

Performance Optimiser for Hydrogen Fuel Cell

Cost-effective means for rapidly monitoring performance and state-of-health of hydrogen fuel cells in operation (online)

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Background

Fuel cells (FCs) have in recent years become an increasingly viable option for energy generation and storage due to significant advances in the technology. FCs provide specific advantages vs. other energy sources but high life cycle expenses remain a barrier for adoption. Ensuring FCs operate efficiently, and reducing fault conditions are therefore very important when considering FC systems.

Generally, high quality electrical impedance response analysers are used to assess the state-of-health or condition of FCs that are non-operational (offline), but these analysers are slow in determining fault conditions that led to the cell becoming non-operational. Active or online FCs experience rapid state changes due to dynamic environments, such as flooding of fuel cells, which in turn render slow response impedance analyser ineffective. Simple but faster voltage and current measurements from online FC systems provide limited insights into operational systems.

To improve the economic viability of FC systems, fast and more detailed real-time condition or diagnostic information is needed for online FC systems to react to fast-changing environmental conditions. Improving the control will reduce the probability of FC damage or failure, and potentially improve overall efficiency of a FC system. A diagnostic technology which extracts a wide breadth of information from an online FC and with a fast response time would add significant value to improve the operations and reliability of the FC system.

Technology Overview

UCT has developed a technology which is termed Optimised Broadband Impedance Spectroscopy (OBIS). OBIS consist of injecting multiple superimposed waveforms of different frequencies into a FC stack and measuring the impedance response. The impedance response curve is plotted and the data is interpreted to obtain detailed information on the state-of-health of the FC stack while online. OBIS was specifically developed to provide a fast response to accommodate changing states of FC systems whilst operational i.e. condition information is obtained in less than 5s.

The OBIS technology allows for a cost effective implementation to enhance current condition monitoring FC sub-systems and provide a greater breadth of diagnostic information. OBIS can also be added as a stand-alone system element to an existing operational FC system with the diagnostic information feeding into a control system.

Benefits

The OBIS technology provides the following benefits:

- OBIS has the ability to provide fast (<5s) and detailed impedance response information to online FC systems
- Faster and more detailed diagnostic information has the potential to enable better decision-making to reduce FC system failures, improve operational efficiency and ultimately improving the economic viability of FC investments
- Fast diagnostic information is especially important in highly dynamic environments such as automotive and unmanned aerial vehicle applications
- A cost effective implementation of the technology is possible

Applications

The OBIS technology has its core application in:

- Diagnostic or condition monitor technology for online FC systems
- Automotive, marine and aerospace applications are examples where OBIS could complement FC control systems (e.g. hydrogen-powered aircraft or ships whilst in operation)
- FC systems where more diagnostic information in short spaces of time is required are also prime opportunities for the OBIS technology

Opportunity

UCT has developed the technology up to TRL6 with a prototype demonstrated in a relevant environment, and the potential output information available. The opportunity exist to:

- Partner with UCT and to integrate OBIS into a current FC control system
- License the OBIS technology for various FC applications
- Conduct research on further applications for OBIS
- Undertake a joint industry-academia project

Patents

- USA
- Europe (Regional Filing)
- Canada
- South Korea
- United Kingdom

IP Status

- Patented
- Copyright

Seeking

- Commercial partner
- Licensing
- Seeking investment