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Test results of *Locata* technology for deformation monitoring

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Overview

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- **Locata receiver performance considerations**
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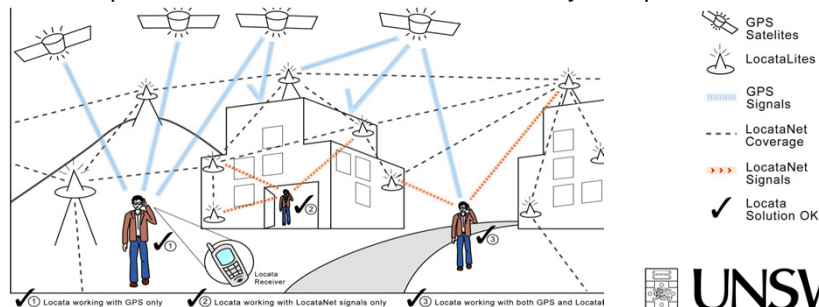
Introduction

- Deformation monitoring requirements typically at millimetre-to-centimetre-level accuracy.
- GNSS is a very popular tool for many structural deformation monitoring applications.
- Issues with GNSS for 24/7 deformation monitoring:
 - possible interference and multipath disturbance
 - relatively low (& variable) number of visible satellites
 - geometric distribution may be poor in certain circumstances



Locata & UNSW...

- Locata Corporation positioning technology known as “Locata”.
- A terrestrial system, with controllable network geometry.
- Ranging signals transmitted in licence-free 2.4GHz ISM frequency band.
- Locata can be used on its own, or in combination with GNSS.
- Several experiments conducted since 2002, initially with pseudolites.



Example 1: Bridge Movement Monitoring (LocataPL-only, May 2004)

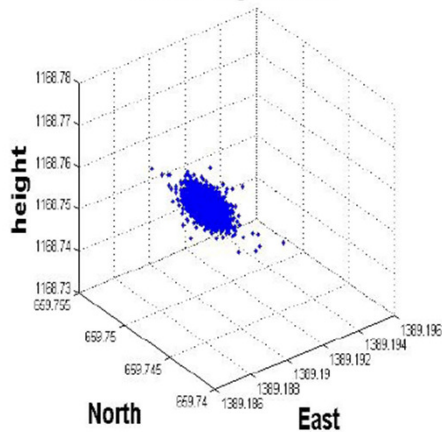


Example 2: Tumut Pond Dam Test (Locata-only, NSW, Nov 2009)

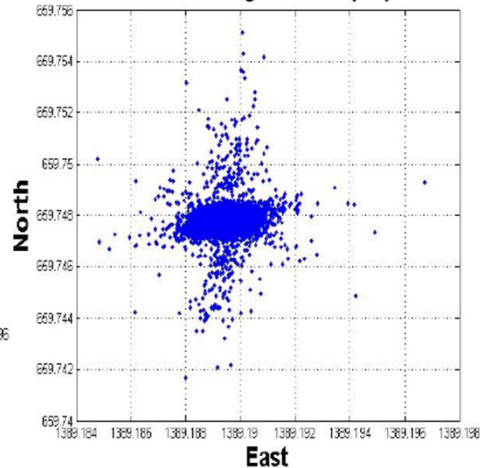


Example 2: Tumut Pond Dam Test

Positioning Solution



Positioning Solution (2D)



Mm-level sensitivity...



Locata receiver performance considerations...

- Number of *LocataLites* in the *LocataNet*
- *LocataNet* geometry
- Signal obstructions
- Atmospheric conditions
- RF interference
- Multipath

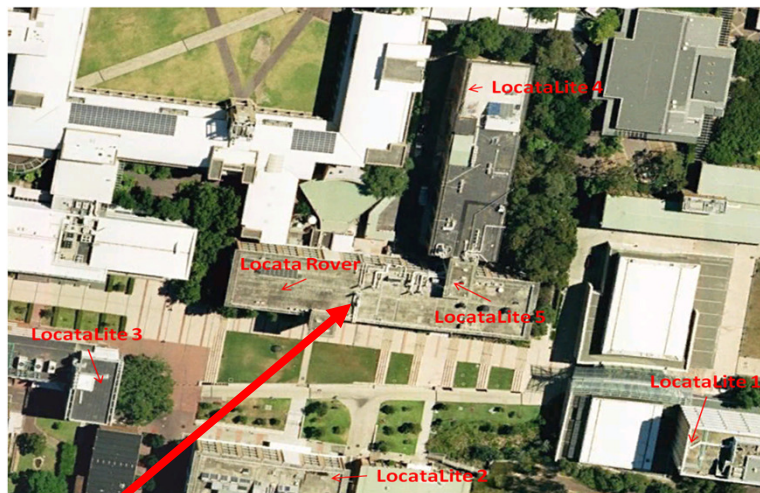


Locata is vulnerable to jamming...

