Sirisha Rambhatla

Contact Information

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Skills and Interests

Statistical Machine Learning, Optimization, Time Series Analysis, Design of Provable Learning Algorithms, and their applications in Deep Learning and Knowledge Representations.

Education

Doctor of Philosophy (Ph.D.) in Electrical Engineering — Sep. 2014 - Sep. 2019
University of Minnesota – Twin Cities, USA
Thesis: *Provably Learning from Data: Algorithms for Matrix/Tensor Decompositions & Factorizations*
Advisor: Professor Jarvis Haupt

Master of Science (M.S.) in Electrical Engineering — Aug. 2010 - Dec. 2012
University of Minnesota – Twin Cities, USA
Thesis: *Semi-Blind Source Separation via Sparse Approximation & Online Dictionary Learning*
Advisor: Professor Jarvis Haupt

Bachelor of Technology (B.Tech) in Electronics & Telecom. Engineering — Aug. 2006 - May 2010
College of Engineering Roorkee (COER), India (81.4% (Honors)) (*Bronze Medalist*)

Awards and Honors

Student Travel Award, *International Conference on Learning Representations (ICLR)*, 2019
Selected Presenter, *"Graduation Day" Session, Information Theory & Applications Workshop*, 2019
Finalist, Student Best Paper Award, *Asilomar Conference on Signals, Systems & Computers*, 2017
National Science Foundation (NSF) Travel Award, *GlobalSIP*, 2016
E. Bruce Lee Memorial Fellowship, *University of Minnesota – Twin Cities*, 2014
SciTechsperience Fellowship, *Minnesota High Tech Association*, 2012
Placed Third in Class of 2010 (Bronze Medal), *Uttarakhand Technical University, India*, 2010
Proficiency Award for Academic Excellence, *COER, India*, Session 2009 – 10 & 2006 – 07

Experience

Postdoctoral Scholar – Research Associate — Oct. 2019 – Present
Mentor: Prof. Yan Liu — Melady Lab, Computer Science Department
Viterbi School of Engineering — University of Southern California, Los Angeles, CA, USA
Focus: Machine learning for spatiotemporal data analysis, probabilistic modeling, and interpretability for real-world data.

- **Explainable Artificial Intelligence (AI)**
  - Develop a feature attribution technique to analyze the predictions by deep learning models, achieving state-of-the-art performance on attribution on real-world tasks.
  - Develop a complementary feature interaction detection algorithm to identify feature interactions.
  - **Applications**: Explaining sentiment analysis, image classification, and recommender systems.
- **COVID-19 Misinformation Analysis**
  - Analyze the information sharing patterns on Twitter to identify COVID-19 misinformation spread.
  - Strategize and devise research direction to analyze misinformation spread patterns to identify flow of misinformation across countries, malicious group of users, and specific spread patterns.
- **COVID-19 Disease Spread Prediction**
  - Develop probabilistic models to analyze the COVID-19 disease spread by integrating epidemic spread models with latent graph inference models.

  - Analyze and interpret the results to strategize for incorporating additional sources of information, such as flight data, government issues lock-down timelines, and other mobility data.

- **Interpretable Deep Fake Detection**
  - Develop the first interpretable architecture for deep fake detection by leveraging identification of unnatural dynamics in videos using prototypical features corresponding to real and deepfakes.

- **Physics Informed Meta-Learning**
  - Develop a meta-learning-based model to transfer the knowledge of physics-based model to improve performance of real-world prediction.
  - The architecture allows to build physics priors for efficient (prediction) learning of dynamics.
  - **Applications**: Climate Modeling and COVID-19 policy evaluation and prediction.

Graduate Research Assistant Feb. 2011 – May 2012 & Aug. 2014 – Present
Dept. of Electrical and Computer Eng. University of Minnesota – Twin Cities, Minneapolis, MN

Theoretical Focus:

- Analyzed matrix/tensor factorization and demixing models for machine learning applications by posing them as semi-supervised and unsupervised learning tasks. Developed provable algorithms for these learning tasks using convex and non-convex formulations.
- Analyzed the algorithms theoretically leveraging tools from statistical signal processing and optimization. Designed and implemented experiments to analyze the performance of these algorithms leveraging high performance computing resources.
- Developed a fast, scalable, distributed algorithm with performance guarantees for recovering the factors of the dictionary learning (a matrix factor) model. Designed and implemented the algorithm as a neural network on graphical processing unit (GPU)s via TensorFlow.
- Developed an algorithm for tensor factorization based on the dictionary learning technique.

Applications Focus:

- Identified applications (and analyzed performance) of the developed techniques on real-world datasets. For instance,
- Developed a technique for localizing targets based on their spectral signatures in hyperspectral images.
- Developed a technique to build maps from Lidar data using tensor decompositions to localization and navigation of vehicles.
- Leveraged the tensor factorization model for simultaneous clustering and pattern recovery to analyze Enron's organizational behavior and sports analytics.

ExplorCSR Mentor Oct. 2018 – Feb. 2019
Volunteer Group Leader University of Minnesota – Twin Cities, Minneapolis, MN

- Identify, formulate, and design a research problem for hedging strategies using optimization techniques for financial portfolio management.
- Successfully lead and prepare the team to present the research findings at the 2019 MinneWIC Conference organized in Duluth, Minnesota.

