Joe Chow Personal Info

- **Institute Professor in Electrical, Computer, and Systems Engineering, RPI; CURENT ERC RPI Site Director & Control Thrust Lead**
- **Research Interests: Large-scale power system dynamics and control, phasor measurement data analysis, control of renewable resources**
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2020-2021 Research Projects

1. Dynamic Capacity Hosting Improvement for Wind Turbines (CURENT: Control)
2. Thévenin Equivalent Modeling using ThevNN method (CURENT: Control and Modeling)
3. Transient Stability Assessment using 2D Convolutional Networks (CURENT: Control)
4. Locating Forced Oscillations using Cross Power Spectral Density – NASPI Oscillation Source Location Competition winner (CURENT: Control and Monitoring)
5. Compression of PMU Data via Higher-Dimensional Structure (CURENT: Monitoring)
6. Electromechanical Wave Propagation in Future Power Grids with High Converter Penetration (CURENT: Control)
7. Extension of Corsi-Taranto Method of Real-time Voltage Stability Margin Computation (CNPq, Brazil)
8. Risk Segmentation and Portfolio Analysis for Pareto Dominance in High Renewable Penetration and Storage Reserves (ARPA-E PERFORM)

Dynamic Capacity Hosting Improvement for Wind Turbines

Task Goals:

- Develop an adaptive dynamic braking scheme (aDPR) for Type-3 wind turbines to enhance transient stability.
- Extend control to interarea transient stability.
- Prove effectiveness of control compared to other methods.

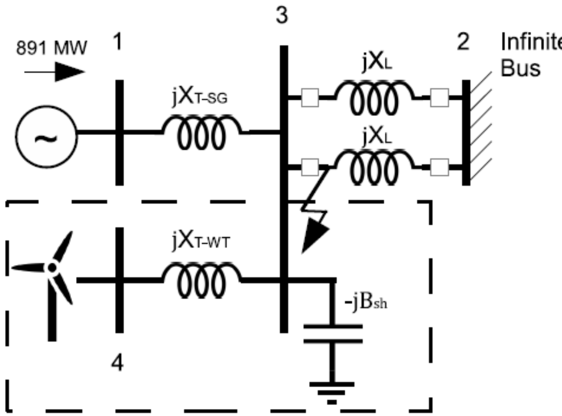


Fig. 1: Single-Machine Infinite-Bus and Wind-Turbine System.

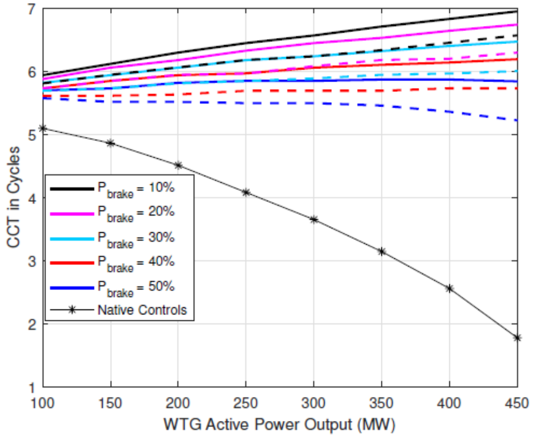
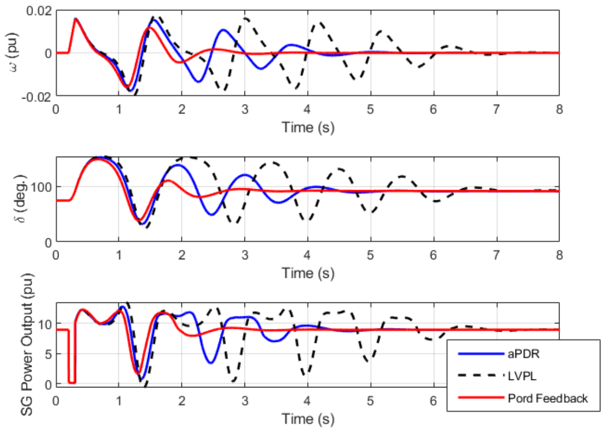
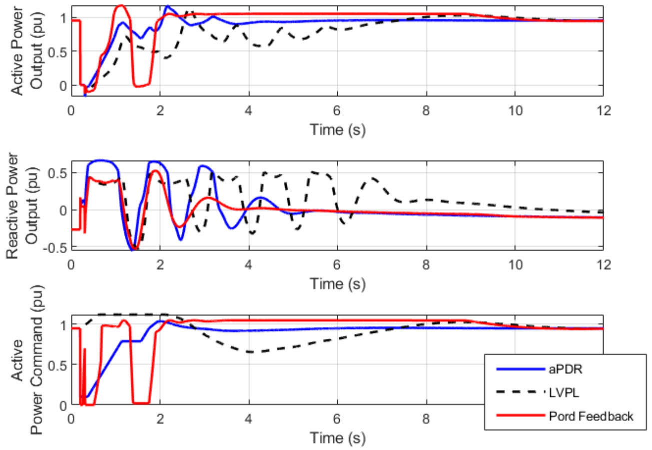


