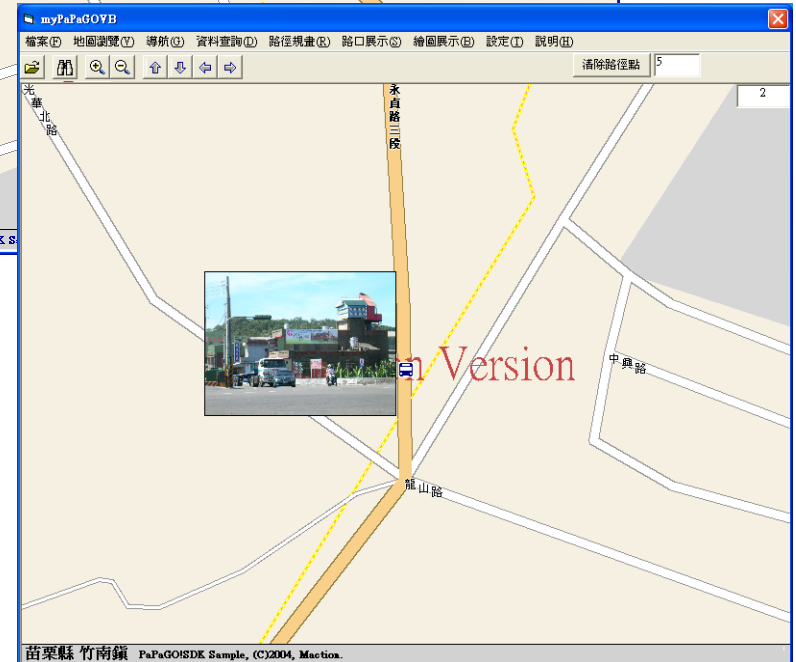
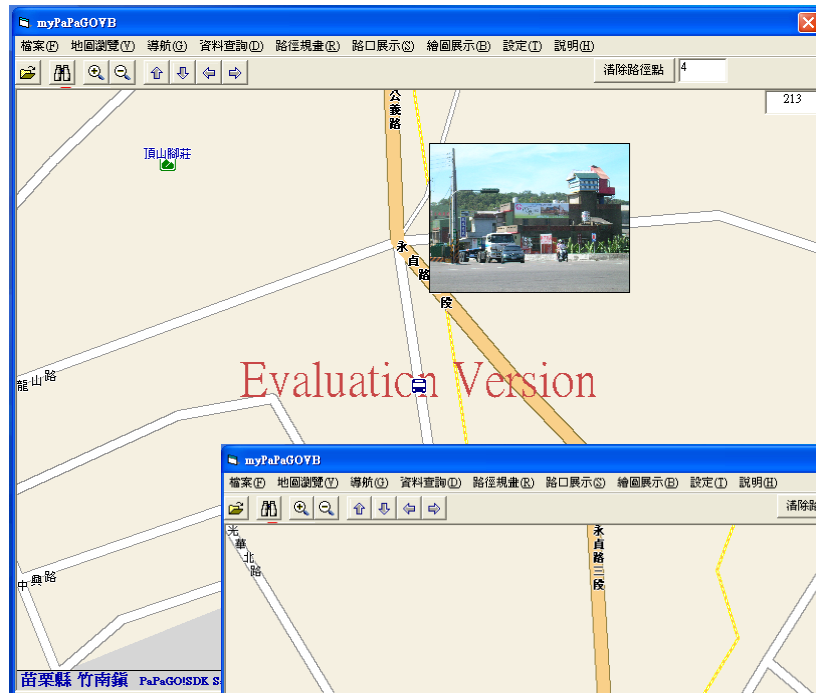
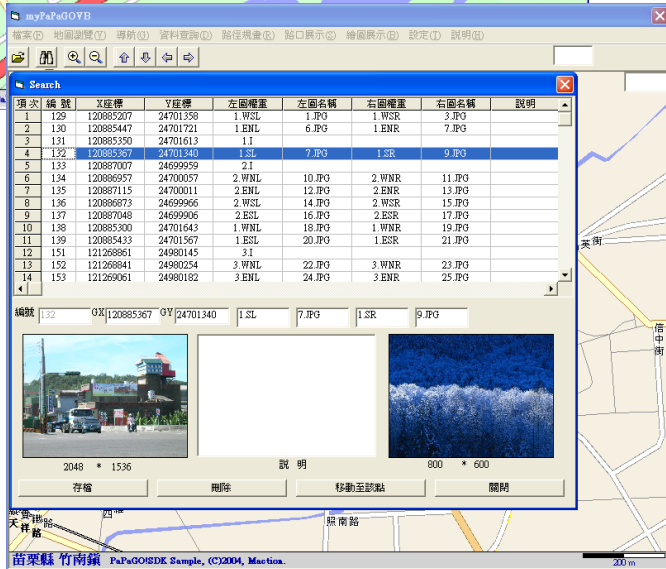
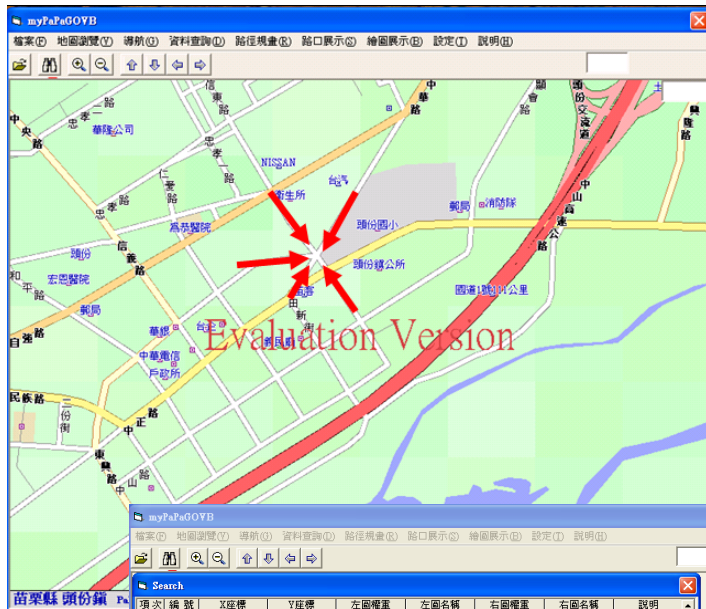
查詢姓名	查詢相似值	會員編號	姓名	球車編號
K120022221	類尚揚			
K120023232	類尚群			
T122565623	陳志忠			
Q120128379	田壘			

打球日期	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	差點	總桿數
2005/8/18	5	4	5	3	6	5	5	6	4	4	5	5	6	3	5	4	6	5		86
2006/2/16	4	4	6	4	5	6	5	6	5	4	5	6	5	4	6	5	6	6		92
2006/3/22	5	4	5	3	7	6	5	5	4	4	5	6	6	4	5	5	5	6		90
2006/4/21	5	5	5	3	5	6	7	6	5	5	5	6	6	4	5	5	6	6		95



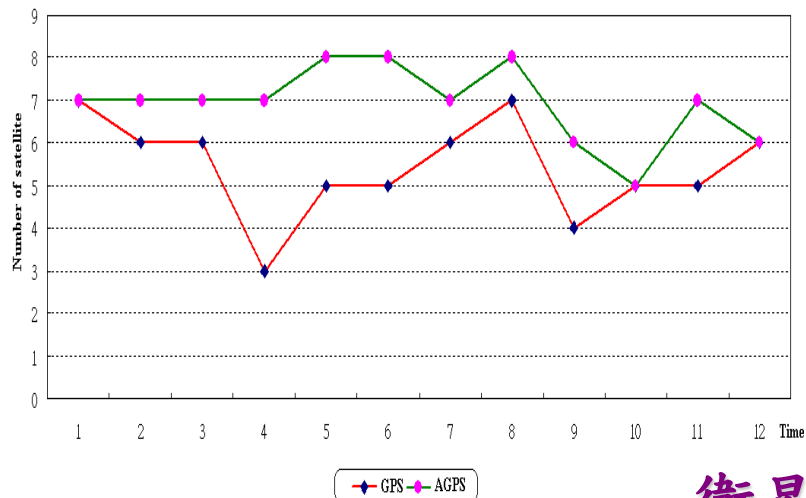
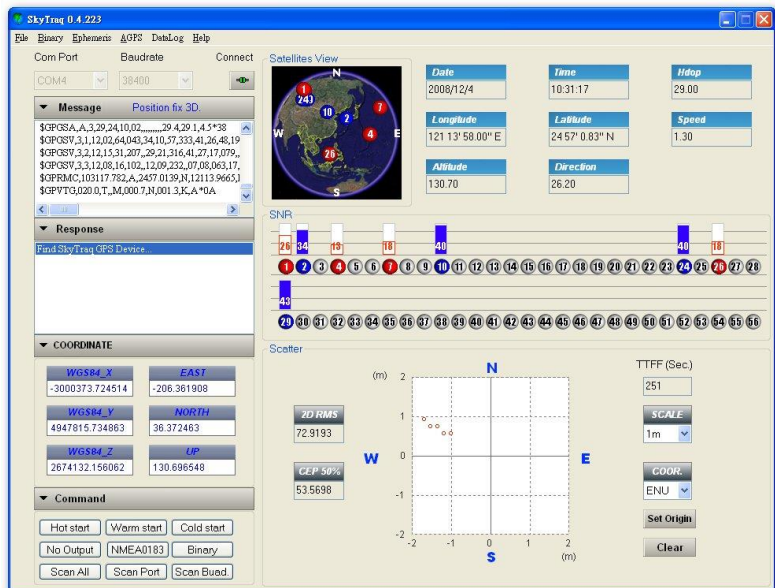


圖像導航顯示

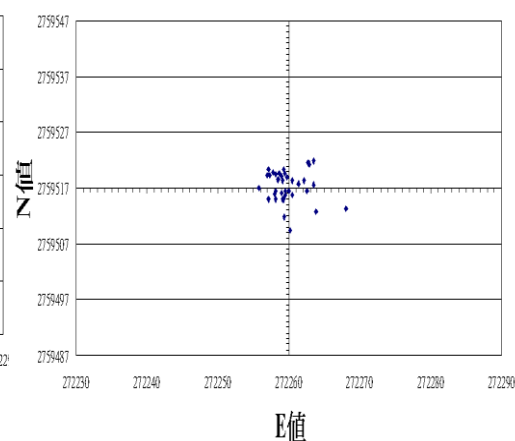
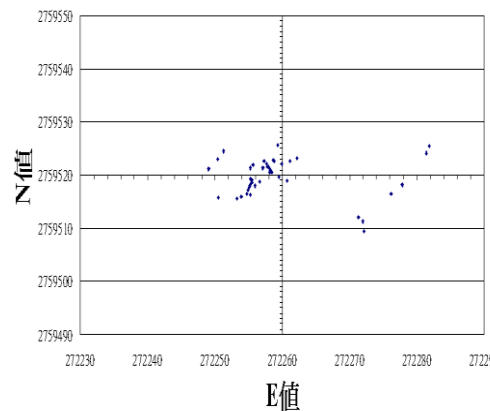




A-GPS 室內定位



衛星顆數

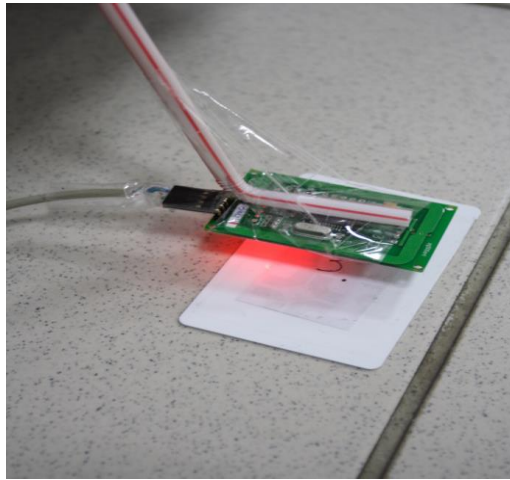


定位精度約可提升65%





RFID室內監控



System

移動權限設定 about

儲藏室

實管系
研究生研究室

00000003	Tag_ID
00003000	工位標識
00003000	7座標識
下午 11:32:59	目前時間
	其他
-1	權限
20	限制移動時間
5	公尺/秒 移動速率
1.84	區域距離
13.56	標籤頻率
Text1	

移動物軌跡追蹤 儲存資料欄 清除軌跡 結束

Clear Message Exit

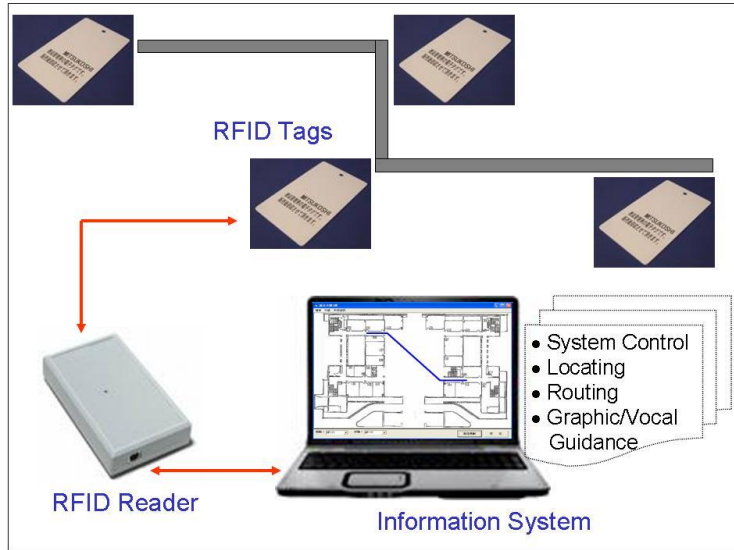
id	tag_id	tag_x	tag_y	tag_security	tag_time
17	2160	3040	-1		
18	2260	3040	-1		
19	4560	3040	-1		
20	5760	3040	-1		
21	960	4920	-1		
22	2160	4920	-1		
23	3360	4920	-1		
24	4560	4920	-1		
25	5760	4920	-1		
id	tag_id	tag_x	tag_y	tag_sec	tag_time
2379	4	3720	1560	100	下午 11:32:26
2380	1	3000	1560	100	下午 11:32:30
2381	2	3000	2280	100	下午 11:32:34

