

Yi Zhao¹, Khaled Mohammed Alshuaibi¹, Xinlan Jia¹, Chengwen Zhang¹, Yilu Liu^{1,2}, Deepak Ramasubramanian³, Evangelos Farantatos³, Lin Zhu³

¹ The University of Tennessee, Knoxville

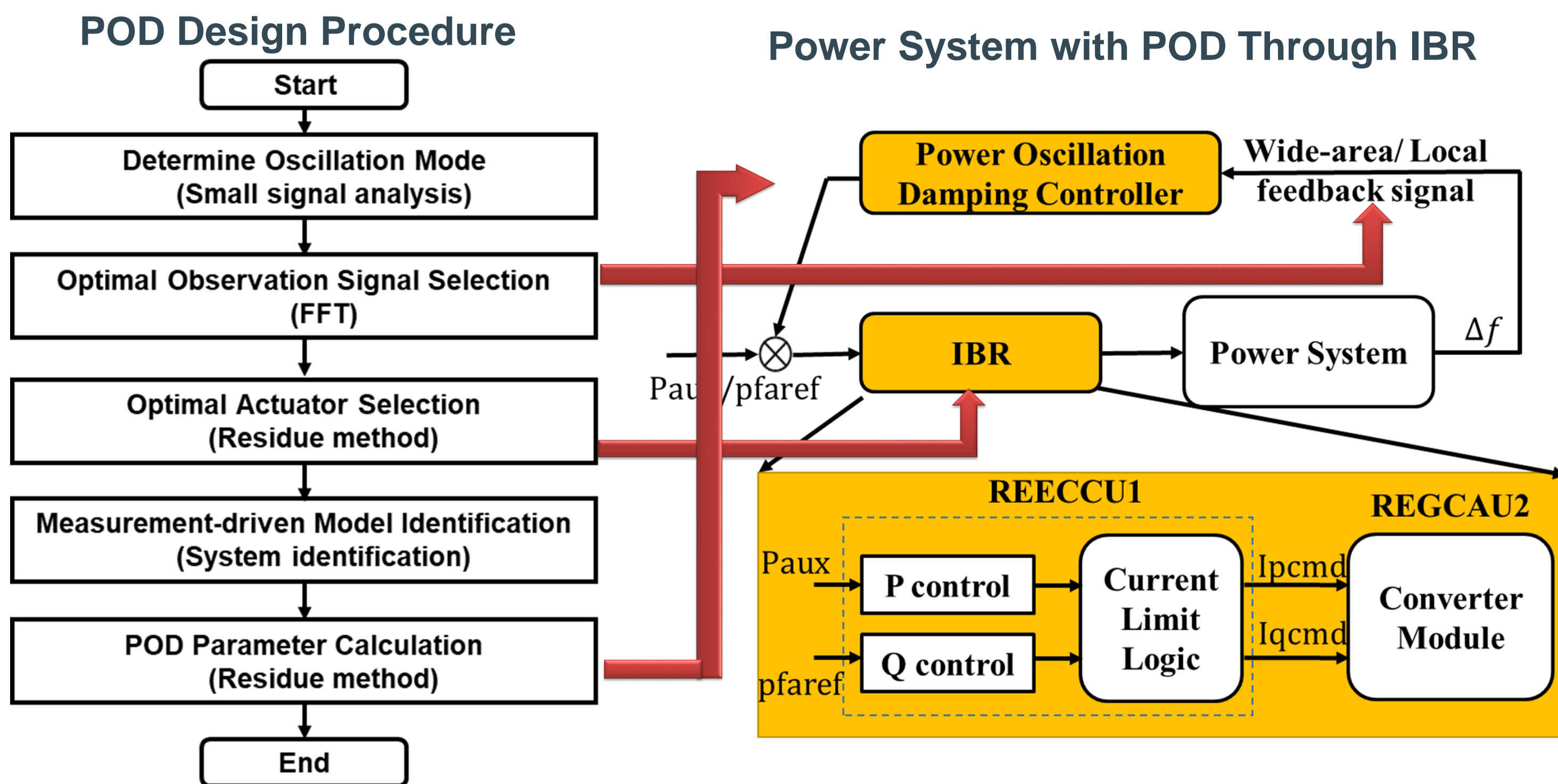
² Oak Ridge National Laboratory

³ Electric Power Research Institute

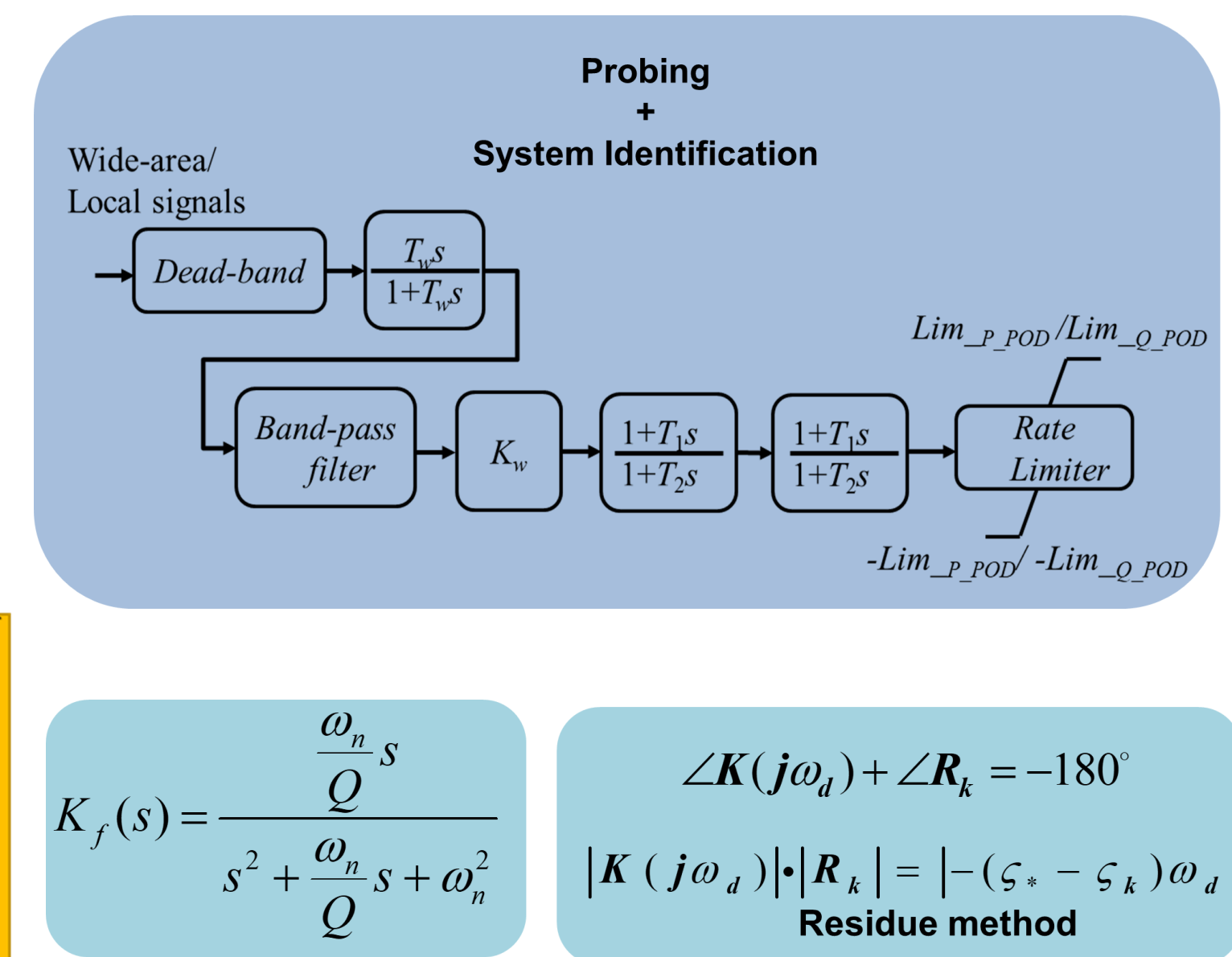
INTRODUCTION

- The retirement of conventional synchronous generators and the increasing penetration of inverter-based resources (IBRs) can potentially lead to insufficient stabilizing capability available from the remaining conventional synchronous generators.
- The control performance of Power Oscillation Damping (POD) through IBRs with either wide-area measurements or local measurements as an input signal is investigated to suppress both local and inter-area low-frequency oscillations (LFOs).
- Synthetic Texas power system model is used to demonstrate that the proposed POD through active power modulation of IBRs is more effective than POD through reactive power modulation of IBRs and wide-area POD via synchronous generators.

