

PEMFC Hybrid System Optimization Methodology: Application to the Heavy-Duty Transport Case

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Decarbonization of Heavy-Duty (HD) transport sector has drowned the attention of the energy research recently. Proton exchange membrane fuel cell (PEMFC) systems arise as fundamental in piece in this process due to their easier and faster refueling process that can be fitted in the already existing day-to-day routines of freight transports. However, the HD application calls for challenging durability requirements [1]

PEMFC power response is slower than the power demand of road transport and therefore, they are typically combined in hybrid systems to compensate this hindrance. Energy storage systems (ESS) like batteries or supercapacitors are used to alleviate the highly dynamic power demand required. Despite of the increase on system complexity, hybridization can grow into a pivotal strategy to address the durability requirements to the entire hybrid system and in addition to material and component development. On the other hand, hybridization may be used a fundamental factor to shape the power demand to the PEMFC not only for durability optimization purposes but also for system efficiency optimization.

This work will use a systematic methodology [2] to calculate power demand in a hybrid HD PEMFC system-based vehicle. This method will be also used to optimize the hybrid system (size and strategy) to alleviate the power demand to the PEMFC and maximize system efficiency. The impact of parasitic consumption for the balance of plant components on the efficiency will be analyzed and proposition of component performances that optimize operation conditions will be given.

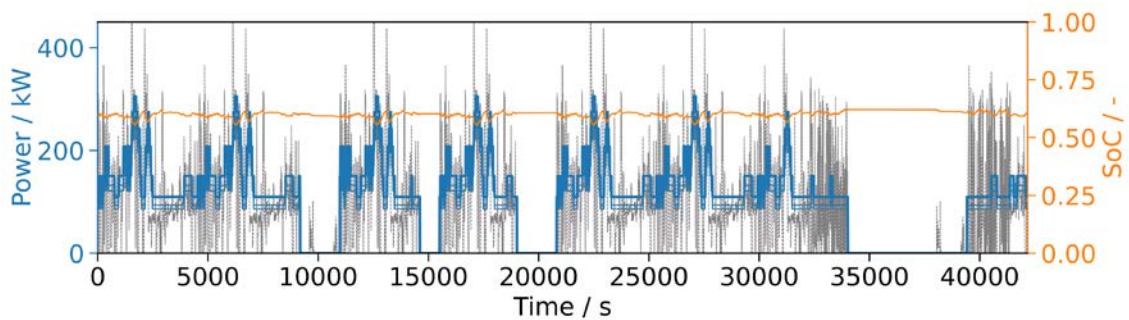


Figure: Stack power demand (grey), PEMFC power (thick blue), PEMFCs net power (thin blue) and ESS state-of-charge (SoC, orange) for an analyzed driving cycle

References

- [1] Strategic Research and Innovation Agenda 2021 – 2027. 2022, Clean Hydrogen JU.
- [2] Sánchez-Monreal *et al.* Application relevant load cycles for PEMFC component development and hybrid system optimization (In Preparation)

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