TECHNISCHE UNIVERSITÄT WIEN
Vienna University of Technology

INSTITUT FÜR MECHANIK UND MECHATRONIK
Mechanics & Mechatronics

# Announcement Project- and Seminarworks

## Deep Reinforcement Learning (Deep RL) for robust control of unstable systems

### Motivation and Content

Technological advancements, particularly the continuous increase in computing power and the development of high-performance hardware have led to a growing significance of machine learning (ML) and reinforcement learning (RL) in recent years. The rapid progress in artificial intelligence (AI) is opening new possibilities for innovative applications across various fields – from robotics and autonomous control to the optimization of complex processes.
The goal of this project is to investigate the potential of reinforcement learning for controlling unstable systems. A model-free RL algorithm will be developed and trained to stabilize the system effectively. In addition to configuring neural networks, various RL algorithms and agent types will be considered to determine the optimal control strategy. Both simulations and real-world experiments will be conducted to validate the practical applicability of these approaches.
A key aspect of this project is the comparison of RL-based control methods with established techniques from classical control theory, such as the Linear Quadratic Regulator (LQR) and Model Predictive Control (MPC). The final evaluation will be based on relevant Key Performance Indicators (KPIs), including convergence speed, control quality, stability, and generalization capability, assessed through both simulations and experiments on the real test setup in the mechatronics laboratory.

### Tasks

- Development and training of an RL agent for stabilizing an unstable system using various model-free algorithms
- Optimization of neural networks and evaluation of different RL algorithms
- Conducting simulations and experiments for validation on the real test setup
- Comparison of RL agents in terms of training time, computational effort, and stability
- Benchmarking against classical control approaches (LQR, MPC, etc.)
- Analysis of results based on relevant KPIs (e.g., convergence speed, control performance)
- Documentation and presentation of results

### Your Profile

- Successfully completed advanced courses in control engineering offered by the institute
- Experience in laboratory work is an advantage
- Knowledge and understanding of reinforcement learning are beneficial

The thesis can be written in either German or English.
If you are interested or have any questions, feel free to contact us.

### Contact

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