EIS HEALTH CODE

HEALTH-CODE implements an advanced monitoring and diagnostic tool for μ-CHP and backup PEM fuel cell systems. Oxygen-fed and air-fed stacks are used. Such a tool is able to determine the FC current status to support stack failures detection and to infer on the residual useful lifetime.

Five failure modes are detected:

- ✓ change in fuel composition
- ✓ air starvation
- ✓ fuel starvation
- ✓ sulphur poisoning
- ✓ flooding and dehydration

Several algorithms are considered relying on on-board measurements of the fuel cell stack impedance (EIS). Moreover, low-cost diagnostic concepts are also considered for a straightforward implementation on FCS controllers.

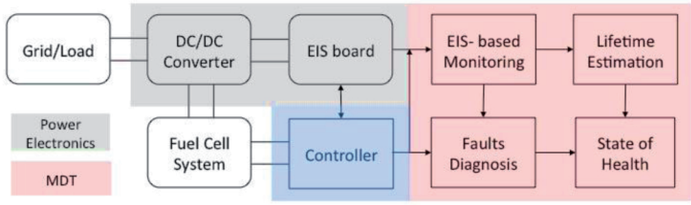
MAIN PROJECT OBJECTIVES:

1. The enhancement of electrochemical impedance spectroscopy (EIS) based diagnosis
2. The development of a monitoring and diagnostic tool for state-of-health assessment, fault detection and isolation as well as degradation level analysis for lifetime extrapolation
3. The reduction of experimental campaign time and costs. Moreover, the improvement of power electronics for FC is also considered

The achievement of HEALTH-CODE objectives is guaranteed by the proper **exploitation of Electrochemical Impedance and voltage response** through the implementation of the following concepts:

1. EIS-based monitoring
2. Faults diagnosis
3. Lifetime extrapolation
4. Industrial application
5. Enhanced power electronics

The figure shows the scheme of the monitoring and diagnostic tool and the links with the fuel cell system.



COMMUNICATION ACTIVITIES OF HEALTH-CODE PROJECT:

EVENTS

FCH 2 JU Review days
Brussels
November 2016

7th Fundamentals & Development of Fuel Cells
Stuttgart
January 2017

One-Day Workshop on Monitoring, Diagnostics and Control for Fuel Cells
Lucerne
July 2017

PUBLICATIONS

Russo et al., Journal of Power Sources 353 (2017) 277-286

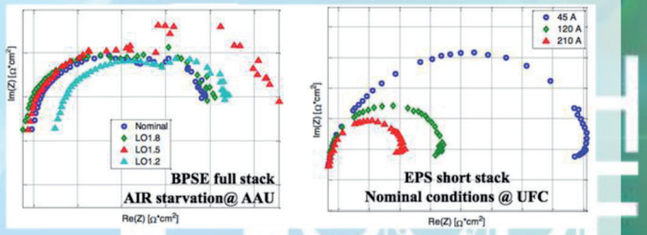
Petrone et al., Fuel Cells (2017)

ACHIEVEMENTS

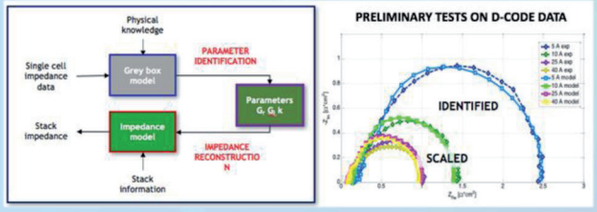
The **first prototype** of the **EIS module** is fitted into an aluminum box that contains the Analog Front End board (for the acquisition of the Voltage and Current measurements) and a BeagleBone Black (for storing and processing the acquired data).

EIS box | AFE (bottom) | Communication board

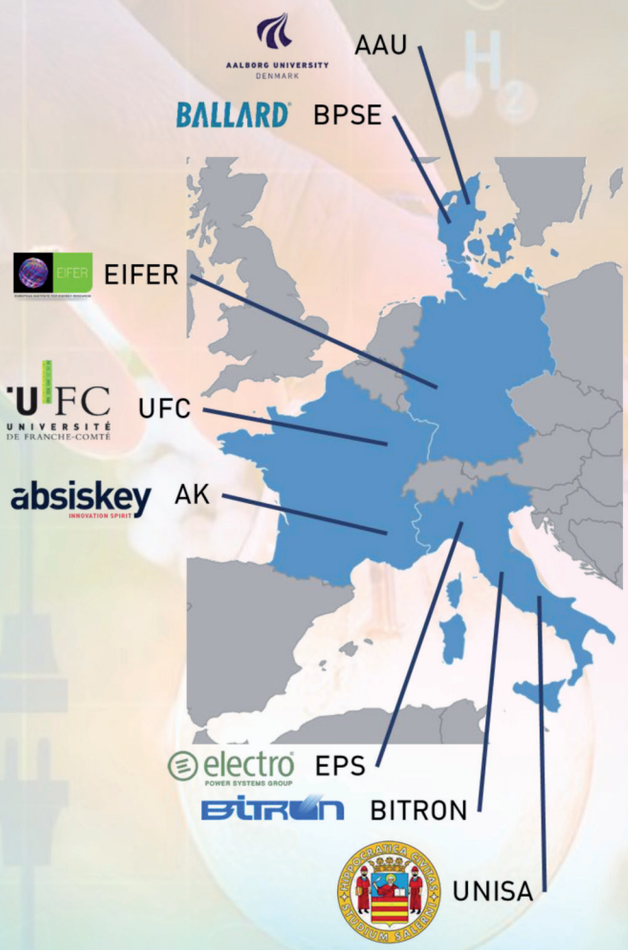
The complete set of about 1500 spectra (normal and faulty conditions) have been acquired and used for algorithms development.



A novel **scaling-up algorithm** has been developed; it is able to extrapolate full stack performance and impedance behavior from single cell, single repeating unit or short stack data.



HEALTH-CODE PARTNERS



http://pemfc.health-code.eu/

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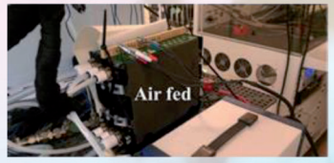
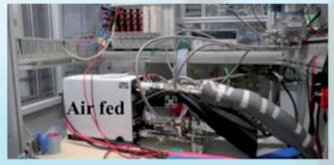
EIS HEALTH CODE

REAL OPERATION PEM FUEL CELLS HEALTH-STATE MONITORING AND DIAGNOSIS BASED ON DC-DC CONVERTER EMBEDDED EIS

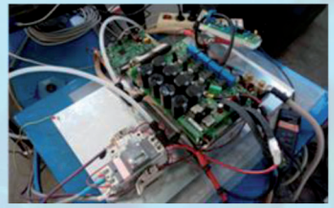
EPS stack experiment @ UFC



Ballard stack experiment @ AAU



Ballard stack experiment @ EIFER



DC/DC converter @ BITRON

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HORIZON 2020