

The use of GNSS to aid the Structural Health Monitoring of the Severn Suspension Bridge's Suspension Cables and Support Towers.



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Professor Gethin Wyn Roberts
The University of Nottingham Ningbo, China
Chartered Institution of Civil Engineering Surveyors



Fig Commission 6 Chairman

Chris John BROWN, Xu TANG,
Oluropo OGUNDIPE.



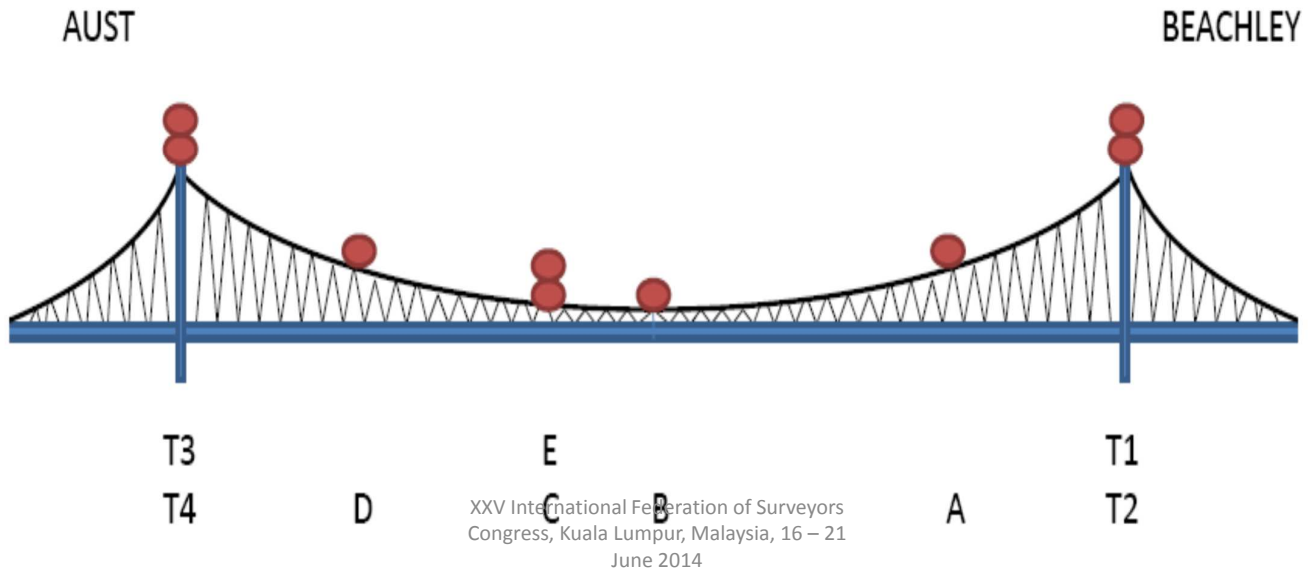
The Severn Bridge



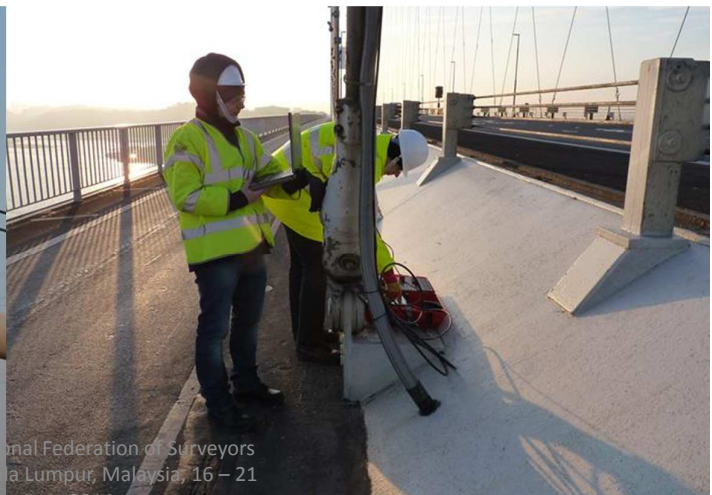
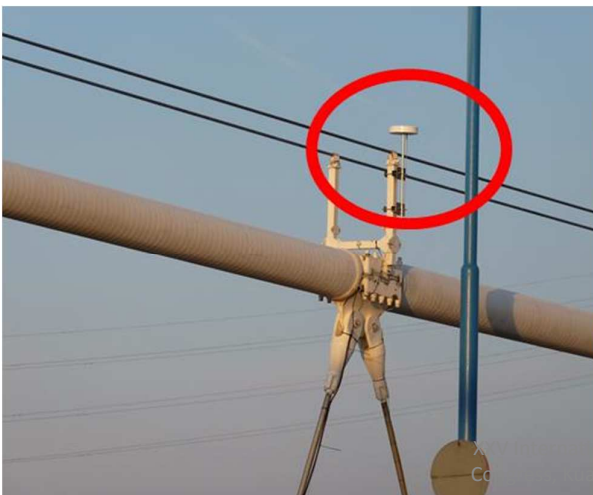
