The use of GNSS to measure the synchronized movements of the Severn Suspension Bride's 136m tall support towers and suspension cables.

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Outline of presentation

- The application of GPS to structural monitoring
- Principles and limitations
- Application in the context of the M48 Severn Bridge
- Results – in particular the support towers
- Next steps

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The application of GPS to structural monitoring

- Gives synchronised position at precise times
- Hence can monitor movement (displacement) and frequencies
- Advantages for remote locations, with a very well-defined non-ground based reference point (i.e. satellite geometry)

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The application of GPS to structural monitoring

- Previous work on Humber, Forth, Avonmouth, Millennium, Pusan

- Technique now widely published

Principles and limitations

- Can be used to transmit “real-time” to remote monitors
- Currently post-processed for our tests
- Needs to have local reference stations
- Equipment is not “cheap”

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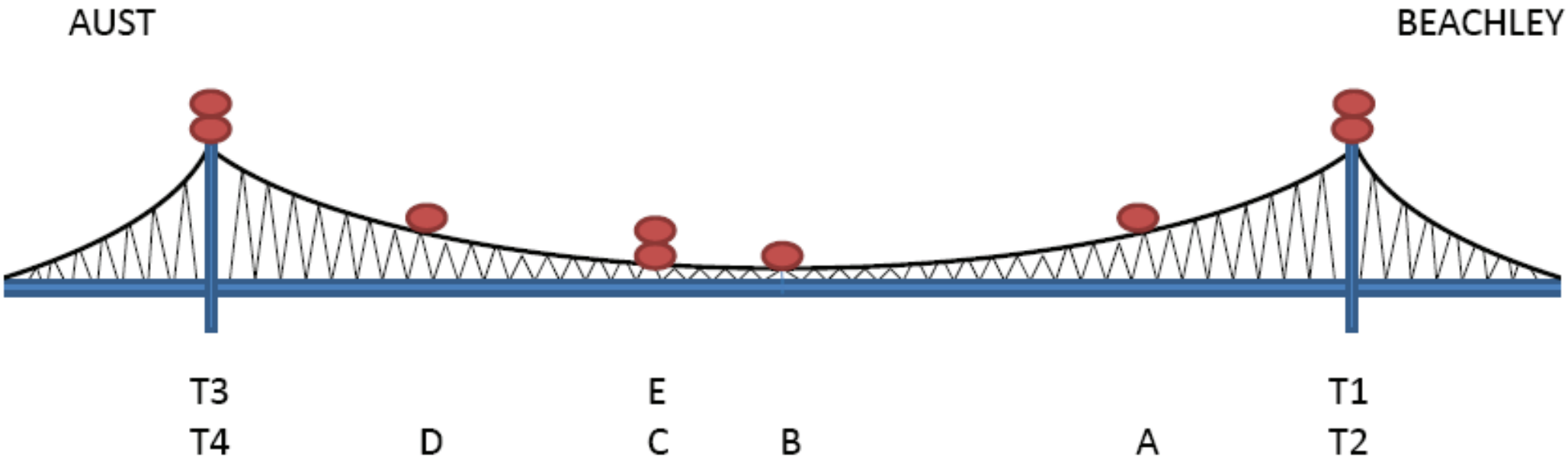
Application to M48 – Severn Bridge

- Precise 3D coordinates at 20Hz
- 5 locations on bridge and top of 4 towers – 9 locations total. 2 Reference Stations
- 9th – 12th March and 18th March
- Vast amount of data, Millions of data points

- Schematic of GPS Antenna Locations



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- Reference Stations

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- T2 Locations and Cable Antenna

