

ADAPFI-H2MOBILITY

Confidence-Aware Digital Twin and Predictive Energy Management
for Hydrogen Mobility Systems

CONCEPT AT A GLANCE

A safer, more observable and more efficient hydrogen powertrain

ADAPFI-H2MOBILITY proposes an adaptive, confidence-aware digital twin for hydrogen mobility. The solution combines fuel-cell and storage-system monitoring, multimodal sensor fusion, anomaly detection, health and range prediction, and hybrid fuel-cell/battery energy management. It is designed to remain useful when operating conditions change or measurements become noisy, incomplete or contradictory.

TARGET	Hydrogen road vehicles, mobile machinery and demonstrators
PROJECT	12-month validation with one or two complementary SME partners
CALL FIT	IH-MIE Open Call - hydrogen mobility value chain

THE OPERATIONAL CHALLENGE

Degradation Fuel-cell ageing, contamination and thermal or hydration imbalance evolve over time.	Uncertainty Sensor noise, missing values and changing duty cycles reduce the reliability of fixed models.
System coupling Fuel cell, battery, storage, auxiliaries and vehicle demand must be managed together.	Actionability Operators need early warnings, remaining-range estimates and explainable confidence levels.

ADAPFI'S PROPOSED TECHNOLOGY

- Adaptive estimation of fuel-cell health, performance and latent degradation states.
- Fusion of voltage, current, pressure, temperature, flow, humidity and vehicle-demand data.
- Confidence-aware anomaly detection with explicit uncertainty and fallback indicators.
- Prediction of hydrogen consumption, remaining range and maintenance needs.
- Online optimisation of power split between the fuel cell and battery while respecting operational constraints.

PROPOSED DEMONSTRATOR

From data integration to partner-validated prototype

01 Instrument & connect Define use case, interfaces, datasets and safety constraints; connect historical or live test data.	02 Model & adapt Configure adaptive state estimation, digital-twin components and confidence metrics.	03 Predict & optimise Deploy anomaly, health, consumption and energy-management functions.	04 Validate Compare against partner baselines on a bench, vehicle or representative mobility demonstrator.
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EXPECTED OUTPUTS AND VALIDATION INDICATORS

Technical outputs	Illustrative validation indicators
Integrated confidence-aware digital twin Health and anomaly dashboard Predictive range and maintenance functions Hybrid energy-management module	State-estimation and prediction error Anomaly-detection lead time and false-alarm rate Hydrogen consumption and energy-efficiency improvement Robustness under missing or degraded measurements

PARTNERS SOUGHT

Hydrogen technology SME	Fuel-cell stack or system, hydrogen storage, balance-of-plant, sensors or test bench.
Mobility / pilot SME	Vehicle, mobile machinery, fleet operation, integration capability or representative operational data.
ADAPFI contribution	Adaptive algorithms, multimodal fusion, confidence management, prediction, optimisation and digital-twin integration.

WHY ADAPFI

ADAPFI SAS is a French deep-tech company based near Toulouse. Its team brings more than 30 years of expertise in adaptive filtering, signal processing, state estimation, sensor fusion, prediction and intelligent control. The platform is designed for uncertain, non-stationary and degraded environments and is applicable across mobility, energy, robotics, space, healthcare and industry.

LET'S BUILD THE IH-MIE PROJECT TOGETHER

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This preliminary concept is intended for partner discussion. Final scope, targets, work plan and budget will be co-defined with the selected consortium.