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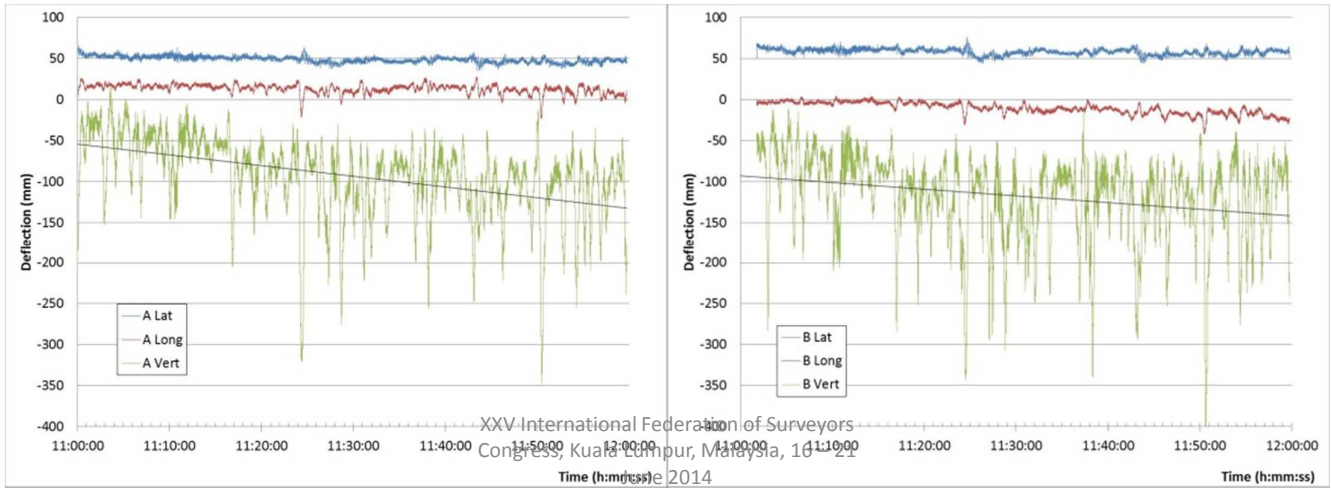
- 998m long central suspended span
- Survey carried out in March 2010
- 4 days of data, 10 and 20Hz
- 9 Bridge locations, 2 reference stations
- Locations included the tops of the 4 towers and directly on the suspension cables
- Some initial results previously, more work now.



- Lightweight choke ring antennas
- Placed by Severn Bridge engineers
- Easy and safe access to antenna cables.



- Lat, long and Vertical deflections at A and B
- 1 hour dataset
- Synchronized, as well as gradual drop; temperature

