# Enhanced Condition Monitoring Systems for Offshore Wind Turbine Drive Trains through Hilbert-Huang Transform and Supervised Machine Learning Algorithm

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## BACKGROUND & MOTIVATION

*Issues* with current condition monitoring (CM) techniques:

- Complexity and accuracy issues with the non-linear and non-stationary characteristics of SCADA data.
- Installation of *multiple intrusive sensors* - local to each component of wind turbine drive train (WTDT).
- *Limited monitoring* - unable to detect multi parameter phenomena such as electromagnetic coupling.
- Complications with sensor and data fusion for CM.
- *Limited reach* on the WTDT. Multiple sensors for one component of WTDT – Increases the weight and cost of CM.

## CONTRIBUTION

- *Magnetic-signature modeling* of the entire WTDT through FEA.
- Extraction of wind generator magnetic signatures and demonstration of *Magnetic Flux Density (MFD) as a good fault indicator.*
- Fault detection through the *Hilbert-Huang transform.*
- Fault classification through multi-class *supervised machine learning.*

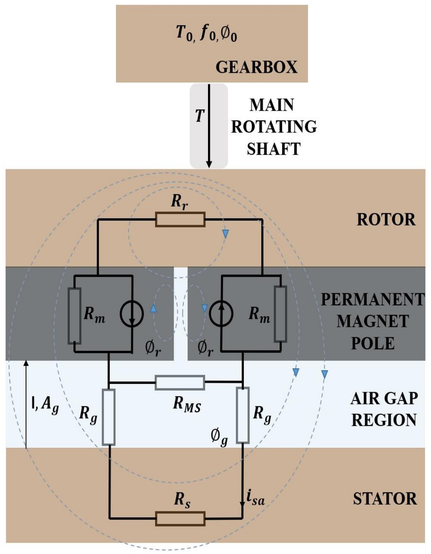


Fig. 1. Magnetic equivalent circuit of WTDT

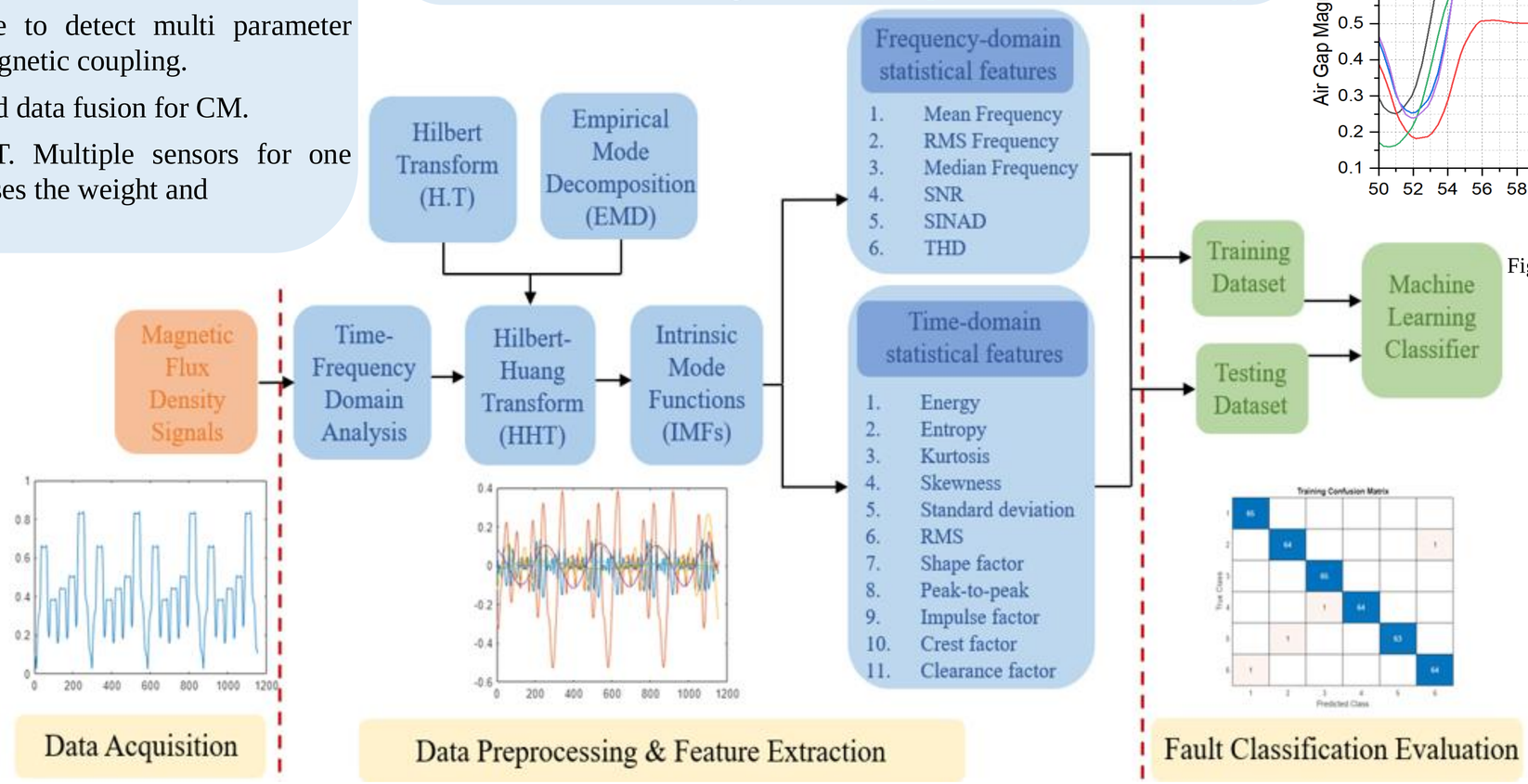


Fig. 2. Fault detection and classification flowchart

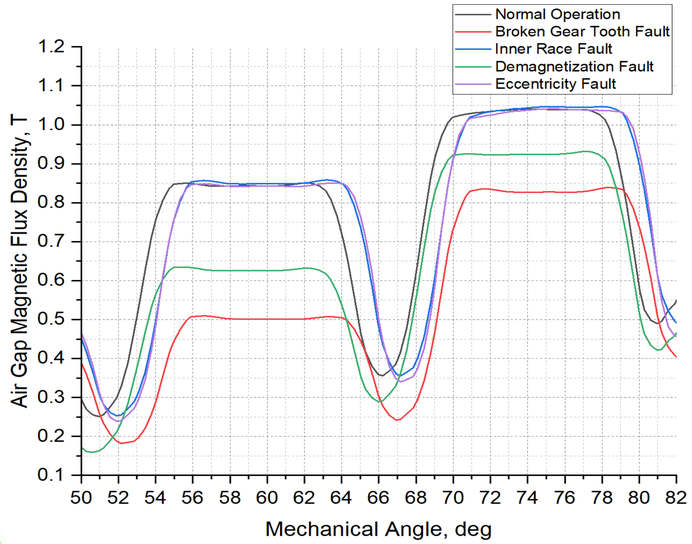


Fig. 3. A comparative analysis of air gap MFD

## RESULTS & DISSCUSSION

- *Magnetic modeling successfully demonstrates* how fault in one of the WTDT components alter the common MFD due to the electromagnetic coupling effects.
- *Significant changes are observed* on MFD for each fault case, making it is a *good fault indicator* for CM.
- Various electrical and mechanical faults on multiple components of the WTDT are *successfully classified* through the *Hilbert-Huang transform data processing system* and *supervised machine learning* algorithms.

**AFFILIATION**

NJIT New Jersey Institute of Technology

**Green Technology Research & Training Laboratory & Sensor Research Laboratory.**

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NJEDA ECONOMIC DEVELOPMENT AUTHORITY

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