Oscillation Detection and Analysis

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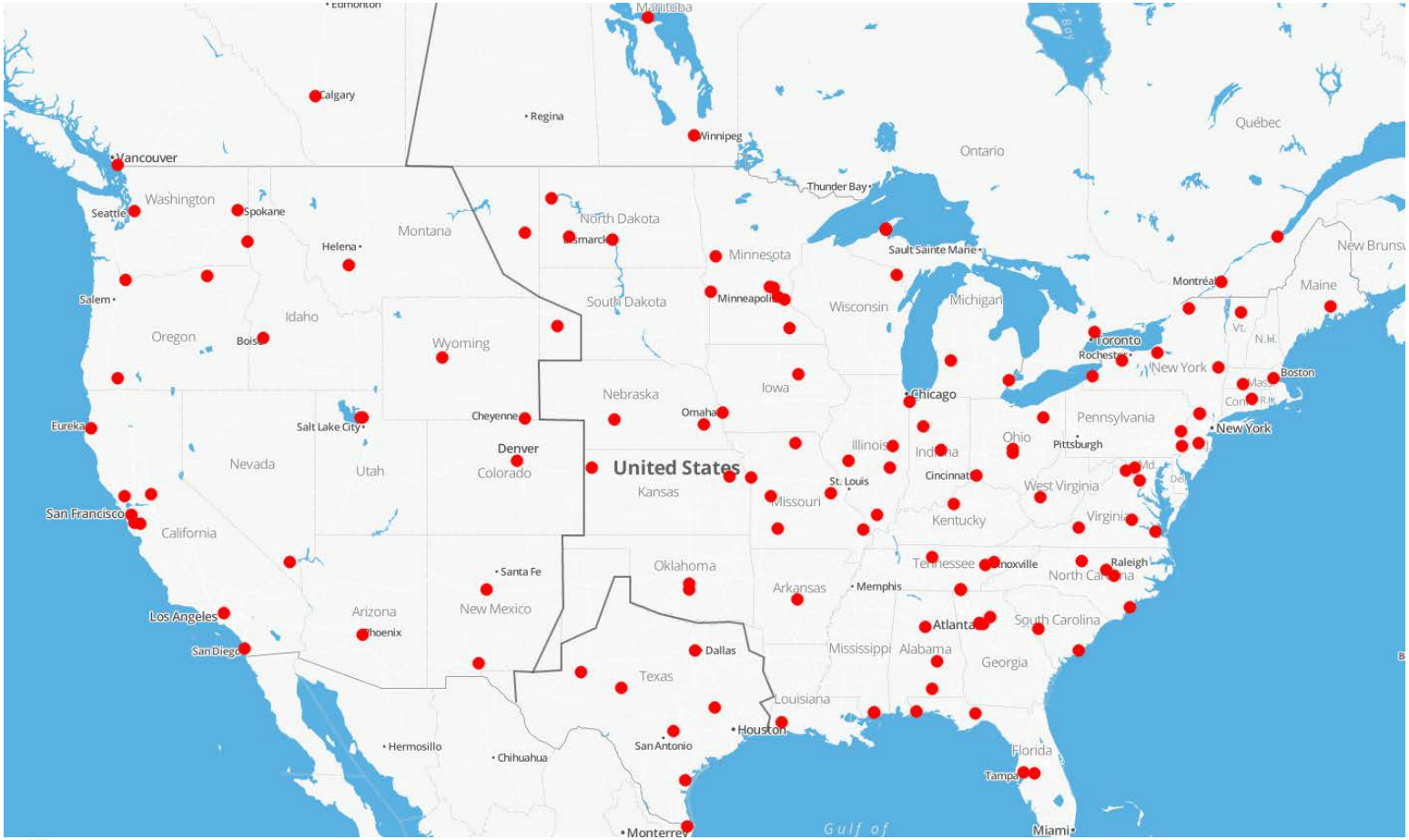
2015 NASPI Work Group Meeting