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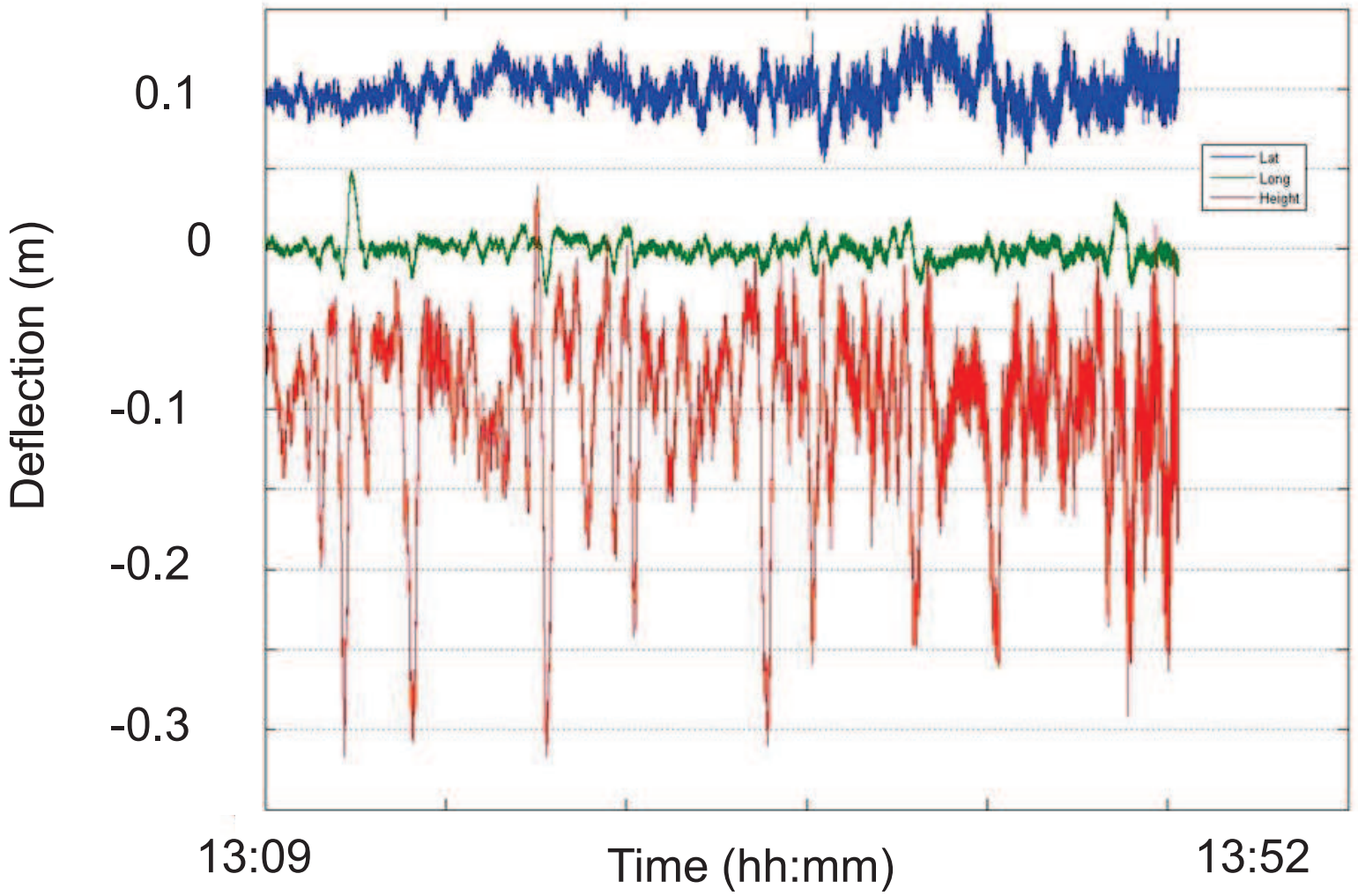
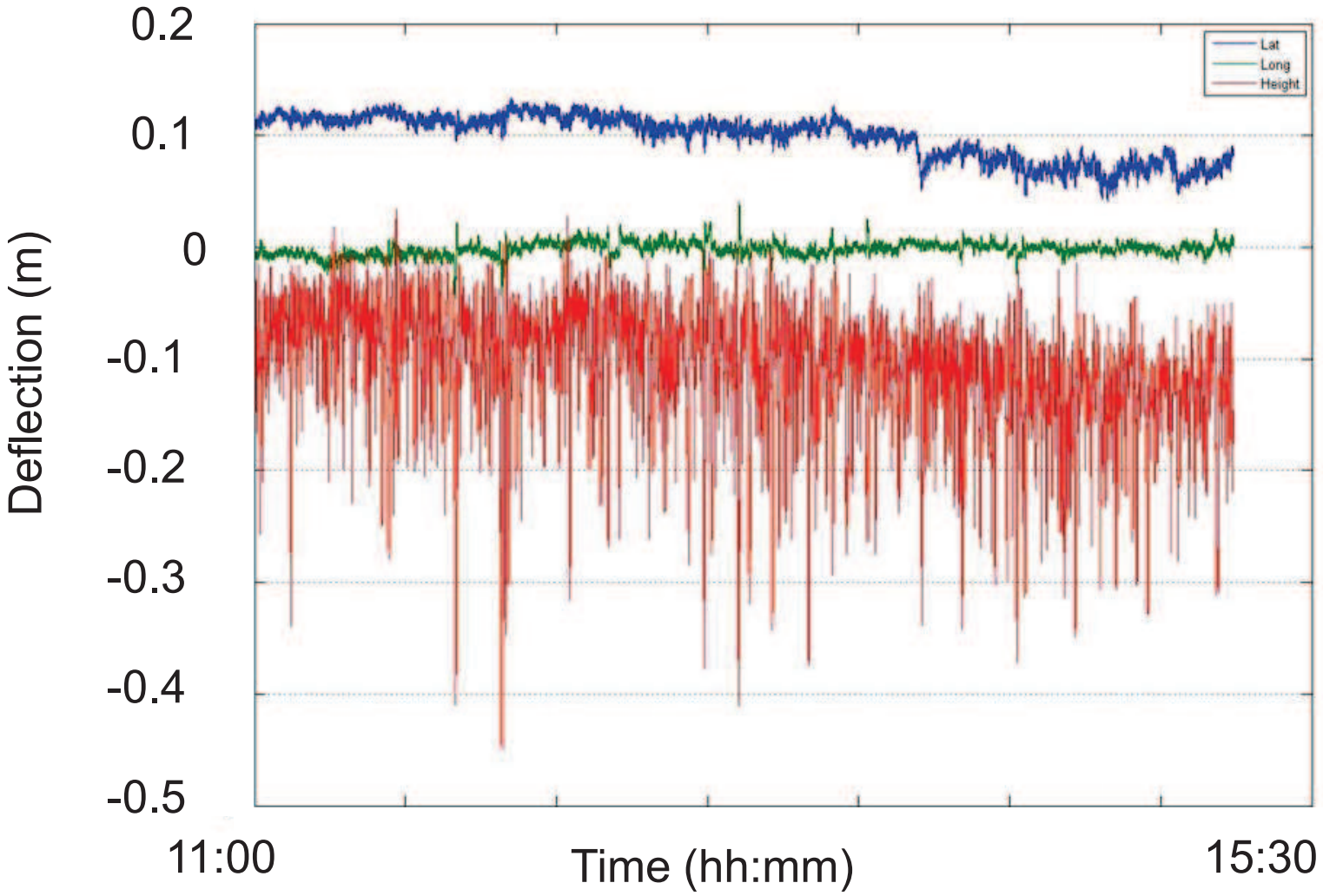
Results