POD DESIGN of IBRS

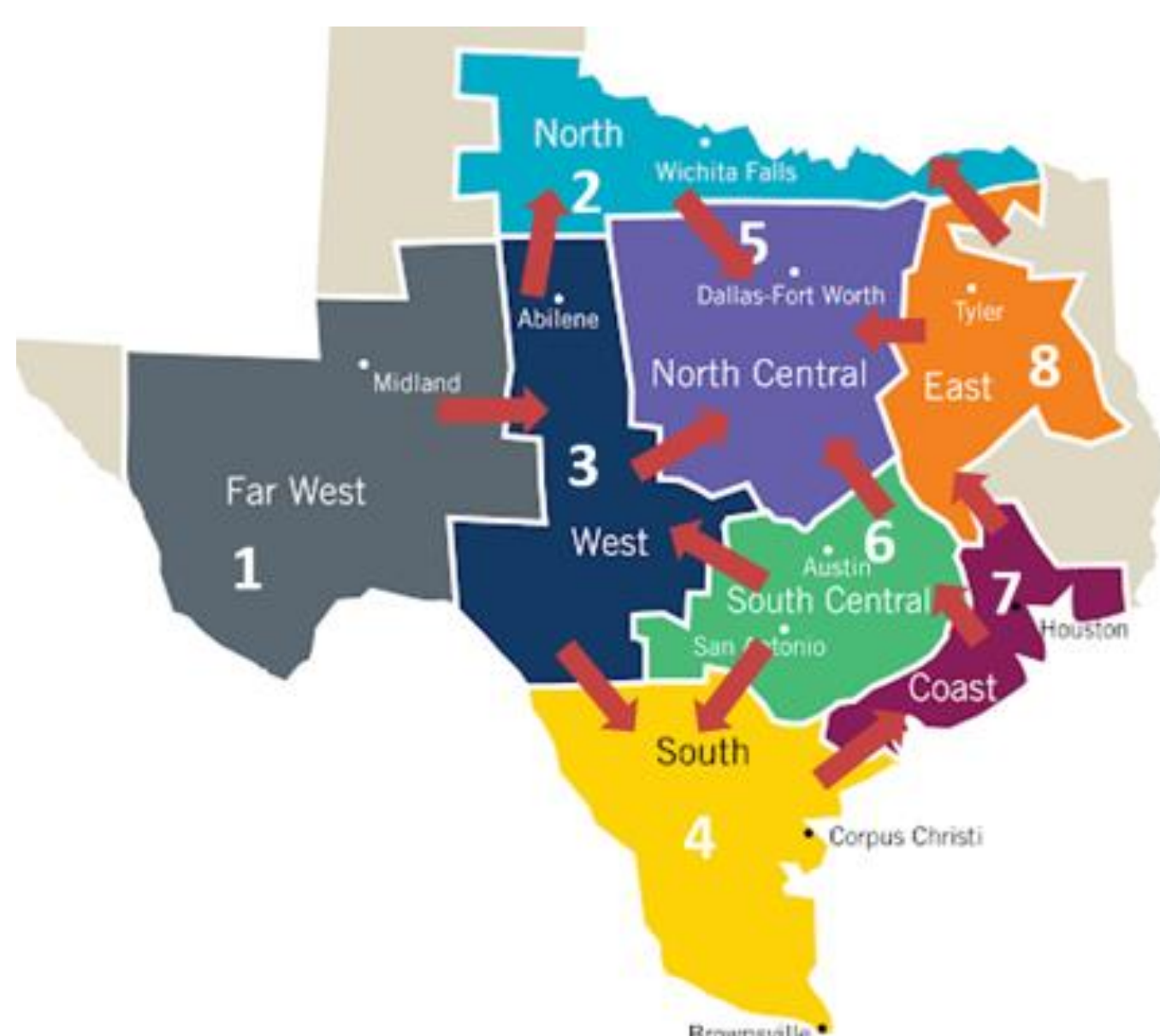


POD structure at IBRs



STUDY CASE: TEXAS POWER GRID

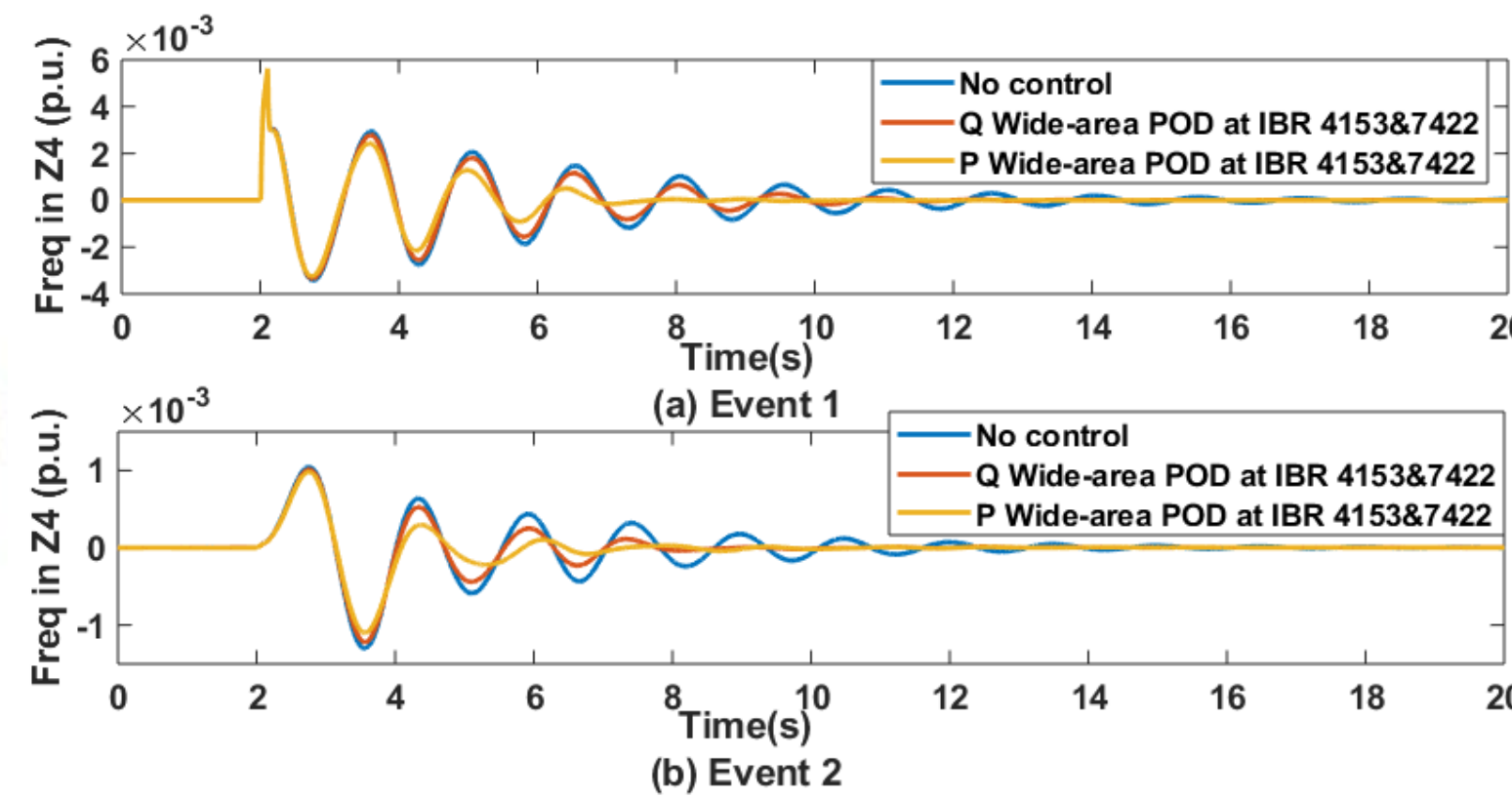
Texas power grid diagram



