Adaptive Power Oscillation Damping Control via VSC-HVDC for the Great Britain Power Grid

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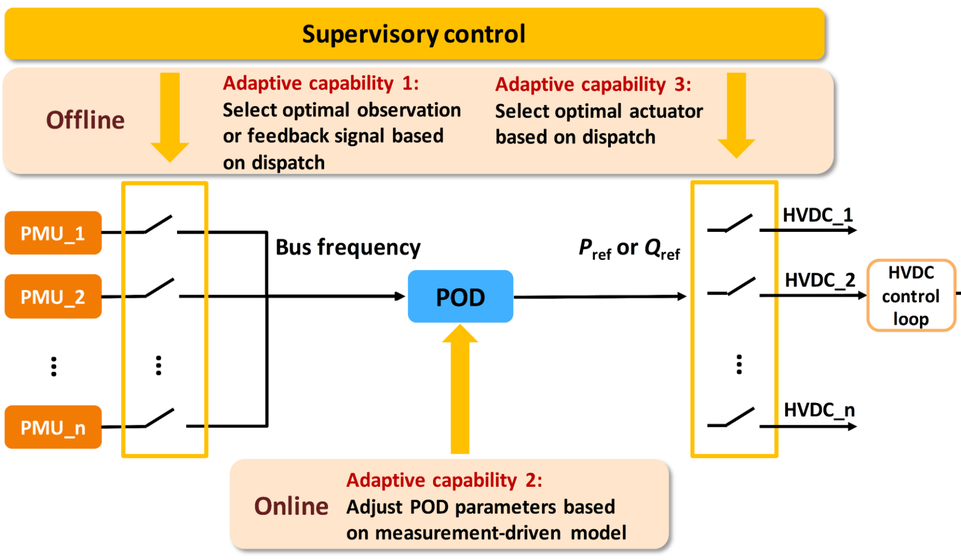
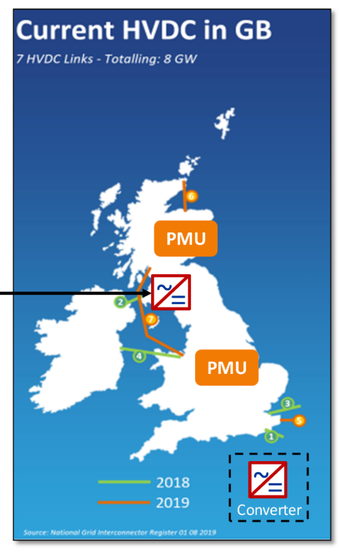
INTRODUCTION

- The increasing number of phasor measurement units (PMUs) makes it feasible and urgent to deploy adaptive wide-area power oscillation damping (POD) controllers in transmission networks.
- An adaptive wide-area POD controller through voltage source converter based HVDC (VSC-HVDC) links based on a measurement-driven approach is proposed for the Great Britain (GB) power grid.
- The proposed POD controller has the following features:
  - The designed POD controller can suppress the targeted oscillation mode by modulating the active power and/or reactive power of the selected VSC-HVDC link.
  - Under different system dispatches, the designed POD controller can switch its input/feedback signal and actuator using a loop-up table.
  - When the GB power grid is operating under different system dispatches, the POD controller can adjust its control parameters using the measurement-driven approach to guarantee its control performance.