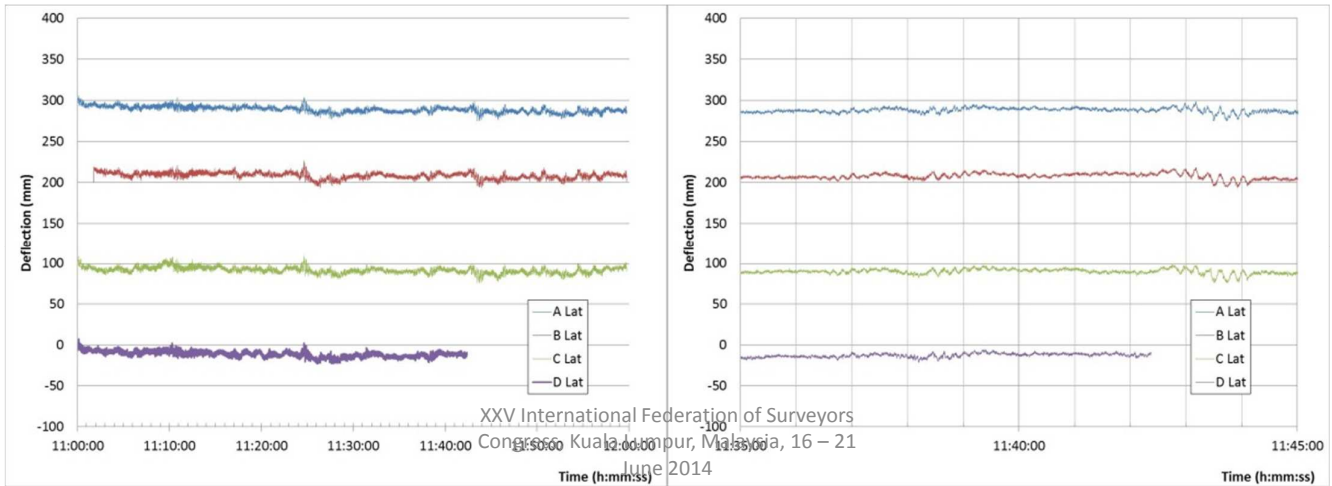


- Example comparisons

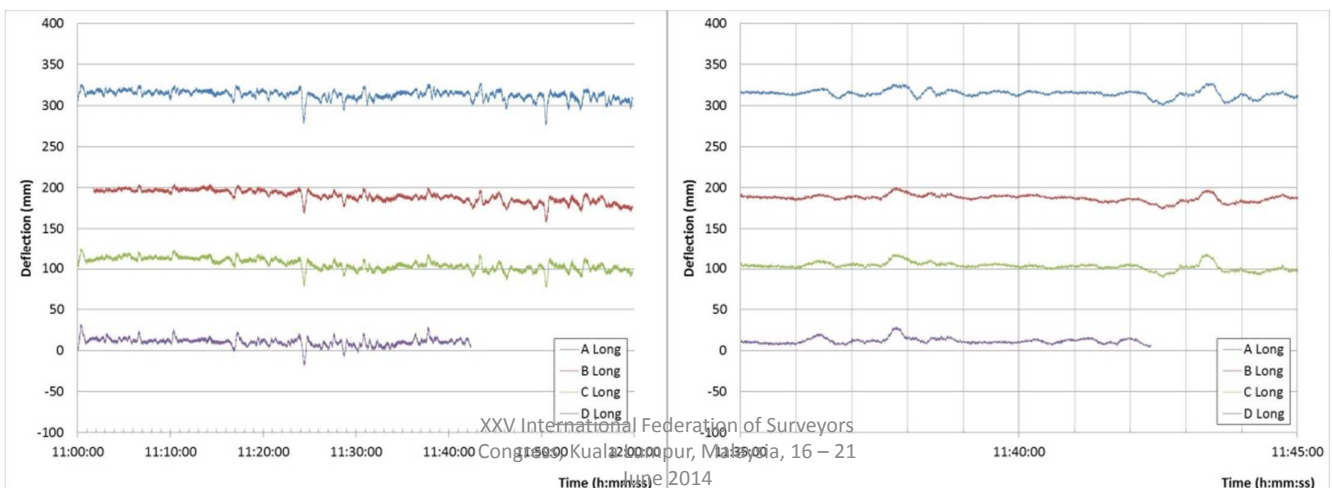
Location	11:24:26			11:38:19		
	Lat Displacement (mm)	Lon Displacement (mm)	Vertical Displacement (mm)	Lat Displacement (mm)	Lon Displacement (mm)	Vertical Displacement (mm)
A	17.5	46	283.2	11.6	19	217.5
B	26.2	32.1	295.1	12.7	15	321.1
C	24.5	35.1	260.1	12.9	16.4	319.4
D	22.3	39.3	208.9	14.2	20.9	233.9

Location	11:50:31		
	Lat Displacement (mm)	Lon Displacement (mm)	Vertical Displacement (mm)
A	13.1	41	332.1
B	17.3	30.2	403.7
C	13.4	32.2	333.8
D			