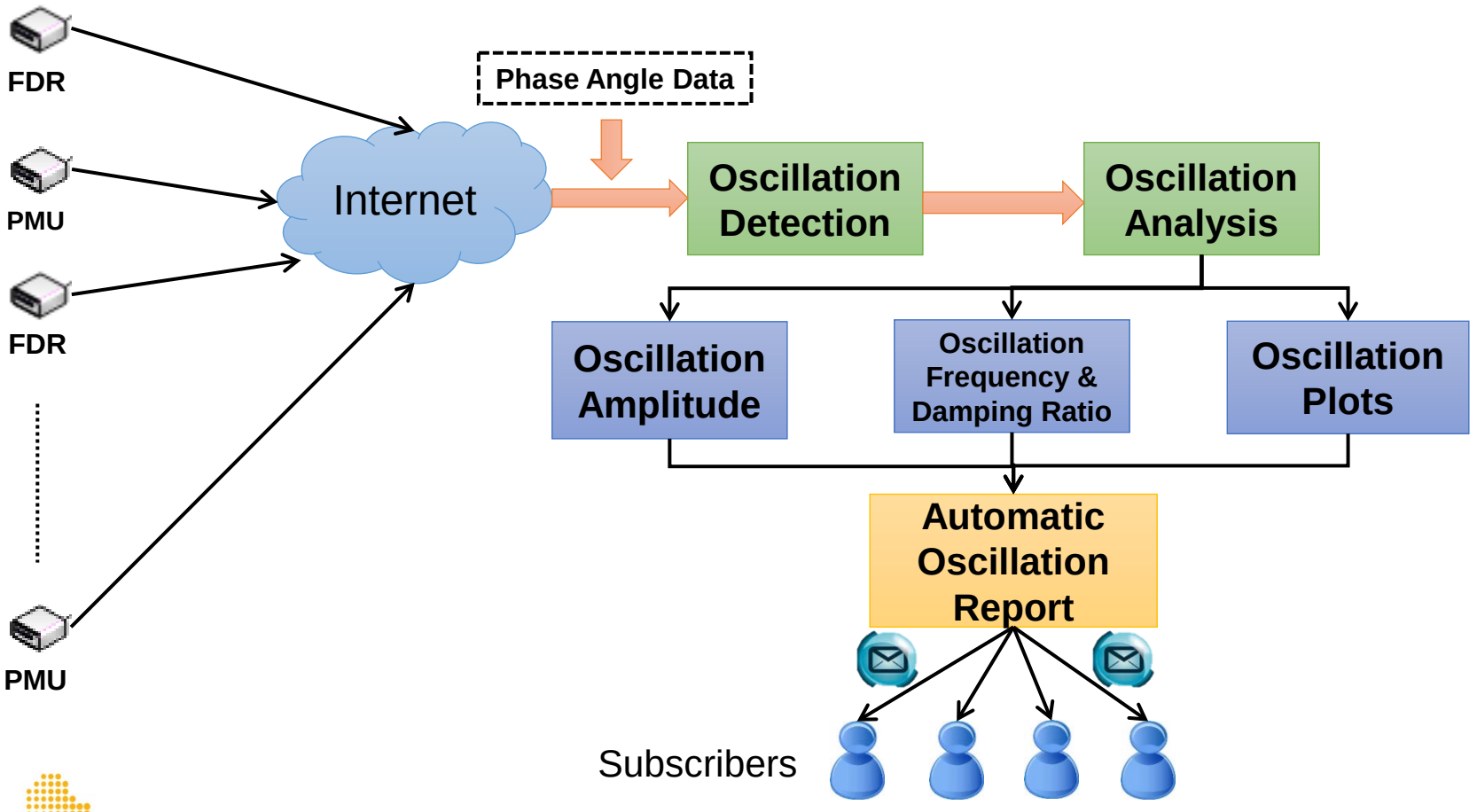
I. Introduction

- In power systems, changes in load, generation, topology, and control may initiate oscillations that could lead to instability if not well damped.
- Synchrophasor technology makes it possible to detect oscillations.
- **Visualization** provides operators with an intuitive understanding of what is happening.

