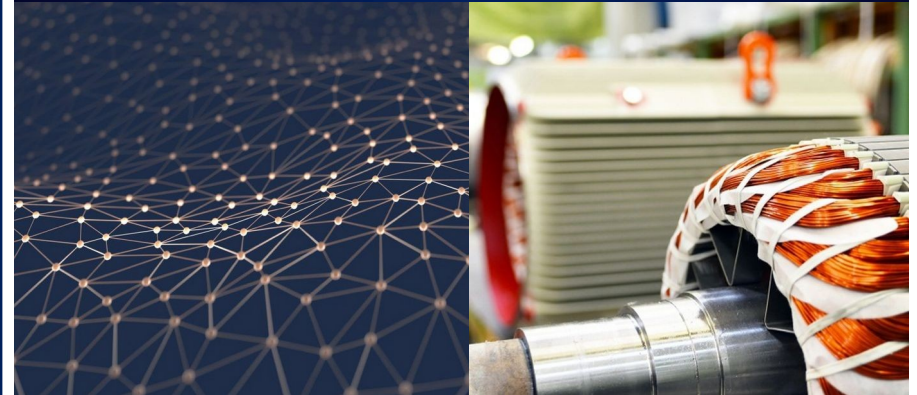
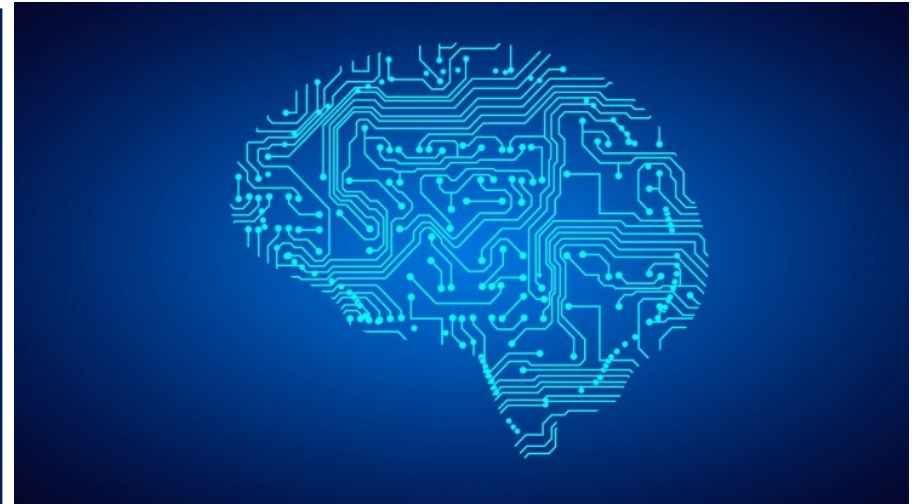




Power Electronics and Electrical Drives
Prof. Dr.-Ing. Joachim Böcker



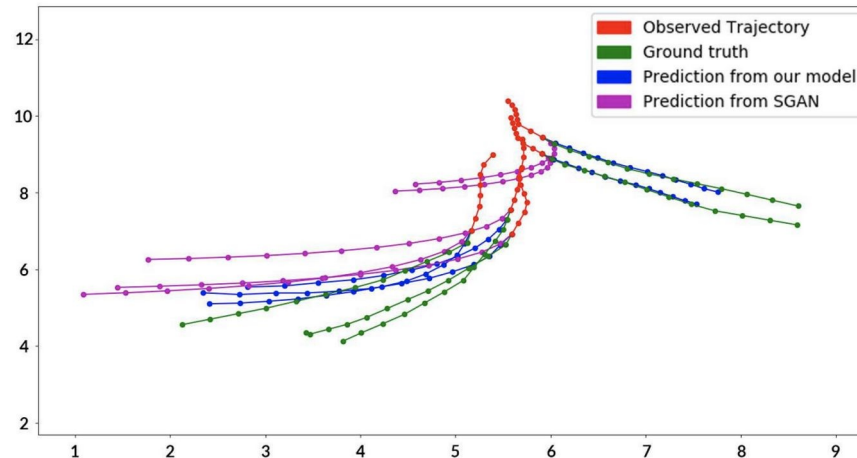
UNIVERSITÄT PADERBORN
Die Universität der Informationsgesellschaft