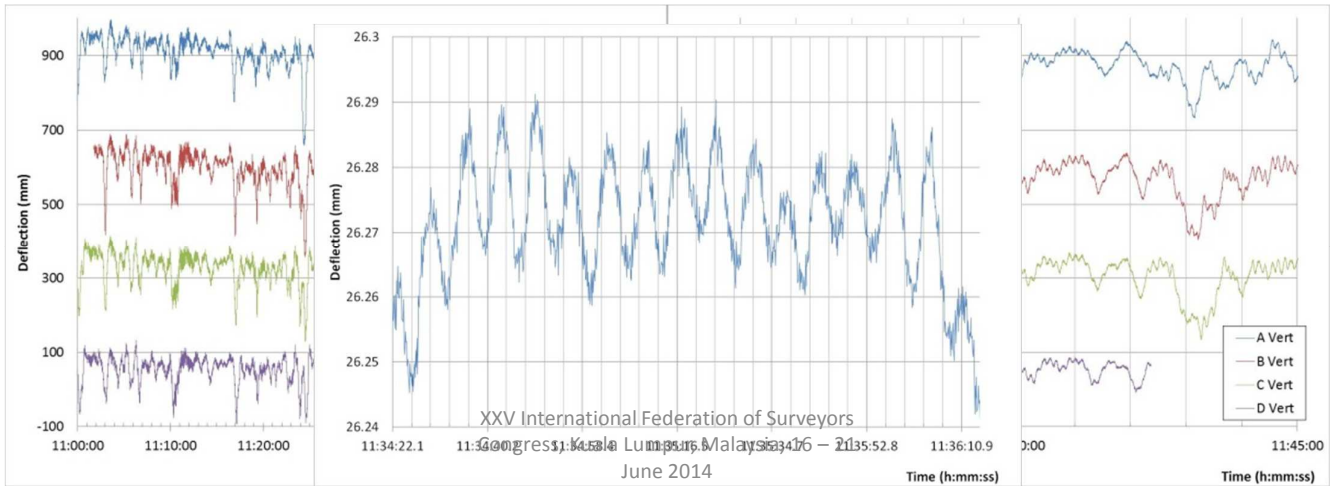
- Lateral movements at 4 suspension cable locations
- 1 hours and 10 mins



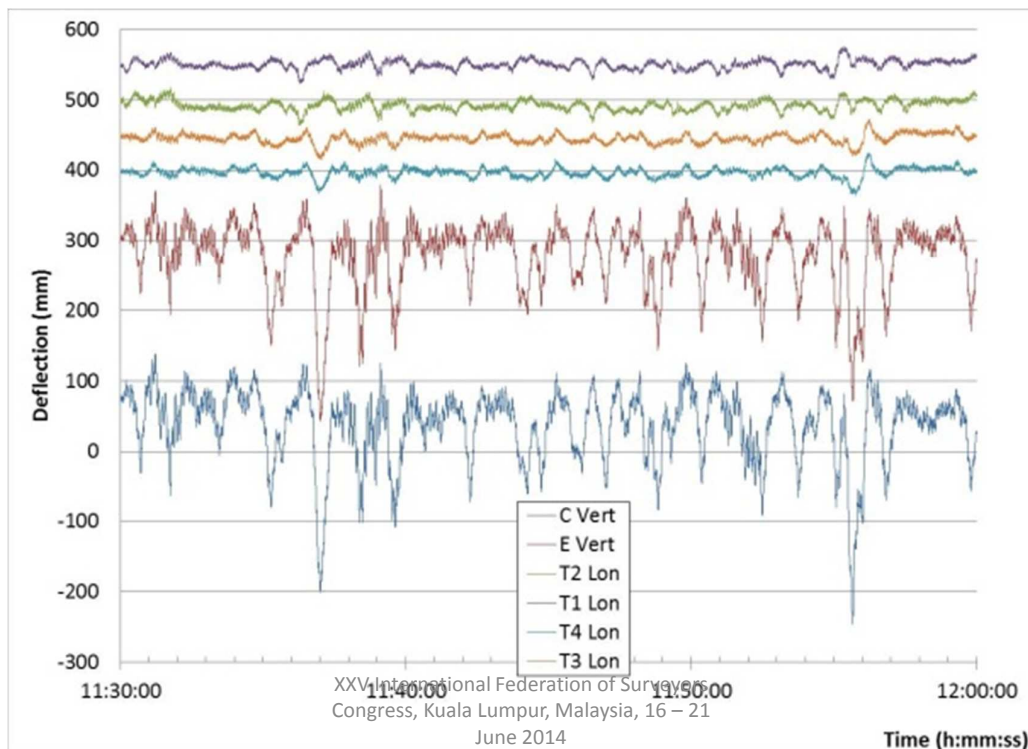
- Longitudinal movements at 4 suspension cable locations
- 1 hours and 10 mins

