



**FALL 2023**

# **RENSSELAER POLYTECHNIC INSTITUTE**

**DEPARTMENT OF MATHEMATICAL SCIENCES COLLOQUIUM**

**Jiajin Li (Stanford University)**

**December 4, 2023 - 4pm**

**TROY 2012**

## **Nonsmooth Nonconvex-Nonconcave Minimax Optimization: Algorithm Design and Convergence Analysis**

Nonsmooth, nonconvex-nonconcave minimax optimization has gained widespread interest in recent years in machine learning and data science. However, much of the existing work focuses on a variant of the gradient descent-ascent (GDA) algorithm, which exhibits several limitations: (1) They are only applicable to smooth problems, where gradient information is available. (2) They may not converge globally, and they may suffer from limit cycles. (3) No single algorithm can be universally applied to all minimax optimization problems, such as nonconvex-concave and convex-nonconcave minimax settings.

In this talk, we will tackle these challenges for a class of structured nonsmooth, nonconvex-nonconcave minimax optimization problems. The main difficulty in algorithmic design for minimax optimization is balancing the primal decrease and dual increase in an efficient way. To overcome this difficulty, we develop a novel primal-dual error bound that serves as the foundation for both convergence analysis and algorithmic design. This gives rise to a new algorithm design principle known as optimal primal-dual balancing. Following this principle, we develop a single algorithm, doubly smoothed (prox-linear)/ gradient descent ascent, which universally works for all minimax optimization problems. Our algorithm finds an  $\epsilon$ -stationary point in  $\mathcal{O}(\epsilon^{-4})$  iterations. If additional regularity is assumed (weaker than standard assumptions imposed in the literature), we obtain sharper, even optimal, iteration complexity results. We showcase the effectiveness of our algorithm in getting rid of limit cycles in challenging nonconvex-nonconcave minimax optimization problems.

*Refreshments served at 3:30pm 4<sup>th</sup> floor Lounge – Amos Eaton*

## Biographical Sketch

Currently, Jiajin Li is a postdoctoral researcher in the Department of Management Science and Engineering (MS&E) at Stanford University, hosted by Prof. Jose Blanchet. She also works closely with Prof. Yinyu Ye. Previously, Li received her Ph.D. degree in Department of Systems Engineering and Engineering Management from the Chinese University of Hong Kong (CUHK) in 2021, where she was advised by Prof. Anthony Man-Cho So. From Aug 2020 to Mar 2021, Li worked with Prof. Justin Solomon as a visiting Ph.D student in the Geometric Data Processing Group at Massachusetts Institute of Technology (MIT). Prior to joining CUHK, Jiajin Li obtained her bachelor's degree in Statistics from Chongqing University. Her research focus on mathematical optimization and its applications in data-driven decision making, machine learning, and data science.



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