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Control strategy of a fuel-cell power module for electric forklift

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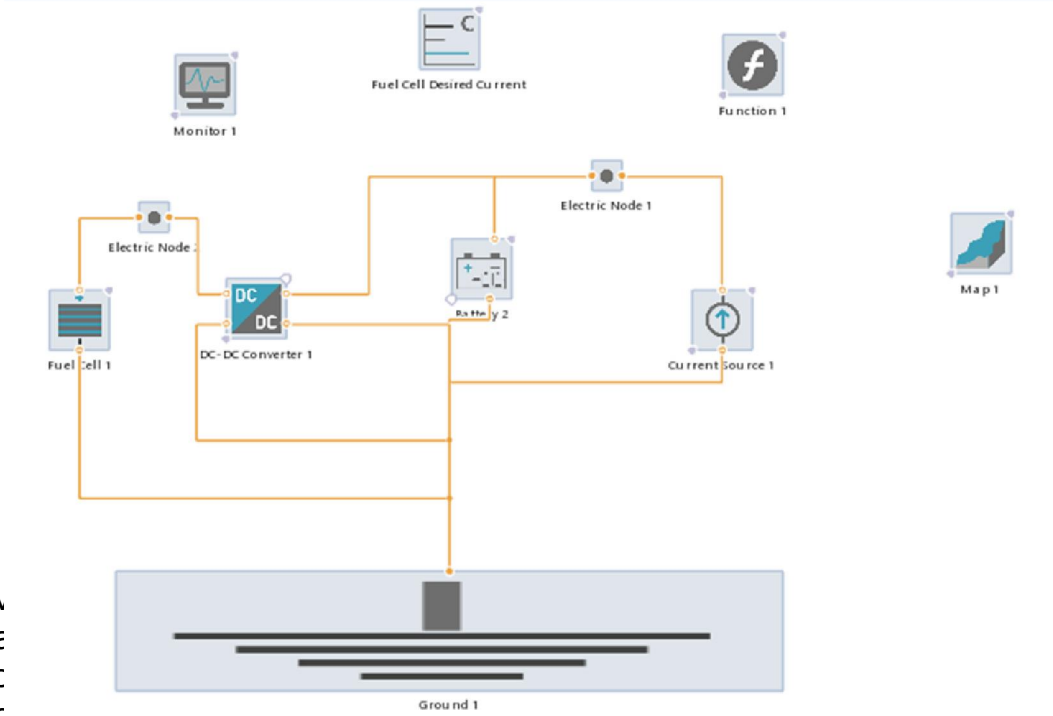
Abstract
Material handle vehicles are irreplaceable and widely used in the industry. In indoor operations and other conditions which have strict requirements, lift trucks, powered by lead-acid batteries, dominates. The weaknesses of battery modules are a short working time and a long charging time which result in cost increase. The solution is the high efficiency, zero emission energy produced with fuel cell. In this article, analysis and optimization of the fuel cell/battery hybrid system were provided. For the specific application, an optimal battery capacity and fuel cell stack power were determined. An optimum energy strategy has been defined for different operation cycles and working conditions. A numerical model of specific forklift powered by fuel cell – battery hybrid system has been made and validated with available experimental data. Simulations have been made for different operating cycles (according to VDI2198 standard) and validated with experimental data [1].
The most important influence parameters on forklift performance have been defined and evaluate, such as energy lost, ageing, different polarization curves, different load cycles of the battery. With the detailed analysis of output characteristics and energy flow of the fuel cell and battery, a load current following the energy management strategy is proposed to realize the management and distribution of the fuel cell/battery hybrid forklift energy to improve the system energy efficiency, dynamic response performance, and extend the life of the fuel cell. Simulation with different battery size/capacity and fuel cells has been investigated and optimum battery capacity and fuel cell stack power have been defined.

A schematic of the fuel cell/battery power pack for the lift truck is shown in Figure 1. The battery is directly connected to the DC bus, whereas the fuel cell stack is coupled to the bus via a unidirectional DC/DC converter that enables control of the fuel cell stack output power.



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References
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