Qiyang (Colin) Li

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Research Interests

Efficient and robust learning algorithms that closely resemble human intelligence. Adversarial Robustness. Theories that could explain the empirical strength and vulnerability of existing deep learning models. Machine learning applications for robotics and control.

Education

2015.09 –
2020.05
(expected)

BASc in Engineering Science (Major in Robotics Engineering), *University of Toronto*, cGPA: **3.95/4.00**, sessional average (6 terms): 96.3, 92.2, 91.8, 91.8, 94.3, 96.4 .
BASc Thesis Advisor – Prof. Roger Grosse

Publications

2019 **Conference Paper**, **Qiyang Li***, Saminul Haque*, Cem Anil, James R Lucas, Roger B Grosse, and Joern-Henrik Jacobsen. Preventing gradient attenuation in lipschitz constrained convolutional networks. In *Advances in Neural Information Processing Systems (NeurIPS)*, 2019.

2019 **Conference Paper**, Sicong Huang, **Qiyang Li**, Cem Anil, Xuchan Bao, Sageev Oore, and Roger B. Grosse. Timbretron: A Wavenet(CycleGAN(CQT(audio))) Pipeline for Musical Timbre Transfer. In *International Conference on Learning Representations (ICLR)*, 2019.

2019 **Conference Paper**, Keenan Burnett, Andreas Schimpe, Sepehr Samavi, Mona Gridseth, Chengzhi Winston Liu, **Qiyang Li**, Zachary Kroeze, and Angela P Schoellig. Building a winning self-driving car in six months. In *International Conference on Robotics and Automation (ICRA)*, 2019.

2017 **Conference Paper**, **Qiyang Li**, Jingxing Qian, Zining Zhu, Xuchan Bao, Mohamed K Helwa, and Angela P Schoellig. Deep neural networks for improved, impromptu trajectory tracking of quadrotors. In *International Conference on Robotics and Automation (ICRA)*, 2017.

2017 **Pre-print**, **Qiyang Li**, Xintong Du, Yizhou Huang, Quinlan Sykora, and Angela P. Schoellig. Learning of coordination policies for robotic swarms. 2017.

Academic Experience

2017.12 –
Present

Research Student, Prof. Roger B. Grosse, *University of Toronto Machine Learning Group, Vector Institute.*

- **Lipschitz Convolutional Network**: Introduced a parameterization of orthogonal convolution that addressed both the common issues of Lipschitz-constrained model expressiveness and the optimization challenge from the disconnectedness of the orthogonal convolution space that we discovered. With this parameterization, our Lipschitz-constrained convolutional networks outperformed the state-of-the-art deterministic adversarial robustness under L_2 metric on CIFAR10 and MNIST, as well as achieving a better Wasserstein distance estimation compared against other competing Lipschitz-constrained architectures (to appear in NeurIPS 2019). Paper link: `arxiv.org/pdf/1911.00937.pdf`

- **Unsupervised Musical Timbre Transfer**: Developed a system that could perform high-fidelity raw waveform reconstruction from constant-Q transform representation for music data using conditional WaveNet. This model was part of the first waveform-to-waveform high-fidelity musical timbre transfer system we developed (Jointly supervised by Prof. Sageev Oore; accepted in ICLR 2019). Website: `www.cs.toronto.edu/~huang/TimbreTron`. Paper link: `arxiv.org/pdf/1811.09620.pdf`

- **Curriculum Learning for Automated Theorem Proving**: Investigating the learning of curriculum in the context of automated theorem proving where a teacher model online generates a distribution over theorems to maximize the learning efficiency of a student model that is trained on solving theorems from this evolving distribution. The goal of this project is to exploit this framework to accelerate the training of automated theorem provers, as well as strengthen their ability to prove harder theorems.

2017.01 – 2017.05	**Teaching Assistant, 3rd Year Undergraduate CS Course (Algorithm Design, Analysis and Complexity)**, *University of Toronto*.

- Duties including leading weekly tutorials and grading exams.

2016.05 – 2017.09	**Research Student, Prof. Angela P. Schoellig**, *Dynamic Systems Lab, University of Toronto Institute for Aerospace Studies*.

- **Neural Network on Improving Trajectory Tracking Performance of Quadrotors**: Improved trajectory tracking performance by 43% as measured by the RMS tracking error on ARDrones (on 30 random trajectories) against the baseline controller by refining the control inputs to the quadcopter controller using a neural network. This work was accepted in International Conference on Robotics and Automation (ICRA) 2017. Video: `youtu.be/Sl7pDtdwC7w`. Paper: `arxiv.org/pdf/1610.06283.pdf`.
- **Learning of Coordination Policy for Robotic Swarms**: Achieved faster convergence on partially observable multi-robot rendezvous task compared against circumcenter distributed control law by imitating globally optimized policy. Paper pre-print: `arxiv.org/pdf/1709.06620.pdf`.

Working Experience

2018.05 – 2019.09	**Deep Learning Intern**, *NVIDIA*, Santa Clara/Toronto.

- Software development for ISAAC SDK, a robotic framework for industrial applications (C++, Python)
- Contributed to the machine learning infrastructure of ISAAC SDK that allows users to deploy deep learning models conveniently.
- Worked on physics-based animation using deep reinforcement learning techniques that generated realistically looking human motions in simulation.
- Applied flow-based generative model for efficient video distribution modeling and likelihood estimation.

Organizations

2019	**Reviewer**, *International Conference on Robotics and Automation (ICRA) 2020*.
2018	**Reviewer**, *International Conference on Robotics and Automation (ICRA) 2019*.
2017.09 – Present	**Autonomy Sub-Team Member → Road and Lane Detection Team Lead**, *University of Toronto's Self-driving Car Team (aUToronto)*.

Achieved real-time lane detection with CPU-only constraint using a light-weight convolutional neural network. The team won the first two years of SAE AutoDrive Challenge (Python, C++, Robot Operating System). My contribution on light-weight lane detection design is part of a system paper that got published in International Conference on Robotics and Automation (ICRA) 2019. Paper: `arxiv.org/pdf/1811.01273.pdf`

2017.01 – 2019.04	**VP Academics → President (Co-founder)**, *University of Toronto Machine Intelligence Student Team (UTMIST)*.

Built a platform that connects undergraduate students to machine learning communities through educational workshops and talk series. Website: `utmist.github.io`.

2017.01 – 2018.12	**Team Member → Assistant Coach**, *University of Toronto ACM International Collegiate Programming Contest (ICPC) Team*, Toronto.

Competed in a team of three and achieved top 10 (out of 139 teams) in ACM-ICPC East Central North American Regional Round.

Awards

- National Olympiad in Informatics, China: Silver Medal (2012)
- Canadian Computing Competition Final Stage: 2 Silver Medals and 1 Gold Medal (2013 – 2015)
- First-Year Summer Research Fellowship Program, Faculty of Applied Science & Engineering, University of Toronto (2016)
- St. George Society Of Toronto Endowment Fund (2016)
- Kenneth Carless Smith Engineering Science Research Fellowship (2017)
- Satinder Kaur Dhillon Memorial Scholarship (2017)
- Daisy Intelligence Scholarships In Engineering Science (2018)
- Andrew Alexander Kinghorn Scholarship (2018)