- Aims of this study:
 - Evaluate the performance of a *Locata* in the presence of WiFi interference.
 - Two ZBL tests to identify possible signal quality issues in using *Locata* for deformation monitoring applications.



Test scenario at UNSW...



VDOP=3.3, HDOP=0.6



Locata receiver outputs...

- Integrated Carrier Phase (ICP)
- Pseudorange (PR)
- *Locata* Signal Strength Indicator (LSSI)
- Low Correlator Output Event (LCOE)



For these tests, ICP values were used...

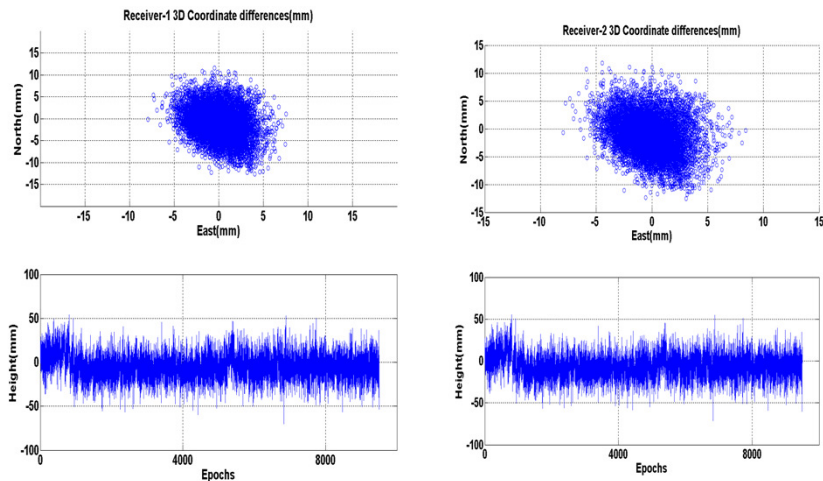


Case 1: Benign conditions

- ZBL setup
- 2 *Locata* receivers
- A Hyperlink Omni antenna (model: HG2403MGURB)
- Signal splitter



ZBL results...



Note: weak vertical geometry!

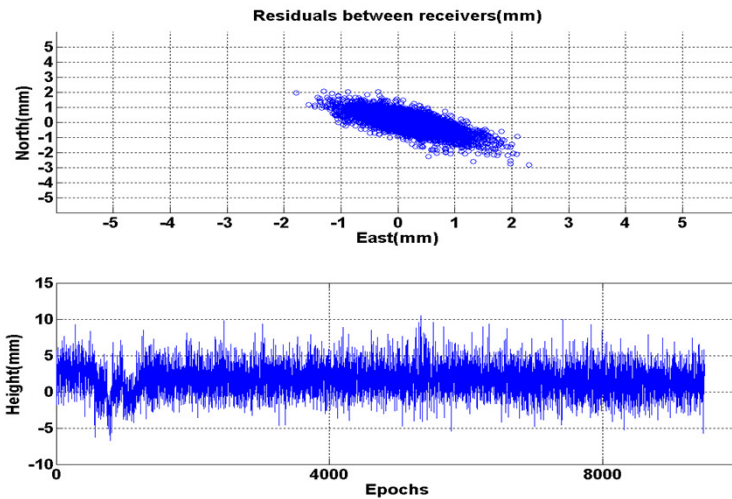


Comparison: Case1

Receiver	Mean (metres) \pm std(1σ)			Max Residuals (mm)			Min Residuals (mm)			RMS (mm) (99.7% CI)		
	E	N	H	E	N	H	E	N	H	E	N	H
R1	-108.401 ± 0.002	45.897 ± 0.004	25.035 ± 0.02	8	13	70	-8	-13	-70	6	11	56
R2	-108.400 ± 0.002	45.897 ± 0.003	25.029 ± 0.02	8	13	71	-8	-13	-71	6	11	57
R1-R2	0 ± 0.001	0 ± 0.0004	0.006 ± 0.003	2	3	11	-2	-3	-11	2	2	9