Fig. 8: Stability Margin for Various WTG Output Levels and Braking Power Levels. Solid lines - aDPR control; dashed lines - without Q Damping Control.

Research Achievements:

- Improvement of transfer capability of lines for up to 450 MW more for same CCT.
- Better transient behavior of adjacent plants, smaller angle excursions.
- Better utilization of existing transmission infrastructure.
- Minimization of wind plant mechanical actuation.





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Thèvenin Equivalent Modeling using ThevNN Method

Task Goals:

- Accurately model the system as Thevenin parameters using data taken from load buses experiencing small variation in power consumption and voltage magnitude
- Extract Thevenin parameters directly from system data using deep temporal model.
- Validate model performance on real and simulated systems.

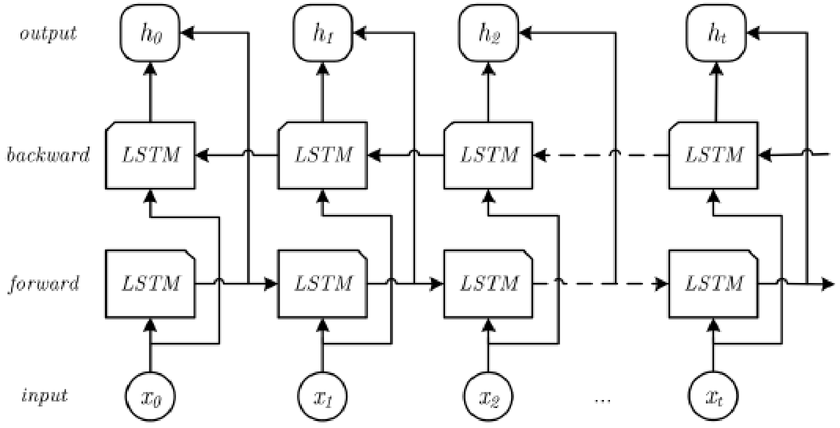
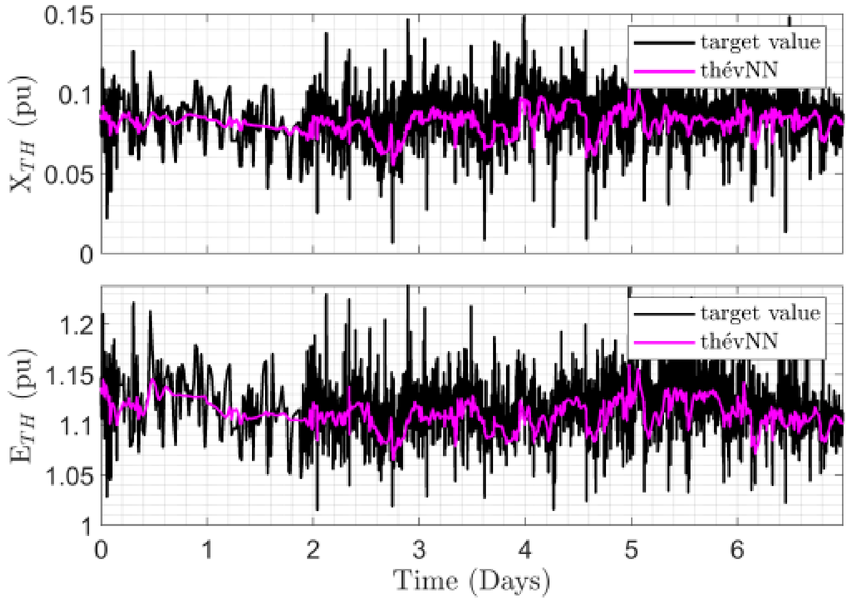


Fig. 4.4. General structure of bidirectional LSTM

Research Achievements:

- Generated equivalent parameter training set using measured PMU data and Thevenin equivalent estimation algorithm.
- Utilized the Long Short Term Memory (LSTM) networks – able to extract features from long-term dependencies on time-series data
- Developed deep learning model for sequence-to-sequence regression of Thevenin equivalent parameters from input time series.



