Fuel cell non-invasive diagnosis through external magnetic field measurement

LABORATORY / place of work

FEMTO-ST Institute, Université de Franche-Comté, CNRS, ENSMM, UTBM,
ENERGY Department
Address: rue Thierry Mieg, 90010 Belfort, France

PHD Description

Introduction: Knowledge of the current density distribution inside the Fuel Cell can indicate an abnormal operation and thus offer an effective diagnosis approach. The magnetotomography is the only noninvasive current density mapping method based on the measurement of the external magnetic field surrounding the stack. Recent work at FEMTO-ST/FCLAB developed a new FC stack magnetic field measurement methodology. This new approach makes possible a more accurate analysis of the current distribution inside the Fuel Cell.

The PEM-DIMAG project will enable the development of innovative diagnosis procedures and current mapping methods for detecting default cell operation inside the volume of the FC stack, based on the new methodology.

In this work, the magnetic field analysis of the fuel cell will permit to take into consideration magnetic 3D effects to improve the existent test bench.

The developed diagnosis algorithms, the new measurement system and methodology will be validated on a real fuel cell stack.

The Ph.D student will be involved in PEM-DIMAG project with the major aims to develop modelling, experimental layout, diagnostic methods for medium power scale PEM fuel cell stacks.

Schedule tasks for PhD Student: The work of the PhD student will include the following major steps:

The modelling and the optimal design of the fuel cell test bench including the measurement system. For the magnetic model, both numerical (finite element) and analytical approaches will be considered.

Characterize the magnetic field of the fuel cell. Realization of a large experimental campaign to test the fuel cell in normal operation as well as in fault operation

Two diagnosis approaches will be elaborated and tested individually: a current mapping based diagnostic, using the mapping methods and a data based diagnostic. For each approach, several diagnostic algorithms will be implemented and tested. A comparative study of the diagnosis results will be realized for several faults in Fuel cell operation.

Keywords: fuel cells, magnetic field measurement and computation, diagnosis, multivariate data analysis, simulation, software engineering, experimental validation.

Group

The FEMTO-ST Institute "Franche-Comté Electronics Mechanics Thermal Science and Optics – Sciences and Technologies", is a joint research institution, which is under the quadruple authority CNRS, UFC, ENSMM and UTBM. www.femto-st.fr. The doctoral work will be carried out in the ENERGY/SHARPAC research group. The supervisors are active in the fields of: fuel cells, magnetic field computation, modelling and diagnostic, fuel cell system diagnostic, control of fuel cell system, data analysis, modelling, design and optimization of electrical systems , measurement techniques and signal processing.

Candidate's profile

Master level in Electrical Engineering is required.

Skills in programming, magnetic field computation, Finite element analysis, data acquisition, statistical analysis would be appreciated. Moreover, preliminary knowledge in Hydrogen Technology will be welcomed.

The candidate should be qualified in these fields and be motivated by physical modelling, experimental measurements, multivariate data analysis, machine learning and in the set up of fuel cell diagnostic research from theory to applications.

Standard practice of English (oral and written) is mandatory. French is useful for day to day life.

Contract duration: 36 months duration doctoral contract, the PhD thesis may start in October 2019.

Application:
Please send your application documents (all in one PDF file) to Stefan Giurgea (Stefan.Giurgea@utbm.fr) including a detailed CV, motivation letter dedicated to the proposed position, marks and ranks you obtained during your master degree or engineering school and at least one contact person (typically your supervisor for a training period, master thesis or responsible of your master diploma).

References:

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