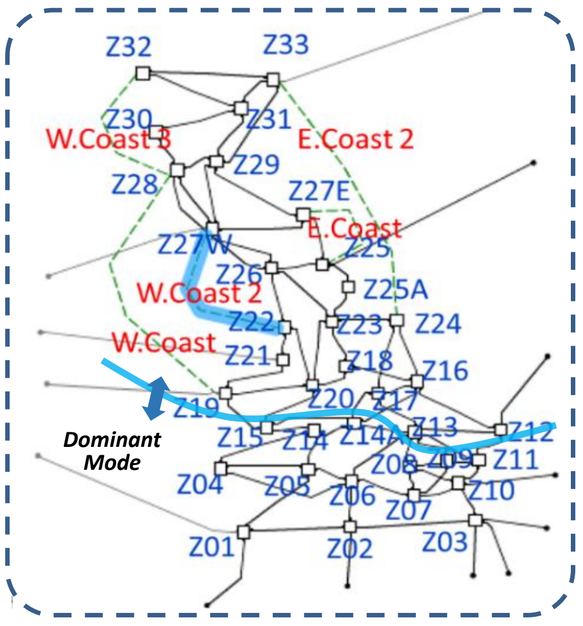
ADAPTIVE POD DESIGN METHOD

POD structure





Optimal observation signal and actuator selection



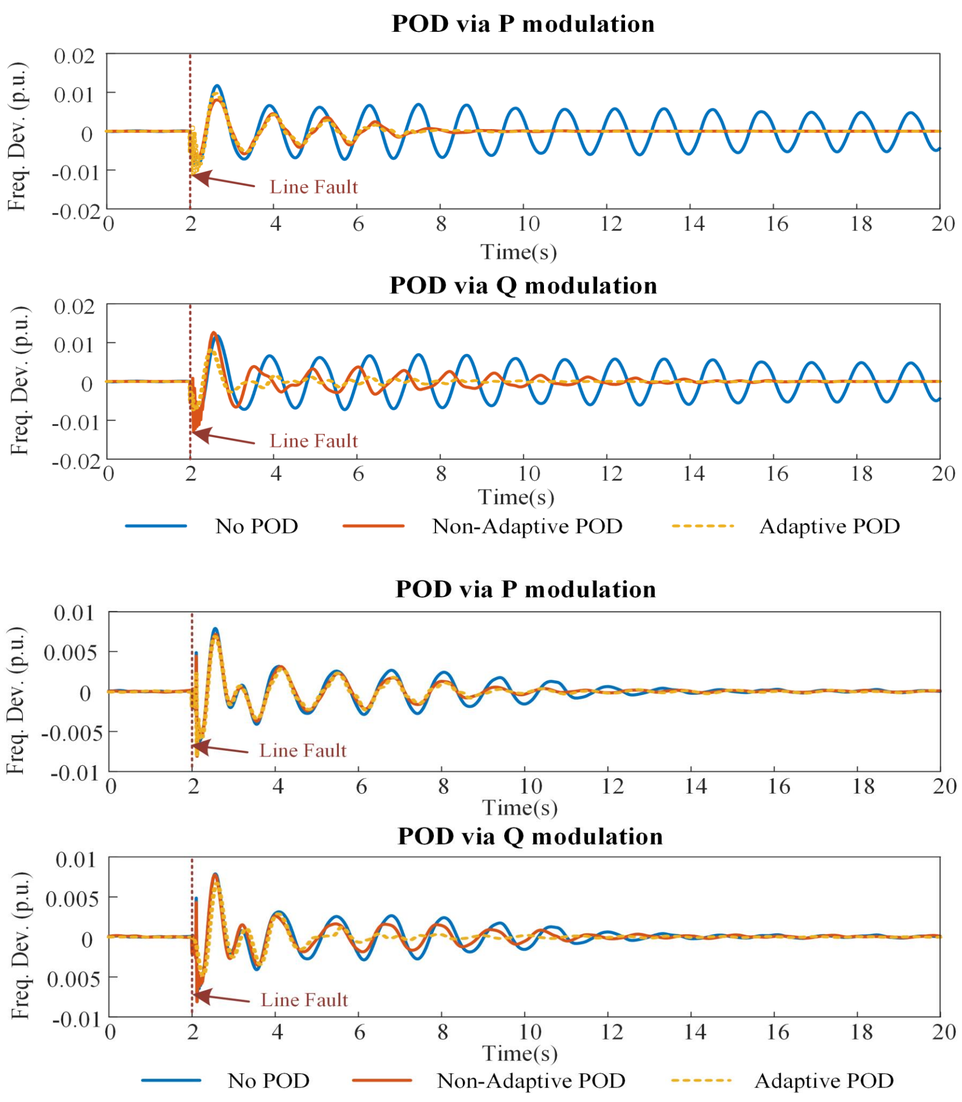
Dispatch 1
- Oscillation Frequency: 0.89 Hz
- Damping Ratio: 3.11%

Dispatch 2
- Oscillation Frequency: 0.85 Hz
- Damping Ratio: 0.82%

Dispatch 3
- Oscillation Frequency: 0.77 Hz
- Damping Ratio: 5.07%

Optimal Observation Signal	Optimal Actuator
Frequency difference f_1-f_{32}	W.Coast 3 HVDC

CASE STUDY



POD performance with different parameters under Dispatch 2 and 3

Dispatch No.	Scenario		Oscillation Freq. (Hz)	Damping Ratio (%)
2	No POD	N/A	0.85	0.82
	P modulation	Non-adaptive	0.83	11.32
		Adaptive	0.83	12.09
	Q modulation	Non-adaptive	0.92	**4.51**
		Adaptive	0.85	**>15**
3	No POD	N/A	0.77	5.07
	P modulation	Non-adaptive	0.75	7.48
		Adaptive	0.75	8.67
	Q modulation	Non-adaptive	0.77	**9.89**
		Adaptive	0.77	**>15**

- The POD via either P, Q and P&Q modulation can damp the oscillation effectively.
- The POD can effectively select the observation signal and actuator based on the system dispatch.
- Under different system dispatches, the adaptive POD can adjust its control parameters to achieve better control performance.