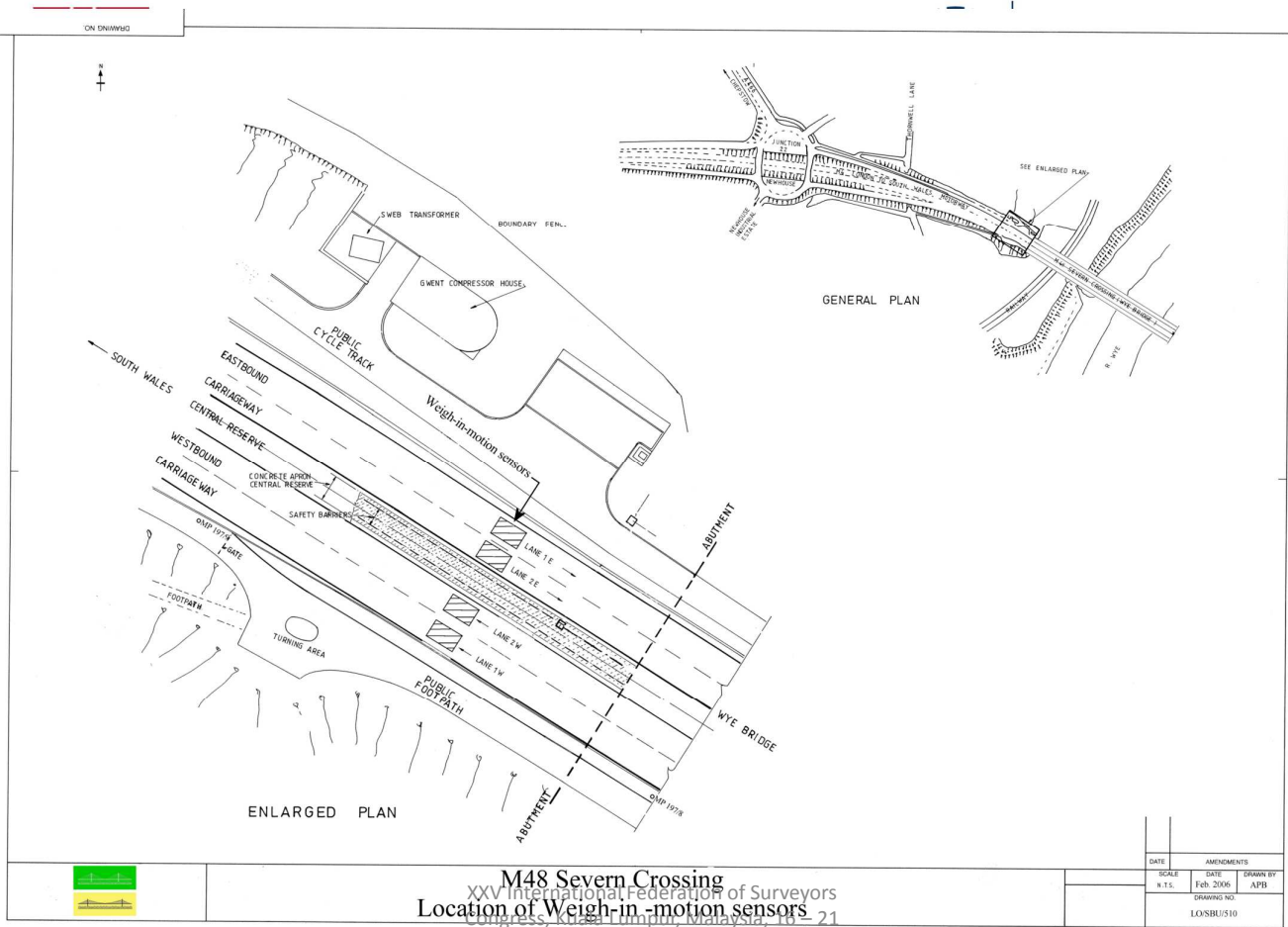


- Vertical movements at 4 suspension cable locations