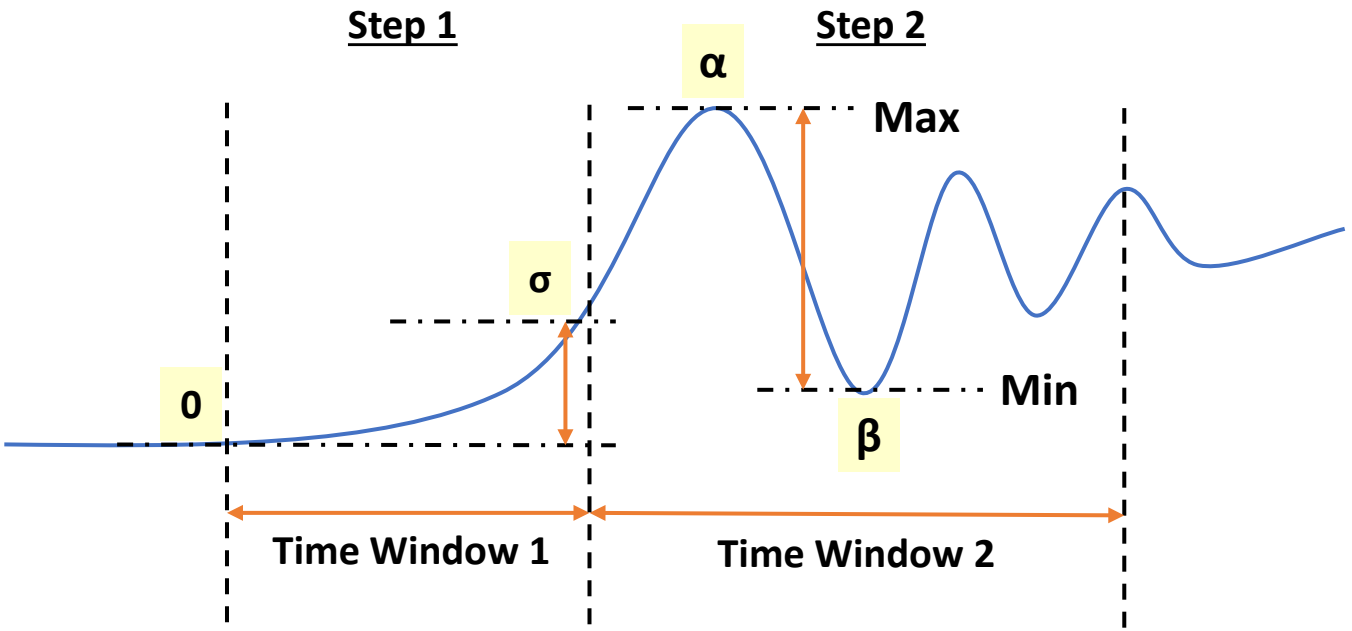
II. FNET/GridEye Overview



II. Application Architecture



II. Detection Algorithm

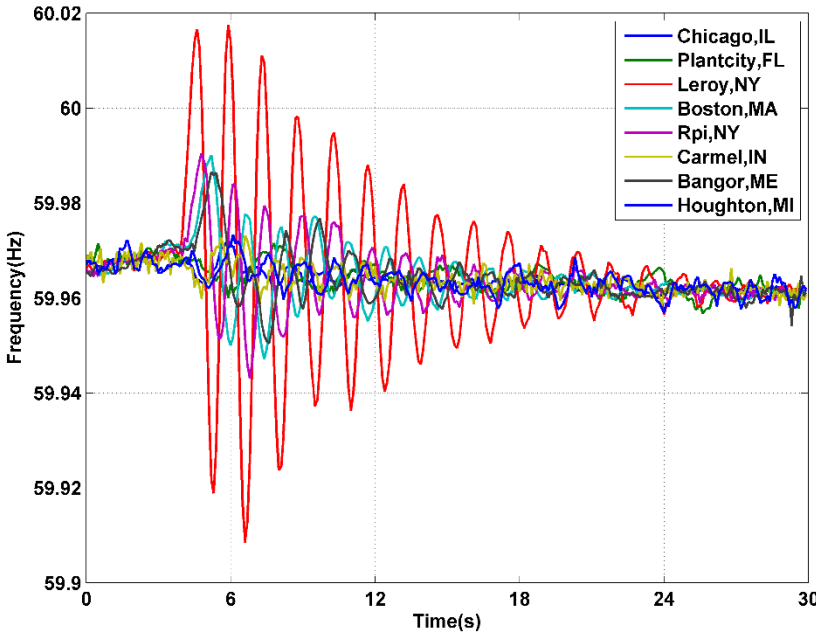


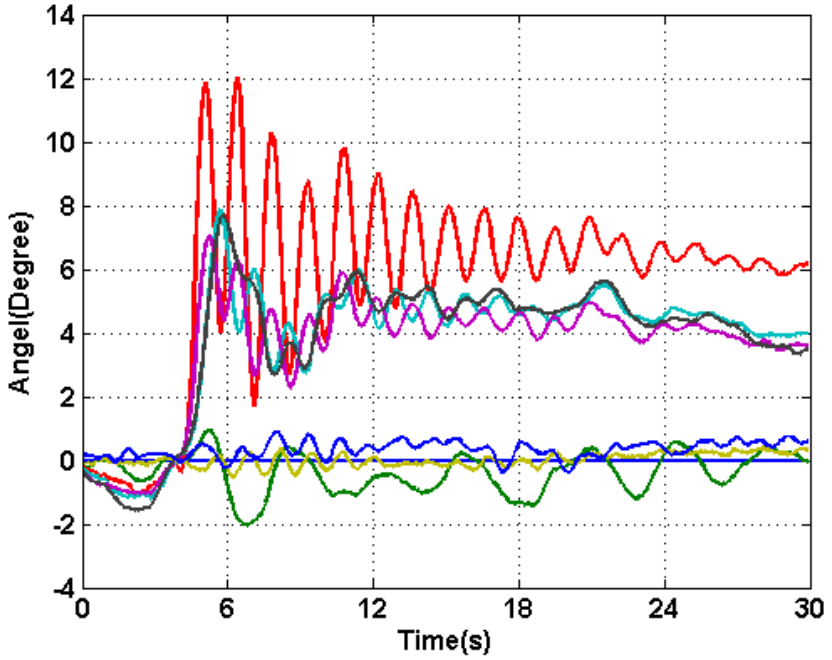