未讀物狀態
已讀物狀態
低權限區域
高權限區域

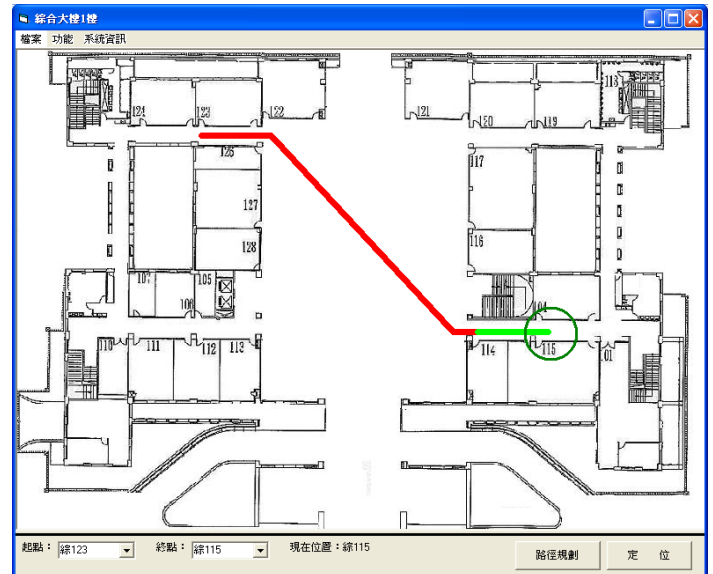




RFID室內導引

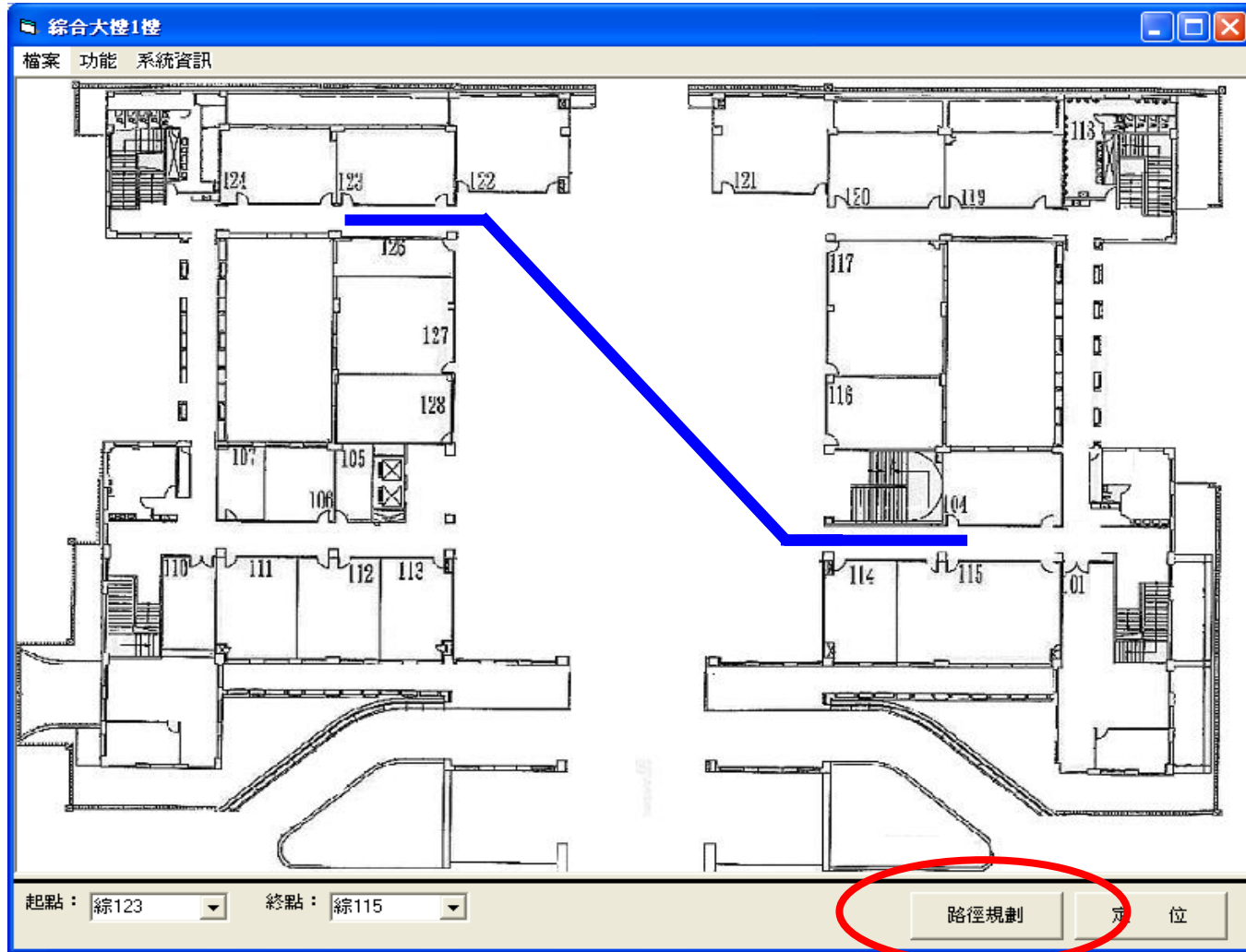


	A	B	C	D
0	Manufacture ID	Expanded	Expanded	
1	Coordinate	Coordinate	Node Code	
2				
3				
4				
5	Spatial Relations to the Adjacent Nodes			Key Value
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				



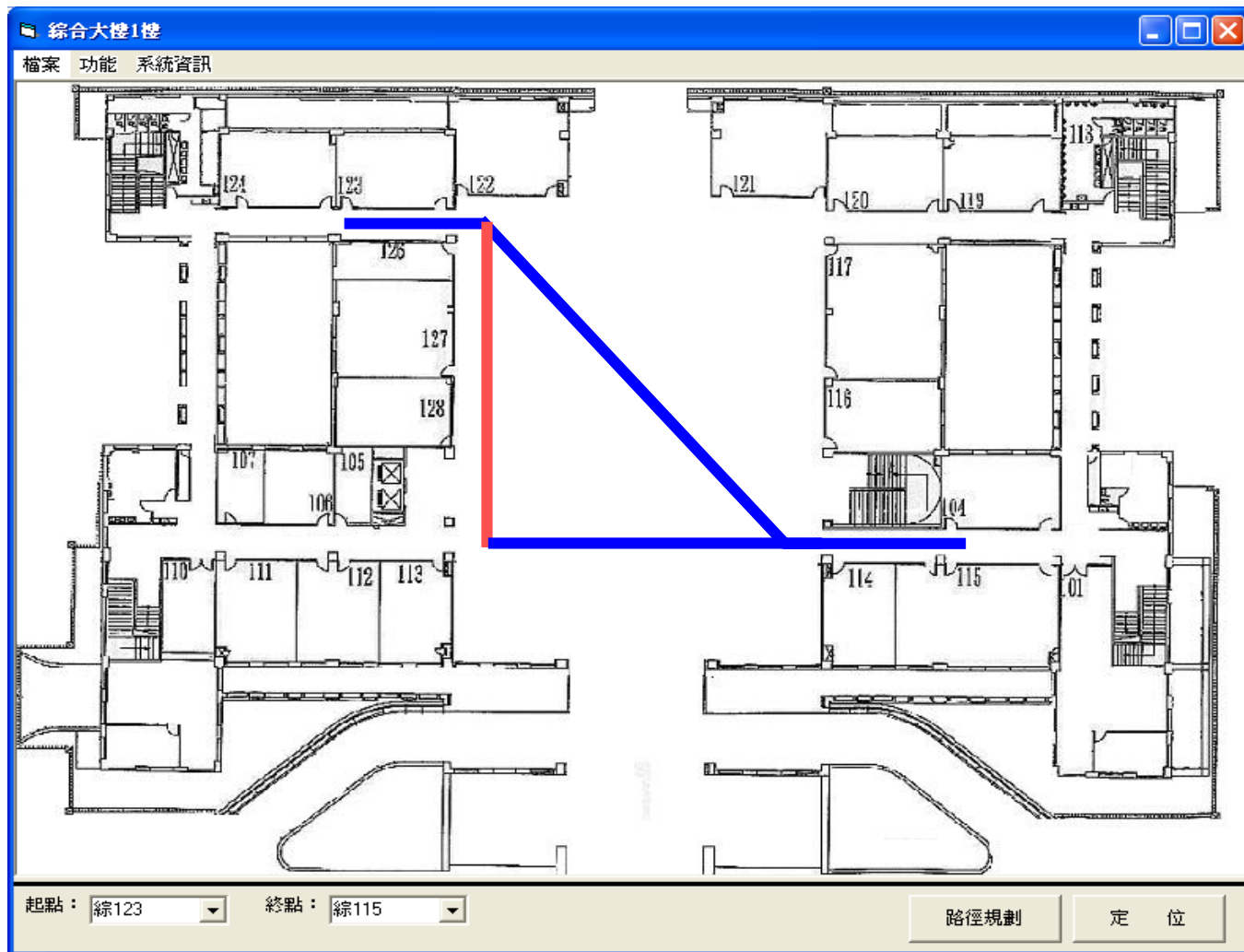


路徑導引



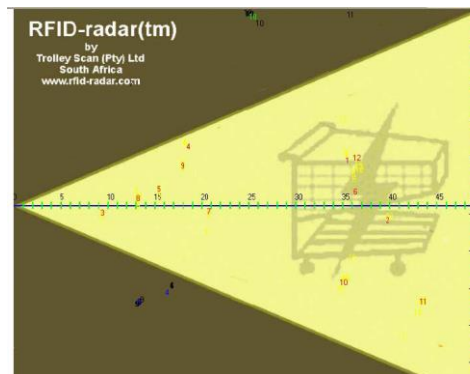


路徑修正





雷達式RFID物品盤點



雷達式RFID庫存資訊盤點系統
啓動 系統功能

具動物品狀況明細查詢
重新整理
Exist Object
Movement Object

目標資訊(第一筆)	
標籤編號:	BCBBB4775
X軸:	-0.05
Y軸:	0.33

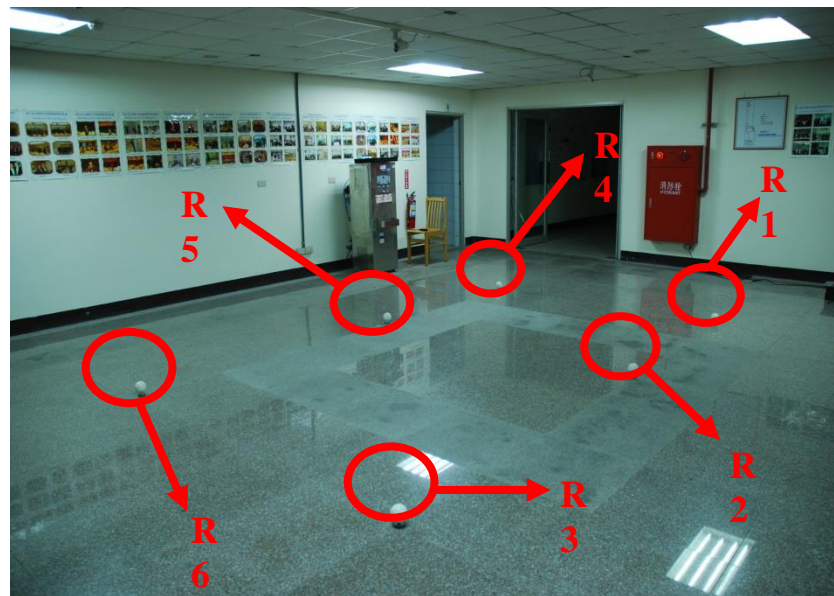
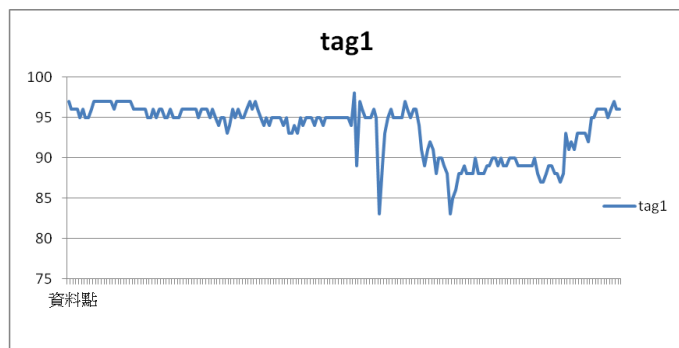
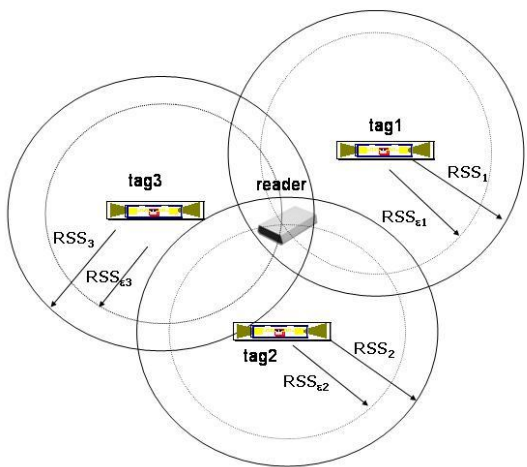
目標資訊(第二筆)	
標籤編號:	BCBBB4775
X軸:	-1.94
Y軸:	4.04

雷達式RFID位置





主動式RFID室內定位



N

E

2D

定位精度(m)

0.97

1.08

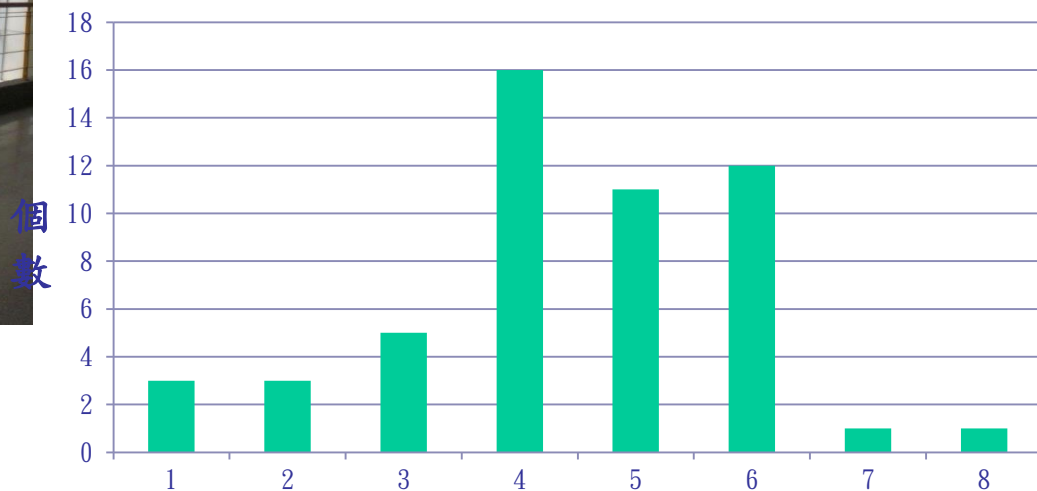
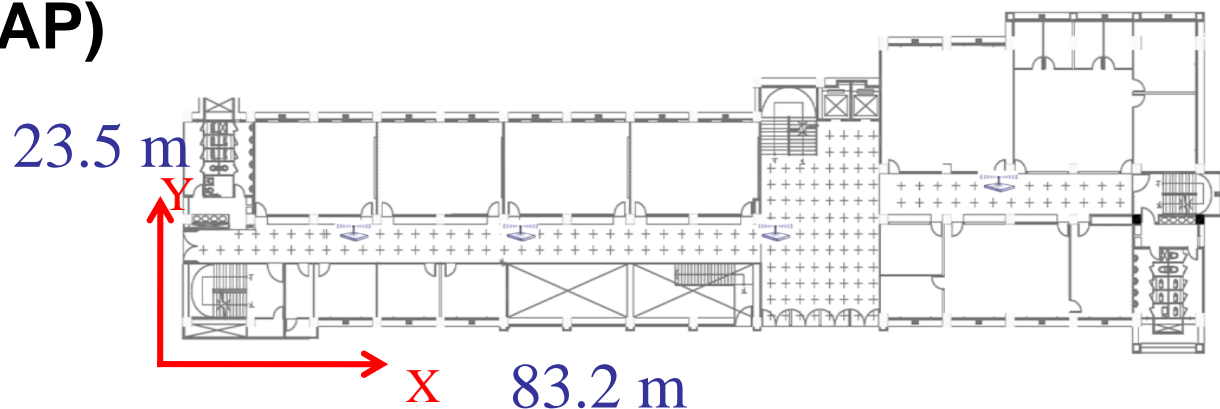
1.45





WiFi室內定位

Wi-Fi存取裝置(AP)