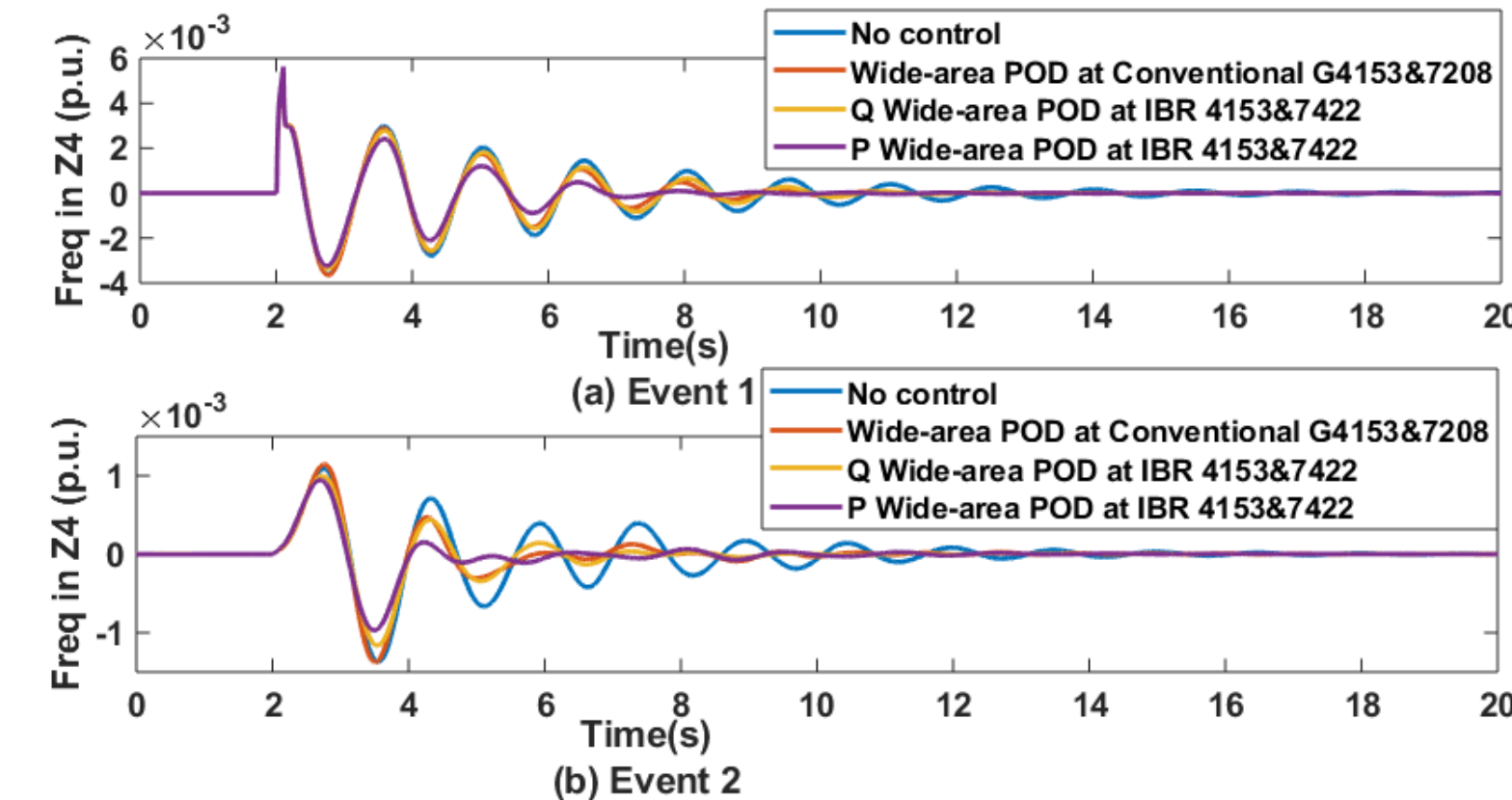
Observation signal and actuator selection results

POD type	Observation signal		Actuator	
	Mode 1	Mode 2	Mode 1	Mode 2
Wide-area	$f_{.4192} - f_{.7076}$	$f_{.4192} - f_{.7076}$	IBR at Bus 4153 Area 4	IBR at Bus 7422 Area 7
Local	Local bus frequency	Local bus frequency	IBR at Bus 4153 Area 4	IBR at Bus 8077 Area 8