- 1 hours and 10 mins



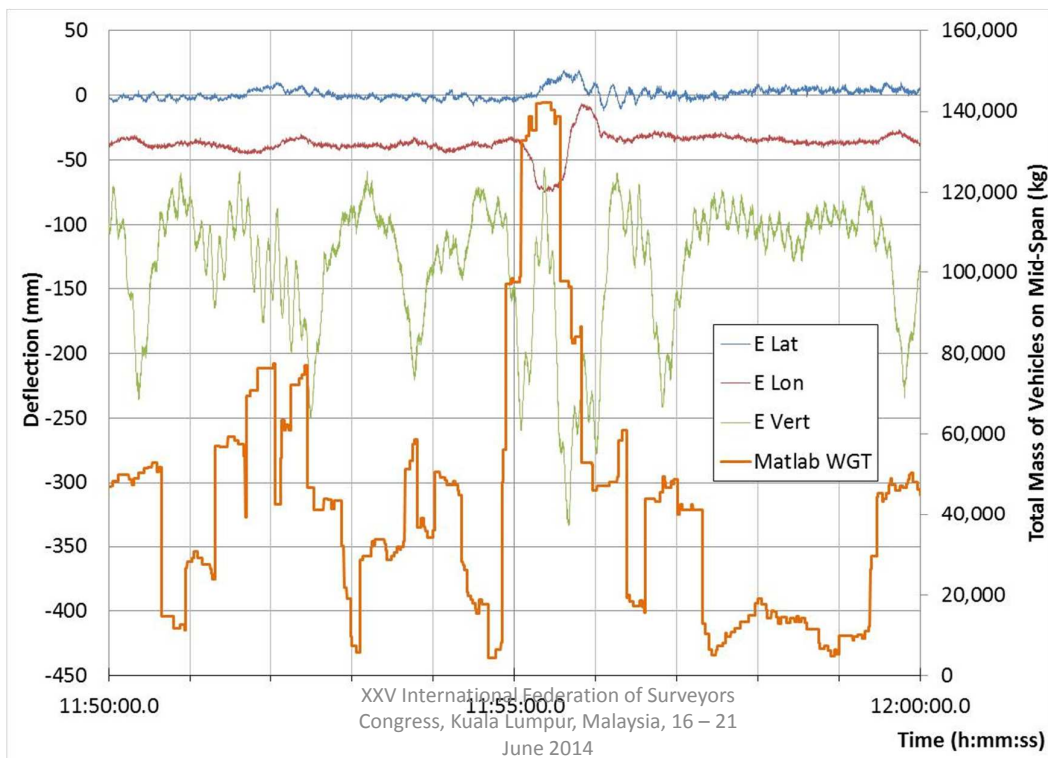
Relative Movements

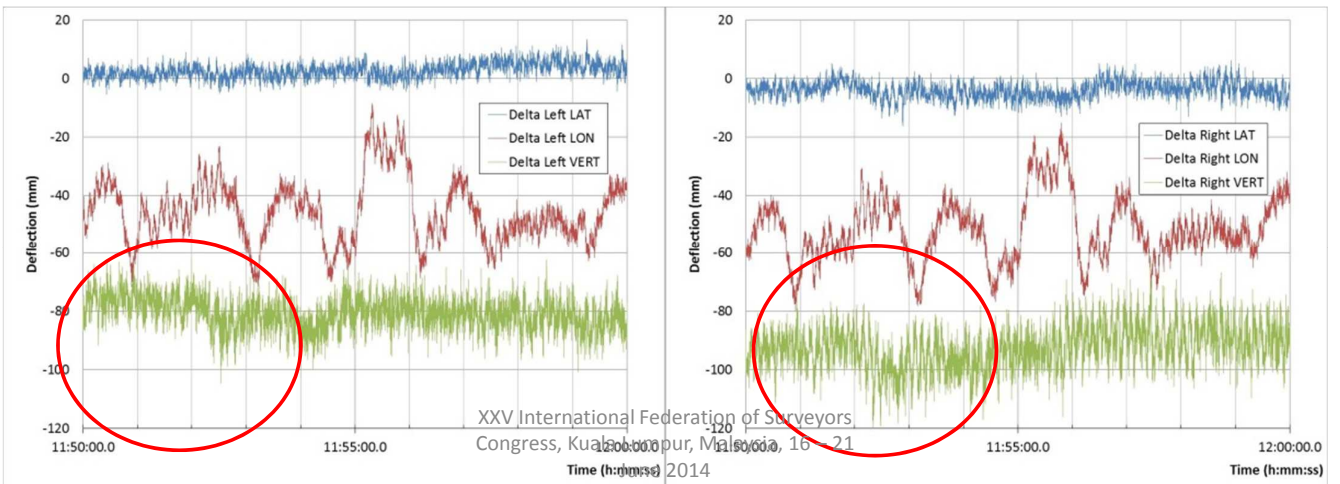