定位精度

$X = 3.8 \text{ m}$

$Y = 4.2 \text{ m}$

$2D = 5.7 \text{ m}$

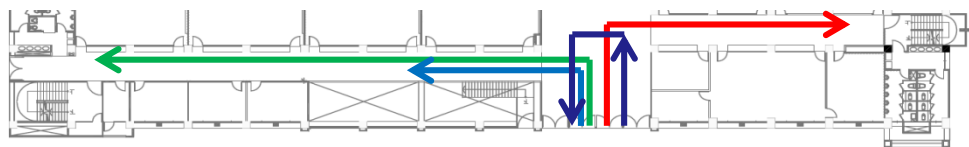
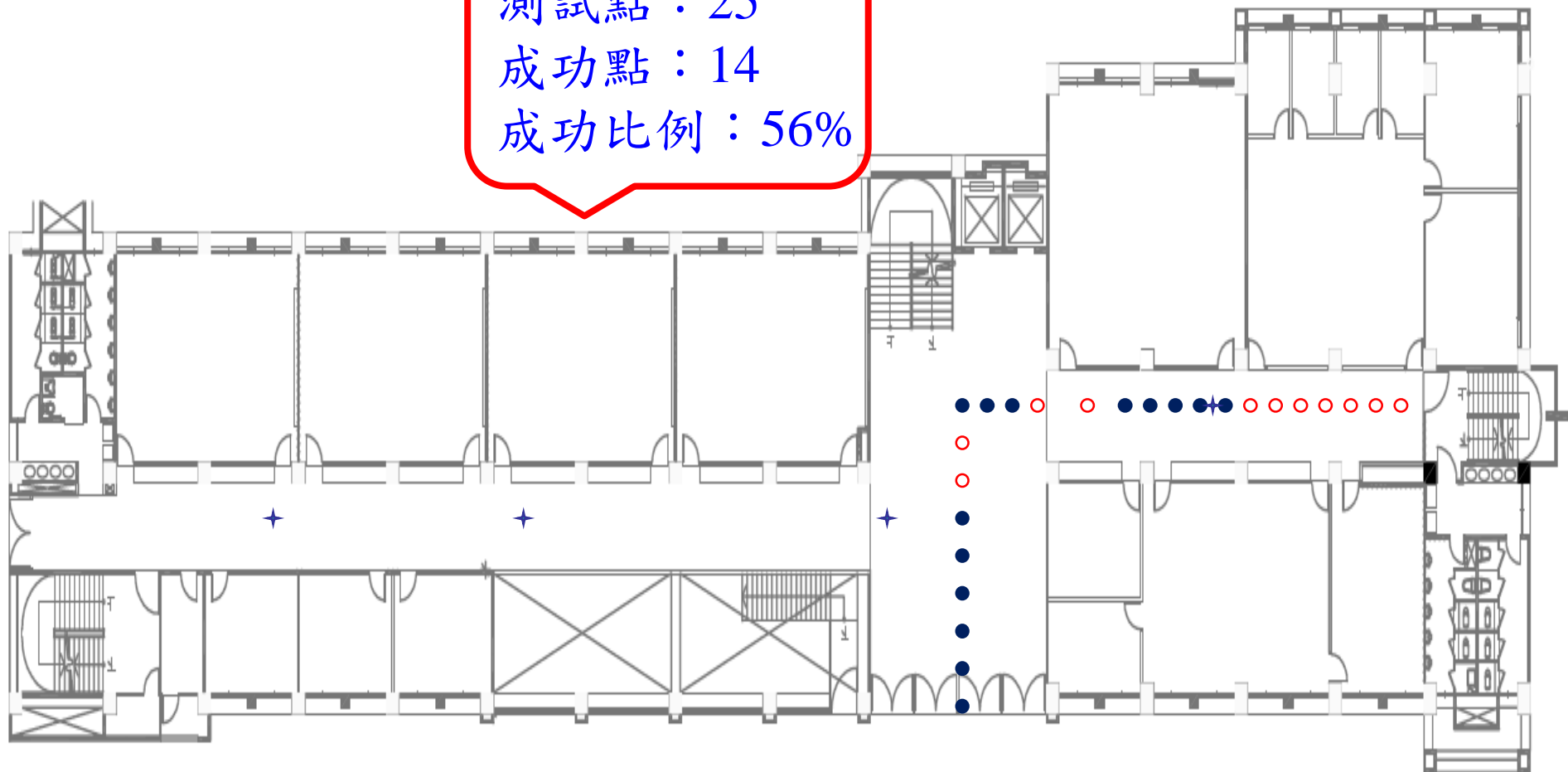
RSS定位誤差(m)





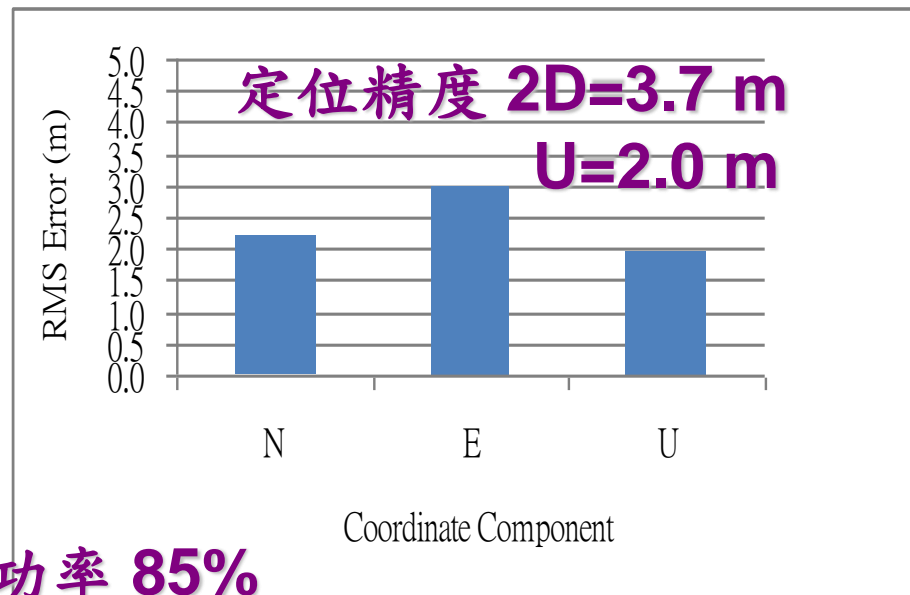
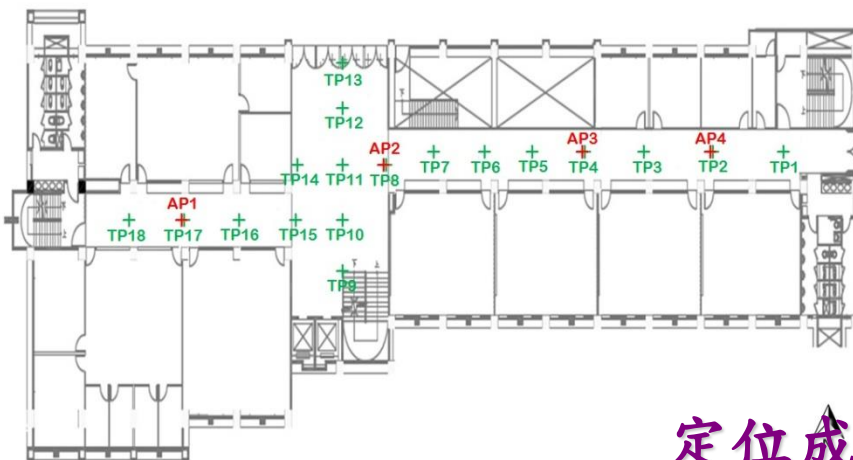
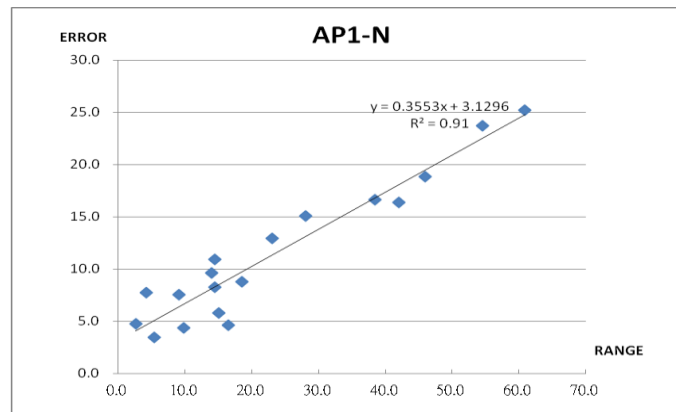
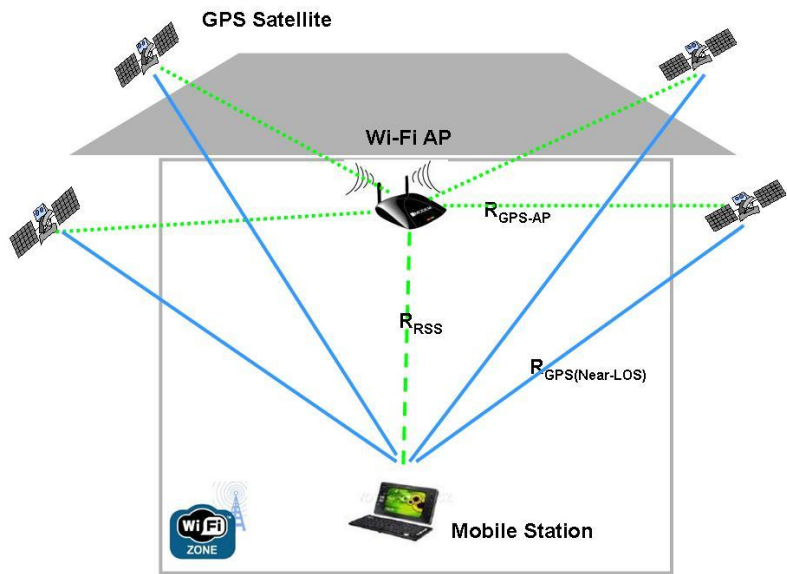
WiFi室內定位成功率

測試點：25
成功點：14
成功比例：56%





單部WiFi室內定位

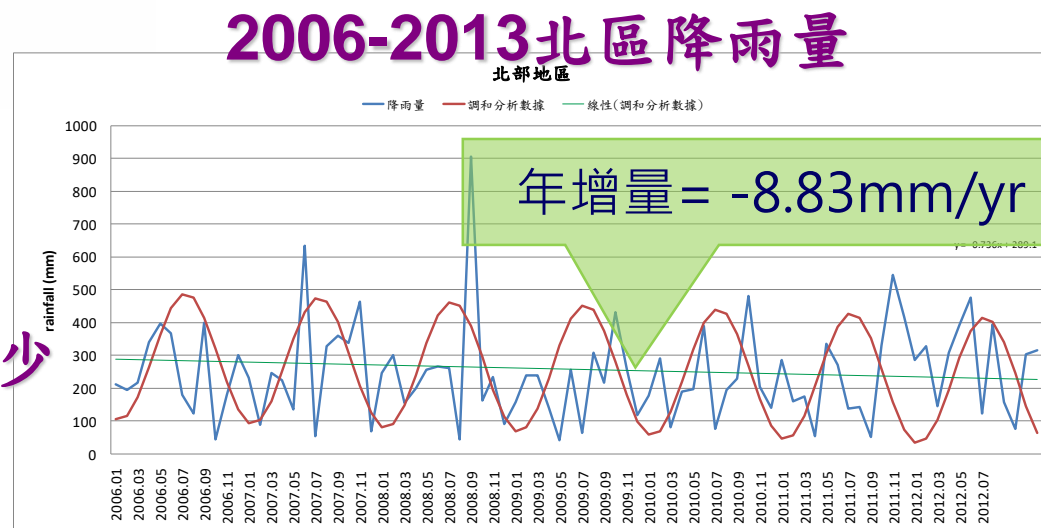
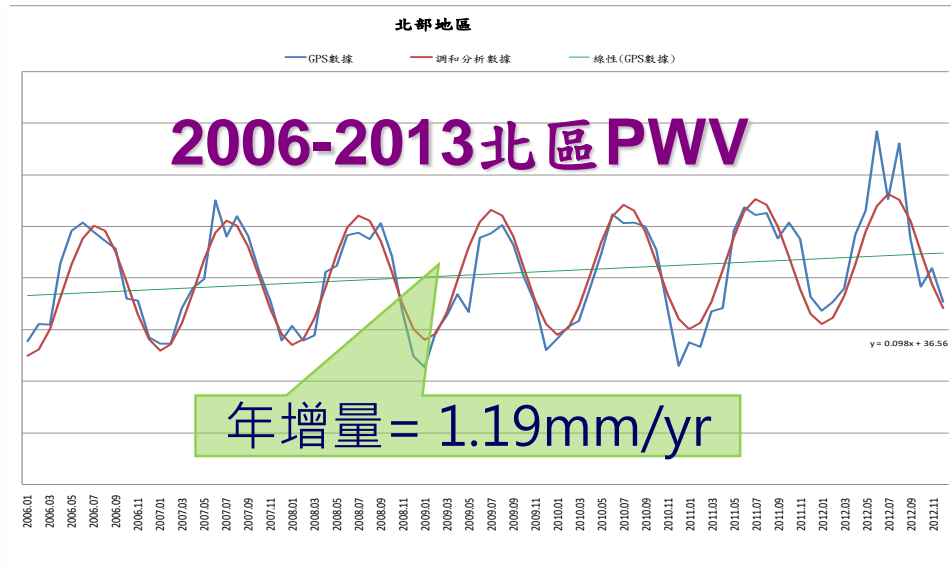
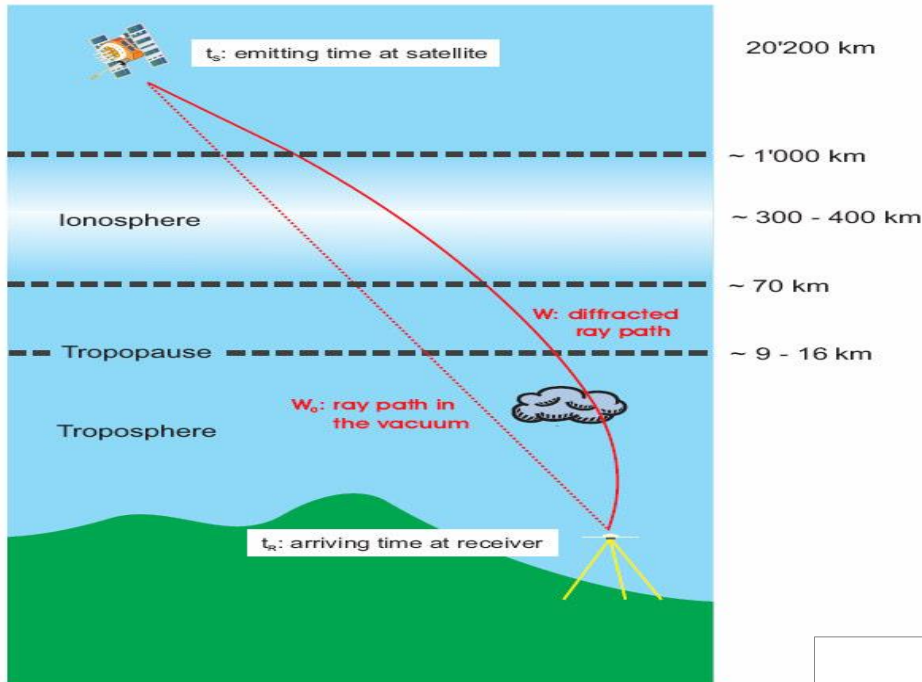


