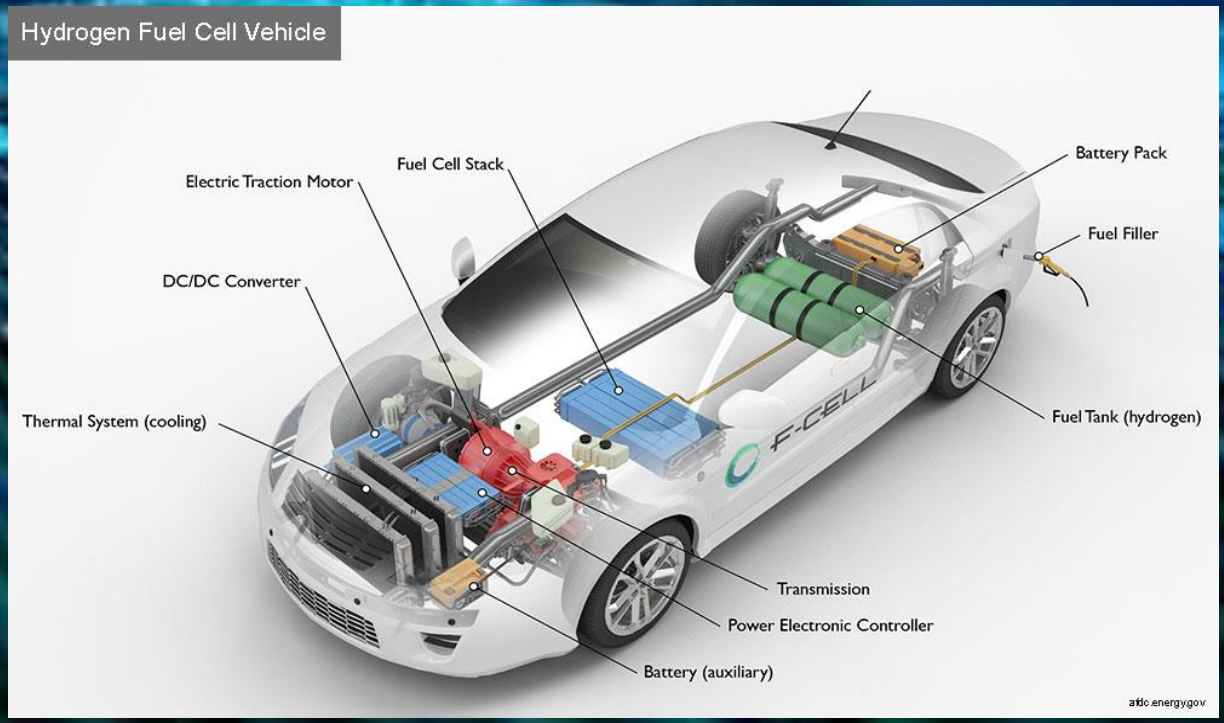
Using Machine & Deep Learning to Predict Fuel Consumption in Hydrogen Fuel Cell Electric Vehicles

ID: 60706
Name: Kokosalakis Nick



Introduction

- Transition to zero-emmition transport is critical for sustainability
- Hydrogen Fuel Cell Electric Vehicle offer promising potential
- Accurate fuel consumption prediction is essential for:
- Reducing hydrogen usage
- Extending fuel cell life
- Enhancing overall vehicle efficiency
- Machine learning (ML) & Deep learning (DL) have emerged as powerful tools

Objective of the study

- Investigate how ML & DL can predict or reduce fuel consumption in HFCEVs
- Compare methods from recent literature
- Explore simulation-based and real-world applications
- Build a knowledge base for designing an intelligent energy management system

Scientific Papers Reviewed

- Deep reinforcement learning-based health-conscious energy management for fuel cell hybrid electric vehicles in model predictive control framework (2024)
- A controllable neural network-based method for optimal energy management of fuel cell hybrid electric vehicles (2024)
- Deep stochastic reinforcement learning-based energy management strategy for fuel cell hybrid electric vehicles
- Energy management of fuel cell hybrid electric bus in mountainous regions: A deep reinforcement learning approach considering terrain characteristics
- Artificial Intelligence-BasedMachine Learning toward the solution of Climate-Friendly Hydrogen Fuel Cell Electric Vehicles (2022)

Common Goals Across the Papers

- All aim to optimize hydrogen consumption through smart control or prediction
- Use of simulations or real driving cycles to train ML & DL models
- Focus on energy management, dynamic response and system adaptability
- Some models trained using Dynamic Programming-based ideal strategies, others via Reinforcement Learning or Supervised Learning

Our Own Machine Learning Dataset Experiment

- As a part of this study we initiated a complementary experiment to explore the training of machine learning models using a custom synthetic dataset
- A virtual dataset was created by simulating the behavior of an HFCEV powertrain under various load conditions and standard driving cycles
- The dataset include key variables Speed (km/h), Weight (kg), Temperature (°C), Road Inclination (%), Hydrogen Consumption (kg/100km), State of Charge (%), Battery Power (kW), Battery Temp (°C)
- This approach complements the reviewed literature and demonstrates the potential of simulation-based ML training when real-world data is unavailable

Draft of the Final Presentation Structure

- Introduction, motivation
- Literature Review – Overview of ML & DL in FCEVs
- Methodology
- Comparison of the models from papers
- Experimental training of Machine Learning models on a custom synthetic dataset and conclusions
- Conclusion & Future Work based on the papers and our experiment

Final Remarks

- ML & DL offer scalable solutions to improve HFCEV performance
- Current research combines simulation and real data to train predictive models
- The final presentation will integrate insights from reviewed studies to propose a structured ML-based approach for fuel optimization


THANK YOU