PG SS 2023 Electric Drive Simulation

04/06/2023

Wilhelm Kirchgässner
Maximilian Schenke
Barnabas Haucke-Korber
Dr.-Ing. Oliver Wallscheid

- Mathematical models approximate physical processes
 - Digital twins
 - Support design phase
- Often tightly integrated into SW frameworks



Rust or C++ Developer/Software Engineer – Tesla Bot Simulations (All levels)

Tesla · Palo Alto, CA

\$114,000/yr - \$150,000/yr + Sign-on bonus, Stock, Stock options (LinkedIn est.) · Full-time · Entry level

10,001+ employees · Motor Vehicle Manufacturing

See how you compare to 128 applicants. [Try Premium for free](#)



Bosch Gruppe

System Simulation Engineer for Sensor Systems (f/m/div.)

Reutlingen · Feste Anstellung · Vollzeit · Erschienen: vor 2 Wochen

[Gehalt anzeigen](#)

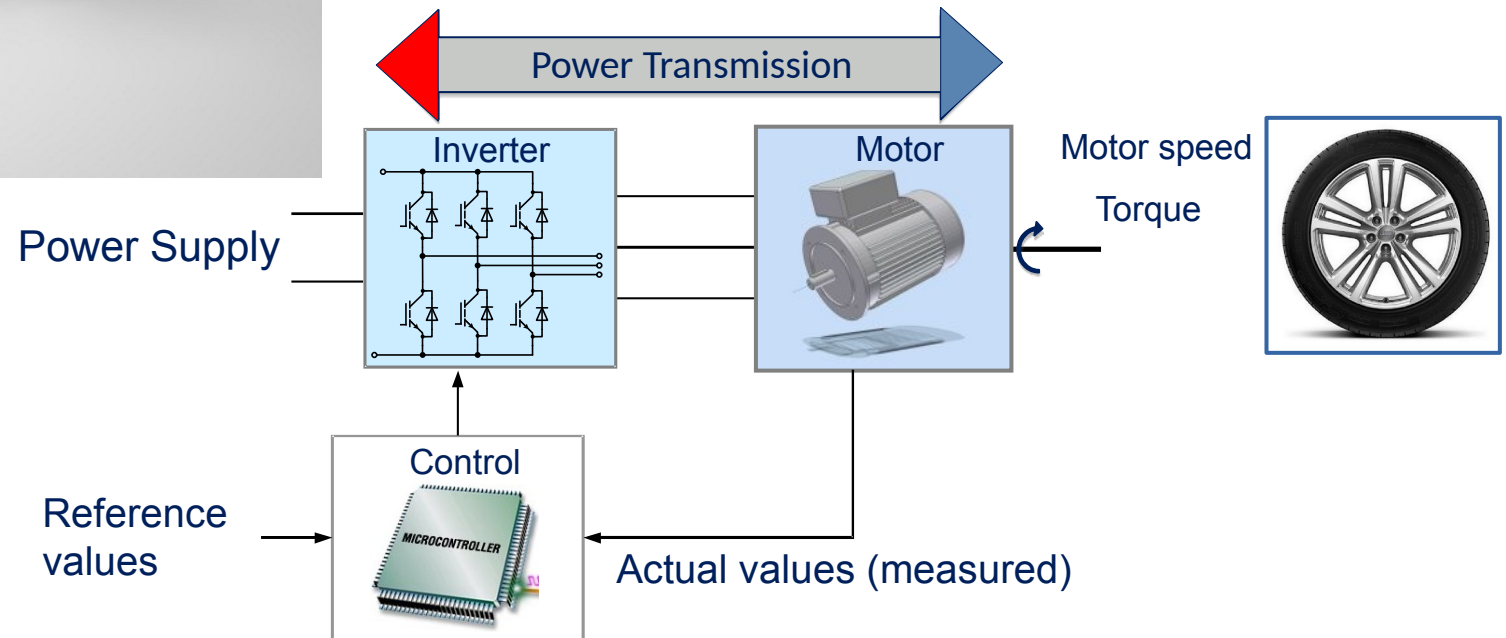
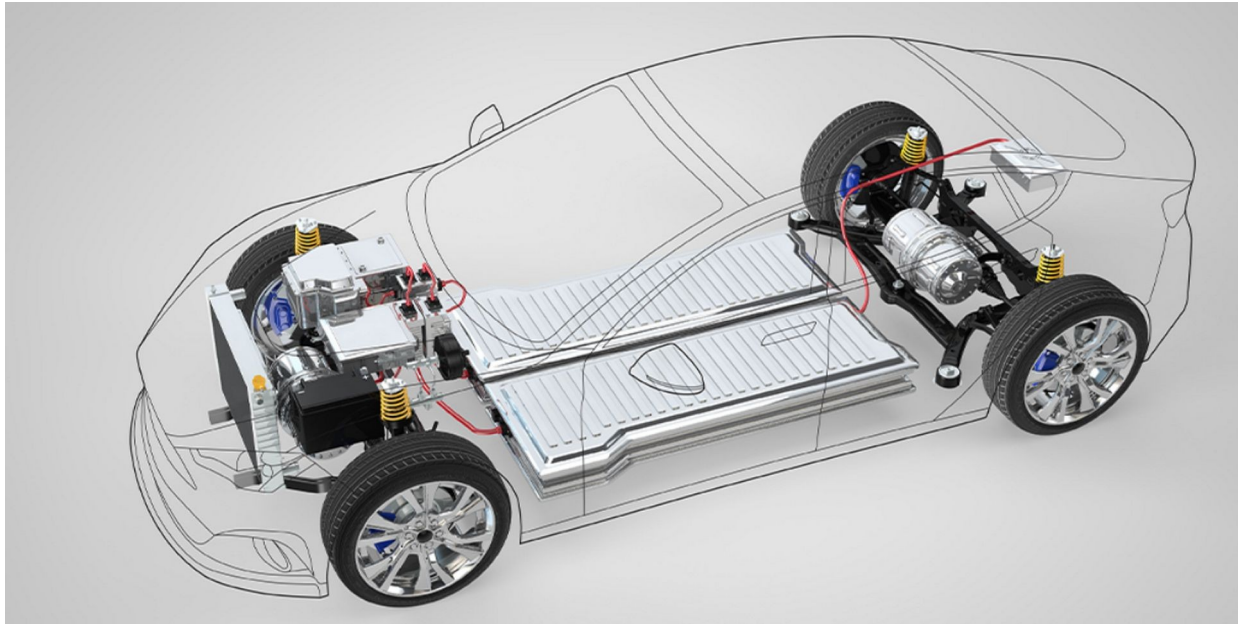