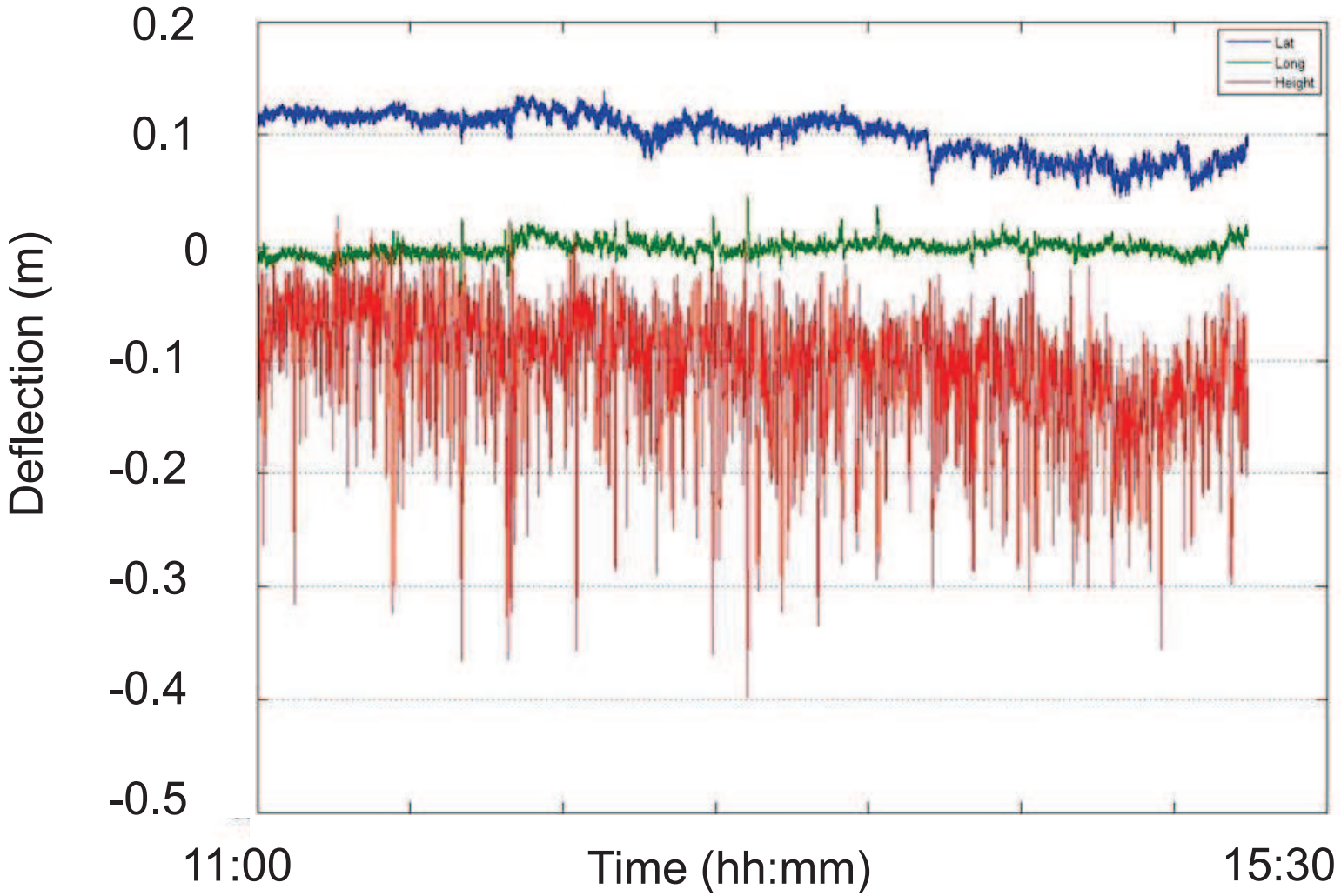
- Deflections at A 13:09:45 to 13:51:55



- Deflections at B 11:00:00 to 15:30:00



- Deflections at C 11:00:00 to 15:30:00



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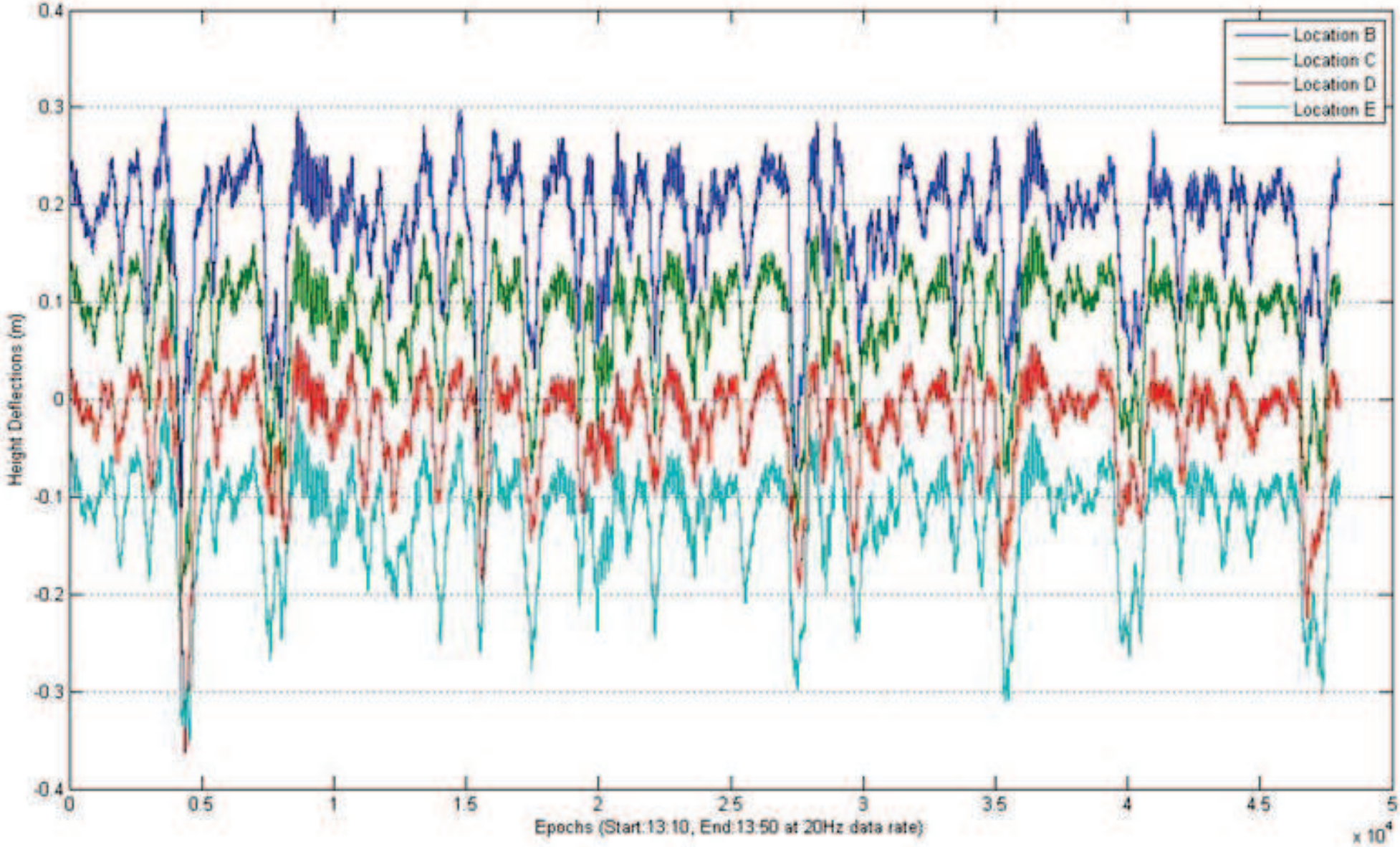
40 minute period