定位成功率 85%





可降水量估測

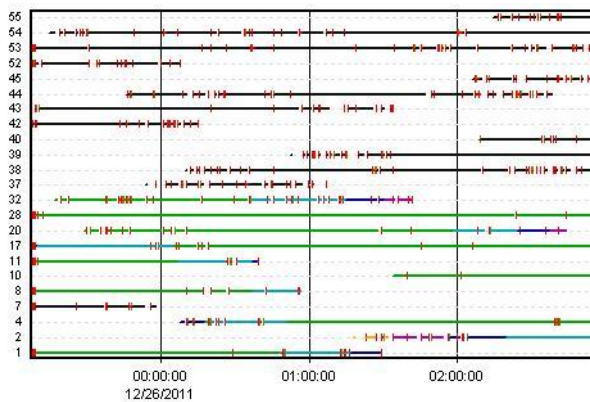
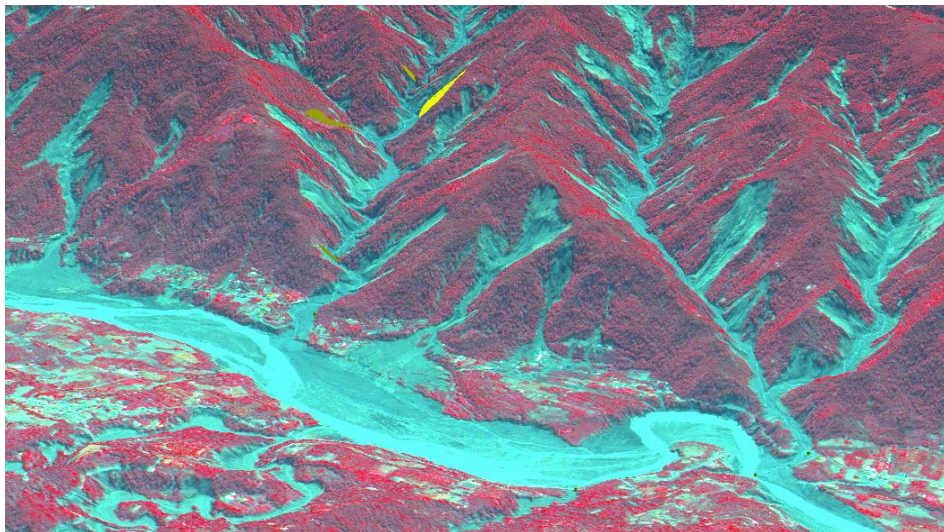


台灣地區大氣中的可降水量逐年上升，實際降雨量卻變少





六龜新開部落土石流坡地監測



西移3-6 cm/yr
沉陷6-15cm/yr





車載簡易行動製圖系統

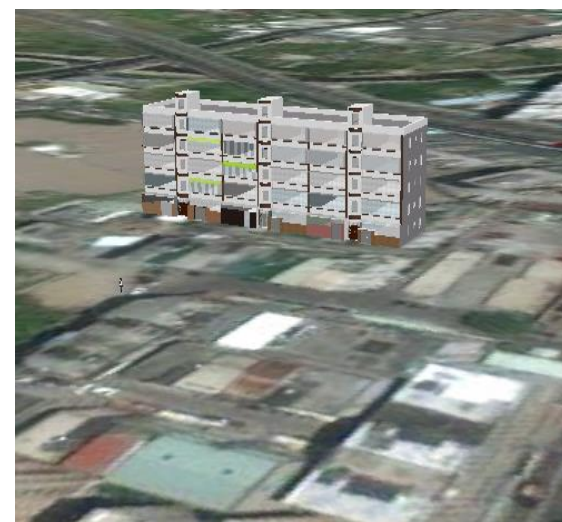
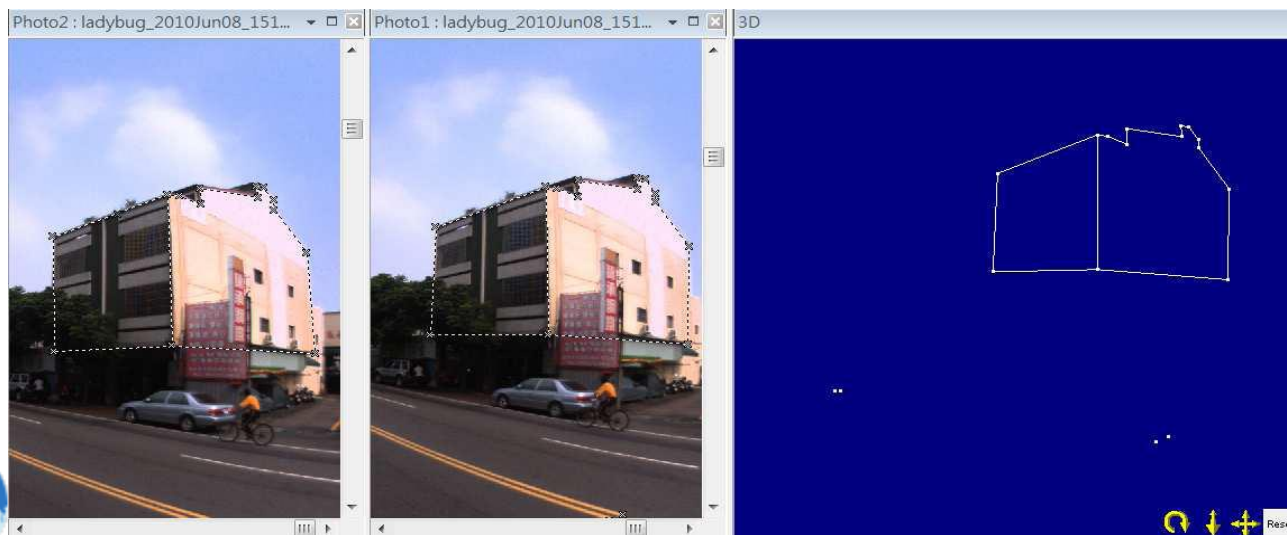


相對精度約±25 cm





簡易調查系統及三維模型展現





頭戴式行動調查系統



專案管理

載入地圖

災情輸入

災情顯示

地標量測

離開系統

災情輸入

災害總數: 10

編號: 2

查詢

災害種類: 邊坡滑動

災害地點: X: 270009.3 Y: 2746417

災情說明: 造成邊坡道路損壞

災情照片: c:\image\p1.jpg

新增

儲存 重設 結束

X: 275890.4 Y: 2752941 經度: 121.2562 緯度: 24.88374

後端接收平台

地圖 衛星 混合地圖

戴台編號: 9714
設備時間: 2012/4/27 上午 09:14:48
目前電量: 99%
移動時速: 0km/hr

停止 拍照 錄像 音頻

顯示

編號	使用者帳號	使用者密碼	IP位置
1	9714	0000	101.13.212.72

連接埠: 12345

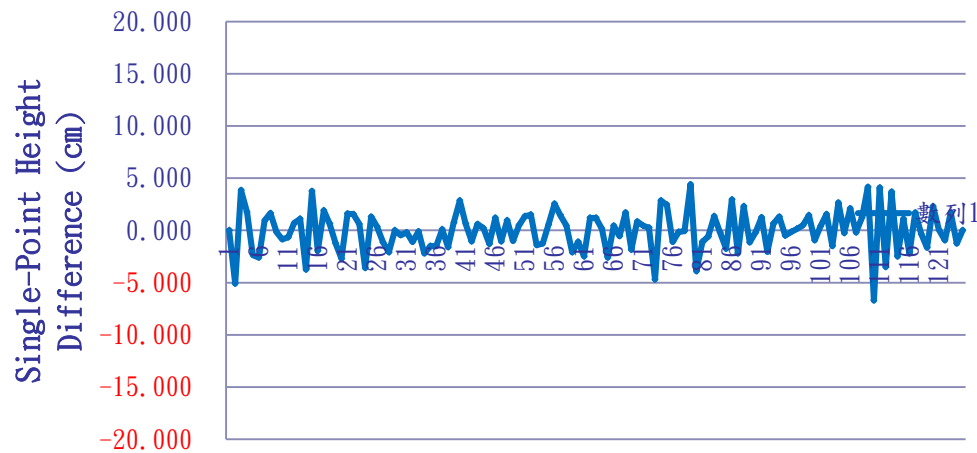
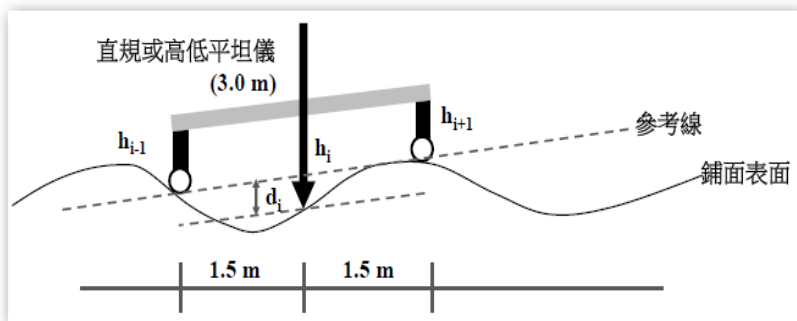
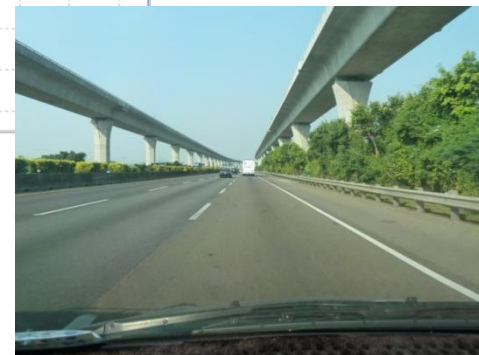
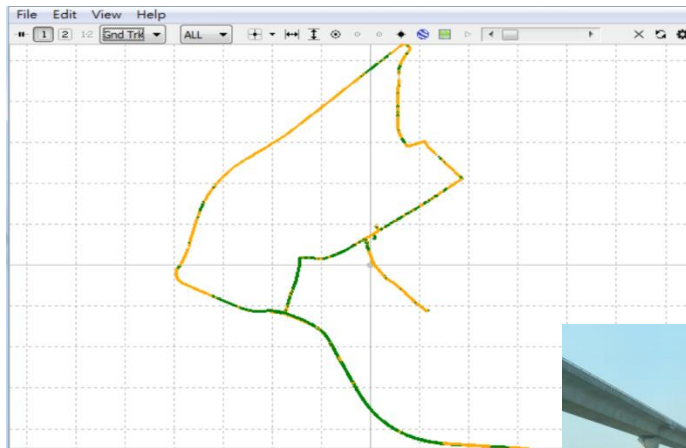
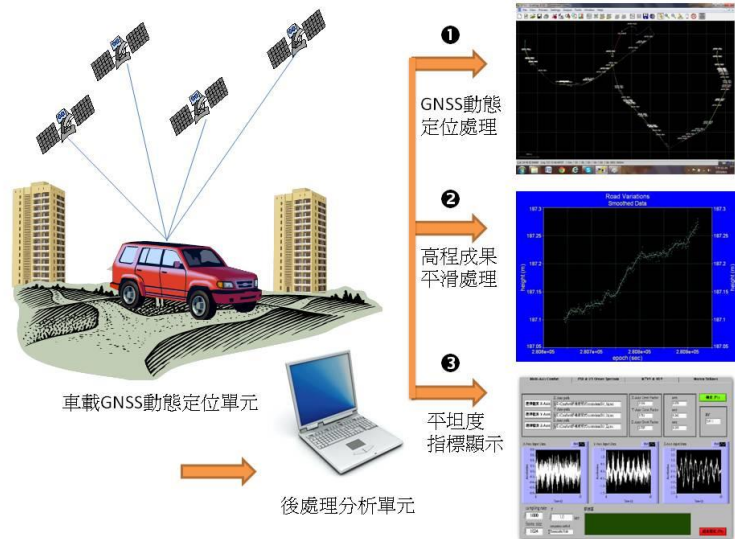
結束連線

*2012/4/27 上午 09:28:09
\$GPRMC,3.557910,308.09797,9714,0.000,042
7.0927,99.0,0,20120427,091448,N,245648
66,E,1211345.76,0,166*14