$|\sigma - 0| > \text{Threshold1}$

$|\alpha - \beta| > \text{Threshold2}$

III. Case Studies:

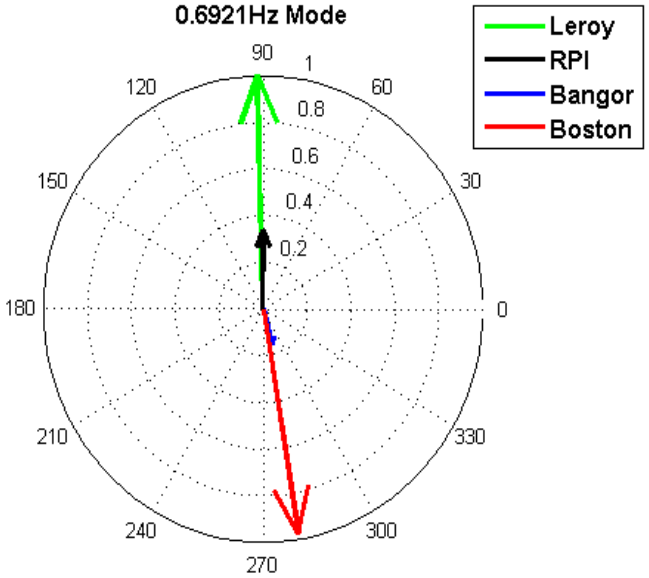
1. Oscillation caused by an incident in EI on 500kV network (03/14/2013 11:15:33 UTC)





