VIRTUAL-FCS

VIRTUAL & PHYSICAL PLATFORM FOR FUEL CELL SYSTEM DEVELOPMENT

Project ID	875087
PRR 2024	Pillar 3 – H_2 end uses: transport
Call topic	FCH-01-3-2019: Cyber-physical platform for hybrid fuel cell systems
Project total costs	EUR 1 897 806.25
FCH JU max. contribution	EUR 1 897 806.25
Project start - end	1.1.2020–30.4.2023
Coordinator	SINTEF AS, Norway
Beneficiaries	Ballard Power Systems Europe AS, Banke ApS, Communauté d' universités et établissements Université Bourgogne–Franche–Comté, École nationale supérieure de mécanique et des microtechniques, SEAM AS, Solaris Bus & Coach Sp z.o.o., Université de Franche-Comté, Université de technologie de Belfort Montbéliard, Vivarail Ltd

https://www.sintef.no/projectweb/virtual-fcs/

PROJECT AND GENERAL OBJECTIVES

The overall objective of the Virtual-FCS project is to make the design process of hybrid fuel cell and battery systems easier, cheaper and quicker. Virtual-FCS will produce a toolkit combining software and hardware for designing and optimising hybrid systems of proton-exchange membrane fuel cells and batteries. The platform will be entirely open source, allowing everyone in both industry and research to benefit from and contribute to the future development of the framework. The software tools are being developed in close collaboration with end users and system integrators, securing widespread accessibility.

NON-QUANTITATIVE OBJECTIVES

- Virtual-FCS aims to significantly reduce development times for new fuel cell and battery hybrid systems. The advanced modelling, simulation and emulation tools developed in Virtual-FCS will enable end users with limited experience of fuel cell systems to design and implement new systems more quickly.
- The project aims to create a development platform for hybrid fuel cell systems with integration capabilities and corresponding simulation models. The real-time software platform combined with a full range of emulated components will enable end users to seamlessly integrate real, simulated and emulated components together in a mixed software–hardware system.
- It aims to create analytical tools and instrumentation to validate the different systems and energy management methodologies developed. Virtual-FCS will validate different energy management systems on the mixed software–hardware system. The characterisation of the systems will be carried out using the standard techniques to validate system performance.
- Virtual-FCS aims to create high-performance, real-time emulators of the dynamic behaviour of real components and subsystems. Virtual-FCS will develop new and improved balance-of-plant and stack models capable of accurate real-time emulation of components' dynamic performance, along with their degradation.
- The project aims to enable the establishment of an EU-based supply industry for hybrid fuel cell system simulation and the experimental tool environment (XIL platform) to boost the competitiveness of the EU fuel cell industry. The system simulation tools and methods for making and using the experimental platform will be available to the entire European industry free of charge to boost competitiveness.

PROGRESS AND MAIN ACHIEVEMENTS

- Virtual-FCS has demonstrated cyberphysical hardware integration.
- The project has demonstrated fuel cell electric vehicle simulations.
- The project has demonstrated real-time system emulation. It has demonstrated this capability by emulating a full stack system with an energy management strategy that can take real-time input from a physical sensor, use this feedback for real-time control of a standard fuel cell stack test bench and simulate various load cycles on the physical stack.
- The project has integrated components from the physical hybrid system into the system simulated in the software tools and those emulated on a controller.
- The project has arranged explanatory webinars and participated in conferences to demonstrate the feasibility of the Virtual-FCS library. An industrial workshop on 26 April 2023 was arranged.
- A simple fuel cell stack degradation model has been developed.
- Full validation of the fuel cell stack, battery and balance-of-plant models.

FUTURE STEPS AND PLANS

The project has finished.

Clean Hydrogen Partnership
Co-funded by the European Union