Pengfei Li

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Education

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

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 (Full Publication List)

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

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.

Reinforcement Learning for Online Bipartite Matching with Robustness Guarantees (OpenReview)

* 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).

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

* 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; Demonstrate the performance of RCL on control applications (e.g. battery management for electric vehicle stations)

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. (arxiv)

* 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

Other Projects on Robotics

Project 1:Point cloud registration acceleration with CUDA

- Parallel programed Iterative Closest Point (ICP) algorithms using CUDA, implemented memory techniques (block shared memory, memory coalescing) to further speed up the algorithms.
- Achieved more than 10x speed up on EM-ICP algorithm. (Project Report)

Project 2: Car Self-localization and Navigation in Dynamic Environment

- Combined sample-based method with point cloud matching based method for 2D lidar based localization, improve the accuracy and robustness of re-localization module.
- Adopted Timed-Elastic-Band algorithm for local trajectory planner to avoid dynamic obstacles.
- Constructed a simulation environment in gazebo to evaluate our localization mapping and self-navigation algorithms. Deployed SLAM pipeline on a four wheeled robot with hardware parameter calibration. (JHU-HUB-NEWS)