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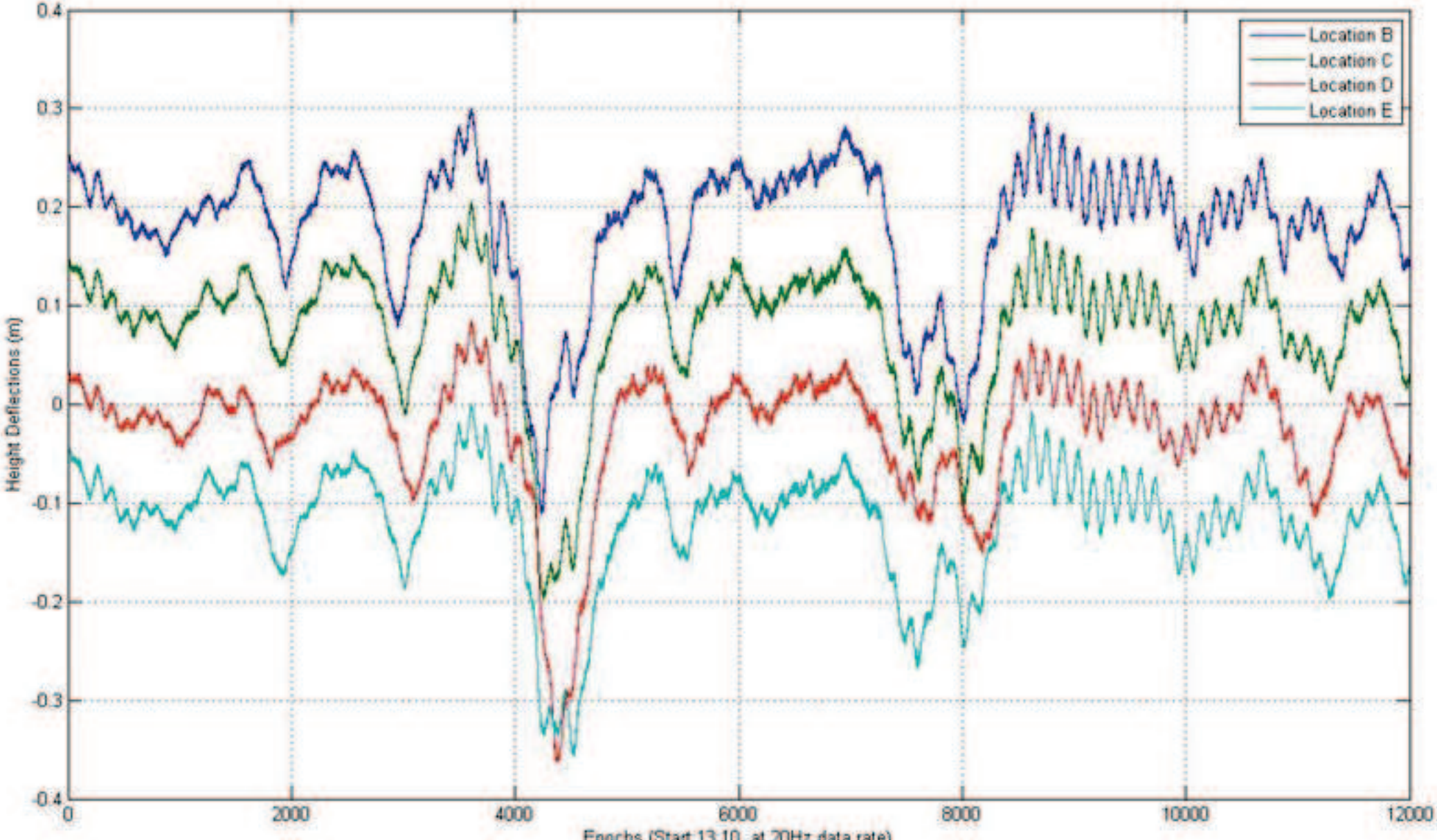