III. Case Studies:

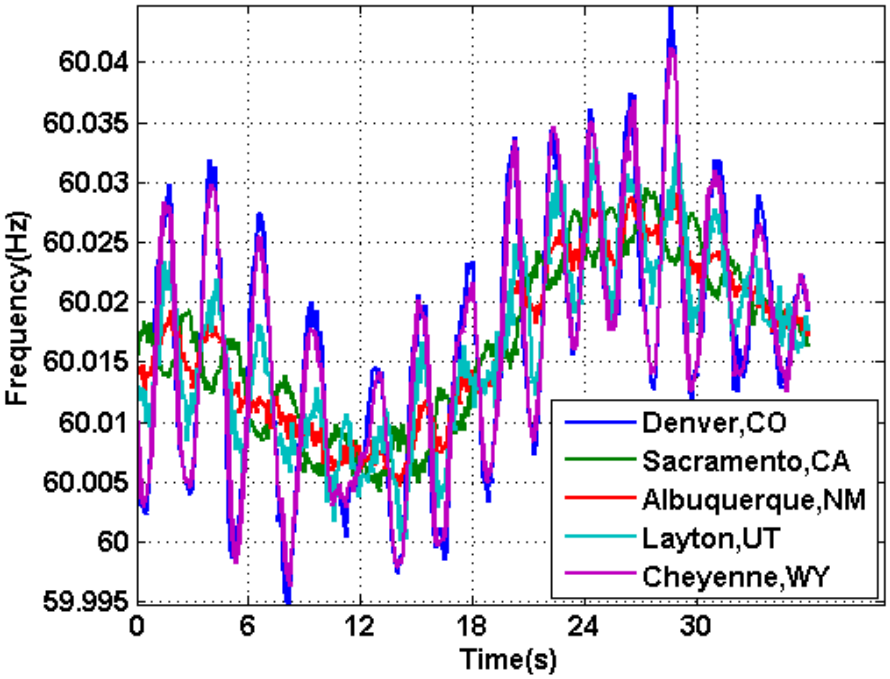
Modal Analysis Result

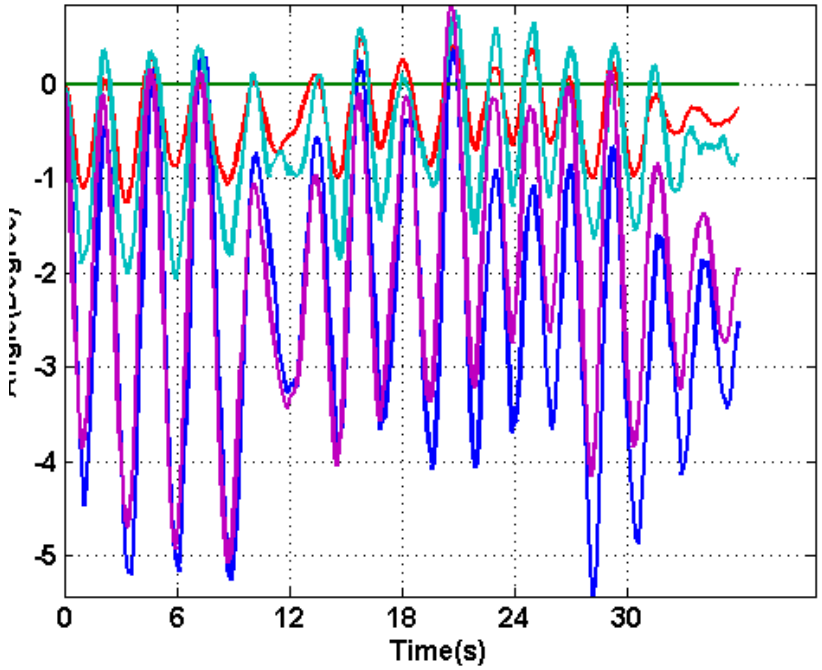


Modes(Hz)		Leroy	Boston
Dominate	Frequency(Hz)	0.6880	0.6983
	Damping Ratio(%)	3.2711	6.2937
Modes(Hz)		RPI	Bangor
Dominate	Frequency(Hz)	0.6910	0.6911
	Damping Ratio(%)	3.9281	3.5285

III. Case Studies:

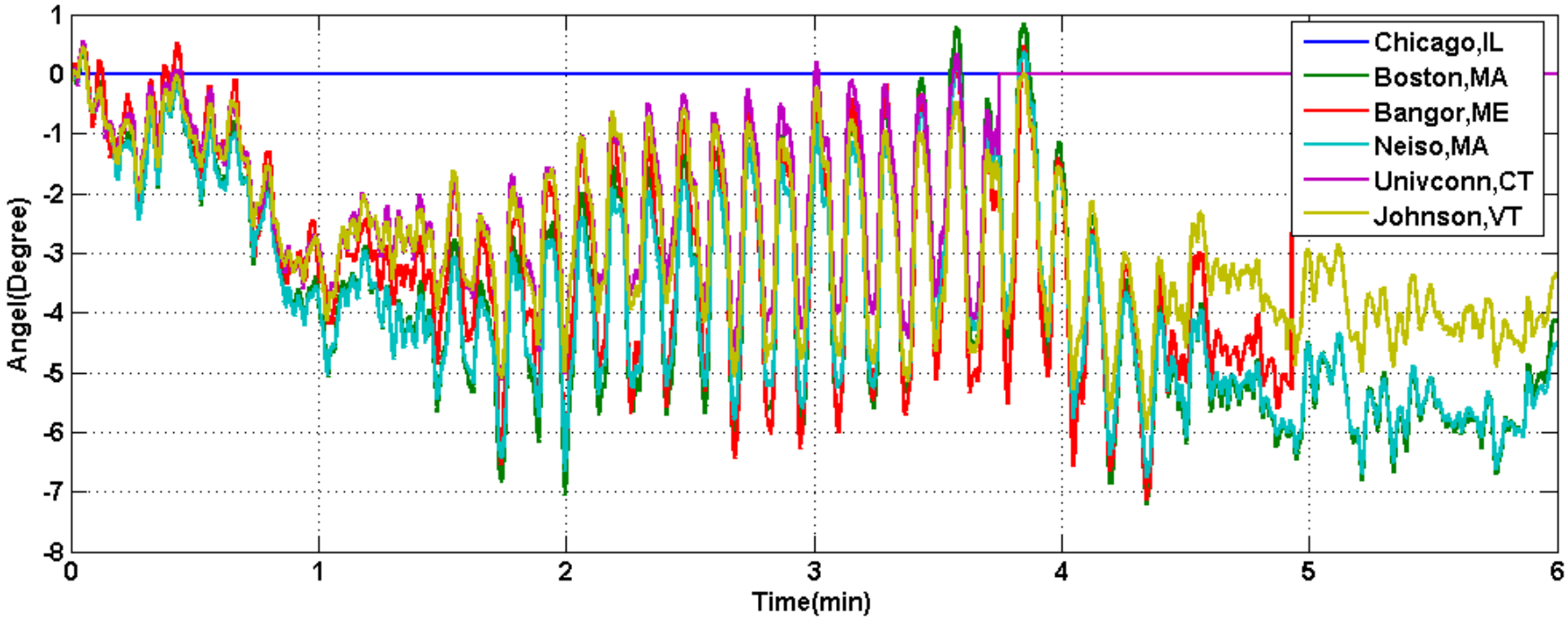
2. Oscillation case in WECC (06/30/2013 07:35:47 UTC)





