



Enhanced Gearbox Fault Diagnosis with Fusion LSTM-CNN Network

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INTRODUCTION



Gearbox Fault Diagnosis:

- Essential for Uninterrupted Operations
- Preventing Costly Downtime
- Operator Safety
- Machinery Longevity

PREVIOUS WORKS



- Mathematical Models
- Traditional Machine Learning Algorithms

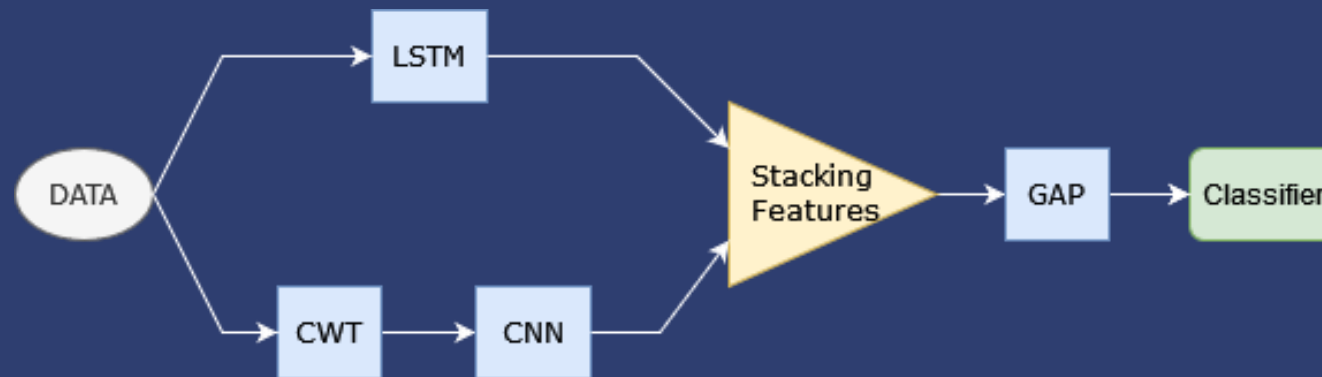
PREVIOUS WORKS



Deep Learning:

- Multiscale CNN (Jiang et al.)
- CNN + DWT (Chen et al.)
- WT-IResNet (Liang et al.)
- LSTM (Xiao et al.)

PROPOSED METHOD



LSTM BRANCH



Long Short-Term Memory:

- Sequential Data
- Temporal Dynamics of System
- Fully Connected Layer: projections to Desired Dimension

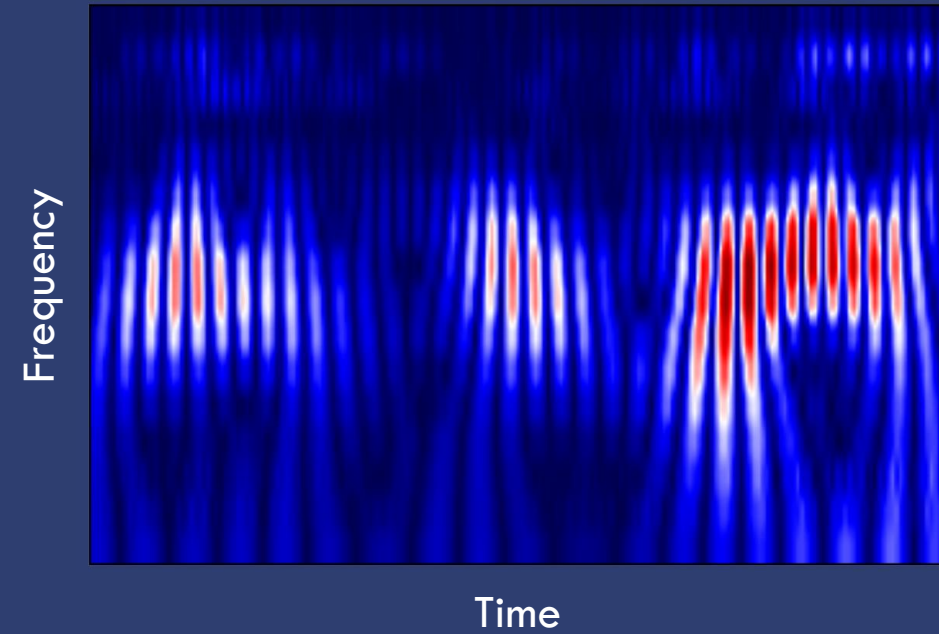
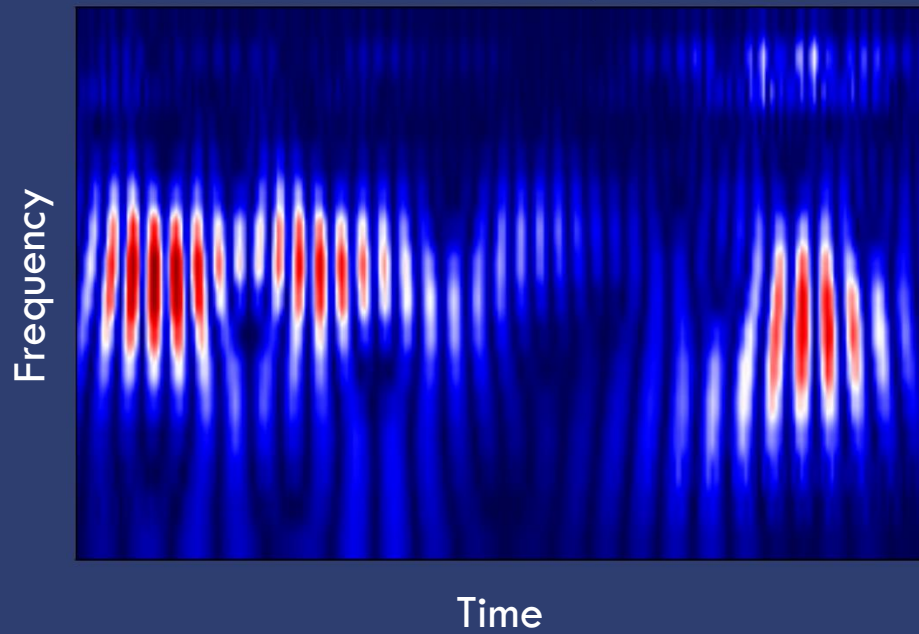
CNN BRANCH