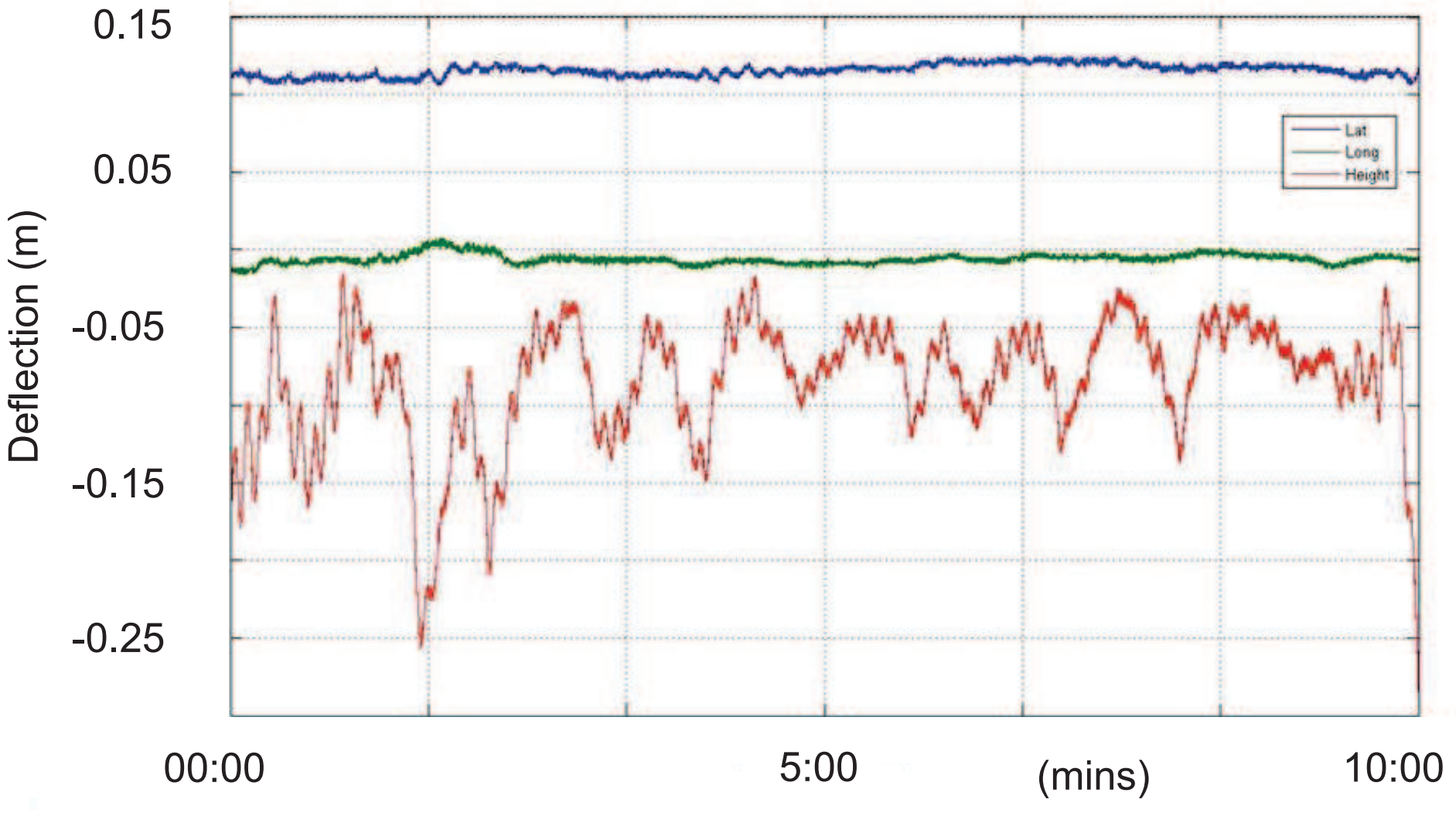
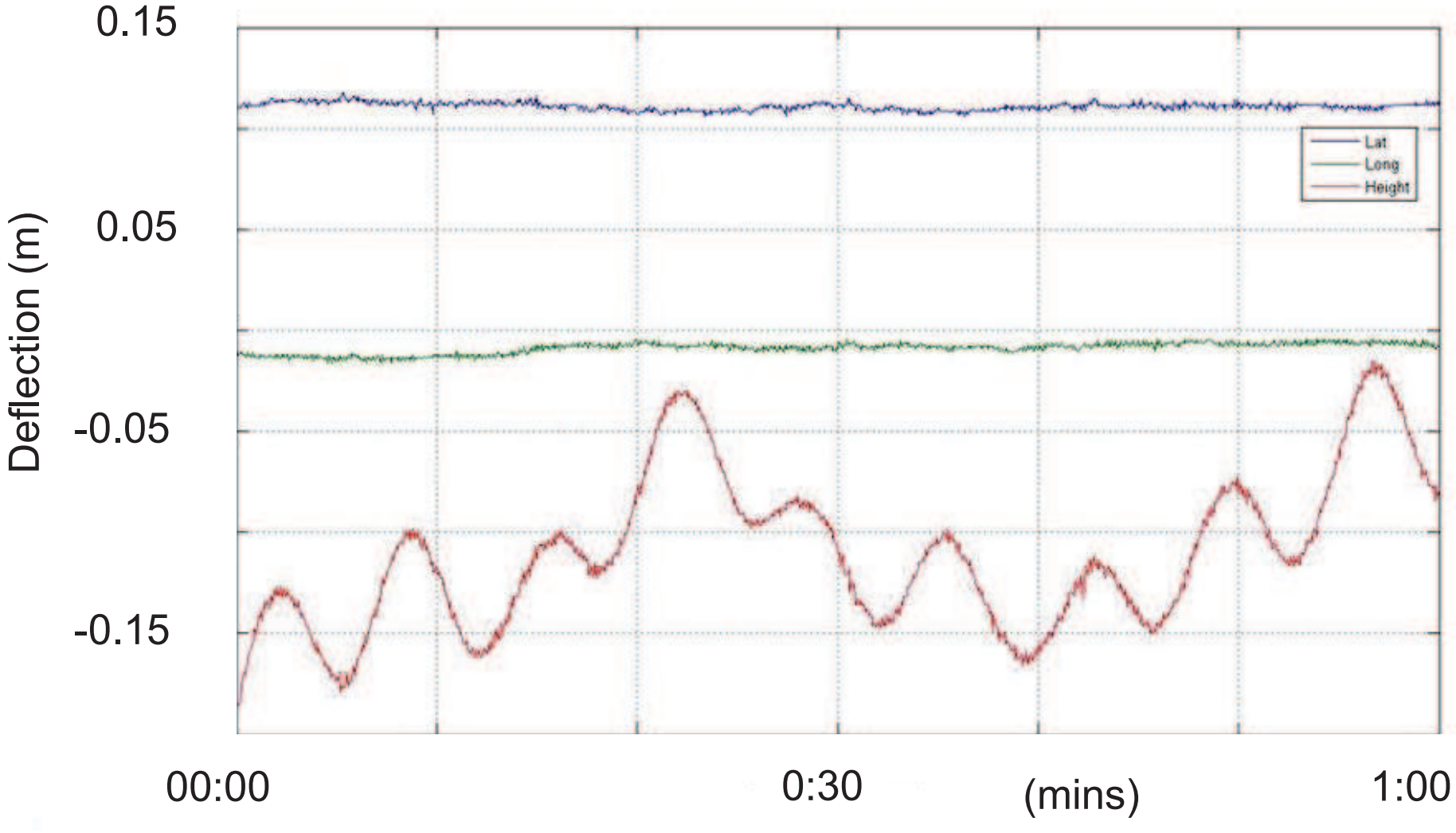
10 minute period



