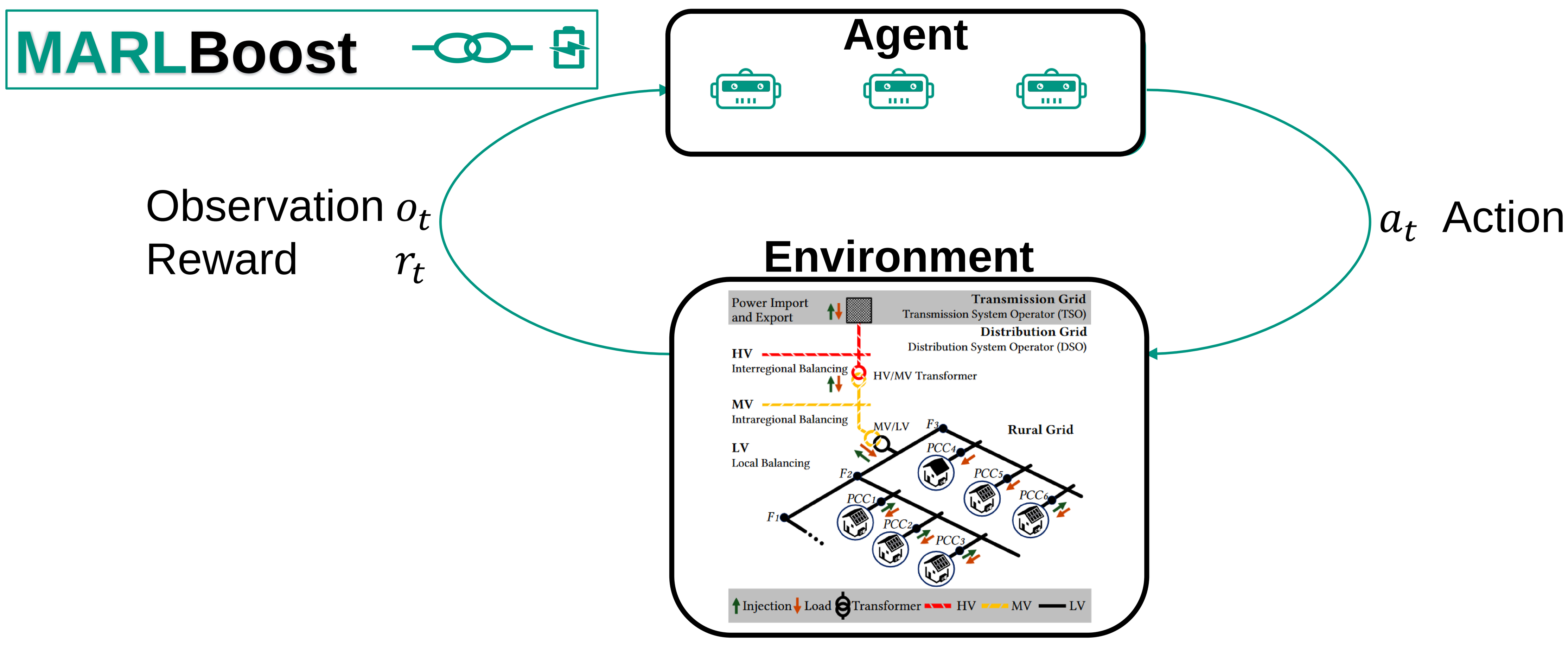
Institute for Automation and Applied Informatics (IAI)

