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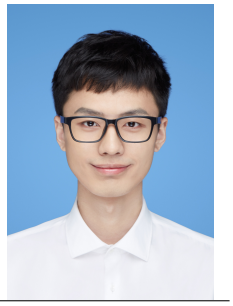

EDUCATION

Tsinghua University (THU) *August 2017 - Present*
Doctor of Philosophy (PhD)
School of Vehicle and Mobility

Beijing Institute of Technology (BIT) *July 2013 - June 2017*
Bachelor of Engineering
School of Vehicle Engineering Ranking: 1/130

REASEARCH INTERESTS

Reinforcement Learning (RL), Autonomous Driving, Optimal Control, Machine Learning

ACADEMIC SERVICE

Reviewer of IEEE ITSC, IEEE TNNLS, IEEE ITS, IEEE TVT, IJIS etc.

FEATURED RESEARCH

Mixed policy gradient
The accurate estimation of policy gradient (PG) is the core problem of RL. The current PG estimation methods include data-driven and model-driven, but their estimation errors are limited by value function estimation and model accuracy respectively. A mixed PG algorithm incorporating data and model is proposed, where the influence of value function estimation error and model error on PG estimation bias is clarified. Based on this, the weighting coefficient is designed to realize the minimum bias estimation of the PG, effectively improving the estimation of the update direction. The experiments in automatic driving show that the mixed PG algorithm achieves the best convergence speed and asymptotic performance. Compared with the data-driven PG, the convergence speed is improved by 5 times; Compared with the model-driven PG, the asymptotic performance is improved by 10 times.

Distributional soft actor-critic
The overestimation problem of the value function is the main challenge of RL. Overestimation will provide wrong policy optimization objectives and severely damage policy performance. This work propose a distributional RL algorithm to suppress the value overestimation, where it first discovers the origin of the overestimation and derives its analytical form. Furthermore, it clarifies the mechanism of overestimation suppression with the distributional value function. Combining the objectives of value distribution and maximum entropy policy, an policy iteration framework of distributional soft actor-critic is established, and the convergence proof of the optimal solution is presented. The experiments in benchmark environments show that compared with the current state-of-the-art algorithm, we improve the cumulative return, time efficiency and value function estimation accuracy by about 20%, 30% and 1000% respectively.

FEATURED PROJECTS

Development of general optimal control problem solver
For the optimal control problem, a general tool chain based on RL is developed, which realizes the functionalities of the full RL lifecycle including problem definition, policy training, automatic code deployment and HIL test. The core is a highly modularized and scalable RL library that compatible with many RL algorithms. Besides, it supports automatic solving and debugging, so that users can focus on theirs problems. It has been proved that the tool chain can obtain the approximate optimal solution of a large-scale constrained optimal control problem (the number of variables $>$ 100000 and the number of constraints $>$ 800000) in 200000 iterative steps.

Development of scalable and computationally efficient driving intelligence
For the high-level automated driving systems, an integrated control framework is proposed. The decision and control problems are divided into two levels: static path generation and dynamic optimal tracking, realizing the decoupling of scenarios and problems. The core of the method is to employ the mixed policy gradient to solve the constrained optimal control problem in the lower level, so as to improve the efficiency of online computing. On this basis, we put forward the vehicle-cloud collaborative online iterative learning architecture to support the self-evolution of driving intelligence. In real road tests, the calculation efficiency is 10 times higher than that of the baseline method.

