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An Application of Meta-Modeling Methods for Surrogating Lateral Dynamics Simulation in Layout-Optimization for Electric Drivetrains

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Abstract : Electric vehicles offer a high variety of possible drivetrain topologies with up to 4 motors. Multi-motor-designs can have several advantages regarding traction, vehicle dynamics, safety and even efficiency. With a rising number of motors, the whole drivetrain becomes more complex. All permutations of gearings, drivetrain-layouts, motor-types and –sizes lead up in a very large solution space. Single elements of this solution space can be analyzed by simulation methods. In addition to longitudinal vehicle behavior, which most optimization-approaches are restricted to, also lateral dynamics are important for vehicle dynamics, stability and efficiency. In order to compete large solution spaces and to find an optimal result, genetic algorithm based optimization is state-of-the-art. As lateral dynamics simulation is way more CPU-intensive, optimization takes much more time than in case of longitudinal-only simulation. Therefore, this paper shows an approach how to create meta-models from a 14-degree of freedom vehicle model in order to enable a numerically efficient drivetrain-layout optimization process under consideration of lateral dynamics. Different meta-modelling approaches such as neural networks or DoE are implemented and comparatively discussed.

Keywords : driving dynamics, drivetrain layout, genetic optimization, meta-modeling, lateral dynamicx
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