CWT:

- Time-Frequency Domain
- Evolution of Frequency Content of Signal

CNN BRANCH

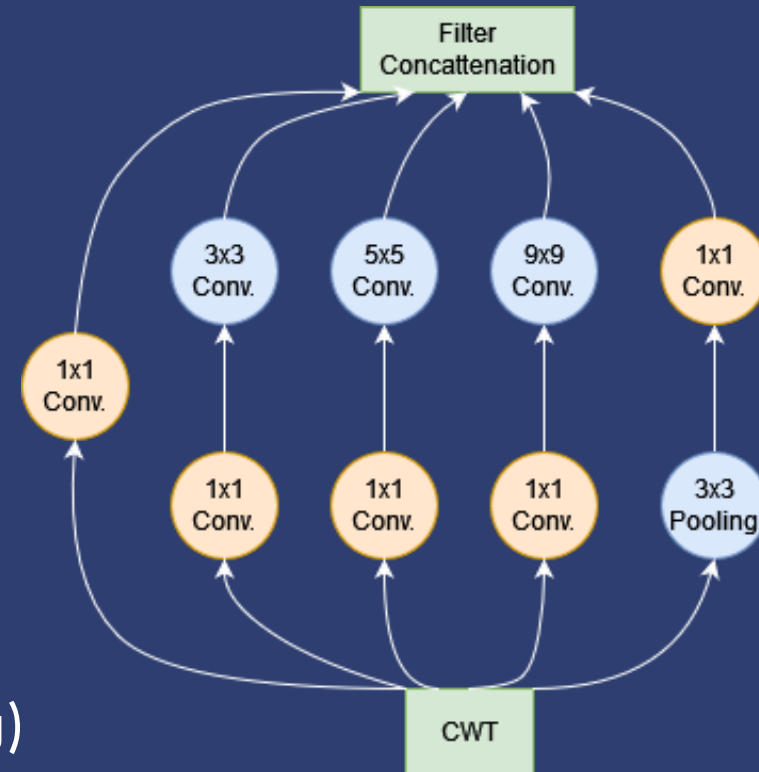


CNN BRANCH

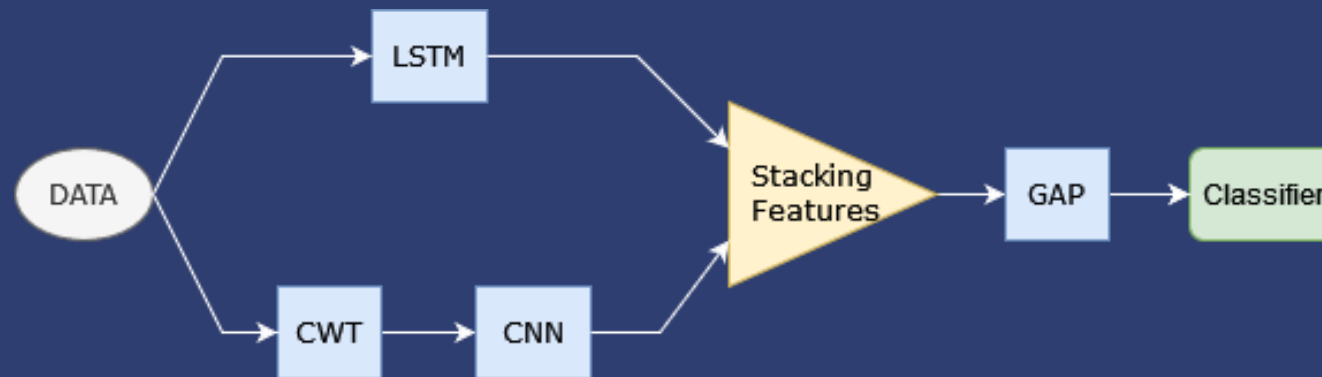


Inception Module:

- Multiple Filter Sizes
- Captures Intricate Features
- Different Spatial Scales
- Dimensionality Reduction (1x1 Conv., Pooling)



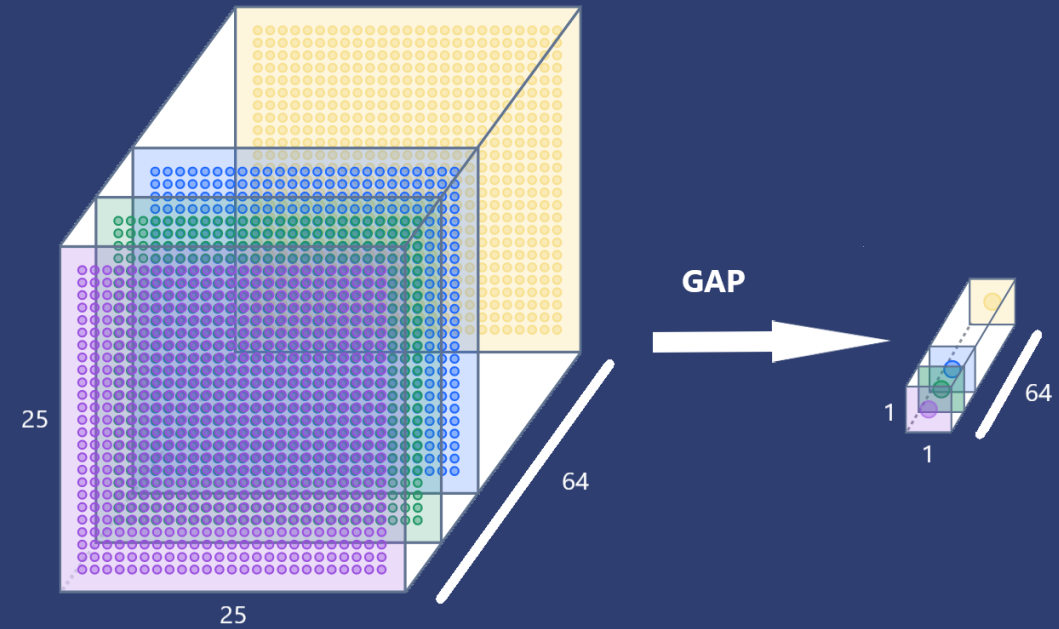