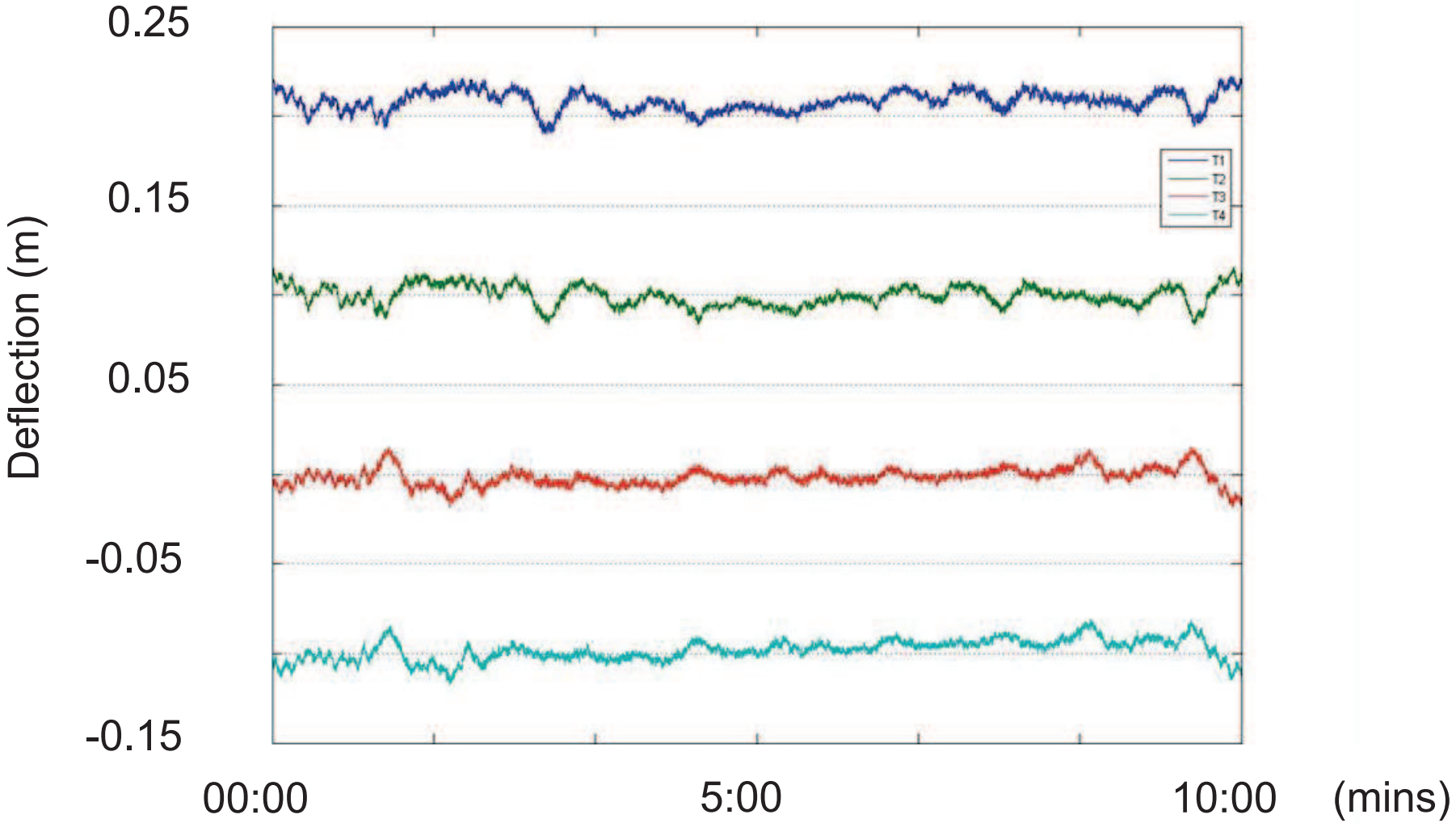
- Deflections at B 10 min period



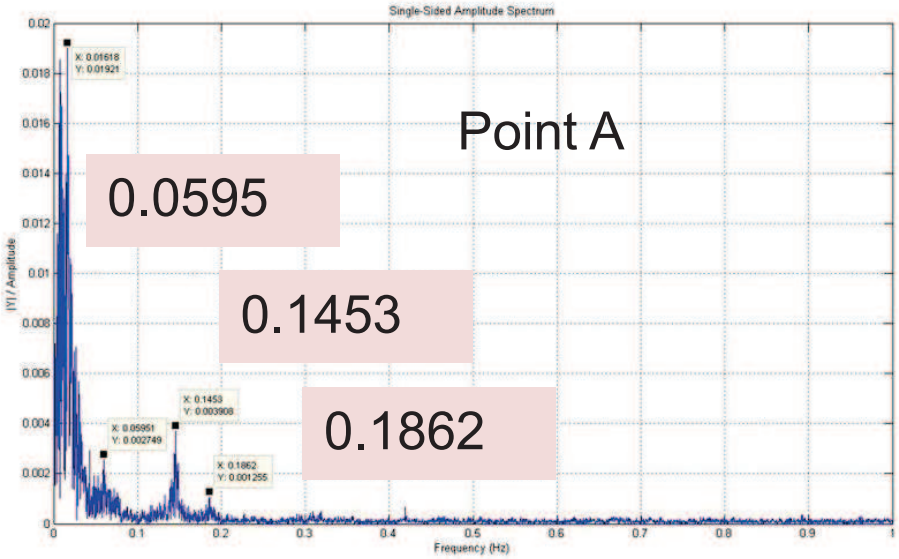
- Deflections at B 1 min period

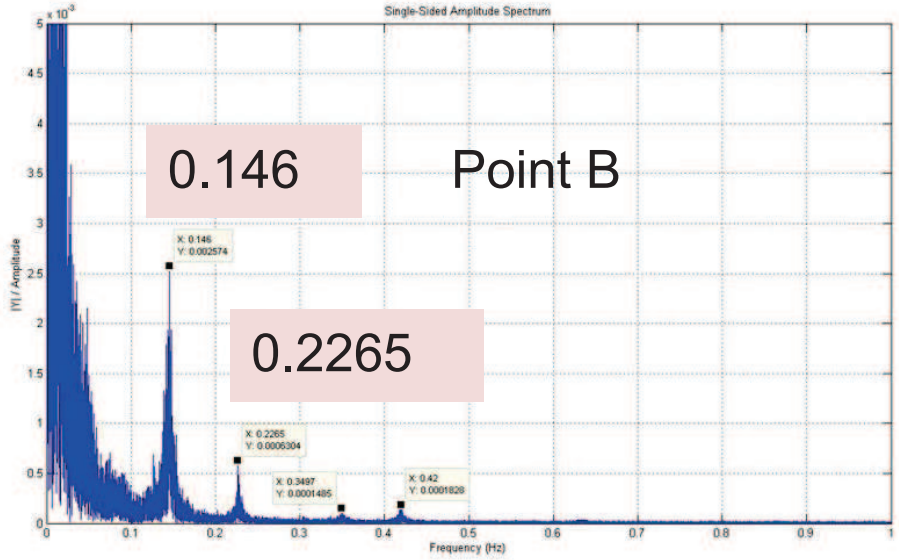


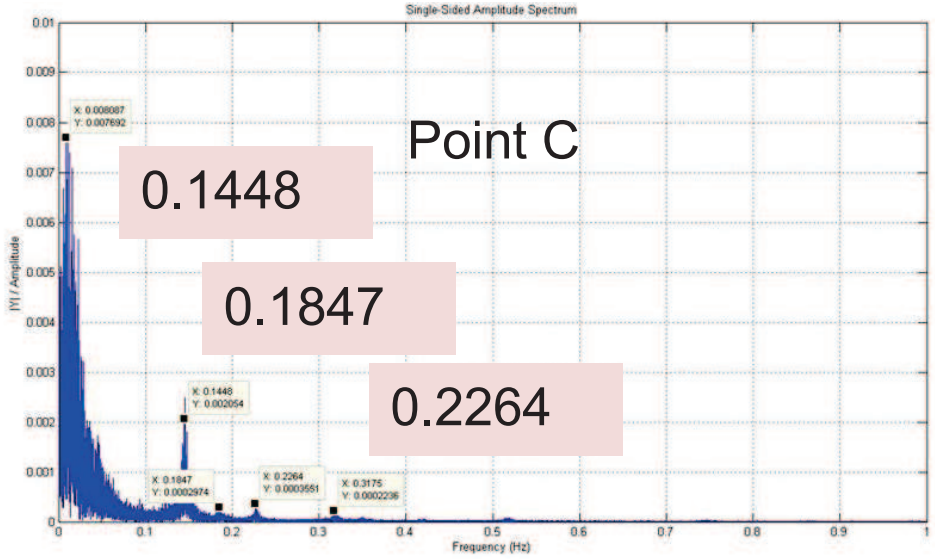
- Deflections at all Towers, longitudinal 10 min period