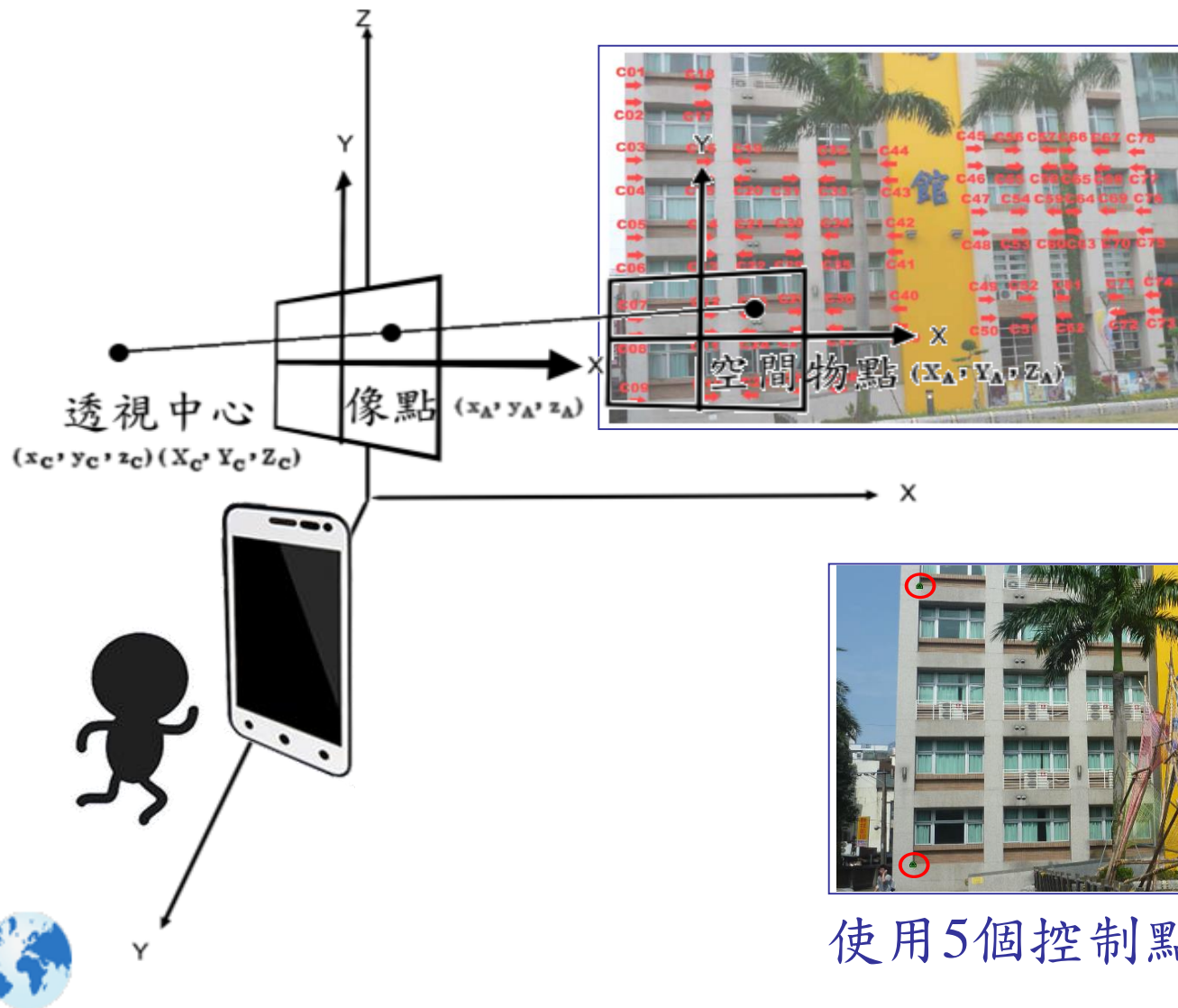


路面平坦度感測





手機取像定位

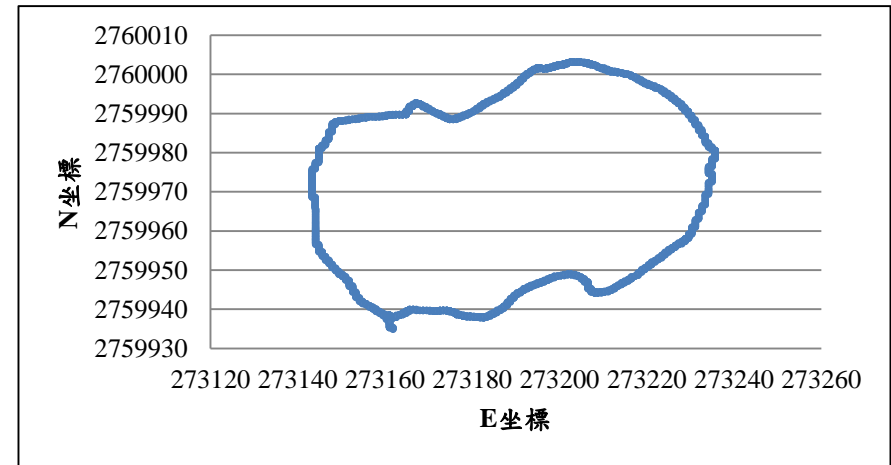
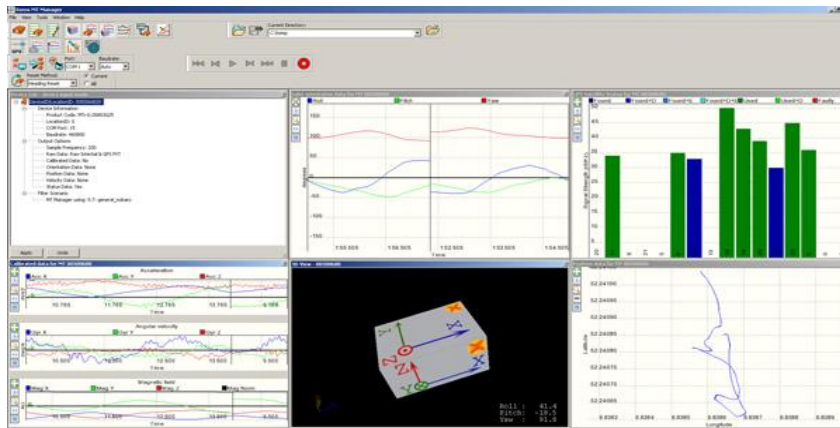
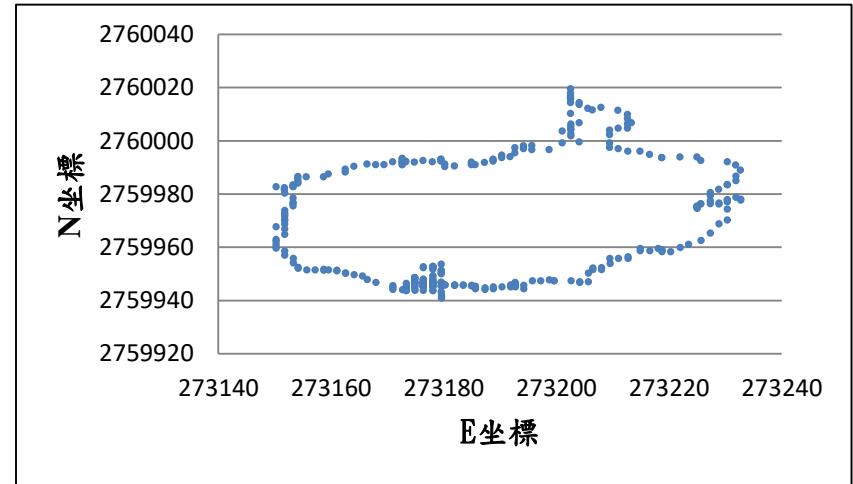
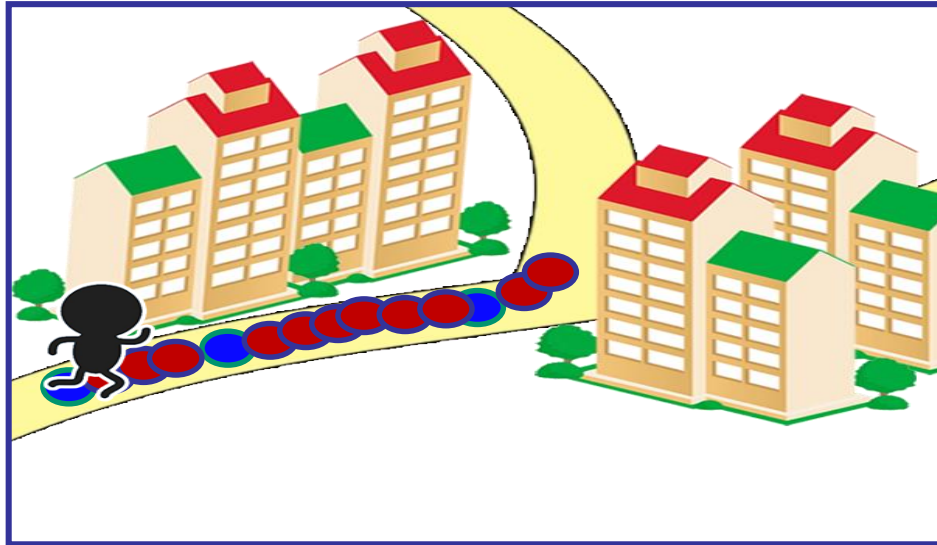


使用5個控制點-誤差約為 1 m





GPS/IMU連續定位

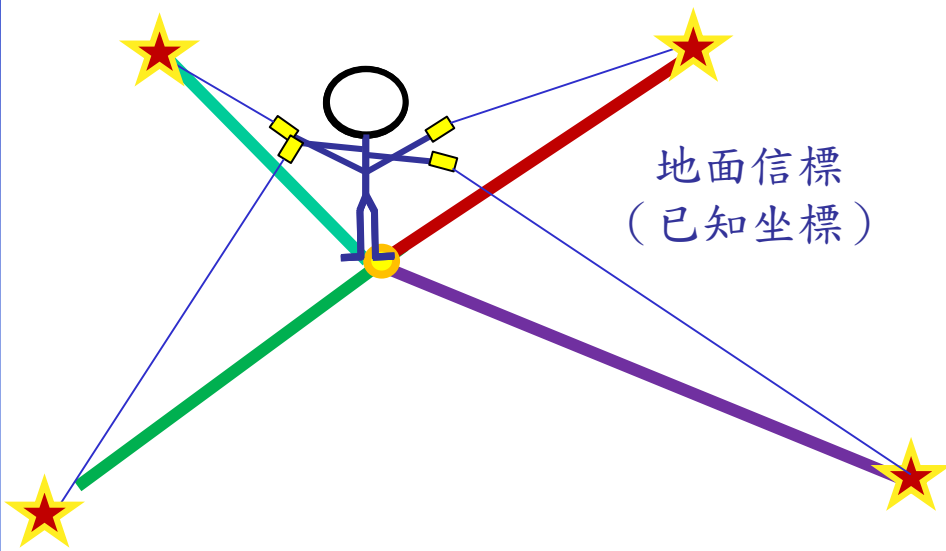


60分鐘後精度可維持約 2 m

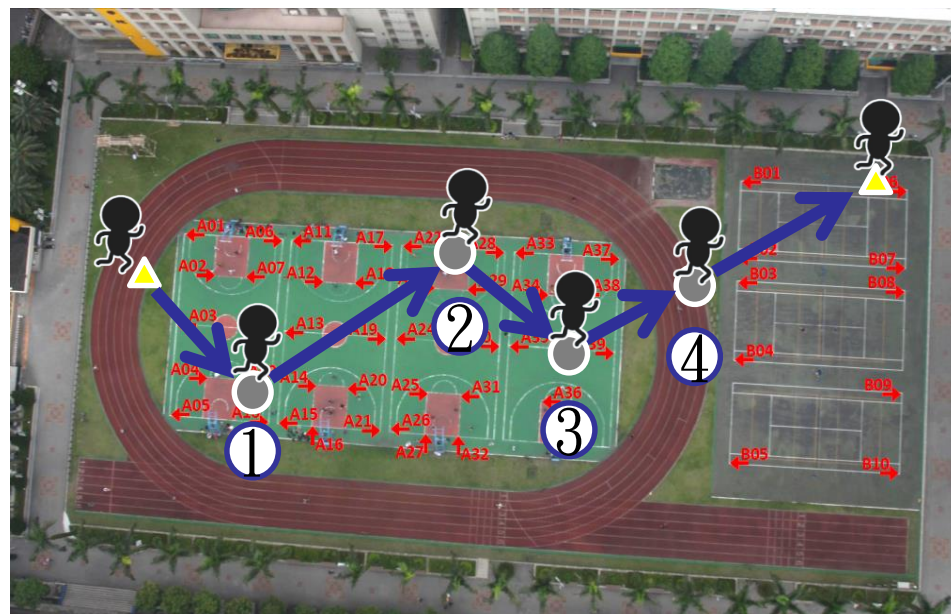




信標交會定位



定位精度可達**0.5 m**



傳遞式-定位精度可達**1.6 m**





網路差分DGPS追蹤器

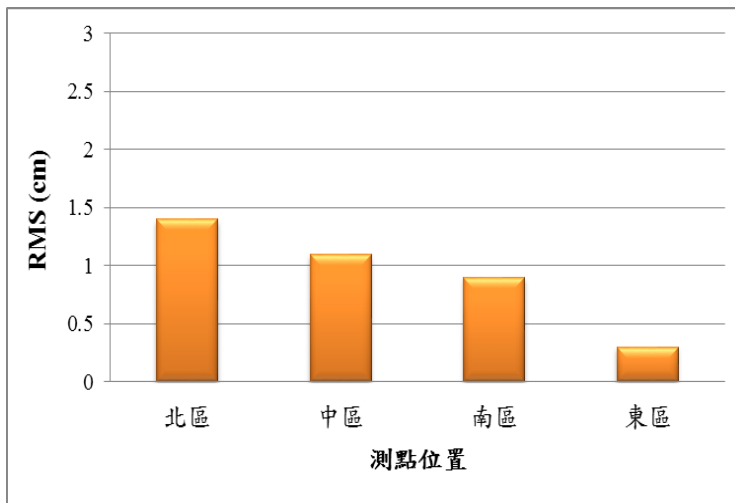


定位精度可達**1.4 m**

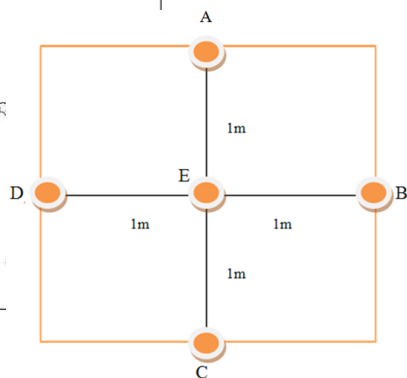
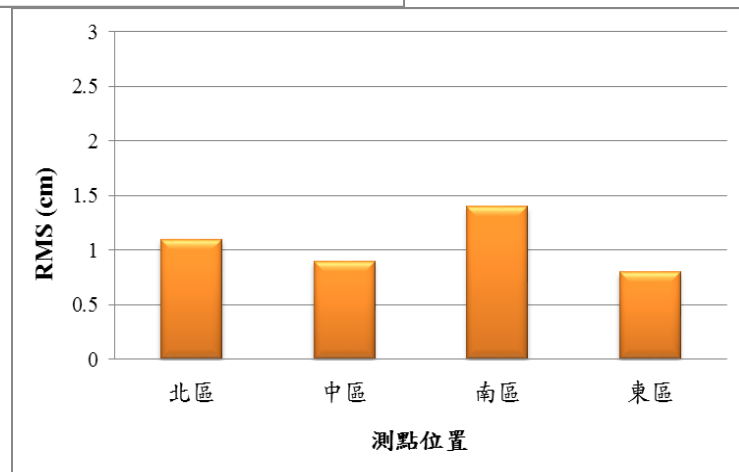




Civil-Net 定位精度測試



下午時段



小型基線

可優於2 cm 64

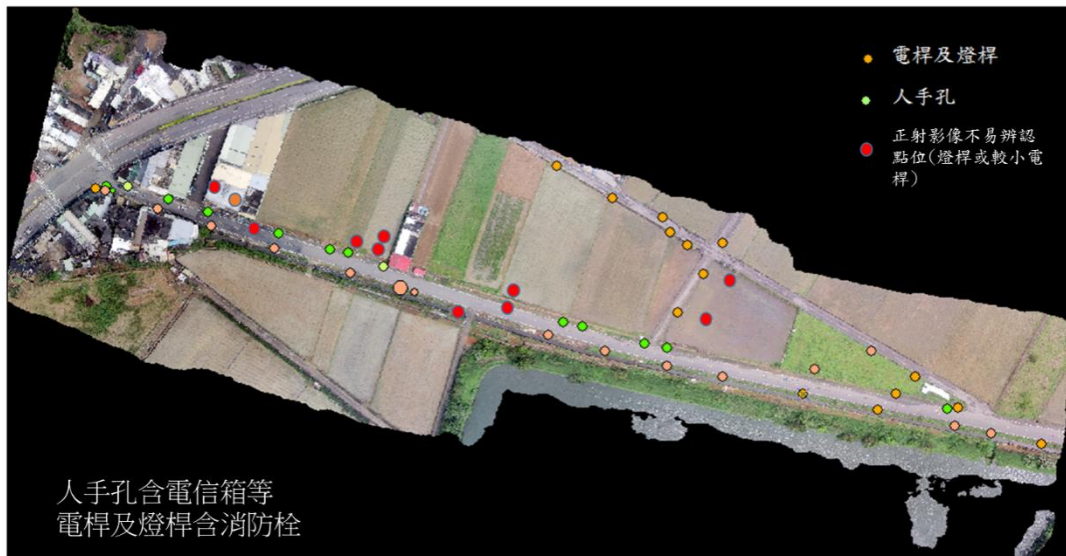




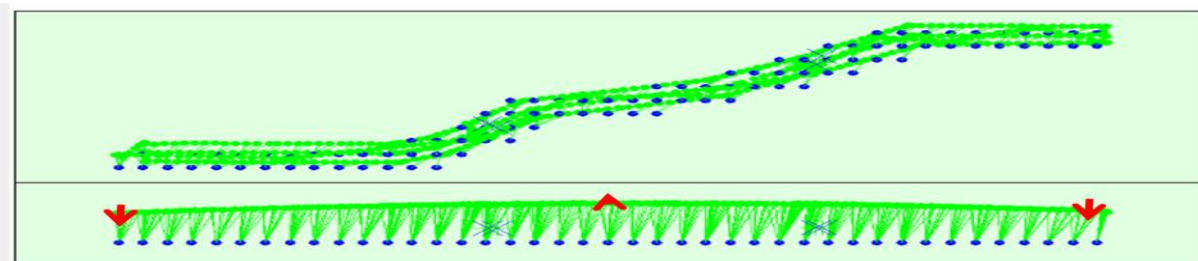
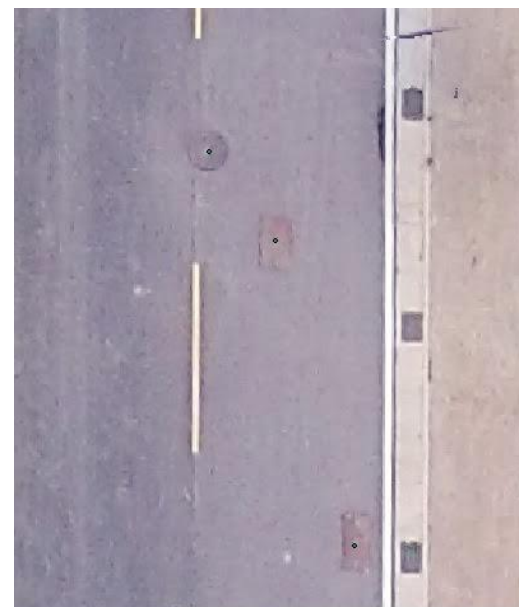
UAV道路孔蓋定位



