Warsaw University of Technology

Faculty of Power and Aeronautical Engineering

Master's Thesis Topics (10 Suggestions)

- Application of artificial intelligence to energy consumption and cooling management in data centers (AI) powered by large-scale hydrogen fuel cells.
- Optimization of hydrogen production via electrolysis using machine learning to stabilize smart grids as the share of renewable energy sources increases.
- Thermodynamic modeling of hydrogen fuel cells in aviation systems with the support of AI predictive models to assess their degradation in real time.
- Risk analysis in hydrogen installations using AI predictive models, with a particular focus on decentralized infrastructure with strategic dual-use applications.
- The use of machine learning algorithms that analyze sensor data to optimize the production of synthetic e-fuels based on green hydrogen.
- Integration of AI into hydrogen storage systems for the energy sector and the design of optimal routes within the European Hydrogen Backbone.
- Modeling methane reforming processes for hydrogen production with AI integration to assess the cost-effectiveness of decarbonizing heavy industry.
- Application of neural networks to optimize hydrogen transport and build supply chain resilience in crisis situations.
- Modeling hybrid hydrogen-AI systems in aviation to predict energy consumption in next-generation zero-emission propulsion systems.
- Predicting failures in electrolysers using deep learning under variable operating conditions dictated by renewable energy sources.

Engineering Thesis Topics (10 proposals)

- Design of a smart hydrogen refueling station for aircraft with an integrated AI system to optimize energy consumption and compression pressure.
- Analysis of sensor data in power grids using Python for early detection of leaks and material fatigue in hydrogen pipelines.
- Design of a hybrid energy system utilizing hydrogen in urban transportation, supported by AI algorithms for fleet and refueling management.
- Optimization of hydrogen process control using genetic algorithms, as illustrated by composite tanks in unmanned aerial vehicles.
- Application of computer vision for monitoring hydrogen systems and automated quality control of critical infrastructure.
- Design of a hydrogen-based emergency power system (with PEM fuel cells) for office buildings, incorporating artificial intelligence to forecast power demand.

Prof. Jarosław Milewski
Institute of Heat Engineering
jaroslaw.milewski@pw.edu.pl
21/25 Nowowiejska Street
00-665 Warsaw
Poland

- Implementation of AI algorithms in the control of aircraft turbines adapted for hydrogen combustion.
- Design of a mobile app with AI for monitoring energy consumption in residential hydrogen-based combined heat and power systems.
- A design for an alkaline electrolyzer for laboratory-scale hydrogen production, complete with Python software for monitoring and predicting its performance.
- Integration of photovoltaics with electrolysers for green hydrogen production using simple weather and demand prediction models.

Computational and Transitional Project Topics (10 proposals)

- Big data analysis from hydrogen systems processed by AI to verify the profitability of hydrogen investments in 2026.
- Simulation of water electrolysis in MATLAB, extended with predictive models for wind farms.
- Hydrogen safety modeling with AI elements using risk analysis via Monte Carlo methods.
- Predicting solar energy production using AI models for virtual, decentralized hydrogen storage systems.
- Computational analysis of fuel cell flow with artificial intelligence support for the analysis of dead zones in flow.
- Hybrid hydrogen-AI simulations for renewable energy sources in the context of microgrids powering military and civilian infrastructure.
- Economic optimization of hydrogen deployments using AI and return on investment analysis (Excel with VBA / Python).
- Modeling hydrogen storage using CFD coupled with simple ML algorithms to accelerate numerical calculations.
- Overview of hydrogen production technologies from renewable sources in comparison with market demand generated by modern AI data centers.
- Simulation of hydrogen-based cogeneration combined with computational optimization of thermal processes using heuristic algorithms.