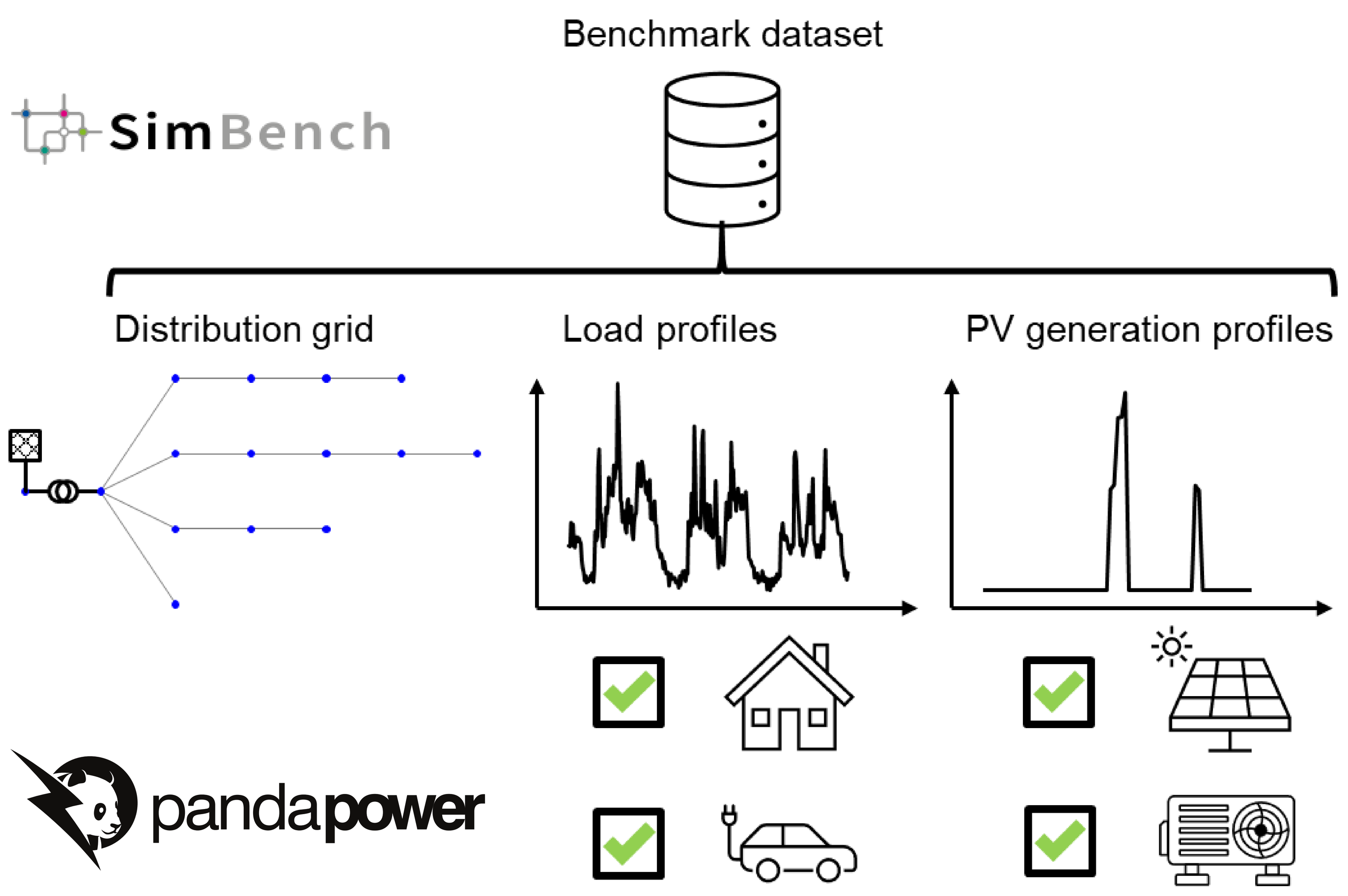
Master thesis

Multi-Agent Reinforcement Learning Grid-Oriented Control for Distributed Energy Resource on Smart Grids

The shift towards decentralized renewable energy sources like solar and wind requires energy demand to adjust to weather conditions, posing challenges for power grids. Traditional solutions involve reinforcing the grid or using management systems based on forecasts and linear optimization or rule-based methods. These conventional models are complex and rigid and require significant manual adaptation to different grid topologies, often limiting optimization potential. As an alternative, Deep Reinforcement Learning (DRL) offers a more flexible and adaptable approach. DRL autonomously explores and learns from its environment, eliminating the need for explicit mathematical formulations and making it ideal for dynamic energy management systems.

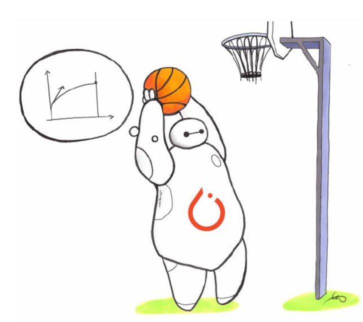


This work aims to develop a control approach based on Multi-Agent Deep Reinforcement Learning (MARL), particularly model-free methods, for distribution grids with photovoltaic (PV) systems and energy storage. Simulations are performed iteratively over one year at 15-minute intervals, resulting in 96-time steps per day. he hypothesis is that employing multiple intelligent agents operating within a network can alleviate grid bottlenecks, such as line capacity and transformer peaks while enhancing grid flexibility and resilience.
Master's students are free to use our high-performance computer clusters, HAICORE, for the work on their theses.



Python libraries:

- pandapower (https://github.com/e2nIEE/pandapower)
- simbench (https://github.com/e2nIEE/simbench)
- stable-baselines3 (https://github.com/DLR-RM/stable-baselines3)
- gymnasium (https://github.com/Farama-Foundation/Gymnasium)



References

[1] Demirel, G., Grafenhorst, S., Förderer, K., & Hagenmeyer, V. (2024). Impact and integration of mini photovoltaic systems on electric power distribution grids. arXiv. https://arxiv.org/abs/2404.02763

Advisor:
Gökhan Demirel, M.Sc.

Programming language:
Python

System, Framework(s):
Windows, Linux, or macOS

Required skills:
- Solid mathematical foundations
- Advanced Python knowledge

Language(s):
German, English

For more information, please contact:

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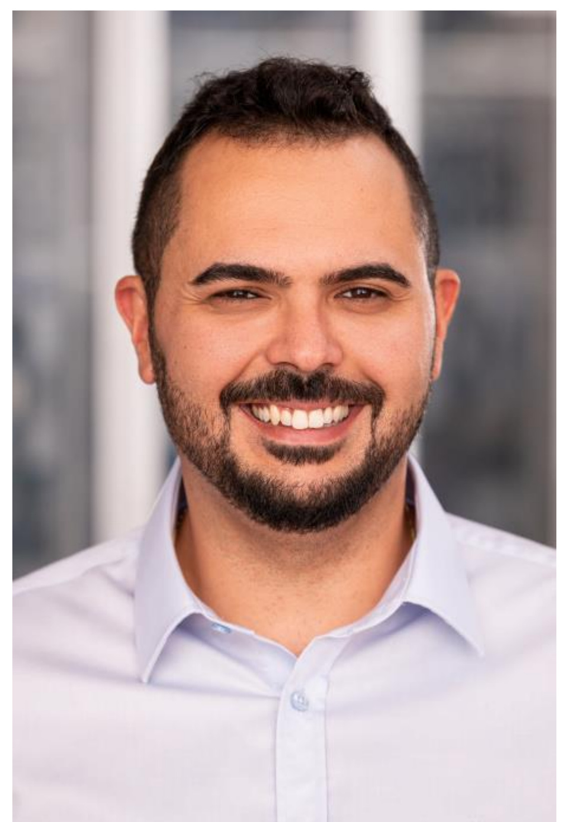

Submit your application directly, including your current grades.

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