Saurabh Sihag

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RESEARCH INTERESTS

Broadly interested in statistical learning, data analytics, information theory, high-dimensional statistics, and optimization.

EDUCATION

Rensselaer Polytechnic Institute, Troy, NY Aug. 2016 - present
Doctor of Philosophy, Electrical Engineering
Dissertation Title: Active Learning of Structures in Random Graphs
Advisor: Prof. Ali Tajer

Indian Institute of Technology, Kharagpur, India Jul. 2011 - May 2016
Bachelor of Technology and Master of Technology, Electrical Engineering
Dissertation Title: Object Recognition using Multi-resolution Deep Belief Networks
Advisor: Prof. Pranab K. Dutta

PROFESSIONAL EXPERIENCE

Research Intern Sep. 2018 - Dec. 2018
IBM Thomas J. Watson Research Center, Yorktown Heights, NY
Manager: Dr. James Kozloski

- Graph-theoretic analysis of the fMRI and DTI data (post-concussion syndrome)
- Time series analysis of the BOLD signal (Huntington's disease)

RESEARCH PROJECTS

Structure Learning in Graphical Models

- Information-theoretic analysis of joint structure recovery of structurally similar graphs.
- Applications to analyzing data in domains like neuroscience, technological infrastructures, and biological networks.

Secure Inference

- An optimal Bayesian parmeter estimation framework is developed for models that are vulnerable to an external adversary or unknown defects. The framework is extended to a distributed implementation to accommodate large scale and efficient applications (e.g., power grids).
- Applications that have been investigated include state estimation in power grids under potential changes in the model (e.g., line outages) and parameter estimation from a stream of data under causative attacks, i.e., when some components of the data may be compromised by an adversary to degrade estimation performance. An asymptotically optimal scalable approach to isolate the compromised data from large dimensional data is also proposed.

Controlled Sensing

- In this project, multi-agent networks are considered in which state parameters can be distributed across the agents, with each agent observing only a subset of unknown parameters and each parameter may be observed by multiple agents. Under the restriction on the number of agents that could collect a new observation at a time, sequential estimation rules based on Fisher information and interaction among agents are developed that leverage the past data to make decisions at the current time about whether to continue sampling and dynamic selection of agents to collect the new data from.

- This network model is relevant to various domains like power systems and Internet of Things in healthcare, where the different health care monitoring devices may be observing common parameters (e.g., blood flow and heart rate) and form an interactive network for applications like remote health monitoring. The theory developed aligns closely with the field of active learning and similar problems in the non-parametric domain can be formulated.

Deep Belief Networks

- Developed a low complexity Deep Neural Networks based classification framework using a generative belief network and wavelet transform.
- Robustness and accuracy of the proposed framework is evaluated on MNIST and USPS digits datasets.

PUBLICATIONS

Journal Papers

S. Sihag and A. Tajer, "Secure Estimation under Causative Attacks", *IEEE Transactions on Information Theory*. (under review)

S. Sihag, J. Heydari and A. Tajer, "Sequential Parameter Estimation in Networked Data", *IEEE Transactions on Signal Processing* (under review)

S. Sihag and A. Tajer, "Scalable Parameter Estimation in Network Models under Uncertainty", *IEEE Transactions on Signal Processing*. (under review)

S. Sihag and A. Tajer, "Power System State Estimation under Model Uncertainty", *IEEE Journal of Selected Topics in Signal Processing*, vol. 12, no. 4, pp. 593-606, Aug. 2018.

Conference Papers

S. Sihag and A. Tajer, in Proc. "Sample Complexity of Joint Structure Learning", in Proc. *IEEE International Conference on Acoustics, Speech and Signal Processing*, May 2019, Brighton, UK.

S. Sihag and A. Tajer, "Non-Linear State Estimation in Power Systems under Model Uncertainty", in Proc. *IEEE Global Conference on Signal and Information Processing*, Nov. 2018, Anaheim, CA.

S. Sihag and A. Tajer,"Scalable Network Parameter Estimation in the Presence of Anomalies", in Proc. *IEEE International Conference on Acoustics, Speech and Signal Processing*, Apr. 2018, Calgary, Canada.

S. Sihag and A. Tajer, "Distributed Estimation under Network Model Uncertainty", in Proc. *IEEE International Conference on Acoustics, Speech and Signal Processing*, Apr. 2018, Calgary, Canada.

S. Sihag, J. Heydari and A. Tajer, "Sequential Estimation of Distributed Parameters in Networks", in Proc. *Conference on Information Sciences and Systems*, Mar. 2018, Princeton, NJ.

S. Sihag and A. Tajer, "Secure Parameter Estimation: Fundamental Tradeoffs", in Proc. *IEEE Global Conference on Signal and Information Processing*, Nov. 2017, Montreal, Canada.

SKILLS AND COURSEWORK

Languages and Packages:
C, C++, Python, Matlab, Verilog

Relevant Courses

- Intro. to Stochastic Signals and Systems
- Intro. to Probabilistic Graphical Models
- Detection and Estimation Theory

- Mathematical Analysis
- Information Theory and Coding
- Intro. to Optimization
- Optimization Methods in Data Analysis
- Stochastic Processes and Modeling
- Machine Learning

HONORS AND ACCOMPLISHMENTS

- Baliga fellowship by the Department of Electrical, Computer, and Systems Engineering, Rensselaer Polytechnic Institute (2016-17).
- Ranked 881 among over 450,000 candidates in the Joint Entrance Examination (JEE) for admission to the undergraduate programs at the Indian Insitutes of Technology (2011).