DONGPING QI

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EDUCATION

Cornell University *08/2017 - Present*
Ph.D. in Applied Mathematics
Adviser: Alexander Vladimirsky

Shanghai Jiao Tong University *09/2013 - 06/2017*
B.S. in Mathematics (Zhiyuan Honor Program)
Adviser: Lei Zhang

RESEARCH INTERESTS

- Numerical Analysis; Computational Mathematics; Scientific Machine Learning.
- Optimal Control; Path Planning; Planning Under Uncertainty; Reinforcement Learning.

SKILLS

Programming Languages C++, Python, TensorFlow, MATLAB, Julia
Software & Tools LaTeX, GitHub

COURSEWORK

Real & Functional Analysis
Convex Optimization
Dynamical Systems
Probability & Stochastic Processes
Machine Learning for Intelligent Systems
Reinforcement Learning
Linear Programming
Matrix & Sparse Matrix Computations
Partial Differential Equations
Parallel Computing
Numerical Data Science

WORK AND RESEARCH EXPERIENCE

High-Performance Deep Learning Algorithms Using Dynamical Systems
Lawrence Livermore National Laboratory (virtual), NSF MSGI *06/2020 - 08/2020*

Research about interpretable deep neural networks and connections between deep learning and continuous dynamical systems.

Together with my mentors, I implemented a new type of neural network, named "SpliNet", which uses B-Spline basis functions to parameterize the layer weights and biases. The performance and robustness of this neural network has been tested on various supervised learning problems. SpliNet in general improves training accuracy and provides more robust predictions.

The network is constructed in Julia based on Flux.jl and Zygote.jl.

Optimal Control Under Uncertainty
Cornell University, REU Research Assistant *06/2018 - 08/2018*

Research about suitable model and efficient algorithms for path planning problems under uncertainty. Guided and cooperated with undergraduate students on two projects:

- Path planning when information of the target or environment is not known initially while can be revealed at a later time: We came up with a planning model using Hamilton-Jacobi-Bellman equations. Furthermore, we compared and contrasted different robust methods (risk-sensitive, chance-constrained optimality, distributionally robustness and so on) for uncertainty quantification. We also developed efficient numerical algorithms for some of the robustness approaches.
- Finding optimal strategies for vehicles encountering traffic lights with randomly switching time: We came up with several reasonable models and finished some numerical experiments.

Dynamic Factoring in Eikonal Equation
Cornell University, Research Intern *08/2016 - 12/2016*

Research about numerical methods for dealing with rarefaction fans caused by non-smooth boundaries, discontinuous PDE coefficients and boundary values.

Together with Prof. Vladimirsky, I developed a dynamic factoring algorithm which helps recover first-order convergence. In particular, the algorithm prevents numerical artifacts around rectangular obstacles when computing the solution for path planning.

The computation is implemented in C++ and visualized in MATLAB.

PUBLICATIONS

1. D. Qi, D. Bindel, A. Vladimirsky, "Surveillance Evasion Through Bayesian Reinforcement Learning." *Submitted for publication.*
2. S. Günther, W. Pazner, D. Qi, "Spline parameterization of neural network controls for deep learning." *Submitted for publication.*
3. D. Qi, A. Dhillon, A. Vladimirsky, "Optimality and robustness in path-planning under initial uncertainty." *Submitted for publication.*
4. D. Qi, A. Vladimirsky, "Corner cases, singularities, and dynamic factoring." Journal of Scientific Computing 79/3: 1456–1476 (2019).

TALKS & POSTERS

SpliNet: Modeling Neural Network Using B-Splines 08/27/2020
NSF MSGI Virtual Presentation

Path Planning Under Initial Uncertainty 12/09/2019
Scientific Computing and Numerics (SCAN) Seminar, Cornell University

Path Planning Under Initial Uncertainty 10/22/2019
Algorithms for Threat Detection Workshop (poster session), George Washington University

Rarefaction Fans and Dynamic Factoring in Eikonal Equation 07/17/2019
International Congress on Industrial and Applied Mathematics (ICIAM), Valencia, Spain