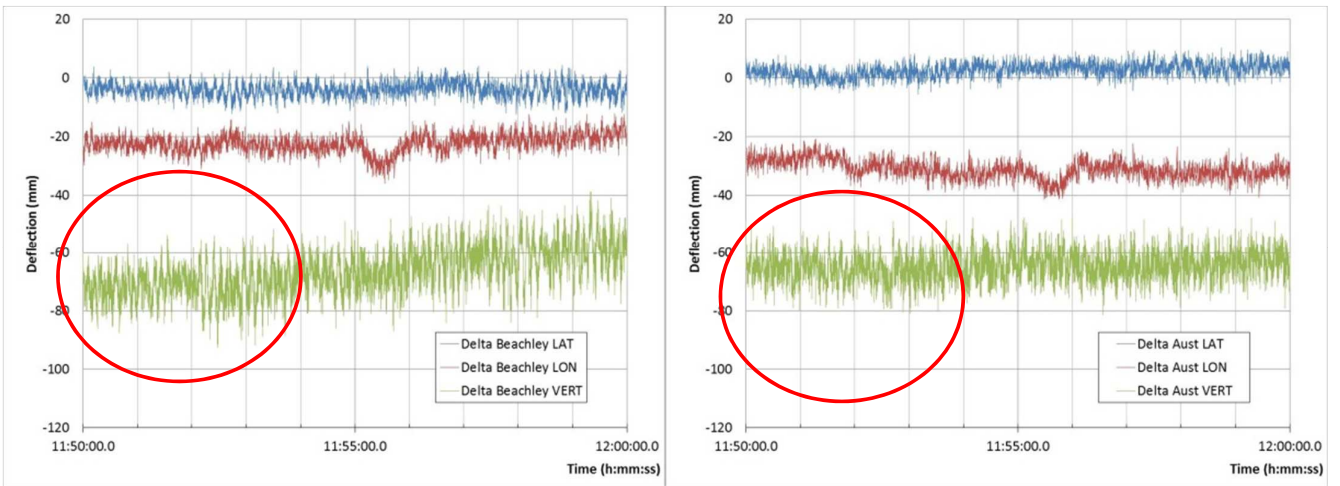
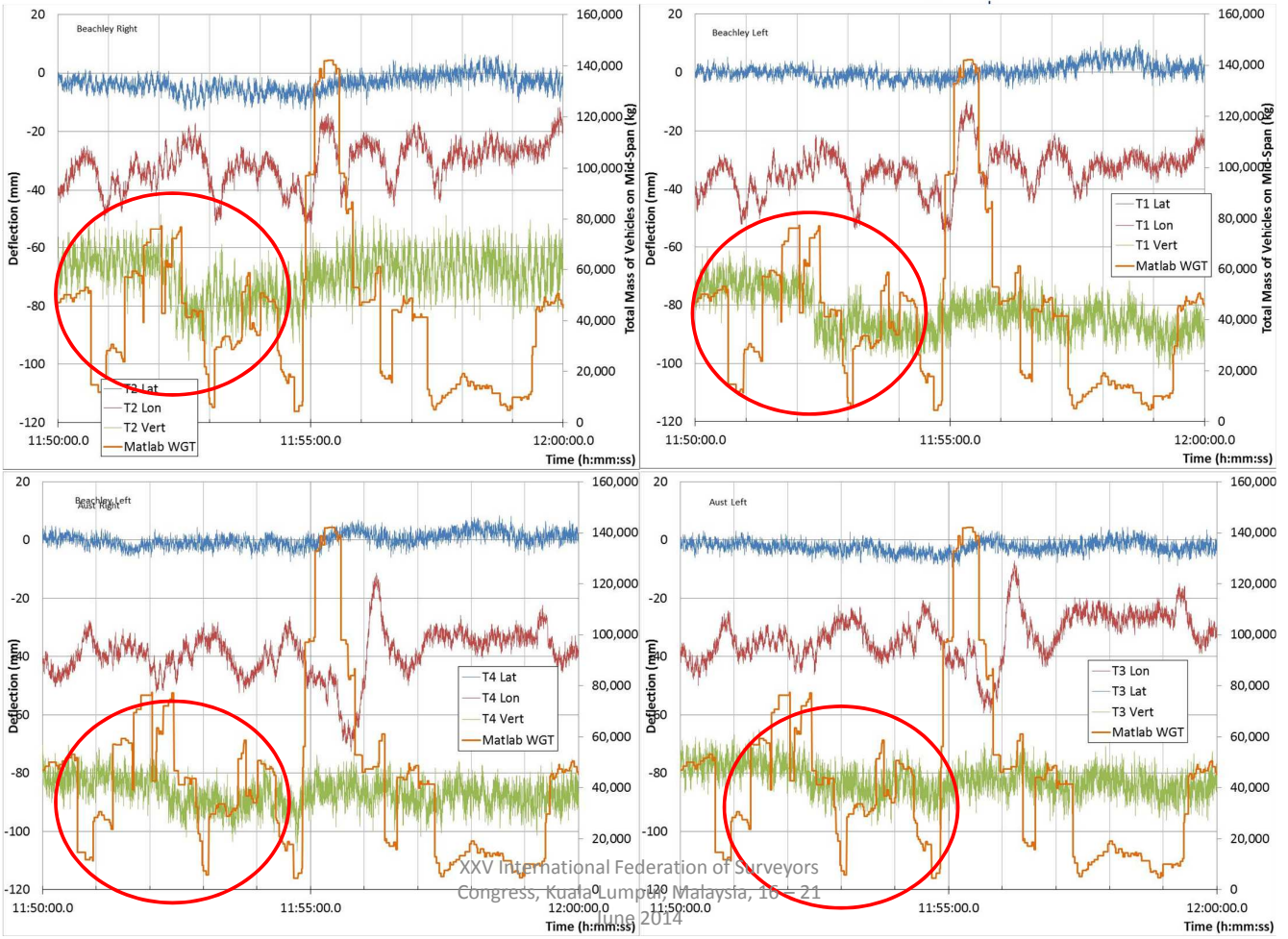




