Pooja Algikar

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Education

Virginia Polytechnic Institute and State University — Washington D.C.
Doctor of Philosophy in Electrical Engineering — *Jan. 2021 – Present*

Virginia Polytechnic Institute and State University — Washington D.C.
Master of Engineering in Electrical Engineering — *Aug. 2019 – Dec. 2020*

College of Engineering, Pune — Pune, India
Bachelor of Engineering in Electrical Engineering — *Aug. 2013 – July. 2017*

Research Interests

Uncertainty quantification, robust estimation, Koopman operator, and Gaussian process

Research Projects

RPM [1] quantifies the uncertainty propagated from intermittent renewable energy sources in the states of a power system. Specifically, it predicts hour-ahead uncertainty bounds on the steady-state estimations of a power system: voltage phasors which are the outputs of the AC power flow model. The stochastic AC power flow model is formulated in a robust Gaussian process framework, the hyperparameters of which are estimated based on the generalized Shweppe-type maximum likelihood estimator. RPM is trained on real-world data: time series measurements of power injections and voltage phasors. The effect of bad data in predictions is bounded by downweighting them with scores calculated using projection statistics, a robust version of Mahalanobis distances.

GP-Huber [4] is a robust process regression model in the Gaussian process framework with the likelihood of observed data expressed as the Huber probability density function. The resulting unimodal predictive posterior distribution is approximated using Gibbs sampling and Laplace approximation methods. High statistical efficiencies at the Gaussian and thick-tailed noise distributions such as Students t, Laplace, and Cauchy distribution with a good amount of outlying data are demonstrated with a numerical example. Finally, the proposed inference methods are applied to estimate the planet-to-star radius ratio of the HD-189733 planetary system.

HOBI [2] addresses non-linear dynamics in blind source separation method for identifying low oscillating modes. Non-linear dependencies are modeled using copula statistics, a b-variate index for measuring higher-order dependence among random variables. The algorithm combined with Hilbert transform (HOBI-HT) and iteration procedure (HOBMI) can identify all the oscillation modes and the model order from the observation signals obtained from the number of channels as low as one.

MUQ-Central [3] quantifies the impact of measurement uncertainties in numerical methods that employ the Koopman operator to identify nonlinear dynamics based on recorded data normalized to have zero means. In particular, the confidence interval of each element in the push-forward matrix is quantified from which a subset of the Koopman operator's discrete spectrum is estimated. A detailed numerical analysis applied to numerical simulations and field data collected from experiments conducted in a megawatt-scale facility at the National Renewable Energy Laboratory is performed.

MUQ-nonCentral [5] propagates the moments of the normal density function specified for measurements' uncertainty through the dynamic mode decomposition. The proposed numerical method to propagate the uncertainty is agnostic of specific dynamic mode decomposition formulations. The estimated second moments provide confidence bounds that may be used as a metric of trustworthiness, that is, how much one can rely on a finite-dimensional linear operator to represent an underlying dynamical system.

Publications

[1] Algikar, P., Xu, Y., Yarahmadi, S., & Mili, L. (2023). A Robust Data-driven Process Modeling Applied to Time-series Stochastic Power Flow. IEEE Transactions on Power Systems.

[2] Algikar, P., et. al. (2023). Identification of Power System Oscillation Modes using Blind Source Separation based on Copula Statistic. 2023 IEEE Power & Energy Society General Meeting (PESGM). Best Paper Finalist

[3] Algikar, P., Sharma P., Netto M., and Mili L. (2023). Measurement Uncertainty Impact on Koopman Operator Estimation of Power System Dynamics. IEEE Transactions on Power Systems (under review).

[4] Algikar, P., & Mili, L. (2023). Robust Gaussian Process Regression with Huber Likelihood. ICML (under review).

[5] Algikar, P., & Mili, L. (2023). Statistical Analysis and Method to Propagate the Impact of Measurement Uncertainty on Dynamic Mode Decomposition. CDC 2024 (under review).

[6] Yarahmadi, S., Algikar, P., and Mili, L. (2023). Electromechanical Wave Propagation for Disturbance Arrival Time Assessment in Power Systems. 2023 IEEE Power & Energy Society General Meeting (PESGM).

[7] Algikar, P.., Xu, Y., & Mili, L. (2022, July). A Measurement-Based Robust Non-Gaussian Process Emulator Applied to Data-Driven Stochastic Power Flow. In 2022 IEEE Power & Energy Society General Meeting (PESGM) (pp. 01-05).

[8] Yarahmadi, S., Algikar, P., and Mili, L. (2022). Electromechanical Wave Propagation Analysis in Power Systems. 2022 IEEE PES Generation, Transmission and Distribution Conference and Exposition–Latin America (IEEE PES GTD Latin America).

[9] Algikar, P., & Mili, L. (2022). Robust Hyperparameter Estimation in Gaussian Process Regression Model. Statistics and Computing (under review).

Experience

Graduate Research Assistant December 2019 – Present
Virginia Tech *Washington, DC*

- Researched random matrix theory-based data-driven uncertainty quantification methods
- Constructed a robust Gaussian process emulator to perform time-series stochastic power flow
- Developed a high-order blind identification method for power system modal identification capturing higher order coupling between the signals

Graduate Intern II, Sensing and Predictive Analytics June 2023 - Feb 2024
National Renewable Energy Laboratory *Golden, CO*

- Derived analytical expressions for the first and second moments of constituent elements of the dynamic mode decomposition operator
- Established a new paradigm to quantify uncertainties using principles from random matrix theory

Summer Intern (PhD), Product Development May 2021 – July 2021
Ford Motor Company *Dearborn, MI*

- Formulated a cost function to comprehensively assess the benefits and risks associated with the aggregator's engagement in the electricity market.
- Established a mathematical model to optimize total credit linked with household aggregation strategy.

Invited Talks

Stochastic Time-Series Power Flow 25^{th} Oct 2023
Prof. Hao Zhu's lab *UT Austin*

Academic Service

Reviewer: IEEE Transactions on Power Systems, IET Generation, Transmission & Distribution, IEEE PES General Meeting (2021, 2022, 2023), IEEE Innovative Smart Grid Technologies, North America (ISGT NA 2023)

Conference Organizer: ISGT NA 2020

Extracurricular and Achievements

Inducted IEEE-Eta Kappa Nu (2022)

Innovation Campus Fellow: Assisting in developing Virginia Tech's new campus: Innovation Campus in Alexandria with many other fellows and university professors. As a fellow, I am engaged with the Innovation Campus Delivery Team (a cross-functional team supporting the project), attend industry-related events, special host seminars, engage with the community, and participate in other activities to support the planning and design of the new campus

Contestant of NASA RASC-AL 2021; Theme: Minimum Mars Ascent Vehicle: As the head of a power subsystem, my contribution was to design a power supply for in-situ resource utilization and ascent vehicle.

Technical Skills

Languages:Python, Matlab, R
Libraries: pandas, NumPy, Matplotlib, TensorFlow, scikit-learn, Keras
Tools: PSCAD, EMT, DIgSILENT, CYME, OpenDss