Science Advisor Mar. 2013 – Jun. 2014
Intellectual Property (IP) and Technology Litigation Robins Kaplan LLP, Minneapolis, MN

- Strategized for various technical issues involved in technology licensing and IP litigation. Analyzed potential IP cases to evaluate their validity and scope, and communicated the results both inside and outside the firm. Performed infringement analysis, including source code inspection.
- Designed experiments to identify infringement. In a particular instance, developed an experiment on-the-fly in a client-facing meeting to save upwards of $\$100,000$ in chip tear-down costs (and time) to prove infringement.

Engineering Intern (R&D) Jun.– Aug. 2011 & Jun.– Oct. 2012
Technology and Engineering Division Ativa Medical Inc., St. Paul, MN

- Develop a signal and data analysis algorithms for instrumentation of flow-cytometry-based blood diagnostic product.
- Develop an imaging based blood diagnostics product. Designed a wavelet based focus-stacking algorithm to improve quality of images to enable identification of blood cells.

Publications

[1] **S. Rambhatla**, X. Li, and J. Haupt. Provable Online CP/PARAFAC Decomposition of a Structured Tensor via Dictionary Learning. (*Manuscript under review*)

[2] **S. Rambhatla**, X. Li, and J. Haupt. NOODL: Provable Online Learning for Dictionary Learning and Sparse Coding. *International Conference on Learning Representations (ICLR)*, 2019. **Student Travel Award**

[3] **S. Rambhatla**, X. Li, J. Ren and J. Haupt, "A Dictionary-Based Generalization of Robust PCA With Applications to Target Localization in Hyperspectral Imaging," in IEEE Transactions on Signal Processing, vol. 68, pp. 1760 – 1775, 2020.

[4] **S. Rambhatla**, N. Sidiropoulos, and J. Haupt. TensorMap: Lidar-based Topological Mapping and Localization via Tensor Decompositions. *IEEE Global Conference on Signal and Information Processing (GlobalSIP)*, 2018.

[5] X. Li, J. Ren, **S. Rambhatla**, Y. Xu, and J. Haupt. Robust PCA via Dictionary Based Outlier Pursuit. *IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*, 2018.

[6] **S. Rambhatla**, X. Li, and J. Haupt. Target Based Hyperspectral Demixing via Generalized Robust PCA. *Asilomar Conference on Signals, Systems, and Computers (Asilomar)*, 2017. **Student Best Paper Award Finalist**.

[7] **S. Rambhatla**, X. Li, and J. Haupt. A Dictionary Based Generalization of Robust PCA. *IEEE Global Conference on Signal and Information Processing (GlobalSIP)*, 2016. **National Science Foundation (NSF) Travel Award**.

[8] **S. Rambhatla** and J. Haupt. Semi-Blind Source Separation via Sparse Representations and Online Dictionary Learning. *Asilomar Conference on Signals, Systems, and Computers (Asilomar)*, 2013.

All preprints/reprints available on `axiv` and at `www.sirisharambhatla.com/about`.

Packages Developed

`NOODL`: A Provable Online Learning Algorithm for Dictionary Learning and Sparse Coding.
- Distributed implementation across CPU cores via MATLAB,
- Distributed neural network implementation across GPUs via TensorFlow

`D-RPCA`: Dictionary-Based Generalization of Robust PCA. (MATLAB)
- Analysis of Theoretical Properties, and Target Localization in Hyperspectral Images.

`TensorMap`: Lidar-based Mapping and Localization via Tensor Decompositions. (MATLAB)

Technical Service

- Organizer, AI for COVID-19 in LA Virtual Symposium 2020
  — *University of Southern California, Los Angeles, CA*
- Ambassador, Women in Data Science (WiDS) 2020
  — *University of Southern California, Los Angeles, CA*
- Session Co-Chair, Reinforcement Learning 2019
  — *Information Theory and Applications Workshop 2019, San Diego, CA*
- Session Co-Chair, High-dimensional Statistics 2019
  — *Information Theory and Applications Workshop 2019, San Diego, CA*
- Session Chair, Deep Learning-based Signal Processing for Wireless Communication 2018
  — *GlobalSIP 2018, Anaheim, CA*

- International Conference on Artificial Intelligence & Statistics (AISTATS) 2018, 2016
- International Conference on Acoustics, Speech & Signal Processing (ICASSP) 2016, 2015
- Transactions on Signal Processing (T-SP) 2020, 2019, 2018, 2016, 2015, 2014
- Signal Processing Letters (SPL) 2017
- SIAM Journal of Imaging Sciences 2017
- Transactions on Industrial Informatics (T-II) 2017

Skills

Scientific Computing:	MATLAB/Simulink and Mathematica.
Programming Languages:	Python, C, and C++.
Deep Learning Tools:	TensorFlow, PyTorch.
Embedded Programming:	dsPIC, ATMEGA16/32, and MPLAB.
Other skills:	Linux/Unix Shell, Supercomputing, and Version control.

Relevant Coursework

Tensor Decompositions, Machine Learning, Probability and Stochastic Processes, Adaptive Digital Signal Processing, Optimization Theory, Detection and Estimation, Collaborative and Social Computing, Introduction to Nonlinear Optimization, Multirate and Multiscale Signal Processing, Image Processing and Applications, Robust Control System Design, Robotics, and Linear Systems and Optimal Control.

Professional Memberships

Collegiate Member, *Society of Women Engineers (SWE)*, since 2018.
Student Member, *IEEE* and *IEEE Signal Processing Society (SPS)*, since 2018.