PUBLICATIONS

- **Guan Y.**, Li S. E., Duan J., et al. Direct and indirect reinforcement learning (2021). In IJIS. (**Cover paper, IF: 10.312, Q1 top**)
- **Guan Y.**, Ren Y., Li S. E., et al. Centralized cooperation for connected and automated vehicles at intersections by proximal policy optimization (2020). in IEEE TVT. (**IF: 5.319, Q1**)
- Duan J.*, **Guan Y.***, Li S. E., et al. Distributional soft actor-critic for mitigating value overestimations (2021). In IEEE TNNLS. (*Equally contributed, **IF: 10.451, Q1 top**)
- **Guan Y.**, Ren Y., Ma H., et al. Learn collision-free self-driving skills at urban intersections with model-based reinforcement learning (2021). in IEEE ITSC. (**Top conference of intelligent vehicles, Best student paper: 2/597**)
- Ren Y., Duan J, Li S. E., **Guan Y.**, et al. Improving generalization of reinforcement learning with minimax distributional soft actor-critic: a simulation study (2020). In IEEE ITSC. **(Best student paper: 3/573)**
- Peng B., Mu Y., Duan J., **Guan Y.**, et al. Separated proportional-integral lagrangian for chance constrained reinforcement learning (2021). In IEEE IV. **(Best student paper Finalists: 3/220)**
- **Guan Y.**, Li S. E., Duan J., et al. Markov probabilistic decision making of self-driving cars in highway with random traffic flow: a simulation study (2018). In JICV.
- **Guan Y.**, Ren Y., Li S. E., et al. Integrated decision and control: towards interpretable and efficient driving intelligence (2021). in IEEE Cybernetics (under review). Available at https://arxiv.org/pdf/2103.10290.pdf
- **Guan Y.**, Duan J., Li S. E., et al. Mixed policy gradient (2021). In IEEE TNNLS (under review). Available at https://arxiv.org/pdf/2102.11513.pdf
- Li S. E., **Guan Y.**, Hou L., et al. Key technique of deep neural network and its applications in autonomous driving (2019). In JASE.
- Kong Y.*, **Guan Y.***, Duan J., et al. Decision-making under on-ramp merge scenarios by distributional soft actor-critic algorithm (2021). In IEEE TVT (under review). Available at https://arxiv.org/pdf/2103.04535.pdf
- Gao J.*, **Guan Y.***, Li S. E., et al. Beyond backpropagate through time: efficient model-based training through time-splitting algorithm (2021). In IJIS (under review).
- Ma H., **Guan Y.**, Li S. E., et al. Feasible actor-critic: constrained reinforcement learning for ensuring statewise safety (2021). In JMLR (under review). Available at https://arxiv.org/pdf/2105.10682.pdf
- Li J., Li S. E., **Guan Y.**, et al. Ternary policy iteration algorithm for nonlinear robust control (2021). Available at https://arxiv.org/pdf/2007.06810.pdf
- Jiang J., Ren Y., **Guan Y.**, et al. Integrated Decision and Control at Multi-Lane Intersections with Mixed Traffic Flow (2021). In ICoIV.
- Duan J., Li S. E., **Guan Y.**, et al. Hierarchical reinforcement learning for self-driving decision-making without reliance on labeled driving data (2020). In IET ITS.
- Peng B., Mu Y., **Guan Y.**, et al. Model-based actor-critic with chance constraint for stochastic system (2021). In IEEE CDC.
- Xin L, Kong Y, Li S. E., Chen J., **Guan Y.**, et al. Enable faster and smoother spatio-temporal trajectory planning for autonomous vehicles in constrained dynamic environment (2020). In JAE.
- Tang K., Li S. E., Yin Y., **Guan Y.**, et al. Approximate optimal filter for linear gaussian time-invariant systems (2021). In IEEE ICoIV.
- Zhang Y., Mu Y., Yang Y., **Guan Y.**, et al. Steadily learn to drive with virtual memory (2021). Available at https://arxiv.org/pdf/2102.08072.pdf.
- Ma H., Chen J., Li S. E., Lin Z., **Guan Y.**, et al. Model-based constrained reinforcement learning using generalized control barrier function (2021). In IEEE IROS.
- Duan J., Ren Y., Zhang F., **Guan Y.**, et al. Encoding Distributional Soft Actor-Critic for Autonomous Driving in Multi-lane Scenarios (2021). In IEEE TNNLS (under review).
- Peng B., Duan J., Chen J., Li S. E., Zhang C., Xie G., **Guan Y.**, et al. Separated proportional-integral lagrangian for model-based chance-constrained reinforcement learning (2021). In IEEE TNNLS (under review).
- Li S. E., Cheng B., Xin L., **Guan Y.**, et al. "An adaptive driving style trajectory planning method". PTC Patent No. PCT/CN2019/070859.

  * Equally contributed

AWARDS

Best student paper in IEEE ITSC 2021 (Ranking: 2/597)	2021
Cover paper in IJIS (IF: 10.312)	2021
Best student paper Finalists in IEEE IV 2021 (Ranking: 3/220)	2021

Best student paper in IEEE ITSC 2020 (Ranking: 3/573)	2020
First-class scholarship for comprehensive excellence in Tsinghua University	2021
Outstanding Graduates of Beijing	2017
National Scholarship for two consecutive years	2014-2016
Pacemaker to Merit Student for three consecutive years	2014-2016