III. Case Studies:

3. Oscillation case in EI (04/05/2013 23:31:01 UTC)



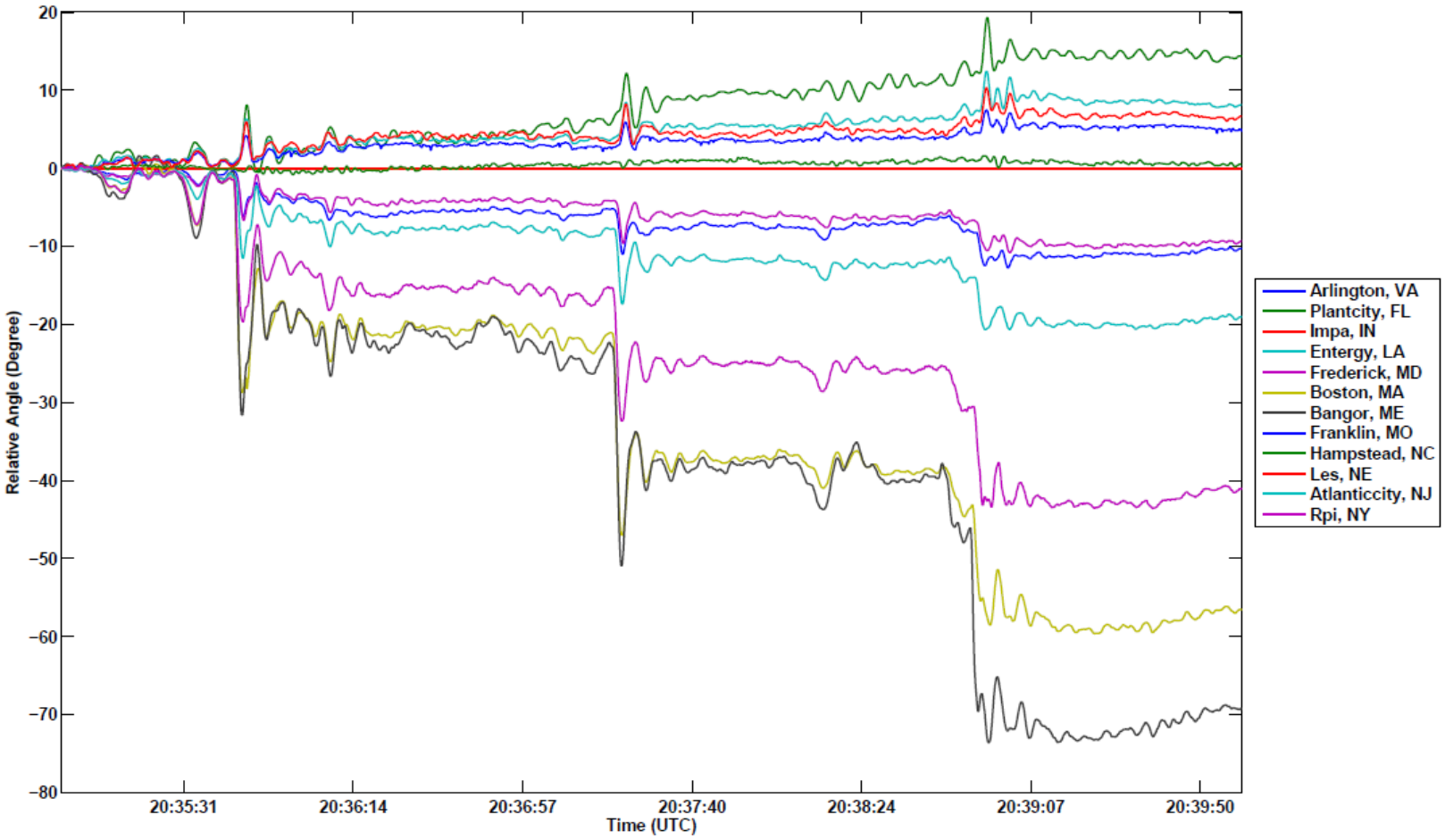
III. Case Studies:

