

Study of Pressure and Air Mass Flow Effect on Output Power of PEM Fuel Cell Powertrains in Vehicles and Airplanes- A Simulation-based Approach

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Abstract : The performance of Proton Exchange Membrane Fuel Cell (PEMFC) is highly dependent on the pressure and mass flow of media (Hydrogen and air) throughout the cells and the stack. Higher pressure, on the one hand, results in higher output power of the stack but, on the other hand, increases the electrical power demand of the compressor. In this work, a simulation model of a PEMFC system for vehicle and airplane applications is developed. With this new model, the effect of different pressures and air mass flow rates are investigated to discover the optimum operating point in a PEMFC system, and innovative operation strategies are implemented to optimize reactants flow while minimizing electrical power demand of the compressor for optimum performance. Additionally, a fuel cell system test bench is set up, which contains not only all the auxiliary components for conditioning the gases, reactants, and flows but also a dynamic titling table for testing different orientations of the stack to simulate the flight conditions during take-off and landing and off-road-vehicle scenarios. The results of simulation will be tested and validated on the test bench for future works.

Keywords : air mass flow effect, optimization of operation, pressure effect, PEMFC system, PEMFC system simulation

Conference Title : ICHEFCT 2022 : International Conference on Hydrogen Energy and Fuel Cells Technology

Conference Location : Dubrovnik, Croatia

Conference Dates : October 06-07, 2022