# Neural Ordinary Differential Equations based System Identification for Reinforcement Learning with Provable Guarantees

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**Résumé**

Stability guarantees have been developed for Model-Based Reinforcement Learning (MBRL) through Control Lyapunov Function (CLF) and Input-to-State Stable CLF (ISS-CLF) conditions, but these guarantees critically rely on the availability of an accurate system model. This work addresses this limitation by leveraging nonlinear system identification to enable stable MBRL. A continuous-time Neural Ordinary Differential Equation (NODE) model is first identified from measured data and subsequently integrated into an off-policy Policy Iteration (PI) framework. The identified NODE model enables admissible policy initialization via a Quadratic Program enforcing NODE-based CLF constraints. During exploration, stability is maintained by imposing NODE-based ISS-CLF constraints. The resulting controller achieves model-optimal performance while preserving closed-loop stability throughout the process. Simulation results validate the effectiveness of the proposed approach.

**Mots-Clés:** Continuous, Time System Identification, Reinforcement Learning, Control Learning

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