Seonho Kim

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Research Interests

My research focuses on developing efficient and robust algorithms for data science, machine learning, signal processing, and natural language processing. Leveraging tools from optimization, linear algebra, and applied probability, I specialize in practical, theoretically sound solutions for large-scale, noisy, missing data, and sparse model environments. My expertise spans generalized linear models to advanced deep neural networks and transformers.

Education

- **The Ohio State University** — Columbus, OH, USA
  Ph.D. candidate in Electrical and Computer Engineering, Minor in Mathematics — *August 2019 - Present*
  GPA: 3.86, Advisor: Kiryung Lee
- **Ajou University** — Suwon, South Korea
  M.S, B.S in Electrical and Computer Engineering, Magna Cum Laude — *March 2011 - February 2019*
  B.S. GPA: 3.88, M.S. GPA: 4.00, Advisor: Songnam Hong
  Thesis: Detection methods for uplink massive MIMO systems with one-bit ADCs

Research Experience

- **Low-rank Regularization for Fine-Tuning**: Developed a novel low-rank adaptation method with nuclear norm regularization, outperforming baselines like LoRA and AdaLoRA in NLP benchmarks. Implemented in Pytorch and Hugging Face, achieving 1.5% performance gain with 30% fewer parameters.
- **Iterative Gauss-Newton Algorithm for Robust Phase Retrieval**: Designed a Gauss-Newton algorithm for phase retrieval, proving its efficacy in outlier scenarios using high-dimensional statistics. Implemented surpassing baseline methods in data and computational efficiency for synthetic data and real image data.
- **Max-Affine Regression via First-Order Methods**: Established convergence guarantees for GD and SGD in max-affine regression, using statistical and algebraic tools. Implemented demonstrating SGD's superior data efficiency and faster convergence compared to baselines.
- **Optimization on Low-Rank Matrices with Tensor Norm Regularization**: Implemented ADMM for scalable estimation in multi-task learning scenarios involving low-rank matrices. Proved ADMM's effectiveness, achieving 20x faster computation than traditional solvers.
- **Detection Algorithms for Massive MIMO with One-Bit ADCs**: Developed efficient detectors based on machine learning algorithms, significantly reducing computational complexity. Demonstrated near-optimal performance.

Skills & Selected Courses

- **Languages**: Python, MATLAB, LaTeX
- **Frameworks**: Hugging Face, PyTorch, Gurobi, CVX, TensorFlow, Keras, Scikit
- **Courses (Machine Learning)**: Statistical Learning Theory, Advanced Topics in Machine Learning and Computer Vision
- **Courses (Optimization)**: Nonlinear Optimization, Large-Scale Optimization, Non-Convex Optimization
- **Courses (Mathematics/Statistics)**: Advanced Statistical Theory, Theory of Probability, High Dimensional Probability, Linear Mathematics in Finite Dimensions, Mathematics of Data Science

Selected Publications

1. **S. Kim** and K. Lee, "Max-Affine regression via the first-order methods," *under minor revision in SIAM Journal on Mathematics of Data Science.*[PDF]
2. **S. Kim**, S. Bahmani, and K. Lee, "Max-Linear Regression by Scalable and Guaranteed Convex Programming," *Published in IEEE Transaction on Information Theory.*[PDF]
3. **S. Kim** and K. Lee, "Sequence of linear program for robust phase retrieval," *accepted in IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP), 2024.*
4. **S. Kim** and K. Lee, "Fast max-affine regression via stochastic gradient descent," *Published in the 59 Annual Allerton Conference on Communication, Control, and Computing (Allerton), 2023.*[PDF]
5. RS Srinivasa, **S. Kim**, and K. Lee, "Sketching low-rank matrices of a shared factor matrix by convex programming," *Published in IEEE Journal on Selected Areas in Information Theory 2023.*[PDF]

Honors & Awards

- Distinguished University Fellowship by the Ohio State University — 2019-2024
- 1st Winner, Undergraduate Research Program by Ajou University — 2016
- National Science and Engineering Scholarship by Korea Student Aid Foundation — 2016

Presentations

- Max-Affine regression via the first-order methods. SIAM Great Lakes Workshop, 2023 — 2023.10
- Fast max-affine regression via stochastic gradient descent. Allerton Conference, 2023 — 2023.9