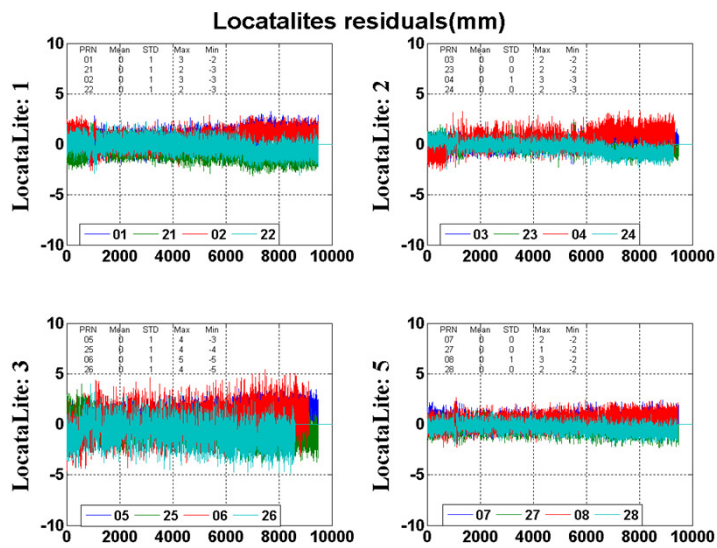
Case1: Residuals between receivers



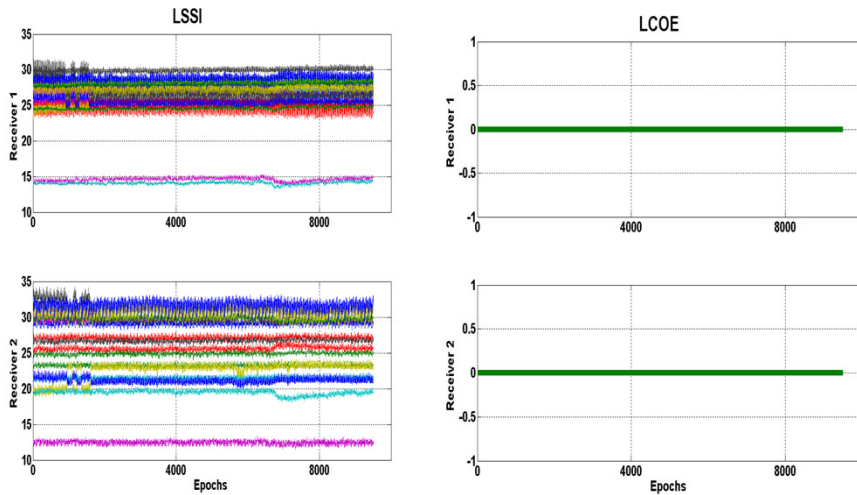
Note: weak vertical geometry!