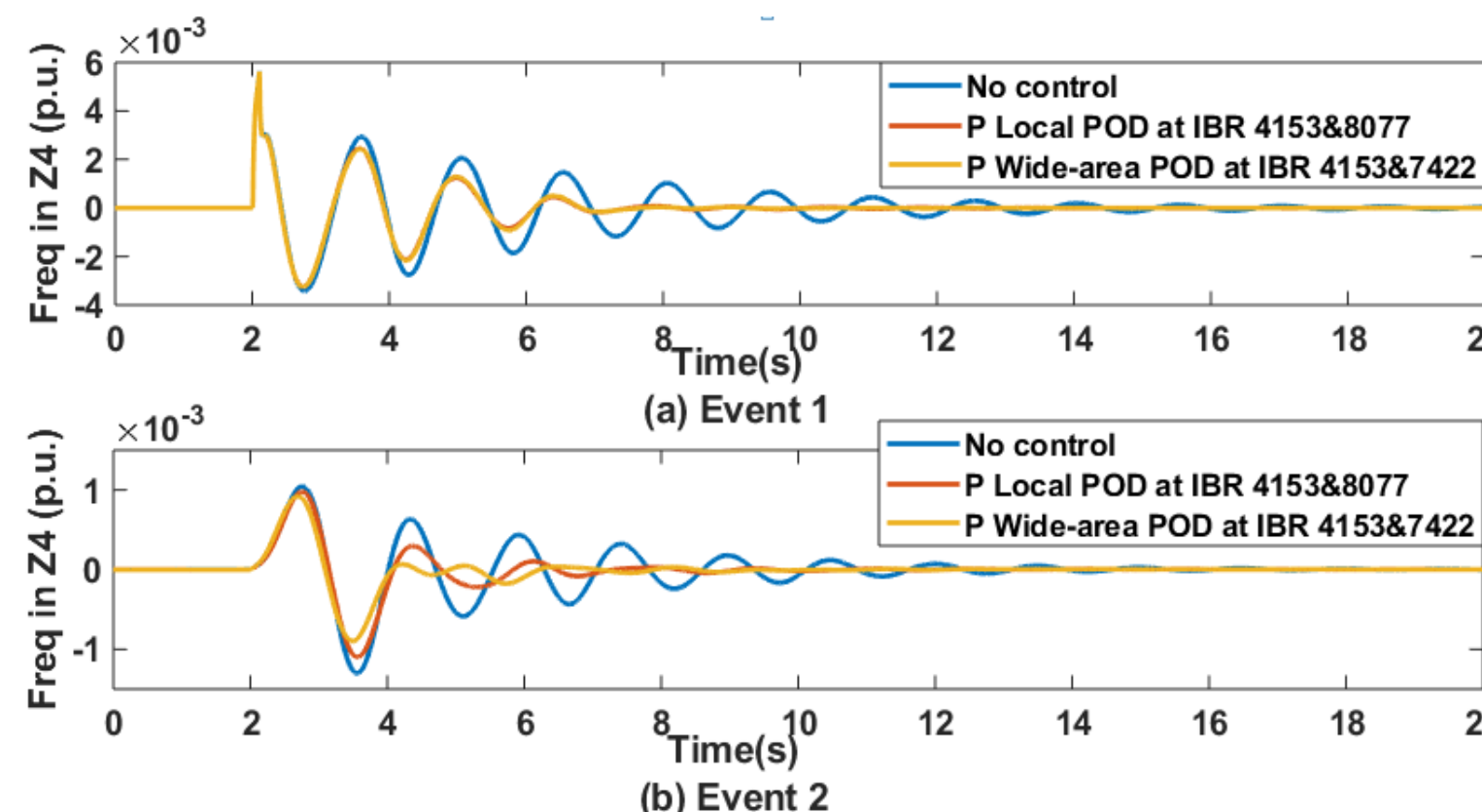
Wide-area IBR POD performance comparison between P and Q modulation



Performance comparison between wide-area POD control through IBR and synchronous generator



Wide-area and local IBR POD control performance comparison through active power modulation



Damping performance of different types of PODs

POD Type	Actuator	Mode 1		Mode 2	
		Freq. (Hz)	Damp. (%)	Freq. (Hz)	Damp. (%)
No POD	N/A	0.670	6.22	0.630	8.70
Local POD via P	IBR at 4153 & 8077	0.726	12.71	0.610	>20
Local POD via Q	IBR at 4153 & 8077	0.706	8.00	0.613	15.32
Wide-area POD via P	IBR at 4153 & 7422	0.702	15.00	0.600	>20
Wide-area POD via Q	IBR at 4153 & 7422	0.712	9.64	0.596	17.09
Wide-area POD via AVR	Synchronous Generator at 4030 & 7208	0.689	10.36	0.595	18.08