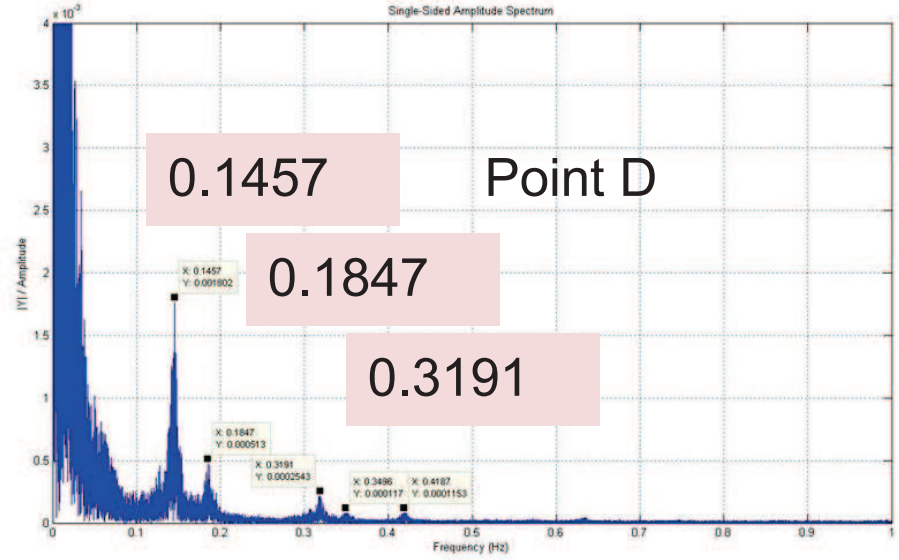


- Frequency response, vertical

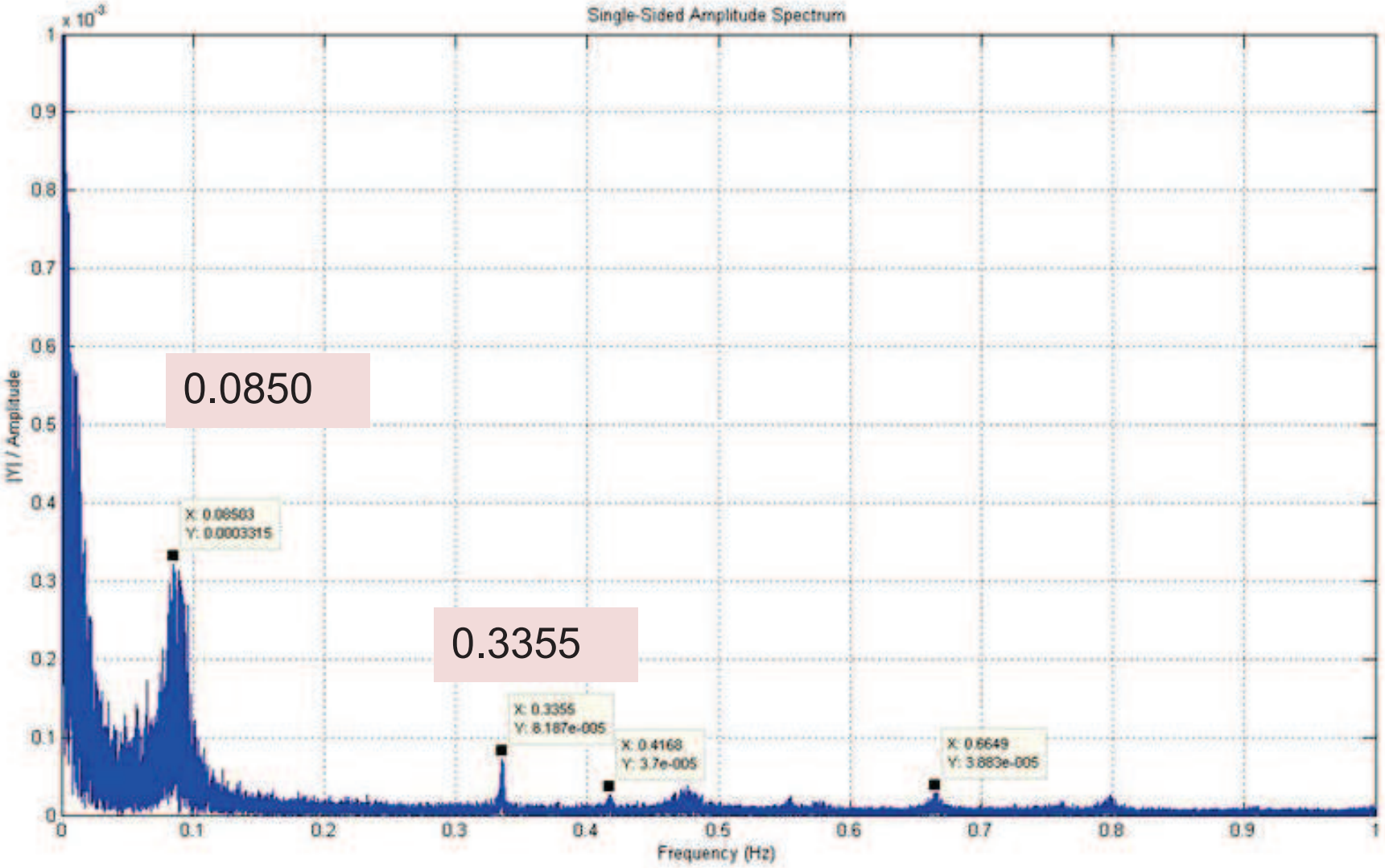




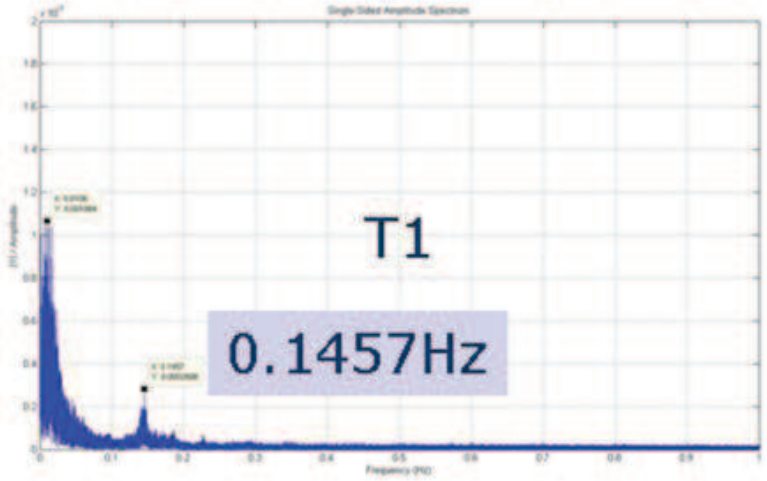


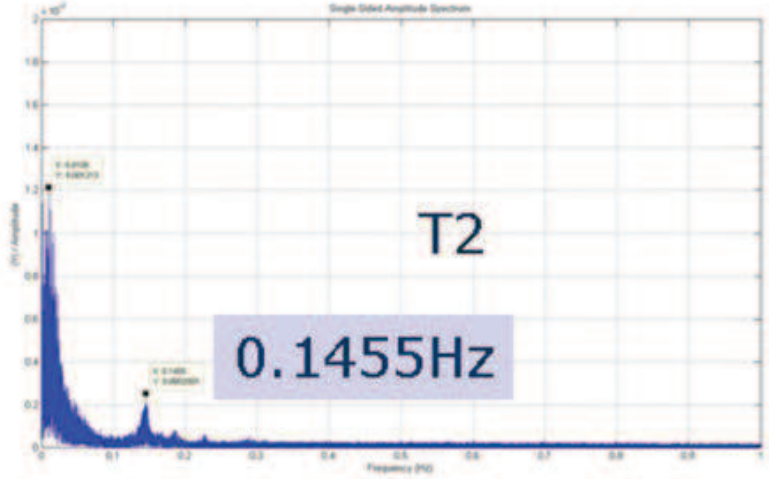


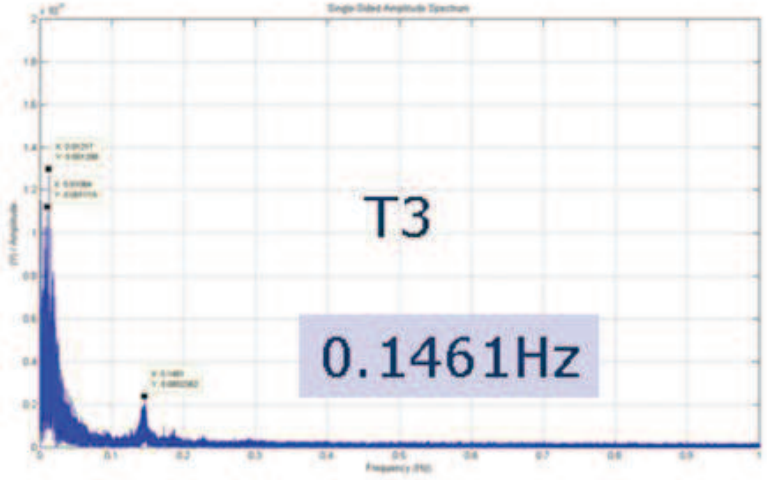
- Frequency response, lateral Point B

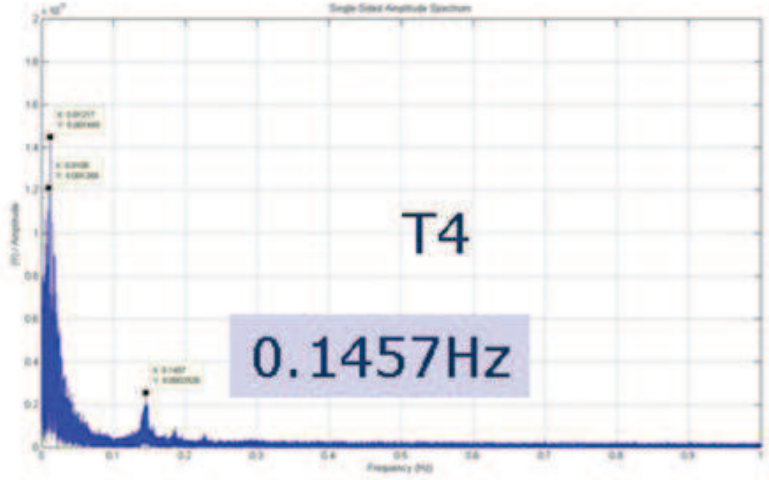


- Frequency response, Towers long









