Impedance estimation analysis for high power PEM electrolysis stacks

Project goal:

Develop a cost-effective method to measure the "health" of large-scale hydrogen electrolyzers using smart signal analysis.

Description: Green hydrogen is a crucial part of our future energy system. We produce it using PEM Electrolyzers. For these systems to be reliable and economical, we need to monitor their long-term stability and health. A key way to determine the “state-of-health” of an electrolyzer is by measuring its impedance**.** For industrial-scale (multi-kW to MW) electrolyzers, the specialized power electronics required for this kind of testing are incredibly expensive. This thesis aims to solve that problem. We will explore a new approach that shifts the technological challenge away from the power electronics to sophisticated data analytics for system identification. This project will take place at HyCentA, where you will have access to several state-of-the-art test benches for electrolyzers up to 1 MW.

Focus Areas:

- Literature research of measurement methods for current measurements (1 month)
- Research and definition of the specifications for the voltage measurements (1 month)
- Development of the evaluation algorithmic in Python, Octave or similar (should be open source) (2 month)
- Execution of measurements and refining of the measurement strategy (1 month)
- Writing of the thesis (1 month)

This project is a perfect fit for students interested in power electronics, signal processing, data analysis, and hands-on experimental work in the future-facing field of green hydrogen.

Start: now
Duration: about. 6 months
Paid Master Thesis!

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Figure 1: Example picture of PEM electrolysis stack [1]

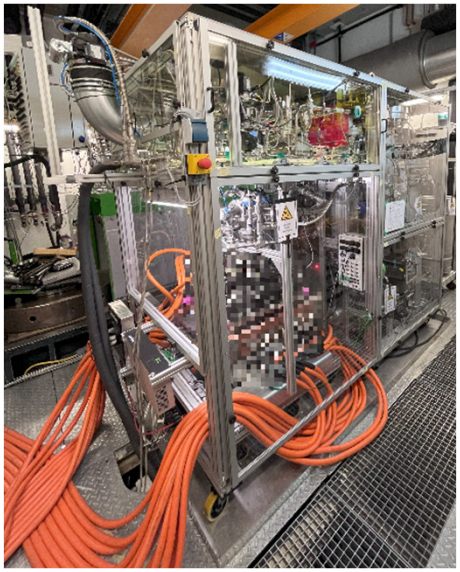

Figure 2: Test Bench at HyCentA

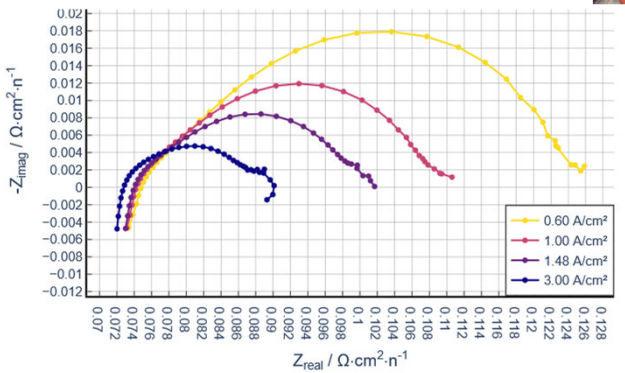

Figure 3: Example measurement result shown as a nyquist plot

[1] Hybrion PEM Electrolysis Stacks | Bosch Hydrogen Energy