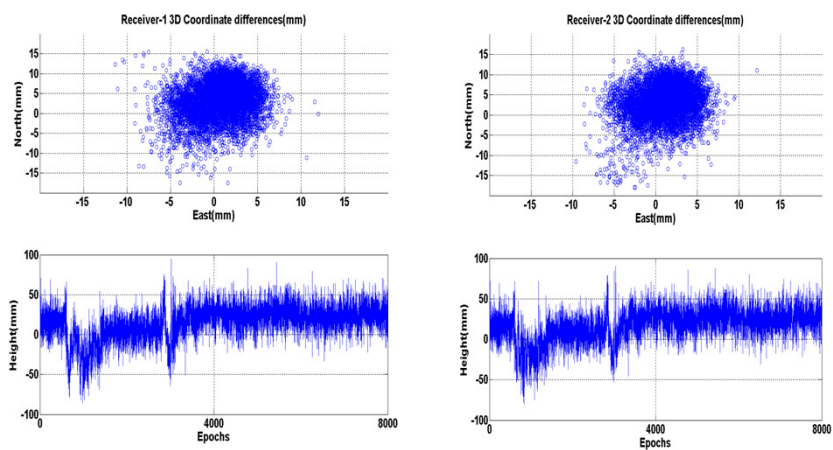
LocataLites residuals



Interference effects on *Locata* quality parameters: Case 1

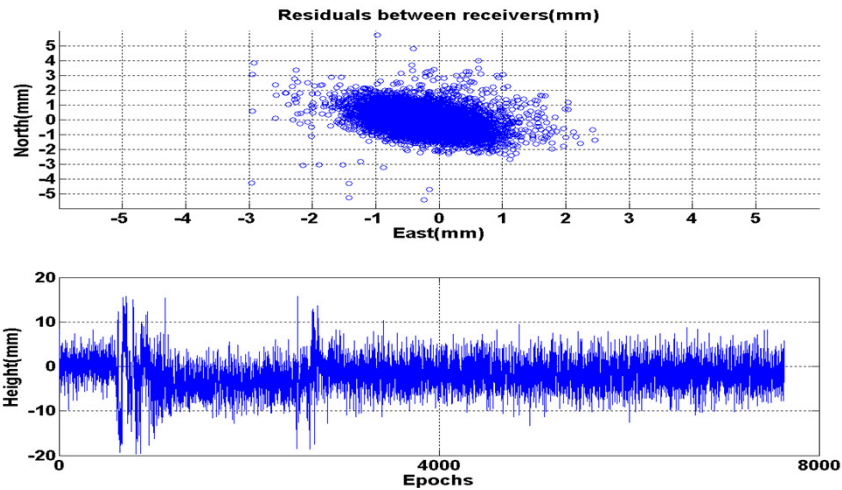


Case 2: With interference... WiFi transfer data files between laptops



Note: weak vertical geometry!

Case2: Residuals between receivers



Note: weak vertical geometry!



Comparison: Case 2 (with WiFi)

Receiver	Mean (metres)+std(1 σ)			Max Residuals (mm)			Min Residuals (mm)			RMS (mm) (99.7% CI)		
	E	N	H	E	N	H	E	N	H	E	N	H
R1	-108.400 ± 0.004	45.900 ± 0.004	25.047 ± 0.023	12	16	95	-12	-17	-85	8	16	80
R2	-108.400 ± 0.003	45.900 ± 0.004	25.050 ± 0.022	12	16	90	-10	-17	-80	8	16	80
R1-R2	0 ± 0.001	0 ± 0.001	-0.003 ± 0.004	3	7	15	-2	-3	-19	2	2	9



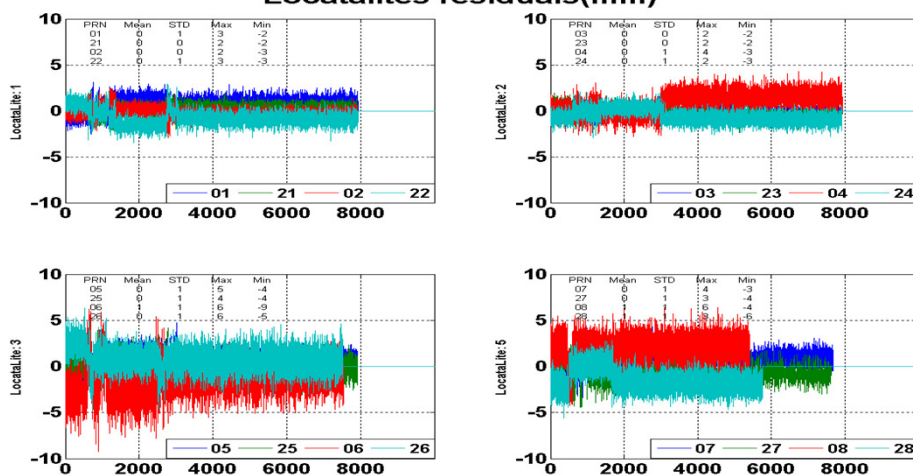
Comparison: Case1 (No WiFi)

Receiver	Mean (metres) \pm std(1σ)			Max Residuals (mm)			Min Residuals (mm)			RMS (mm) (99.7% CI)		
	E	N	H	E	N	H	E	N	H	E	N	H
R1	-108.401 ± 0.002	45.897 ± 0.004	25.035 ± 0.02	8	13	70	-8	-13	-70	6	11	56
R2	-108.400 ± 0.002	45.897 ± 0.003	25.029 ± 0.02	8	13	71	-8	-13	-71	6	11	57
R1-R2	0 ± 0.001	0 ± 0.0004	0.006 ± 0.003	2	3	11	-2	-3	-11	2	2	9