湖口117縣道0K-0K+500正射影像



30
13
10



GCP Name	Accuracy XY/Z [m]	Error X [m]	Error Y [m]	Error Z [m]	Projection Error [pixel]	Verified/Marked
mtp1 (3D)	0.020/0.020	-0.003	-0.004	-0.020	0.472	5 / 5
mtp2 (3D)	0.020/0.020	0.001	-0.003	0.023	0.607	5 / 5
5 (3D)	0.020/0.020	-0.015	0.030	-0.025	0.342	5 / 5
18 (3D)	0.020/0.020	0.015	-0.033	0.008	0.527	5 / 5
Mean [m]		-0.000761	-0.002283	-0.003598		
Sigma [m]		0.010721	0.022316	0.019863		
RMS Error [m]		0.010747	0.022433	0.020186		



平面定位精度可達**20 cm**





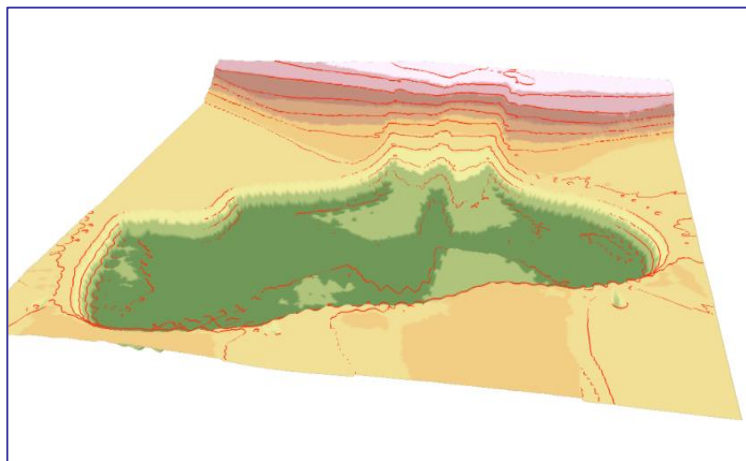
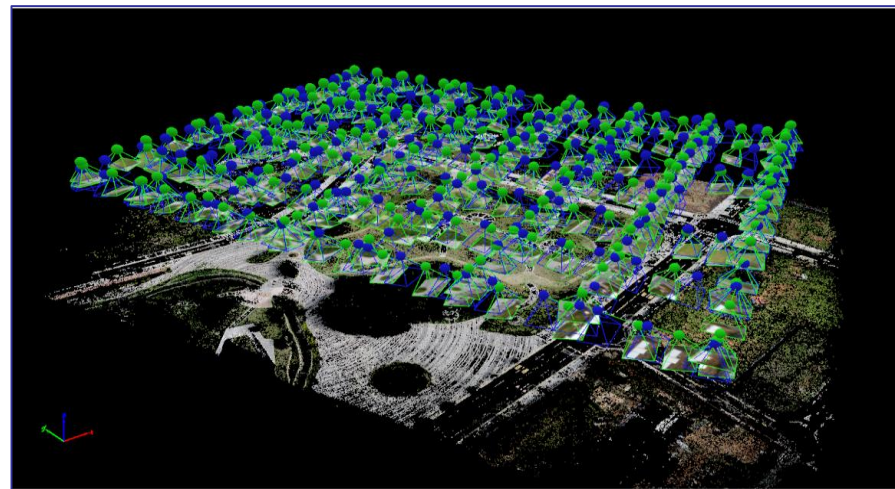
UAV測算土方



台南市白河區鄰近白水溪區域

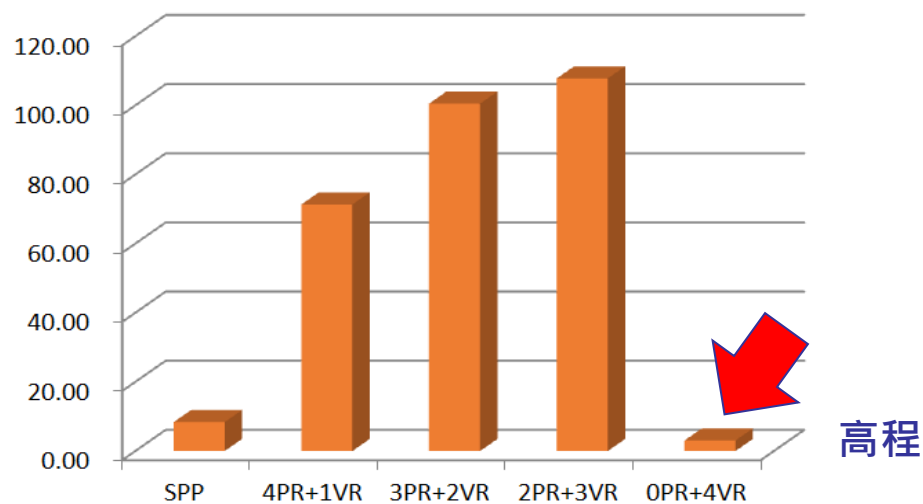
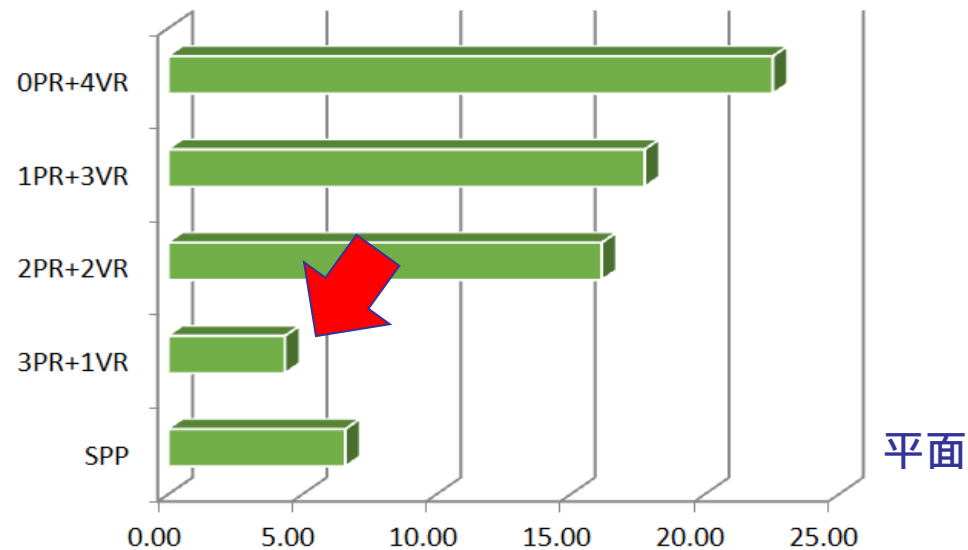
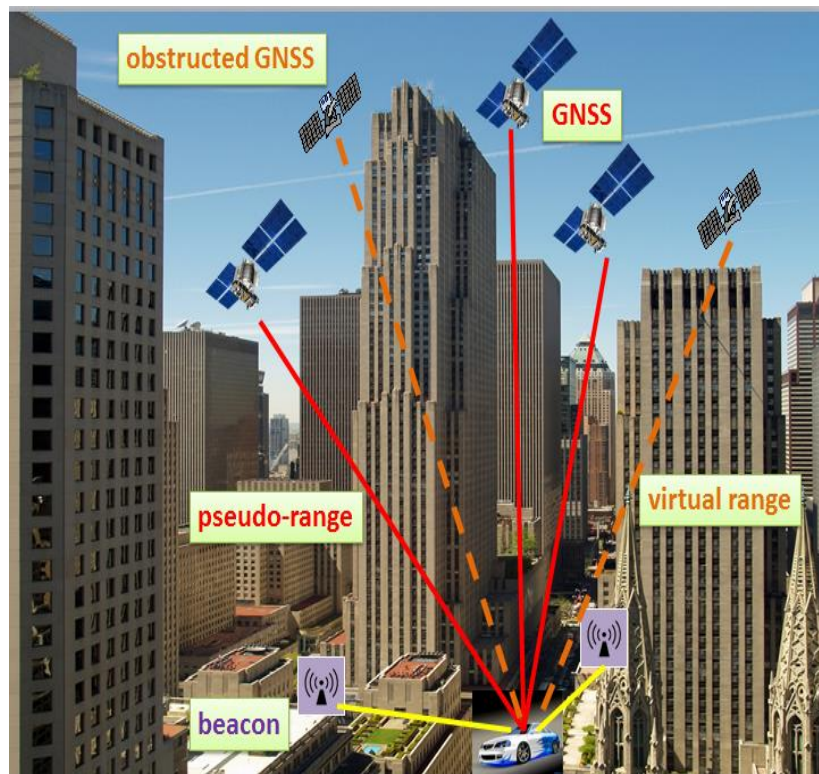


石頭砌成圍牆掩護，非法堆置大量白色廢爐渣破壞河川地，估算高達4.8萬立方公尺。



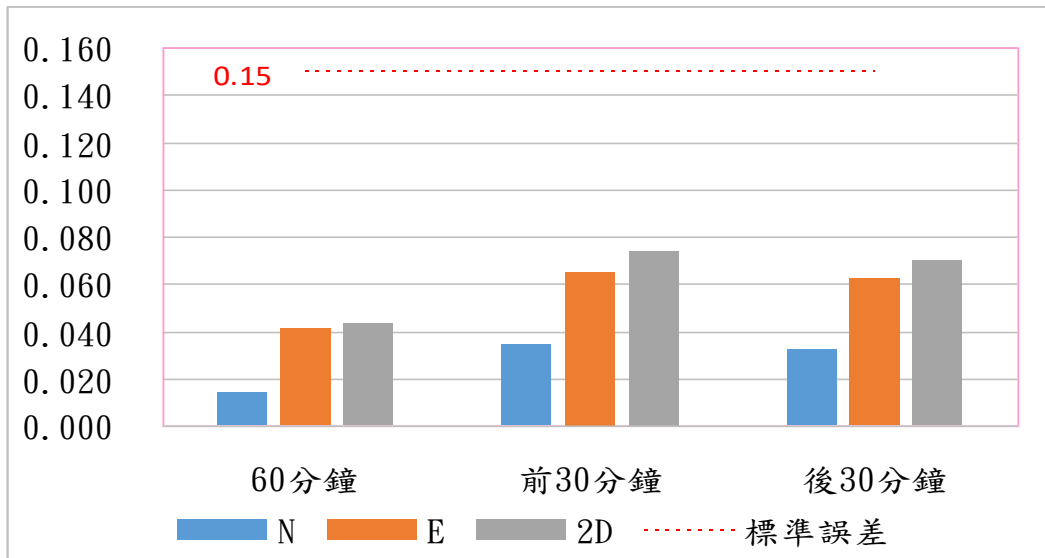


遮蔽衛星輔助定位

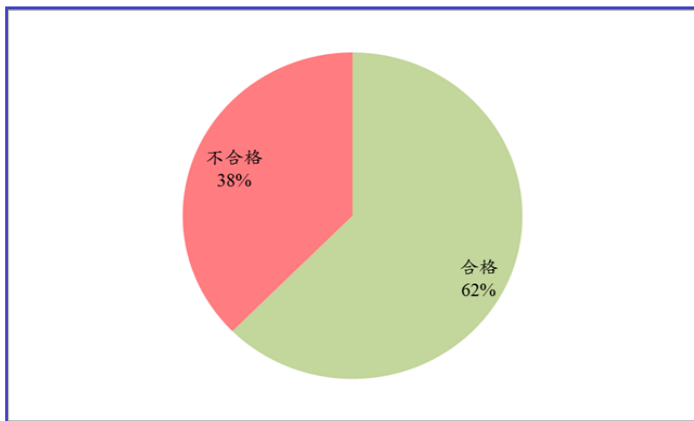




PPP地籍測量



山地圖根點至界址點之位置誤差可小於15公分



坐標點號		觀測60分鐘之2次較差值 (m)		
		ΔN	ΔE	2D
1	GA03	-0.006	0.024	0.025
2	GF68	0.005	0.006	0.008
3	GGM4	0.022	-0.121	0.123
4	GGN7	0.006	-0.003	0.007
5	GH44	0.014	-0.056	0.058
6	GI13	-0.007	-0.017	0.018
7	GI14	-0.022	0.033	0.040
8	GI15	0.016	-0.024	0.029

VBS-RTK施測圖根點2測回坐標成果
平面位置較差應小於3公分





單頻雙頻使用效應

圖根新(補)建規範適用性

觀測量	2 km				7 km			
	2測回較差結果		符合手冊較差規範		2測回較差結果		符合手冊較差規範	
	ΔL	ΔH	ΔL	ΔH	ΔL	ΔH	ΔL	ΔH
GPS L1	0.6	0	○	○	3.3	-7.1	○	×
GPS L1/L2	0.3	0	○	○	0.5	-0.7	○	○
GPS+BDS L1	0.3	2.3	○	○	0.1	-1.4	○	○
GPS+BDS L1/L2	0.4	-0.1	○	○	0.3	-0.4	○	○
GPS+GLN+BDS L1	0.3	0.4	○	○	0.5	1.8	○	○
GPS+GLN+BDS L1/L2	0.4	-0.1	○	○	0.2	0.2	○	○

(空曠區)

(遮蔽區)

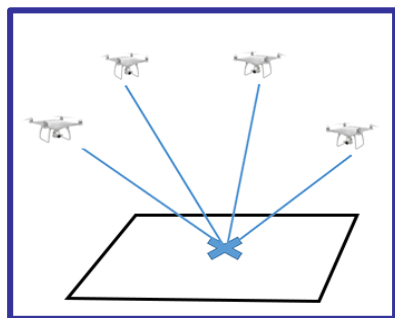
觀測量	2 km				7 km			
	2測回較差結果		符合手冊較差規範		2測回較差結果		符合手冊較差規範	
	ΔL	ΔH	ΔL	ΔH	ΔL	ΔH	ΔL	ΔH
GPS L1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GPS L1/L2	2.2	-1.9	○	○	5.8	2.5	×	○
GPS+BDS L1	6.2	-13.2	×	×	N/A	N/A	N/A	N/A
GPS+BDS L1/L2	2.5	-3.3	○	○	N/A	N/A	N/A	N/A
GPS+GLN+BDS L1	6.3	-13.3	×	×	N/A	N/A	N/A	N/A
GPS+GLN+BDS L1/L2	2.5	-3.3	○	○	N/A	N/A	N/A	N/A



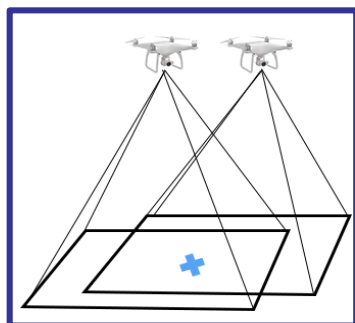


無人機對地定位

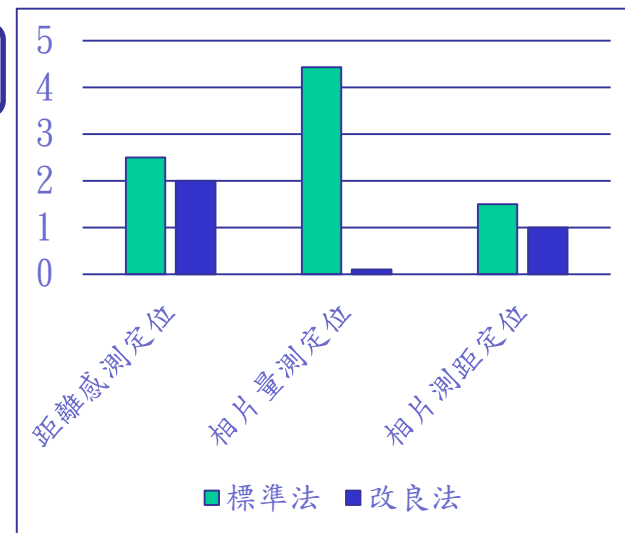
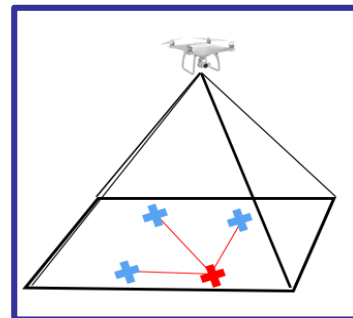
距離感測定位



