Amarsagar Reddy Ramapuram Matavalam

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RESEARCH
INTERESTS

Power Grid Stability - Analysis, Monitoring & Mitigation; Transmission & Distribution PMU Applications; Static & Dynamic Simulation Including T&D Co-simulation; Machine Learning Applications in Power System; Merging Models & Measurements to enhance Cyber-Physical Security; Cyber-Physical Real-Time Test-Bed Implementations.

EDUCATION

Iowa State University, Ames, Iowa, USA

Ph.D. Student, Electrical Engineering (Aug 2013 - Feb 2019) - *GPA: 3.97/4.00*
- Adviser : Dr. Venkataramana Ajjarapu (*Fellow, IEEE*)
- Thesis : Online Monitoring & Mitigation of Short Term and Long Term Voltage Instability using Synchrophasors
- Data-driven and model-based methodologies to analyze, monitor and mitigate voltage stability in transmission and distribution networks over various time scales

Indian Institute of Technology-Madras (IIT-M), Chennai, India

B.Tech. & M.Tech. in Electrical Engineering specializing in Power Systems and Power Electronics; Minor in Operations Research, (Aug 2006-May 2011) - *GPA: 9.1/10*
- Advisers : Dr. N.Lakshminarasamma & Dr. Krishna Vasudevan
- Thesis : Design and Implementation of a Synchronous DC-DC Converter with Soft Switching
- Improving efficiency of a buck converter by synchronous soft switching to reduce losses - received the Bhagyalakshmi and Krishna Ayengar Award for **best Institute wide masters project in energy efficiency**

RESEARCH
EXPERIENCE

Graduate Research Assistant, Iowa State University, Aug 2013 - Present
Long-Term Voltage Stability Assessment using Synchrophasor Data & System Model
- Analytically proved connection between Jacobian and Thevenin index; Proposed Sensitivity based Thevenin Index (STI) that validates the local index and detects noisy/malicious data.
- Incorporated generator reactive limits in the STI extending Thevenin methods to predict both saddle-node & limit-induced bifurcations in real-time - tested on systems upto 3120 buses.
- Extended the Thevenin methodology into distribution systems including the unbalance in topology and loads - enables the estimation of critical regions in distribution systems.

Short-term Voltage Stability Monitoring & Control using Synchrophasors.
- Analyzed and simplified the WECC Composite Load (CMLD) model from the load behavior during Fault Induced Delayed Voltage Recovery (FIDVR).
- Derived FIDVR recovery time from the simplified model and estimated load control using offline learning to ensure recovery within a specified time. The simplified model can reliably detect, quantify and mitigate FIDVR, even in presence of oscillations.
- Extended the methodology using μPMU measurements and distribution topology to localize motor stalling and utilize Q-support from the DERs to mitigate FIDVR in distribution networks with minimal load control.

Development of the Real-Time Cyber-Physical Test-Bed.
- Implemented the WECC CMLD model in Modelica and imported it into Opal-RT for real-time simulation and control of the FIDVR phenomenon using OpenPDC.

Power Flow based on Polar Holomorphic Embedding.
- Developed and efficiently implemented holomorphic power flow using voltage magnitude and phase angle as the embedding variables with execution time similar to runpf() in matpower.

Ongoing Collaborations.
- Prof. Umesh Vaidya, Iowa State University - Koopman linear operator framework for parameter and state estimation from power system DAE data.
- Prof. Decebal Mocanu, Eindhoven University of Technology - Sparse Neural Networks to represent, learn and predict power system behavior after a contingency. I implemented a faster code in python that reduced the training time by 10x. Code is at https://github.com/dcmocanu/sparse-evolutionary-artificial-neural-networks

NSF, DOE & Power System Engineering Research Center (PSERC) Proposal Writing.
- Led successful proposals by coordinating with several faculty in different research disciplines (total $500k); Further supported successful proposals (total $ 2M).