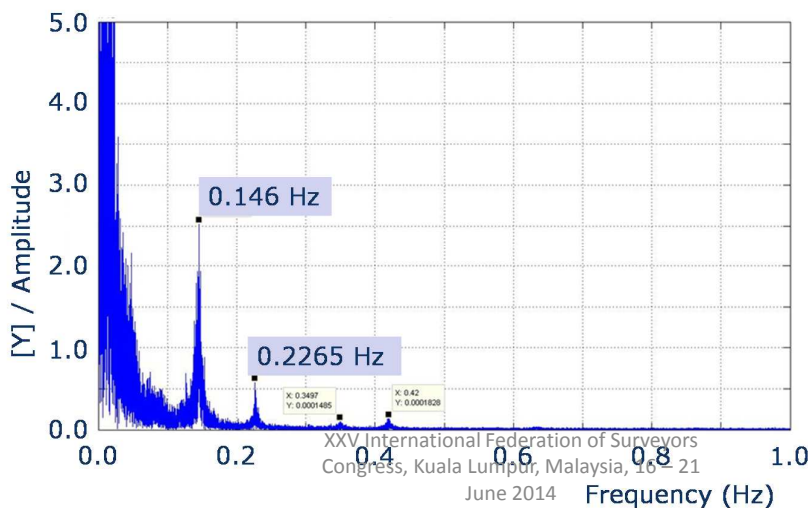
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- New frequency response approaches underway
- Overlapping theory from other subject areas



- Vast amount of data
- This dataset 4x24x60x60x9x10Hz or even 20Hz
- Over 31million 3D coordinates in 4 days
- Easily get swamped in data, can't see the wood for the trees
- Automation, changes, input into SHM
- Frequencies as well as movement changes
- Temperature, traffic and wind loading


Gethin in 1996,
Longest suspended span in
the world, 1.4km



XXV International Federation of Surveyors
Congress, Kuala Lumpur, Malaysia, 16 – 21
June 2014

Accelerated Building

- Bridges, 30/100 longest suspended spans in China, 27 built after 2000
- 10,000km (as of Dec 2012) high speed rail lines.
- 75/298 tallest buildings in China, 15 in Hong Kong.
- Ship and offshore structures, and deformations.
- Wind farms.
- Xihoumen Bridge, 2nd longest suspended span in the world – Zhoushan Island
- Approach can be developed for all.



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