

# Digital Twin of an electric municipal vehicle

## Graduate



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**Introduction:** The electrification of vehicles is a current topic that is being focused on in various areas of technology. For a long time now, not only passenger vehicles have been operated electrically, more and more commercial vehicles are relying on advanced drive technology. This means that additional factors must be considered, for example, in the design of a battery and its cooling system. The development of such vehicles takes a lot of development time. For this reason, a Digital Twin of the electric street cleaning vehicle developed by the company Durot Electric GmbH was made in this work. The goal was to build a basic digital model, which can be adapted in a simplified way to other vehicles of similar design in the following projects of Durot Electric. This model speed up future development projects.

**Approach:** The simulation was implemented in the Mathworks Simulink environment. The semi-graphical programming environment allowed the building of the model using a basic physical structure. The simulation structure is strongly based on the previously developed item definition. The model is divided into systems consisting of the basic components of the vehicle.

With all systems combined, an image of an Electric Vehicle was created to simulate real driving cycles. In many areas, simplifications were chosen for the simulation, which represent the system behavior with the desired accuracy. The most important elements of the simulation are the battery storage, the powertrain, and the thermal consideration of all components. In addition, all auxiliary units were also modeled, which are electrical loads for the battery. In addition to setting up the simulation, parameterization of the components was an important task. For that, a lot of data could be taken from the known manufacturer specifications. But especially in the thermal area, these data were rather sparse. This meant that the model had to be adapted and optimized step by step with measurement data from the real vehicle.

**Result:** In the end, the model was tested and compared with the existing measurement data of the real vehicle. It was found that the system characteristics of the components and systems represented the real vehicle well. Very good results are achieved for the thermal elements considered, such as the drive motor. In addition, some factors with a large influence on the system behavior of the electric drive could be discovered. The current state of the simulation shows a well-approximated image of the real vehicle and can be used for further simulations or developments in this field. For example, in development projects of electric vehicles and the analysis of new cooling concepts.

## Advisor

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## Co-Examiner

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## Subject Area

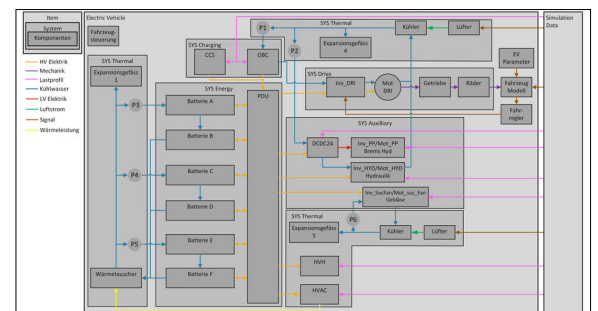
Electronics and Control Engineering

Example of the simulated electrical street cleaning machine  
Own presentation



Item Definition Digital Twin

Own presentation



Compare measured and simulated engine temperature

Own presentation