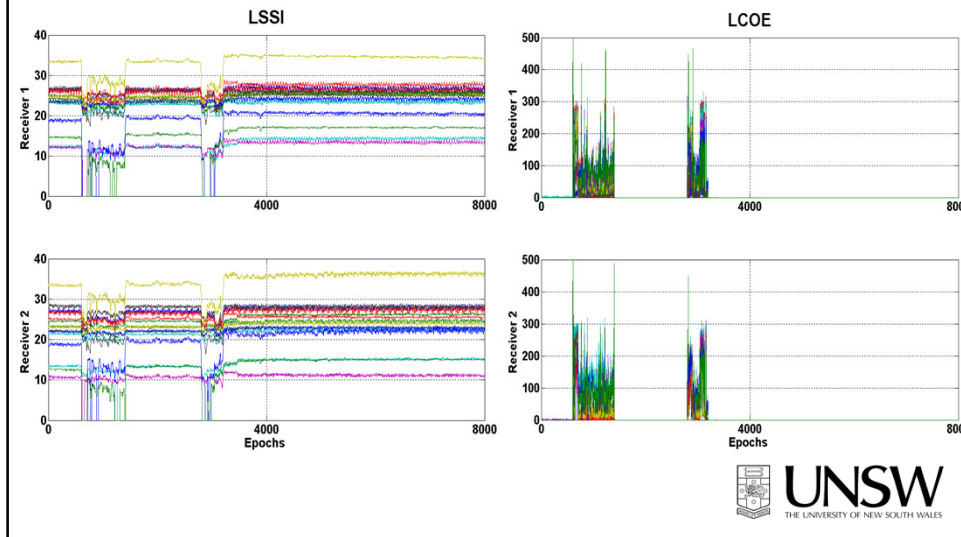


LocataLite residuals

Locatalites residuals(mm)



Interference effects on *Locata* quality parameters: Case 2

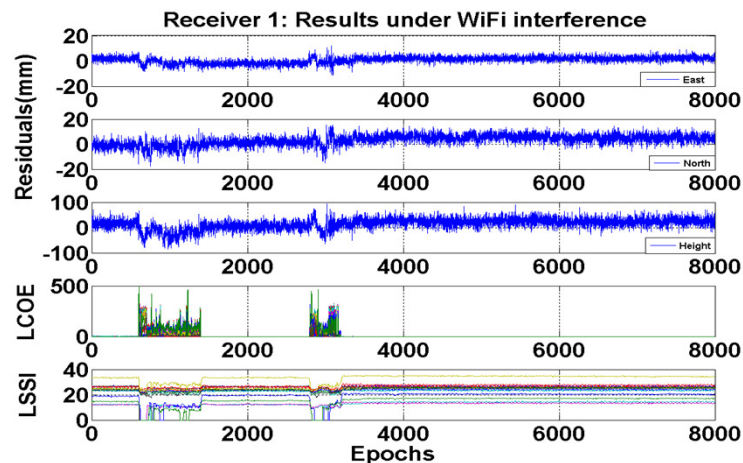


Observations...

- Both receivers perform similarly, *with or without interference*

Receiver	Mean (metres)+std(1σ)			Max Residuals (mm)			Min Residuals (mm)			RMS (mm) (99.7% CI)		
	E	N	H	E	N	H	E	N	H	E \pm	N \pm	H \pm
R1 (without WiFi)	-108.401 ± 0.002	45.897 ± 0.004	25.035 ± 0.019	8	13	70	-8	-13	-70	6	11	56
R1 (with WiFi)	-108.400 ± 0.004	45.900 ± 0.004	25.047 ± 0.023	12	16	95	-12	-17	-85	8	16	80

Results under WiFi interference



Concluding remarks

- Tested *Locata* receiver performance:
 - benign signal conditions
 - WiFi-interfered conditions
- Although accuracy was impacted by sporadic interference, *Locata* provided millimetre-level accuracy for horizontal position, and centimetre-level vertical accuracy.
- This confirmed the applicability of *Locata* for deformation monitoring applications if measurement quality is also monitored.

*THANK YOU FOR YOUR
ATTENTION*

ANY QUESTIONS ?