Airbus Group

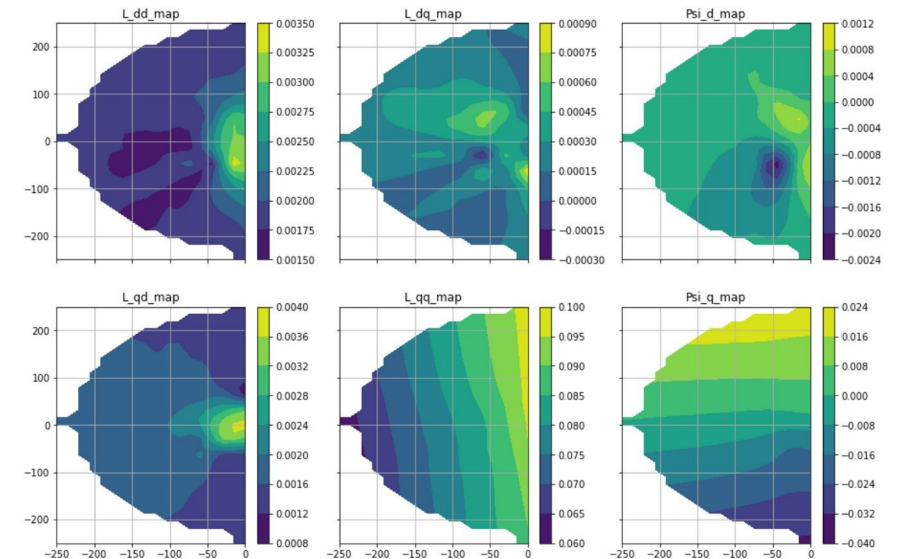
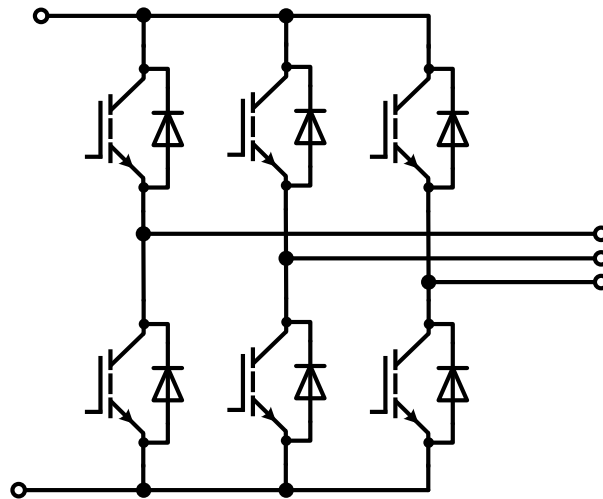
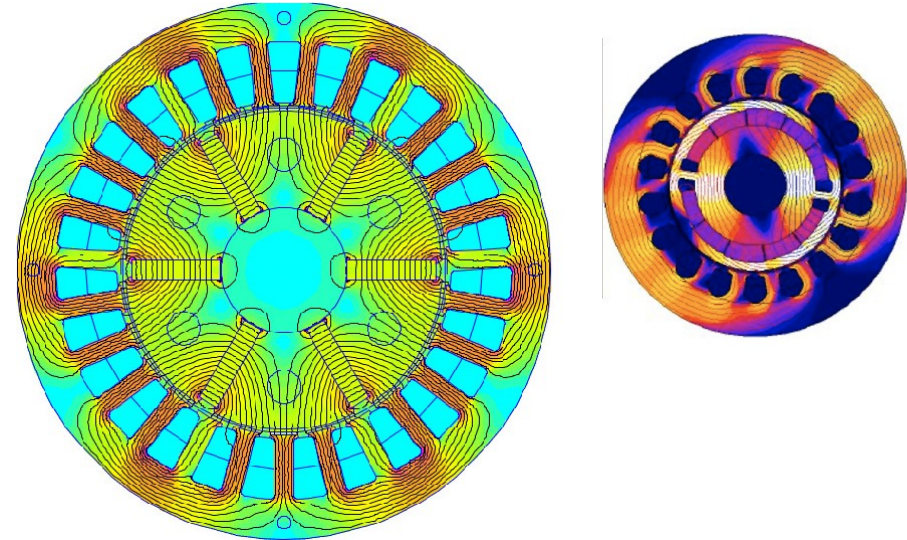
Simulation Software Engineer (m/f/d)

Manching · Feste Anstellung · Vollzeit · Erschienen: vor 3 Tagen

[Gehalt anzeigen](#)

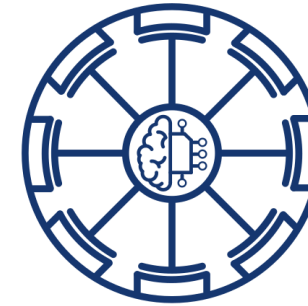


- Rotating magnetic fields interact
- Inductances depend on operation point
- Inverter has finite switching states
 - Switched system cannot produce perfect sinusoidal waves
 - Signal delays