PROFESSIONAL WORK EXPERIENCE	**Summer Intern, GE Grid Solutions, Redmond,WA (June 2015 - Aug 2015)** - Implemented signal processing and data analytics methods (Non-linear PCA, Dynamic Mode Decomposition & Koopman Analysis) on real PMU data for generator model validation. Filed a Patent application for the methodology and it is now part of commercial WAMS **Edison Engineer, General Electric, India (July 2011 - July 2013)** - Developed and tested GE's Global Trip Unit (GTU) and Ground Fault Circuit Interrupter (GFCI) with Self-Test. Incorporated firmware fixes to solve electromagnetic interference issues. - Devised and validated a voltage stability index based on local PMU measurements. Setup Hardware-in-Loop test-bed with OPAL-RT & GE PMU to test online stability monitoring.
JOURNAL ARTICLES - ACCEPTED	**Amarsagar Reddy R.M.**; Ajjarapu, V., "Sensitivity based Thevenin Index with Systematic Inclusion of Reactive Power Limits," *in IEEE Transactions on Power Systems, vol. 33, no. 1, pp. 932-942, Jan. 2018.*
JOURNAL ARTICLES - SUBMITTED	**Amarsagar Reddy R.M.**; Ajjarapu, V., "PMU based Monitoring and Mitigation of Delayed Voltage Recovery using Admittances," *Under review in IEEE Transactions on Power Systems.* [online] https://arxiv.org/abs/1809.08088 **Amarsagar Reddy R.M.**; A. Singhal and V. Ajjarapu, "Monitoring Long Term Voltage Instability due to Distribution & Transmission Insteraction Using μPMU & PMU Measurements," *Under review in IEEE Transactions on Smart Grids.* [online] https://arxiv.org/abs/1810.09511 **Amarsagar Reddy R.M.**; R. Venkatraman and V. Ajjarapu, "Monitoring & Mitigation of Delayed Voltage Recovery using μPMU Measurements with Reduced Distribution System Model," *Under review in IEEE Transactions on Smart Grids.* [online] https://arxiv.org/abs/1810.09510
JOURNAL ARTICLES - IN PREPERATION	S. Liu; D. C. Mocanu; **Amarsagar Reddy R.M.**; "Sparse Evolutionary Deep Learning with hundreds of thousands of Artificial Neurons on Commodity Hardware", in *Neural Computing and Applications* by Springer.

SELECTED CONFERENCE PUBLICATIONS	**Amarsagar Reddy R.M.**; A. Singhal; V. Ajjarapu, "Identifying Long Term Voltage Stability Caused by Distribution Systems vs Transmission Systems", in *IEEE PES General Meeting*, 2018, vol., no., pp.1-5, Aug 2018.

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Amarsagar Reddy R.M.; A. Singhal; V. Ajjarapu, "Identifying Long Term Voltage Stability Caused by Distribution Systems vs Transmission Systems", in *IEEE PES General Meeting*, 2018, vol., no., pp.1-5, Aug 2018.

Amarsagar Reddy R.M.; A. K. Bharati, "Reliability Assessment of Industrial Circuit Breakers with Design Enhancements", in *International Conference on Probabilistic Methods Applied to Power Systems*, 2018, vol., no., pp.1-5, July 2018.

Amarsagar Reddy R.M.; V. Ajjarapu, "Validation of the Sensitivity based Thevenin Index on Large Systems", in *IEEE PES General Meeting*, 2017, vol., no., pp.1-5, July 2017.

J.A.V. Vasquez; **Amarsagar Reddy R.M.**; V. Ajjarapu, "Fast calculation of Thevenin equivalents for real-time steady state voltage stability estimation," *North American Power Symposium (NAPS)*, Denver, CO, 2016, pp. 1-7.

Amarsagar Reddy R.M.; V. Ajjarapu, "PMU based real-time monitoring for delayed voltage response," in *North American Power Symposium (NAPS)*, 2015, vol., no., pp.1-6, 4-6 Oct. 2015.

Amarsagar Reddy R.M.; V. Ajjarapu, "Calculating the long-term voltage stability margin using a linear index," in *IEEE PES General Meeting*, 2015, vol., no., pp.1-5, July 2015.

Amarsagar Reddy R.M.; et. al., "PMU based real-time short term voltage stability monitoring - Analysis and Implementation on a real-time test bed," in *North American Power Symposium (NAPS)*, 2014, vol., no., pp.1-6, 7-9 Sep. 2014.

SELECT HONORS AND AWARDS

- Awarded **3rd Prize** for the Best Graduate Poster at the 2016 IEEE PES General Meeting
- Awarded **2nd Prize** for the Best Paper at the 2015 North American Power Symposium
- Awarded **Institute Merit Prize** at IIT-M for the best Academic Achievement in Power Systems & Power Electronics during 7th and 8th Semester

RELEVANT SKILLS

Languages:	MATLAB, Python, Mathematica, R, Modelica, C#, C++
Software:	PSSE, PSLF, OpenPDC, RTDS, Opal-RT, OpenDSS, GridLab-D
ML Libraries:	Tensorflow, Keras, PyTorch

RELEVANT GRADUATE COURSEWORK

- Power System Dynamics
- Steady State Analysis
- Wind Energy Technologies
- Power System Planning
- Power System Reliability
- Cyber Security in Power Systems
- Statistical Methods I
- Non-Linear Systems
- Harmonic Analysis
- Applied Linear Algebra
- Convex Optimization
- Exploratory Data Analysis
- Data Analytics (audit)

PROFESSIONAL MEMBERSHIP

- Reviewer for IEEE Transactions in Power Systems
- Member of the IEEE PES Student Chapter at Iowa State University
- Active Member of Sankalp - a volunteering student organization at Iowa State University

REFERENCES

Venkataramana Ajjarapu:
- Professor, Department of Electrical Engineering
- Iowa State University
- vajjarap@iastate.edu

James D. McCalley:
- Professor, Department of Electrical Engineering
- Iowa State University
- jdm@iastate.edu

Jay Giri:
- Director, Power Systems Technology Initiatives
- GE Grid Solutions
- jay.giri@ge.com