相片量測定位



相片取距定位



項目	標準法	改良法	改良方法
距離感測定位	2.5m	2.0m	SPP-DGPS
相片量測定位	4.4m	0.1m	無-有地控
相片測距定位	1.5m	1.0m	單-多象限

項目	拍攝作業時間	軟體解算時間
距離感測定位	5-10分鐘	5分鐘
相片量測定位	約略20分鐘	30分鐘
相片取距定位	5-10分鐘	5分鐘





老照片數位歸位

環景影像

可點選照片會挑出另一視窗顯示不完整照片

點選符號後，此處會有事件說明及照片

仁壽宮

西元1957年(民國46年初)，她與在現今大溪仁壽宮的廟前門樓旁，菊菊阿姨從自己家裡走出來，愛拍照的丈夫牽著相機又帶著兩人拍照起來。此時菊菊阿姨和丈夫才成婚半年，夫妻倆是新婚燕爾的甜蜜，面對丈夫的問著此在，本對給婆婆公公婆婆住一陣子的菊菊阿姨，還有些憂愁煩惱，現在在這張照片裡，菊菊阿姨一改原本的想法，明眼笑得很開心，這時的菊菊阿姨已有身孕三個月了，走在初春溼涼的天氣裡，一點也不怕冷。

照片裡的右邊是大溪仁壽宮，原本仁壽宮在民國64年(西元1975年)的初期是修繕為廟舍，但廟基在民國七十年臺灣間津，不再平整，不時也在鄉行築地修繕老廟牆壁，蒙面廟基。

照片裡，菊菊阿姨行走的這一條小巷，左邊的舊式磚厝屋現已於仁壽宮收購拆建，如今這一小巷變成挑著12公



雷射掃描點雲



故事地圖
桃園老照片數位歸位與雲端展示

八德雲裡路建醮祈福

拍攝於1992年，攝者黃偉傑

拍攝地點：桃園市八德區雲裡路51號

建醮就是俗稱「打醮」，是自古流傳習俗，每當廟宇新建或重建，施工完成後均需要打醮。

打醮目的有二：一是酬謝天神、地祇、三界諸神平時庇佑百姓、造福鄉鄰；二是祈求風調雨順、國泰民安、國泰無疆。是一種社會繁榮、太平盛世的象徵，也是一種知恩惜德、知恩感恩的表現。

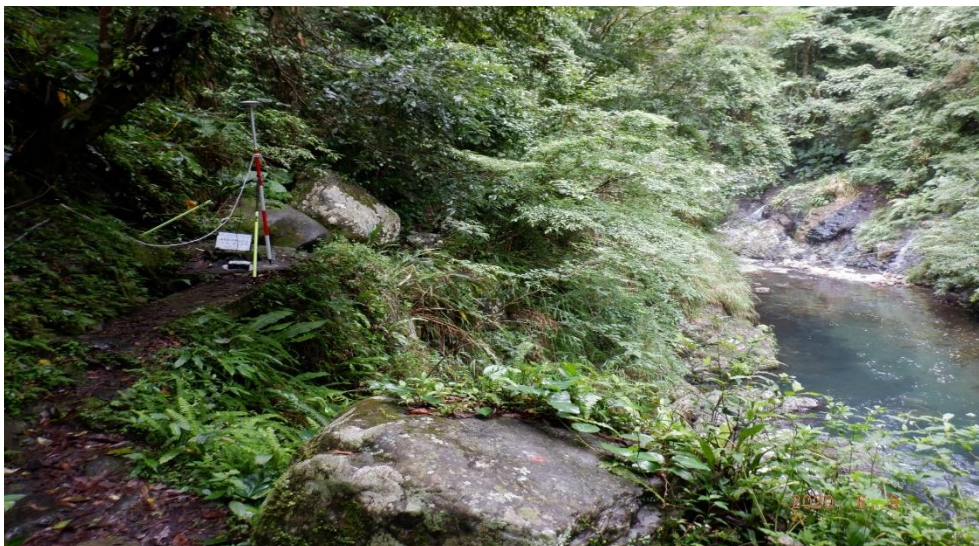
台灣建醮在民間已成為各類祭儀中最莊嚴、最盛大的祭社活動。早年漢人遷居台灣之際，遭遇種種艱辛困苦，造成許多無主孤魂的存在，所以人民建醮的目的，不僅僅是祈神賜福，更增加了施魂解冤的雙重意義。建醮的精髓，是自古民間的信仰，在土生土長後，收現有的風味，表示今年風調雨順非常平安，也會總辦神醮。建醮期間，香客都必須遵守齋戒，以示虔敬之心意，獲得建醮法會的聖潔，避神賜福賜壽，封山醮水表示開始齋戒，表示從此開始直到拜天公開醮為止，善信絕對務必守戒，不得破戒。

主舞台為老照片



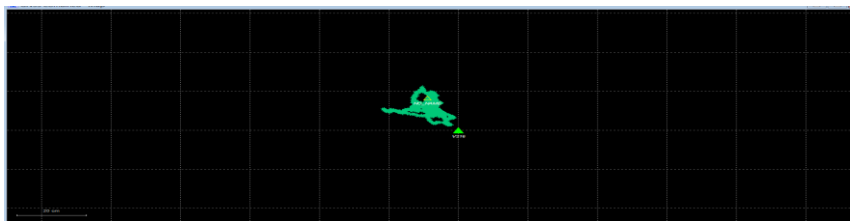


野溪溫泉測勘



```

> 2020 06 11 04 08 21.0000000 0 13 -0.000000000000
END OF HEADER
G11 22161517.661 7 116459555.382 7 -2448.944 46.050 22161524.914 6 90747734.600 6 -1908.264 38.250
G30 21570491.367 7 113353704.989 7 -635.509 43.350 21570503.083 7 88327598.320 7 -495.204 43.300
R12 20007515.254 8 106876174.210 8 -2677.438 49.000 20007520.192 7 83125929.237 7 -2082.450 44.250
E11 22586076.532 8 118690629.126 8 -881.814 48.650 22586088.870 7 90944824.290 7 -675.785 44.900
E24 22252423.814 8 116937271.371 8 -1330.736 51.650 22252450.565 8 89601379.608 8 -1019.718 50.700
C01 37111725.723 7 193250493.717 7 -10.064 46.650 37111737.881 6 149433586.804 6 -7.781 38.500
C03 36270121.605 7 188868044.868 7 30.794 47.550 36270133.952 7 146044793.078 7 23.688 44.850
C07 35743597.269 8 186126287.793 8 327.931 49.750 35743608.178 7 143924690.559 7 253.497 45.650
C08 36290345.255 7 188973355.037 7 121.150 46.100 36290359.617 7 146126225.510 7 93.753 45.050
C13 37261192.744 6 194028820.383 6 543.204 41.300 37261213.638 6 150035438.482 6 420.263 39.450
C23 22554680.714 8 117448132.211 8 -1874.883 50.200
J02 36302307.451 8 190770939.604 8 362.813 49.000 36302318.144 8 148632717.127 8 438.333 49.000
J03 39432738.157 7 207220436.067 7 -152.852 47.000 39432748.201 8 161470506.518 8 -119.105 48.050
  
```

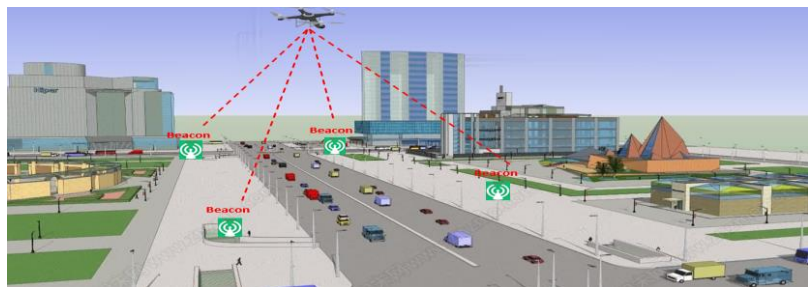
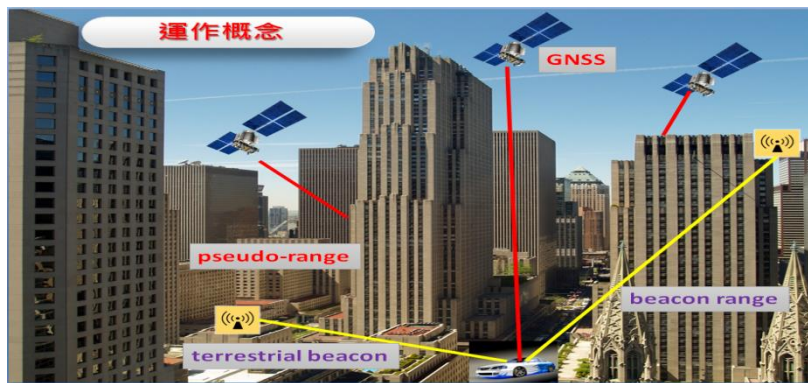


衛星系統	GPS+GLN+GAL+QZSS	+BDS
中誤差 (cm)	700	2

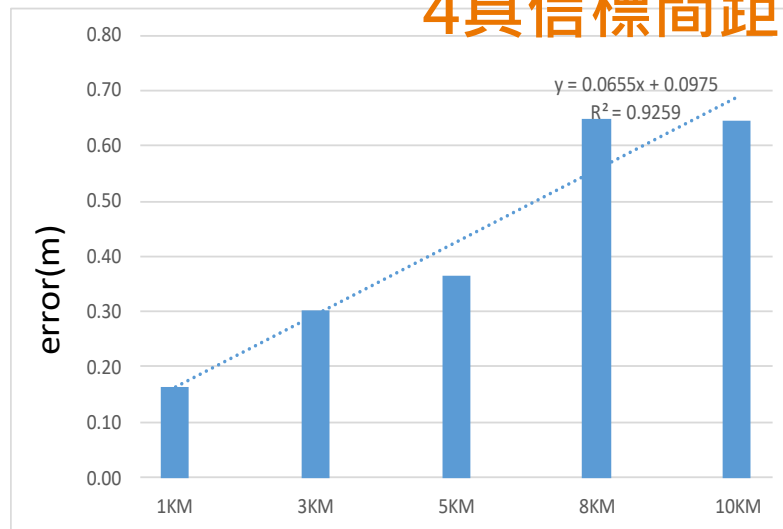




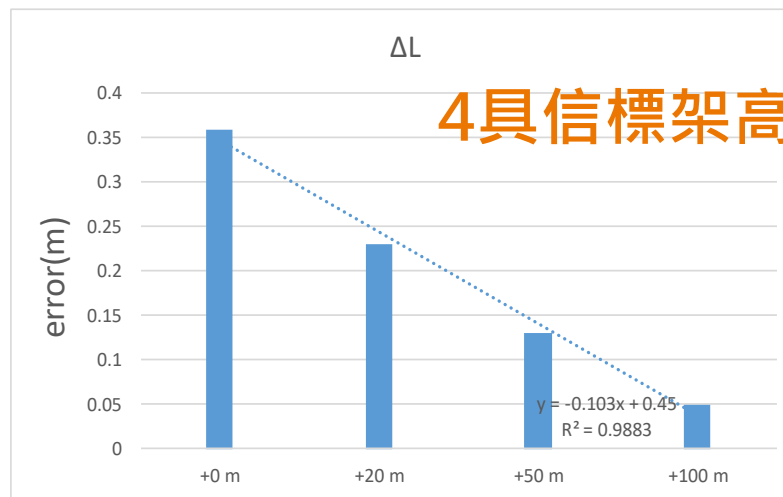
地面信標定位模擬



4具信標間距不同



4具信標架高不同

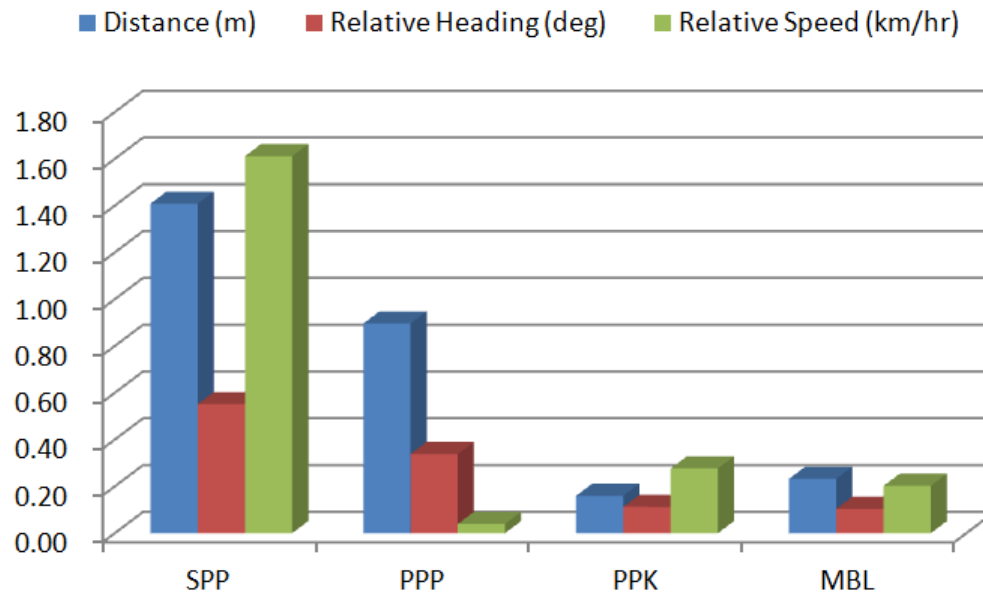
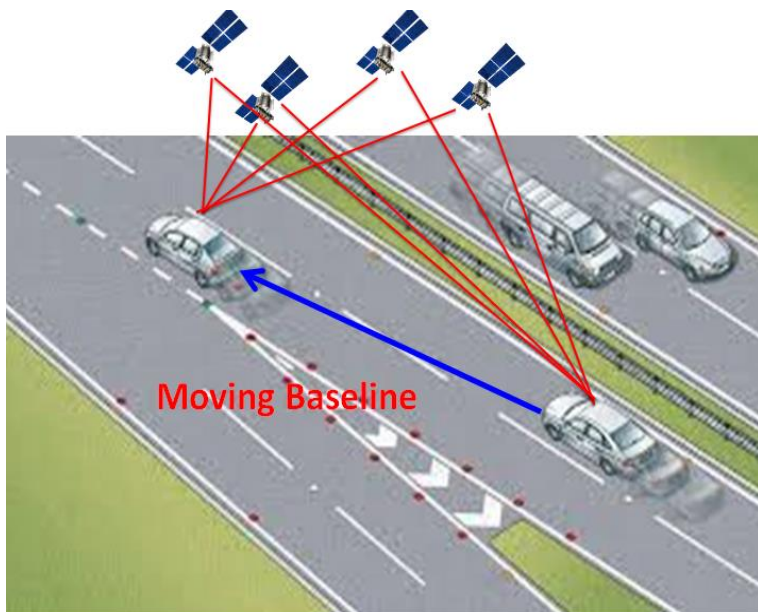


UAV (m)	ΔL	ΔH
不等距 同象限 4具信標 (1+3+5+8 km)	0.17	1.17





移動基線法 (Moving Baseline)