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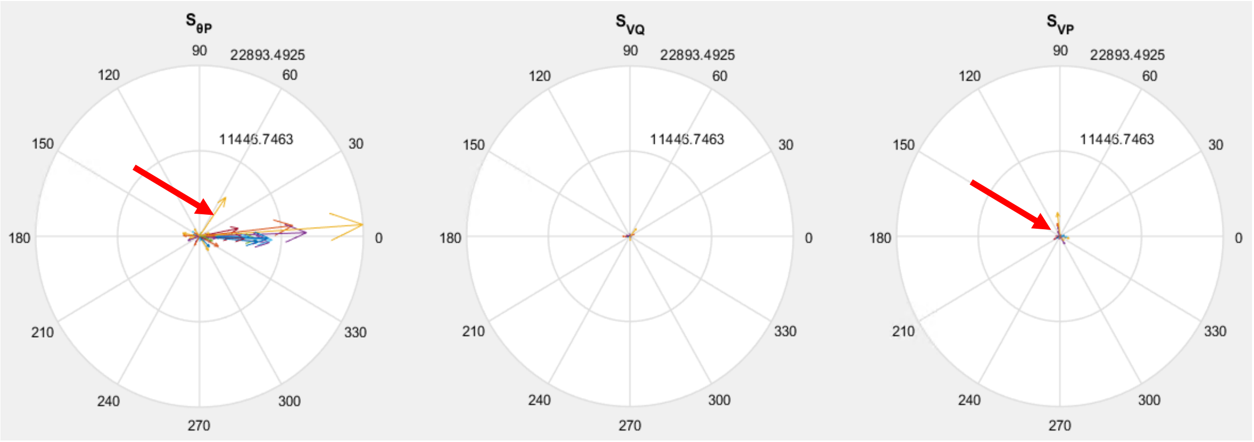
Locating Forced Oscillations using Cross Power Spectral Density

Task Goals:

- Identify the location of the source of forced or poorly damped oscillations
- Determine the cause of the oscillation, such as malfunction in governor or excitation system
- Apply the method to IEEE-NASPI Oscillation Source Location Contest

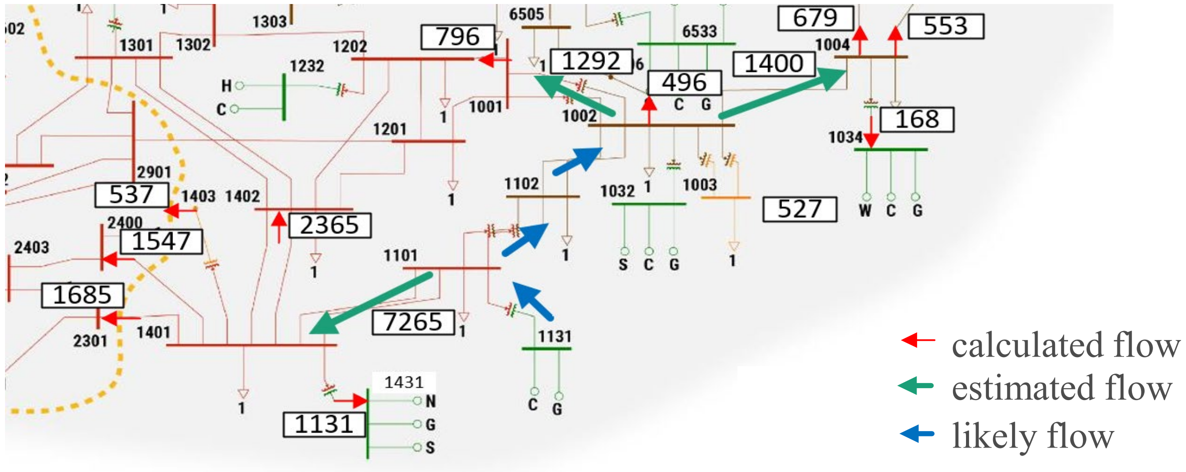
Case 9



Research Achievements:

- Successfully corrected bad and missing data using Tensor based decomposition
- Developed variational mode decomposition based approach to extract dynamic component of the signal from the PMU data
- Developed an approach to located the source of the oscillation using cross power spectral density between active and reactive powers vs voltage magnitude and angle.

Case 3



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