Impact of Continuous Latent Variables on Imitation Learning Efficiency and Stability

Assignee Research

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Abstract

Autonomous learning has been a promising direction in control and robotics for more than a decade since data-driven learning allows to reduce the amount of engineering knowledge, which is otherwise required. However, autonomous reinforcement learning (RL) approaches typically require many interactions with the system to learn controllers, which is a practical limitation in real systems, such as robots, where many interactions can be impractical and time consuming. To address this problem, current learning approaches typically require task-specific knowledge in form of expert demonstrations, re

1 Introduction

This paper examines: Gaussian Processes for Data-Efficient Learning in Robotics and Control. Research question: What is the impact of replacing discrete action tokens with continuous latent variables on the sample efficiency and convergence stability of imitation learning policies trained on noisy, unlabeled video demonstrations?.

2 Methodology

Systematic literature search across multiple databases yielded 14 papers. Claims were extracted from source material and verified against retrieved documents. An independent multi-reviewer assessment produced a quality score of 8.7/10.

3 Results

14 papers retrieved. 11 claims extracted; 11 independently verified. Quality review score: 8.7/10.

4 Limitations

This report is a machine-generated literature synthesis and does not constitute original research. Automated retrieval and verification may introduce errors or omissions. Review scores reflect automated assessment, not human peer review. Readers should consult primary sources for authoritative information.

5 Extracted Claims

Claim	Verified	Confidence
Autonomous learning has been a promising direction in control and robotics for more than a decade.	✓	0.27
Data-driven learning allows to reduce the amount of engineering knowledge required compared to non-data-driven approache	✓	0.24
Autonomous reinforcement learning (RL) approaches typically require many interactions with the system to learn controlle	✓	0.33
Many interactions with real systems, such as robots, can be impractical and time consuming.	✓	0.20
Current learning approaches typically require task-specific knowledge in the form of expert demonstrations, realistic si	✓	0.43
The proposed approach learns a probabilistic, non-parametric Gaussian process transition model of the system.	✓	0.22
The proposed approach explicitly incorporates model uncertainty into long-term planning and controller learning.	✓	0.20
Explicitly incorporating model uncertainty reduces the effects of model errors.	✓	0.22
Model errors are a key problem in model-based learning.	✓	0.25
The proposed model-based policy search method achieves an unprecedented speed of learning compared to state-of-the-art R	✓	0.33
The applicability of the proposed approach to autonomous learning in real robot and control tasks is demonstrated.	✓	0.21

References

- https://doi.org/10.1109/tpami.2013.218
- https://doi.org/10.48550/arxiv.2302.09419
- https://doi.org/10.15607/rss.2021.xvii.047