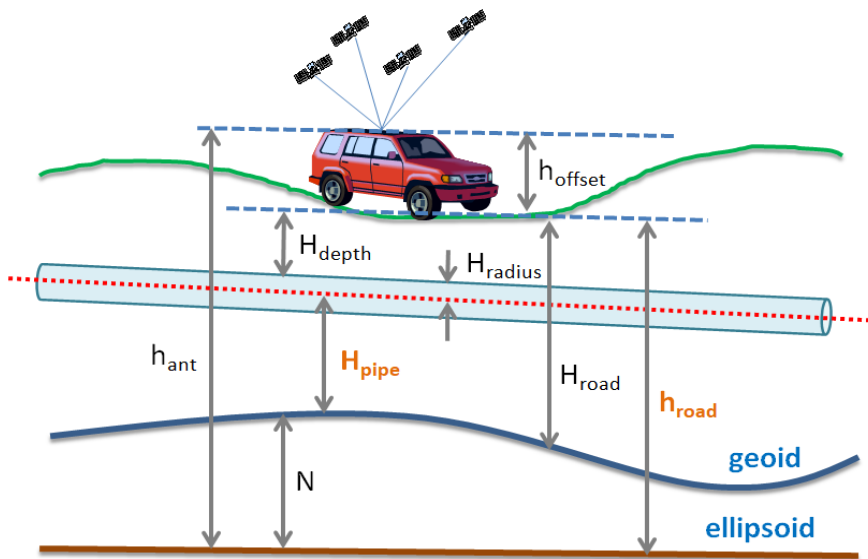
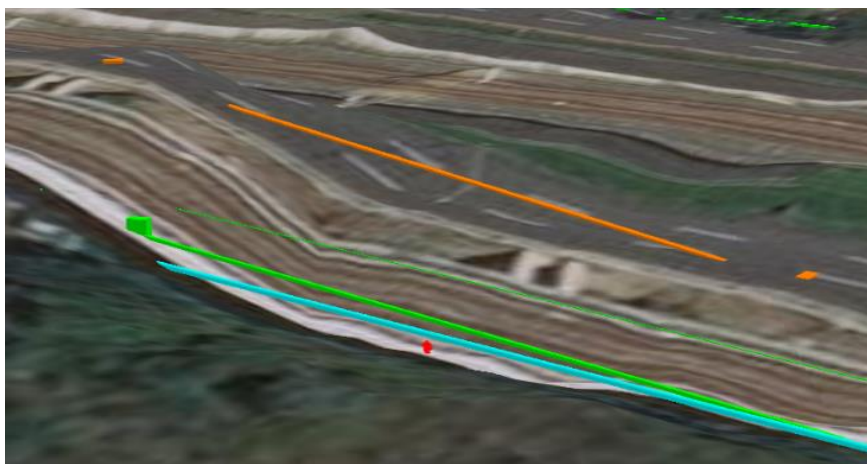


解算模式	距離誤差 (m)	相對航向誤差(deg)	相對速度誤差 (km/hr)	固定解成功率 (%)
SPP	1.41	0.55	1.61	N/A
PPP	0.90	0.34	0.04	31.3
PPK	0.16	0.11	0.28	97.2
MBL	0.23	0.10	0.20	99.4

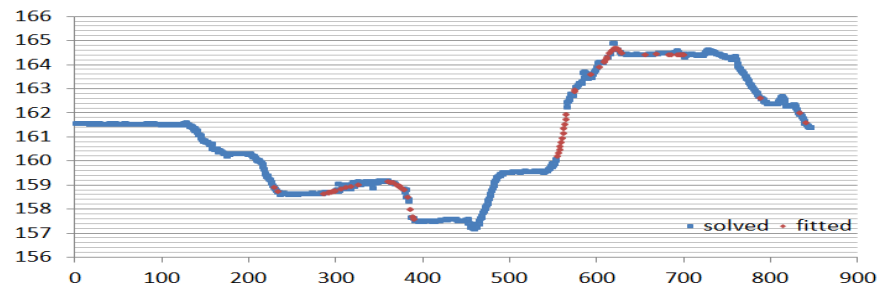




道路高程測算



測試道路	漏測率 (%)	內部精度 (cm)		可用性 SR (%)
		2D	h	
A	9.0	3.2	6.0	93.4
B	0.3	0.9	1.8	99.7
C	7.1	1.5	2.9	97.4
平均	5.5	1.9	3.6	96.8



ANN增補高程精度4 cm

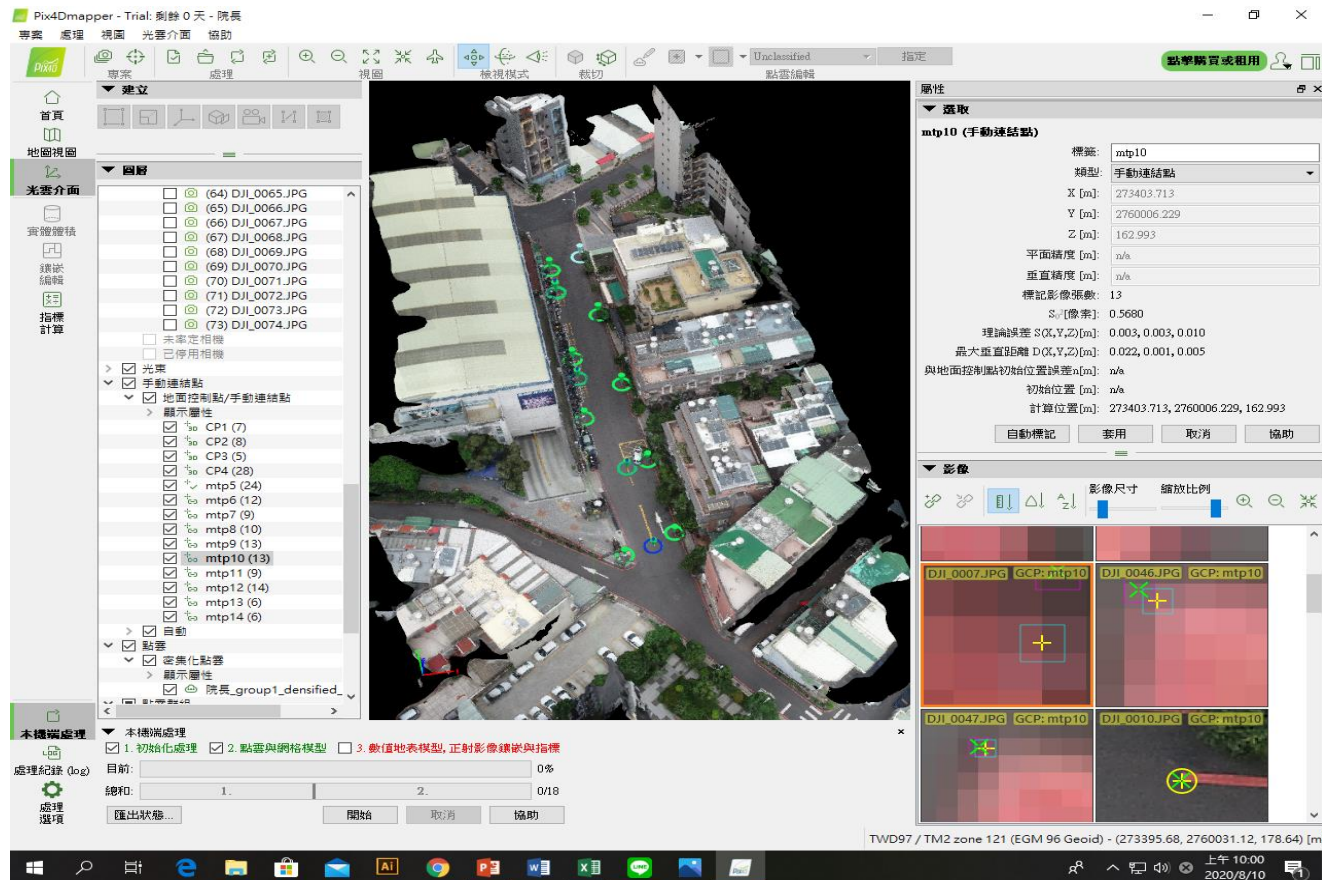
道路測試誤差	PPK-水準	PPK-5米DEM
RMS (cm)	10	61

PPK檢核精度10 cm/等同1米DEM





UAV測算道路高程



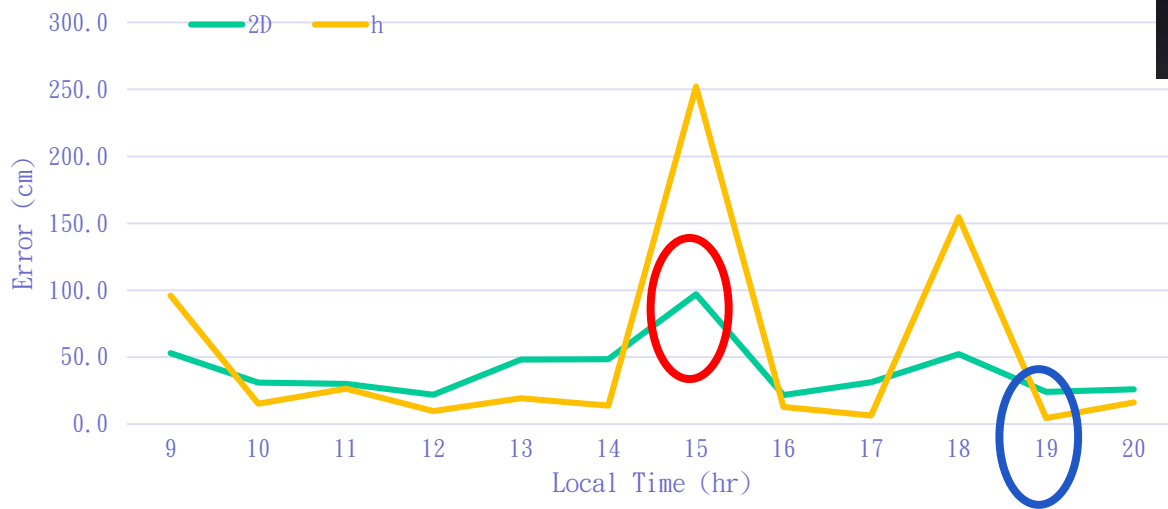
道路高程誤差 (與水準比對)	UAV 3D 模型量測 (無地控)	PPK定位
RMS (cm)	25	7





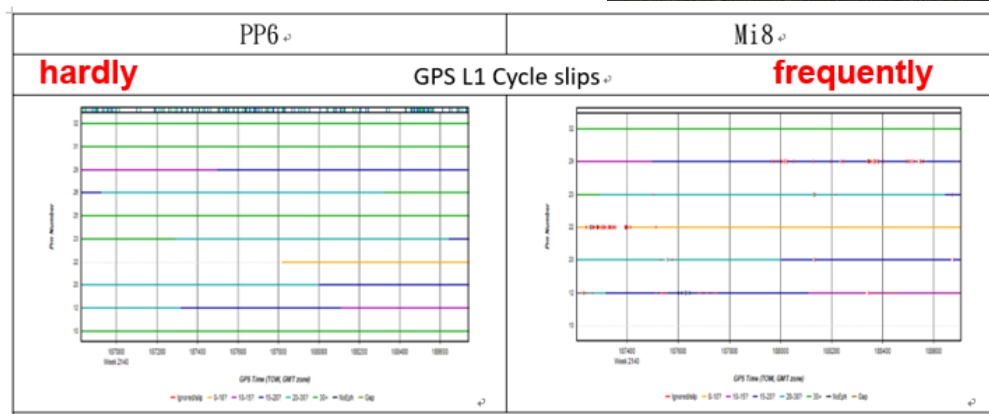
GNSS雙頻相位手機

2021/03/27 9-20h local time



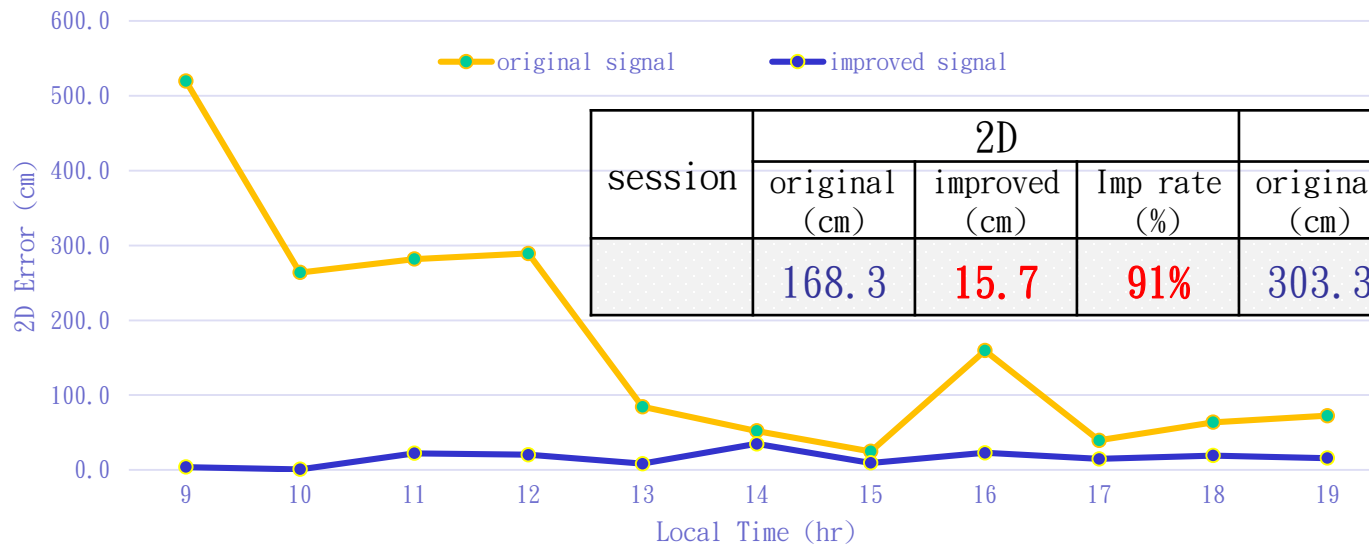
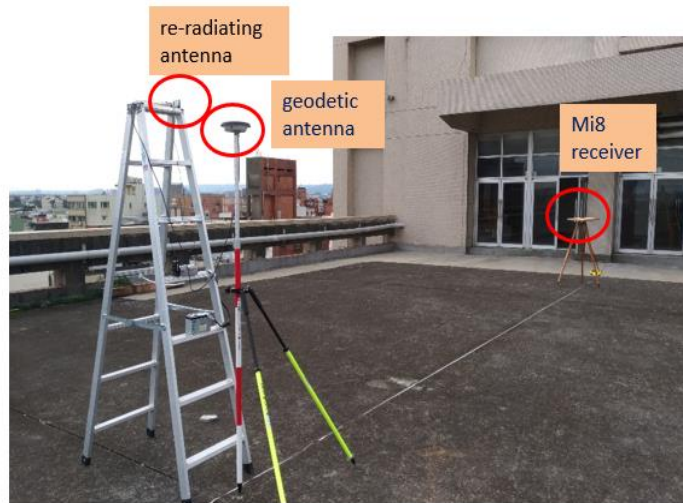
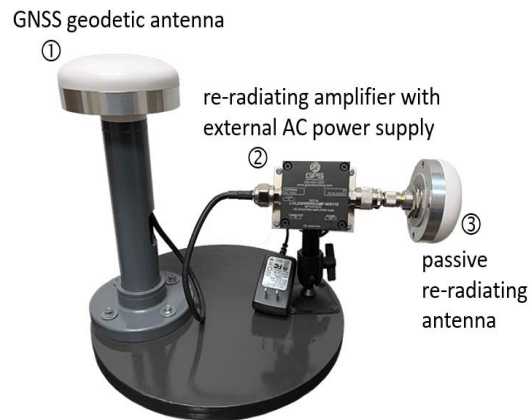
2D (cm) H (cm)

最小誤差	21.7	4.4
最大誤差	97.0	252.2
平均誤差	40.3	52.2





手機改良訊號





經濟部前瞻應用實證賽

結合空間資訊之無人機精準救援方案





實務驗證展示



新聞受訪

百萬大獎

