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MagNet: Data-Driven Methods for Magnetic Core Loss Modeling

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MOTIVATION

MagNet hosts numerous measured data for different magnetic materials across a variety of operating conditions. Intended to supports data-driven magnetics research.

- Manufacturer information is limited.
- Analytic estimations (e.g., iGSE) have limited application scenarios.
- **Machine learning** can open new possibilities.

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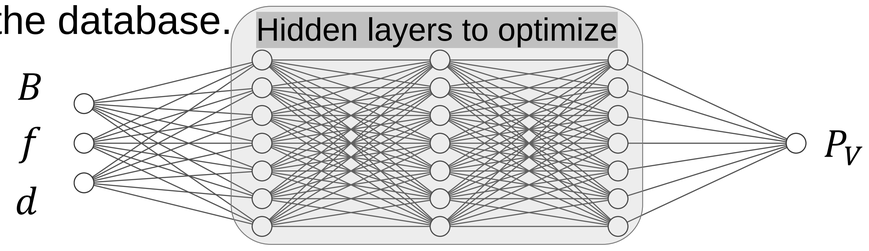
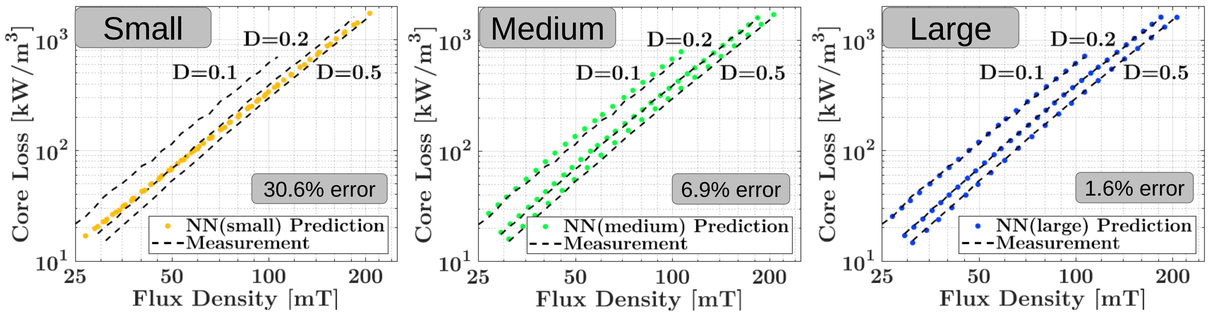
MACHINE LEARNING METHODS

A feed-forward neural network model has been built and trained based on the database.





- The model improves as the network size grows.
- Overcomes the limitations of traditional methods such as iGSE.

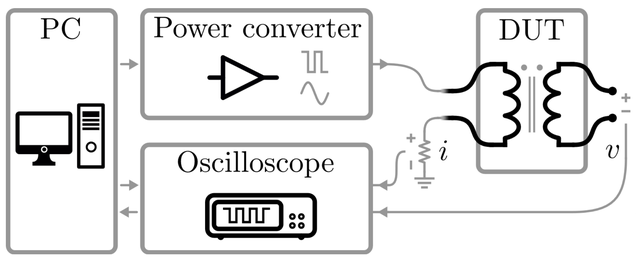
KEY CONTRIBUTIONS

Web-based data visualization tool makes the data easily accessible.

https://share.streamlit.io/minjiechen/pmagnet/main/main.py

Trained and tested machine learning models for core loss prediction.

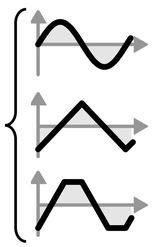
DATA ACQUISITION SYSTEM AND DATABASE

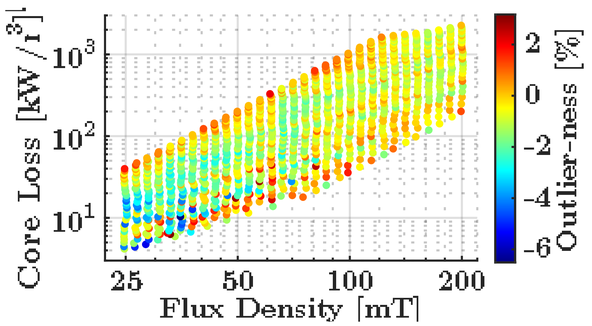


- Fast, automated and accurate (enough) measurements.
- Systematic and statistic error.
- Detection of outlier data points.

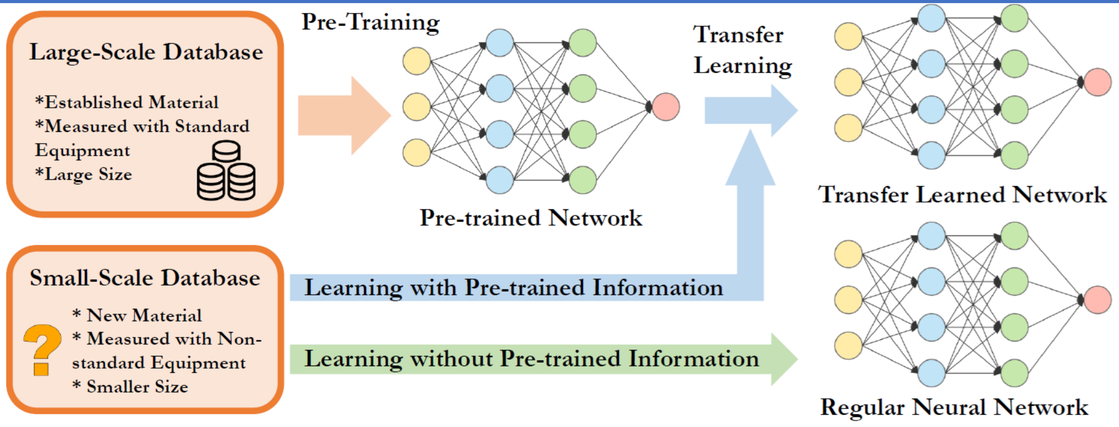
Over 60,000 datapoints:

- Five materials so far
- Excitation waveforms-
- $f \in [10\sim500]$ kHz
- $B \in [20\sim300]$ mT



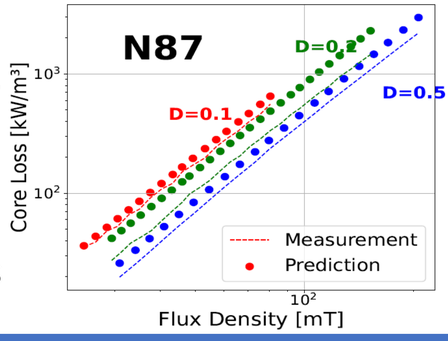


TRANSFER LEARNING



- Pre-trained neural networks retrained with few datapoints of a new material.
- Comparable prediction accuracy for:

training with **1000** N87 **points**
vs
pre-training with 1000 N27/N49 points
and retraining with **100** N87 **points**



COLLABORATORS and SPONSORS

H. Li et al., "MagNet: an Open-Source Database for Data-Driven Magnetic Core Loss Modeling," APEC'22.
E. Dogariu et al., "Transfer Learning Methods for Data-Driven Magnetic Core Loss Modeling," COMPEL'21.

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