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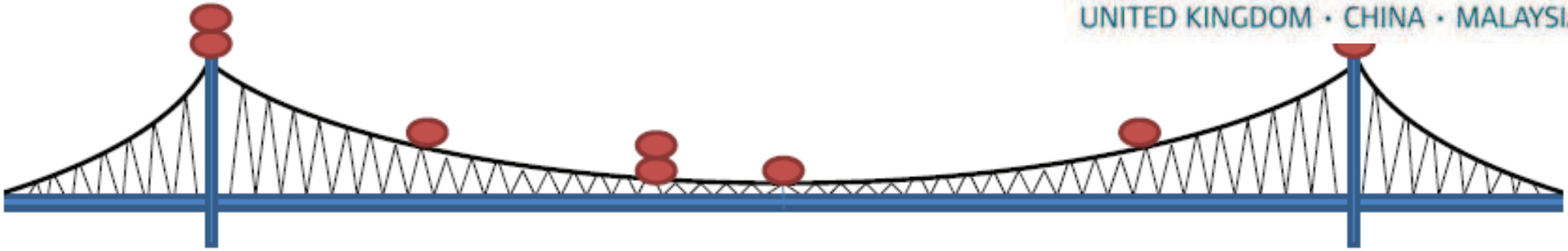

vertical longitudinal

Position	A	B	C	D	E	T1	T2	T3	T4
Freq	0.0595								
Hz	0.1453	0.146	0.1448	0.1457	0.1457	0.1457	0.1455	0.1461	0.1457
	0.1862		0.1847	0.1847					
		0.2265	0.2264		0.2264				

Conclusions

- Synchronisation of towers and deck/cables
- Use for future models and designs
- Long term monitoring required
- Network RTK


Thank you
Xie Xie