



# Physics-Informed Multimodal AI Diagnostics for Reliable Electric Motor Systems

EPSRC funded PhD studentship with full fee waiver and £21,805 pa stipend (2026/27 rate)

**Project Code:** DLA\_DTP\_2026\_18  
**Main Supervisor:** [Dr Helen Miao](#)  
**Co-Supervisor:** [Professor Wenxian Yang](#)

## Project Introduction

Reliable electric motors are essential for electrified transport, renewable energy, and automated industry. Current diagnostic methods often rely on single-sensor measurements and purely data-driven models, limiting robustness and interpretability under variable operating conditions. This project will develop a multimodal, physics-informed diagnostic framework integrating advanced signal processing, deep learning, and data fusion techniques. Using an experimentally validated motor test platform with seeded faults, the research will enable early-stage fault detection and real-time embedded implementation, improving reliability, generalisation, and practical deployment of intelligent motor condition monitoring systems.

## Project Details

### 1. Background and Knowledge Gap

Electric motors underpin electrified transport, renewable energy systems, and automated manufacturing. As electrification accelerates, ensuring high reliability and minimal downtime becomes increasingly critical. Conventional motor condition monitoring methods often rely on single-sensor measurements (e.g., vibration or current) and purely data-driven models. **These approaches show lack of robustness under varying speeds, loads, and environmental conditions, and often provide limited physical interpretability. There remains a clear gap in integrating multimodal sensing with physics-informed machine learning** to enable accurate and real-time fault diagnostics across diverse operating regimes.

### 2. Research Questions

This PhD will address the following key questions:

- (1) How can multimodal sensing (e.g., vibration, stator current, acoustic, temperature) improve early-stage fault detection compared with single-sensor systems?

- (2) Which signal processing techniques most effectively extract physically meaningful and fault-sensitive features under variable operating conditions?
- (3) How can physics-informed machine learning enhance interpretability and generalisation of deep learning models across speeds and loads?
- (4) What data fusion strategies enable robust and computationally efficient real-time implementation on embedded platforms?

### 3. Three-Year Research Plan

Year 1: Design and instrument an experimental motor test platform using existing laboratory rigs. Seed representative faults (bearing defects, air-gap eccentricity, rotor imbalance) and collect high-quality multimodal datasets under healthy and faulty conditions across a range of speeds and loads. Develop advanced signal processing pipelines (time-frequency analysis, wavelet transforms, envelope analysis) to extract diagnostic features.

Year 2: Develop and compare deep learning models, including convolutional neural networks and Transformer-based architectures. Integrate physics-informed constraints and domain knowledge into model structures and loss functions to enhance interpretability and robustness. Systematically evaluate feature-level, decision-level, and attention-based multimodal data fusion strategies.

Year 3: Optimise models for computational efficiency and validate diagnostic performance under dynamic operating conditions. Benchmark against conventional data-driven and single-sensor approaches.

### 4. Expected Outcomes

The project will deliver a validated multimodal, physics-informed AI diagnostic framework for electric motors under varying operating conditions. Outputs will include high-quality journal publications, potential open-access datasets (where appropriate), and deployable real-time algorithms. The research will advance reliable, intelligent condition monitoring for next-generation electrified systems.



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### Project-specific entry requirements

#### Qualifications:

Applicants should hold (or expect to obtain) a first-class or high upper second-class (2:1) undergraduate degree, or a Master's degree with distinction/merit, in Electrical Engineering, Mechanical Engineering, Mechatronics, Control Systems, Energy Engineering, or a closely related discipline. A strong background in electronics, signals, or power systems is essential.

#### Essential Skills:

- Strong foundational knowledge in electric motors, drives, and control systems.
- Proficiency in programming and data analysis using Python, MATLAB/Simulink, or equivalent.
- Understanding of signal processing techniques (e.g., FFT, wavelet transforms, envelope analysis).
- Ability to design, conduct, and analyse experiments using laboratory instrumentation and sensors.
- Strong quantitative, problem-solving, and analytical skills.
- Effective written and verbal communication skills for reporting and presenting technical results.
- Ability to work independently and collaboratively within a multidisciplinary research team.

#### Desirable Skills/Experience:

- Industrial or research experience in electric motor diagnostics, AI applications, or embedded systems is advantageous but not mandatory.
- Familiarity with multimodal data fusion and sensor integration.
- Prior exposure to industrial applications of electric motors, renewable energy systems, or electrified transport.

#### Further Information

This call is open to **UK Applicants only**.

Applicants should be of outstanding quality and exceptionally motivated.

The studentships are funded for 3 years (subject to satisfactory annual performance progression review) and will provide tuition fees and tax-free stipend paid monthly.

Please note that there are more projects than funded studentships available and therefore this is a competitive application process which will include an interview.

Shortlisted candidates will be contacted for an interview in person or via Teams. After interview the most outstanding applicants will be offered a studentship.

Queries about the application process are welcome and should be emailed to [pgrscholarships@hud.ac.uk](mailto:pgrscholarships@hud.ac.uk).

Informal enquiries about this project should be directed to [Dr Helen Miao](#).

**Type of Award:** Doctor of Philosophy (PhD).

**Eligibility:** UK applicants only. First Class or Upper Second-Class Honours degree or equivalent in a relevant subject area, please refer to the entry requirements on the specific projects being advertised.

**Location:** Huddersfield.

**Funding:** 3 years full time research covering tuition fees and tax-free bursary (stipend) starting at £21,805 for 2026/27 and increasing in line with EPSRC guidelines for subsequent years. Funded via the Engineering and Physical Sciences Research Council Doctoral Training Programme.

**Duration:** 3 years full-time plus 12 months writing up (please note no funding is available for writing up period).

**Closing date:** 28<sup>th</sup> April 2026

**Start date:** 1<sup>st</sup> October 2026

#### Application details

- Go to the EPSRC webpage and download the [Expression of Interest Form 2026](#).
- Provide copies of transcripts and certificates of all relevant academic and/or any professional qualifications.
- Provide references from two individuals – please contact your referees and ask them to send them directly to [pgrscholarships@hud.ac.uk](mailto:pgrscholarships@hud.ac.uk) from their email address.
- Proof of eligibility – e.g. scan of passport photo page
- Completed forms, including all relevant documents should be submitted via-email to [pgrscholarships@hud.ac.uk](mailto:pgrscholarships@hud.ac.uk).

**Please note:** if you do not attach all the relevant documentation prior to the closing date your application will not be considered.