



## REAL-TIME CONTROL ALGORITHM FOR A PROTON EXCHANGE MEMBRANE (PEM) ELECTROLYZER

### KEYWORDS

- PEM electrolyzer
- Dynamic output
- Hydrogen production

### Collaboration type

License agreement  
R&D Collaboration

### IP status

Patent pending  
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### Inventors

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### THE TECHNOLOGY IN A NUTSHELL

The technology is a real-time control method specifically designed for a PEM electrolyzer to optimize hydrogen production.

### STATE OF THE ART

Currently, the choice of temperature is made a priori. The temperatures chosen can vary between 50°C and 80°C, depending on the state of degradation of the electrolyzer membrane. The problem is that once the temperature has been chosen, it is no longer possible to modify it according to the evolution of electrolysis and external parameters that can also change (cost of electricity, hydrogen demand, etc.).

### THE INVENTION

It is a predictive control model developed to optimize hydrogen production in a PEM electrolyzer. This optimization is performed dynamically through the control of parameters such as the reaction temperature and the intensity of the cooling water flow. Controlling these parameters will minimize membrane degradation (and thus the associated replacement and maintenance costs) while optimizing hydrogen production.



The idea takes into account other factors such as the cost of electricity, the condition of the membrane, and the ambient conditions in order to also allow an optimization of costs related to production.

### CONTACT

### KEY ADVANTAGES OF THE TECHNOLOGY

- Accurate operating temperature selection for the electrolyzer
- Membrane maintenance cost reduction
- Electricity cost optimization

## TECHNOLOGY READINESS LEVEL



TRL-3 - When running the method on a standard consumer-grade computing system, it is able to compute the optimal sequence of 15-minute-long control inputs (e.g., current to be applied, flow of cooling water) for the next 24 hours in under 15 minutes. This performance would allow the method to be used in a real-world context.

## POTENTIAL APPLICATIONS

The main fields of application are PEM electrolyzer manufacturers and/or control system providers for energy systems. But other larger fields are also possible, such as inter-seasonal storage, coupling to solar or wind farms, industrial microgrids.

## THE TEAM

The **Aero-Thermo-Mechanics (ATM)** department combines expertise in aerodynamics, thermodynamics, combustion, and applied mechanics, utilizing experiments and advanced numerical techniques to address the current challenges of decarbonization. Our research focuses on high-efficiency propulsion, thermal management, and sustainable energy conversion, with a strong emphasis on hydrogen technologies.

## The INVENTORS



**Butrint Avdijaj** is a joint PhD candidate at *Université libre de Bruxelles (ULB)* and *Vrije Universiteit Brussel (VUB)*. His research focuses on developing models and control techniques of integrated hydrogen energy systems.

**Lorenzo Giuntini** holds a PhD in Industrial Engineering from the University of Pisa. Lorenzo works on developing fast-computing models to optimize the real-time production, storage, and use of green hydrogen in complex, distributed, and decentralized energy systems.



**Axel Coussement** is a professor and Head of the Aero-Thermo-Mechanics at ULB. His current research focuses on data-driven and grey-box modeling of energy systems, the electrification of high-temperature industrial processes, and the development of integrated experimental platforms that combine engines, turbines, power-to-X systems, and hydrogen infrastructure.