4. Oscillation case occurred due to HVDC event (07/03/2013 20:33 UTC)

Sequence	Time(UTC)	Interconnections	Amount (MW)
1	20:35:44	Phase II, pole 1	1775
2	20:37:20	Phase II, pole 2	2775
3	20:38:51	Madawaska	280
4	20:38:51	Eel River	100
5	20:36:05	Outaouais	500
6	20:39:08	Chateauguay	700
7	20:39:13	Highgate	200

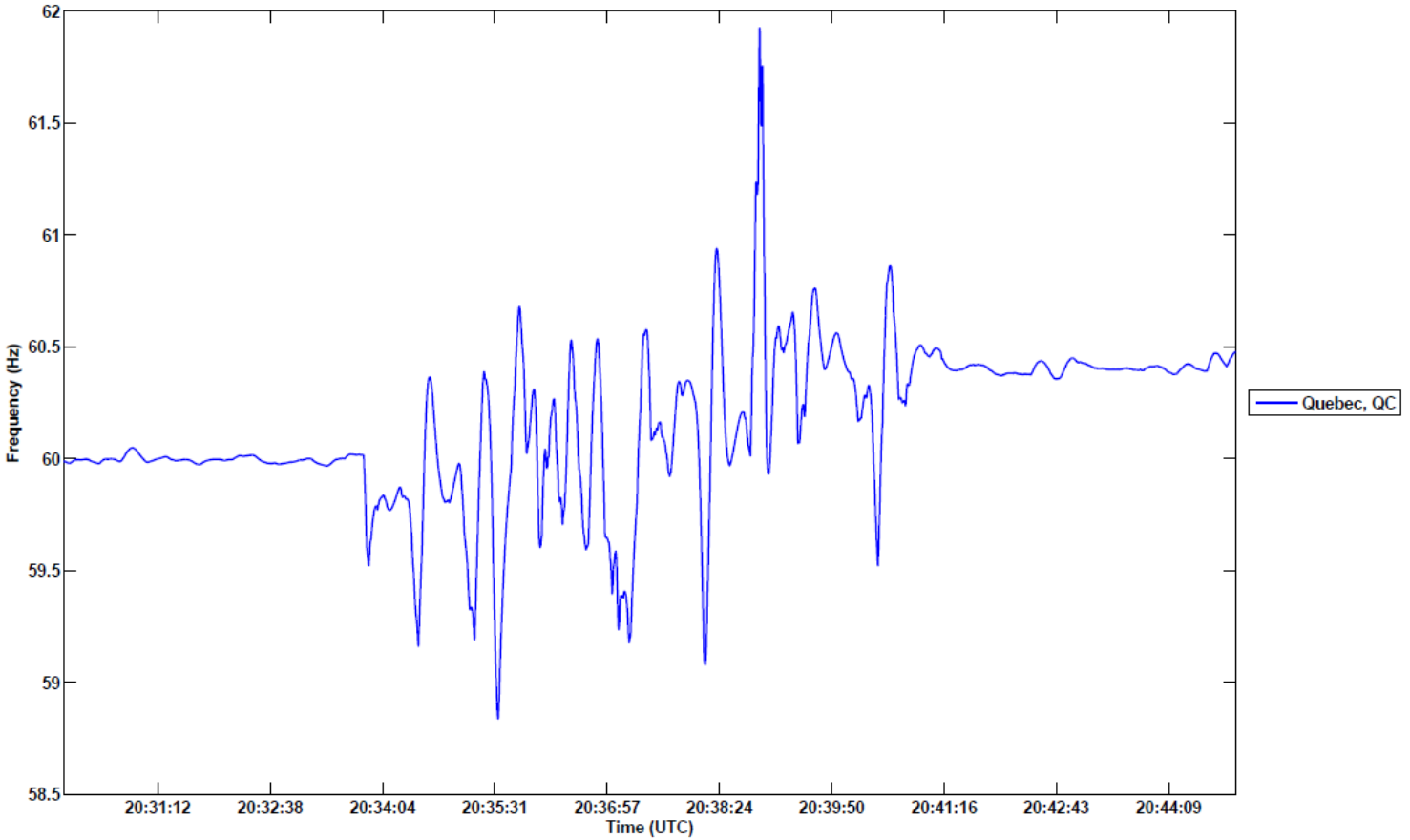
III. Case Studies:

Relative phase angle in EI

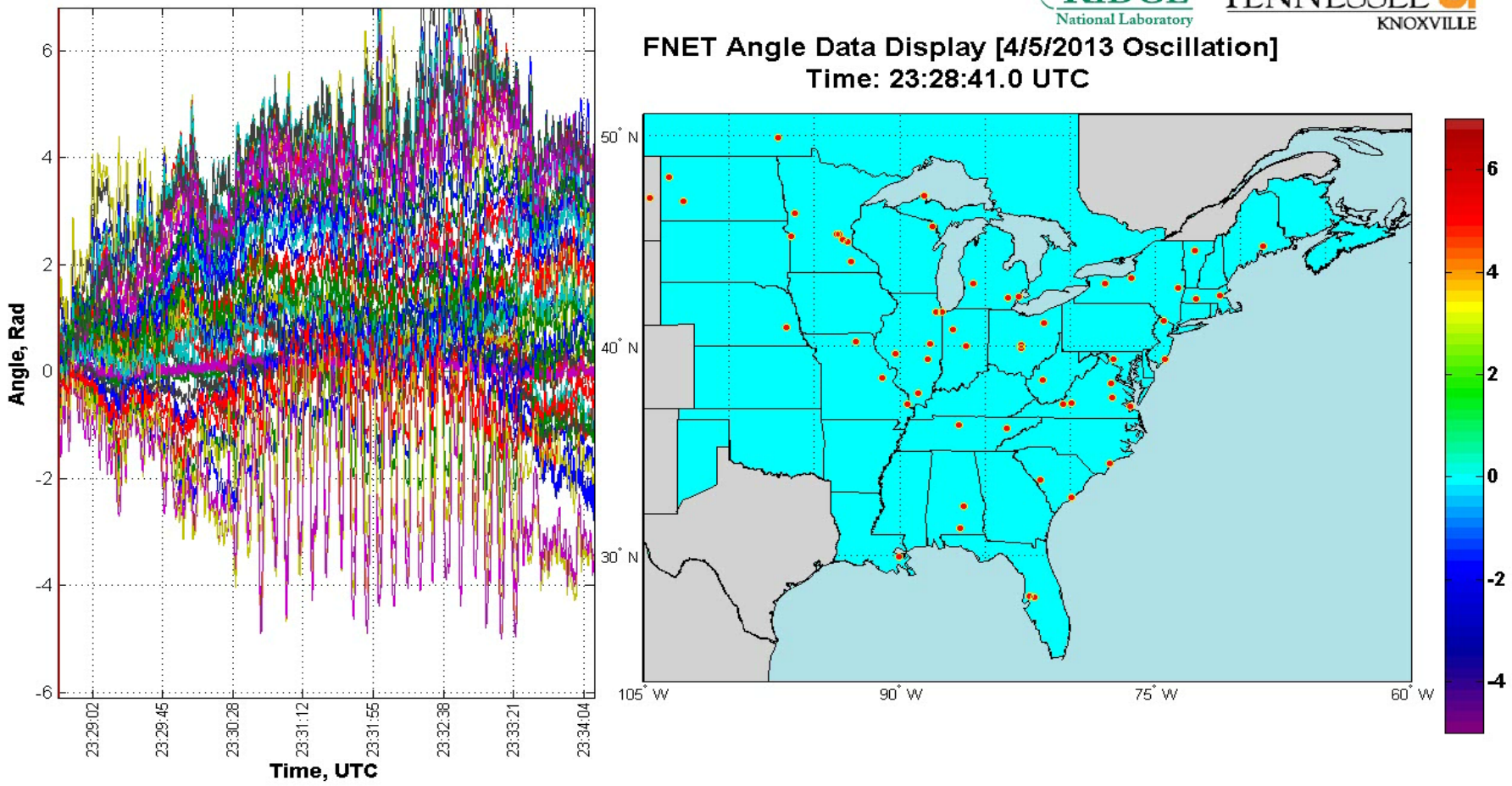


III. Case Studies:

Frequency excursion in Quebec Interconnection



IV. Movie Playback



V. Conclusion

- Visualization of synchrophasors provide insight into power system phenomenon not available through traditional SCADA measuements.