Pengfei Li

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Education

Visiting Ph.D. in CMS, California Institute of Technology 06/2024 – present
Ph.D. in Computer Science, University of California, Riverside 09/2020 – present
M.S.E. in Robotics, Johns Hopkins University 08/ 2018 – 05/2020
B.E. in Electrical Engineering, Zhejiang University 09/ 2014 – 06/2018

Work Experience

Research Intern at Nokia Bell Labs 06/2023 - 09/2023
Research on dynamic digital twins for warehouse management.

Research Area

Nonlinear Optimization; Machine Learning; Reinforcement Learning; Computational Photography.

Technical Skills

Programming Languages & Softwares: C++, Python, CUDA, Cython, MATLAB, PyTorch, Pandas
Selected Courses: GPU architecture & Parallel Programming(A+), Vision as Bayesian Inference(A+), Optimization for Machine Learning (A), Artificial Intelligence(A), Applied Optimal Control (A-)

Selected Projects (Google Scholar)

Research Assistant, California Institute of Technology, Pasadena, CA 06/2022 – Present

LADO: Learning-Augmented Decentralized Online Convex Optimization (SIGMETRICS 25')

* Overview: learning-augmented decentralized online optimization in a networked multi-agent system
* Proposed a ML-augmented policy (LADO) for decentralized online optimization, which selects actions only based on local online information; Provided a worst-case robustness guarantees with respect to the a safe baseline policy

Towards Environmentally Equitable AI via Geographical Load Balancing (eEnergy 24')

* Overview: an equity-aware geographical load balancing algorithm to minimize AI's environmental footprint.
* Addressed the carbon and water footprint of AI system by dynamically scheduling users' demand; Proposed an online equity-aware GLB algorithm; Empirically evaluated the algorithm with the workload trace of BLOOM.

Research Assistant, University of California, Riverside, CA 10/2020 – Present

RCL: Robust Learning for Smoothed Online Convex Optimization (INFOCOM 23', NeurIPS 23')

* Overview: a framework solving the general SOCO problems (e.g. multi-step switching costs and feedback delay).
* Proposed a constrained-projection approach to combine untrusted ML predictions with a trusted expert online algorithm, which ensures a strict worst-case bound on performance; Demonstrated the performance of RCL on control applications (e.g. battery management for electric vehicle stations)

Reinforcement Learning for Online Bipartite Matching with Robustness Guarantees (ICML 23')

* Overview: a novel RL-based approach for edge-weighted online bipartite matching with robustness guarantees.
* Designed a novel online switching operation, which decides whether to follow the expert's or the RL's decision upon each online item arrival; Proposed a RL training algorithm by explicitly considering the online switching operation; Proven that our method is ρ-competitive against any given expert online algorithm; Provided empirical results for some real applications (e.g. movie recommendation, spatial crowdsourcing).

EC-L2O: Expert-calibrated learning to optimize (SIGMETRICS 22')

* Overview: the first framework to address the "how to learn" challenge for machine learning augmented algorithm in smoothed online convex optimization (SOCO) problems
* Proposed a new differentiable expert calibrator EC-L2O , which trains an ML-based optimizer by explicitly taking into account the downstream expert calibration; Provided theoretical analysis for EC-L2O, which bounds tail cost ratio and benefits the average performance; Conducted case study for sustainable datacenter demand response.

Research Assistant, Johns Hopkins University, Baltimore, MD 01/2019 – 05/2020

3D Human Pose Estimation in Crowded Scenes (ECCV'20 spotlight)

* Overview: a multi-person 3D pose estimation method in crowded scenes
* Utilized geometric constraints to solve ambiguity in localizing and matching human keypoints across multiple views, caused by crowded scenes; Formulated crowded human pose reconstruction as a graph optimization problem, considering prior distribution of human shape in 3D, iteratively refine human shape prior with 3D reconstruction results; Surpassed existing methods in crowded scenes evaluated with the MSCOCO keypoint metric

Car Pose Estimation with Context Constraints. (preprint)

* Overview: a car pose estimation framework in uncalibrated monocular camera, using global geometric context
* Proposed an iterative optimization scheme to reinforce consistency between global context and local appearance; Demonstrated our framework can significantly improve the performance of 6-DoF pose estimation using our accurate global context and focal length; Outperformed the state-of-the-art car activity recognition results with car pose estimation