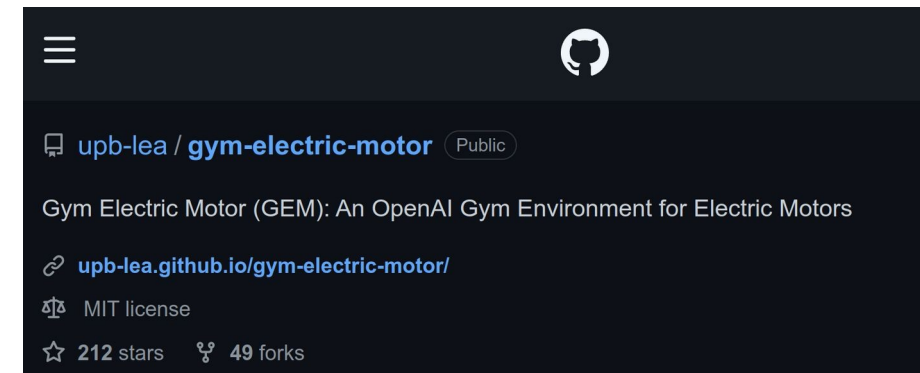
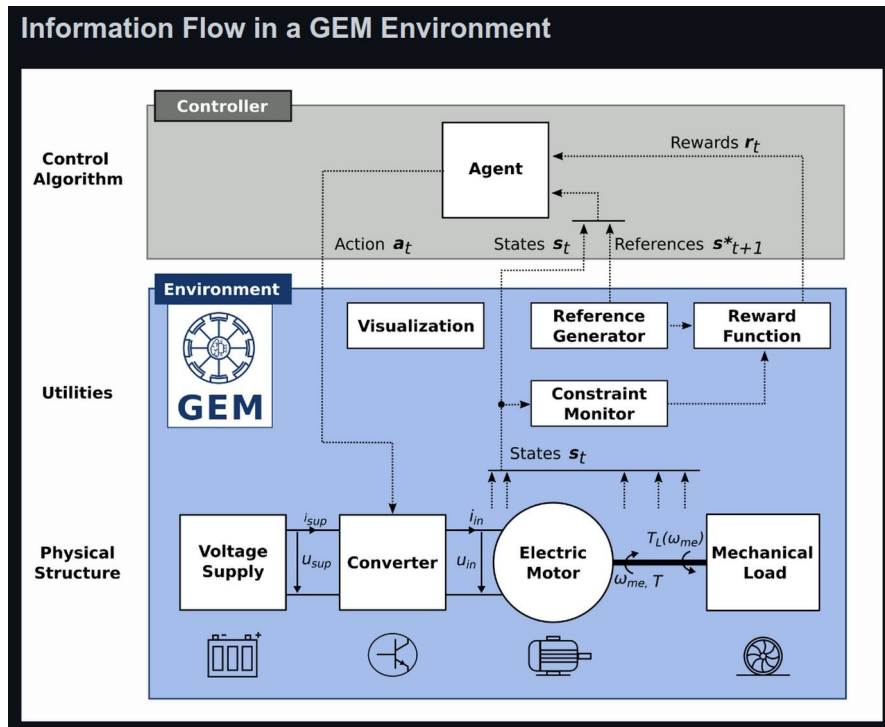
Previous Work on Project Groups

- Motor simulation toolbox designed with the OpenAI Gym API (the people behind ChatGPT)
- Many motors but only with simple math. models
- Single scenarios are simulated at once only



GEM

<https://github.com/upb-lea/gym-electric-motor>



- **Extend the OpenAI Gym environment (+Doc)**
- Update API to gymnasium (successor of gym)
- Add batch processing (PMSM example exists)
- Add multi-level converter
- Add saturation maps (PMSM example exists)
- Add pulse pattern action space
- Evaluate conversion from numpy to JAX
- Create tutorial on using pylecan for generating a saturation map
- Check motulator (contender) for more parasitic effects not covered in GEM so far



Thank you for your attention

Contact:

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