Master's thesis proposal:

Reinforcement learning with Modia vehicle models

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Problem description: Training a controller in simulation is fast, scalable and safe. Therefore, the first training of learning-based controllers is usually done offline, supported by appropriate multi-domain models. Because the controller is adapted based on data generated from the simulation model, the performance as well as the robustness in the real-world application strongly relies on the accuracy of the simulation model. Since in model-free Reinforcement Learning no synthesis model is necessary, a high-fidelity model can be used for training. Within this work it will be investigated how multi-domain Modia models can be included in the training process in order to obtain a controller that performs well in real world applications. The investigation will be performed on various benchmarks of gradually more complex models with the goal to design a learning-based controller to improve the dynamics of a real-world vehicle.

Modia is a Julia package for multi-domain modeling and simulation and can be seen as a prototype environment for the development of next-generation Modelica (a wide-spread multi-domain modeling language). The master thesis will be based on existing knowledge and templates at DLR-SR where simple Julia differential equations are used with Reinforcement Learning packages in Python. The Julia ecosystem provides learning-based packages, but with emphasis on methods utilizing automatic differentiation. The drawback is that there are various restrictions for automatic differentiation in Julia limiting significantly the potential Modia models that can be utilized. The Reinforcement Learning based Python packages allow us to utilize any Modia models without problems and are in general more developed and utilized in a much larger community than the equivalent Julia packages.

Note: the supervision from DLR-SR side (where people are located near Munich, Germany), will be done completely remotely (with web meetings).

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