PROPOSED METHOD



GAP

Global Average Pooling:

- Reduce Dimensions/Computational Complexity
- Spatial Information Summarizer



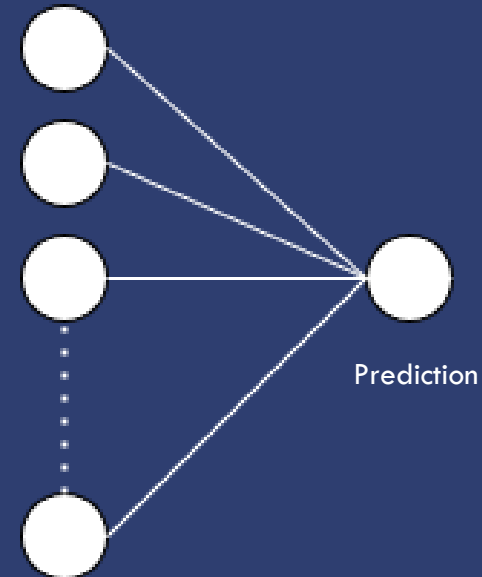


TRAINING

Data Preprocessing:

- Normalization
- Sequence Length Adjustment

Classification



RESULTS



Hyperparameter Optimization

CNN Model

window size	f1-score	support
17	0.98	880
50	0.94	880
100	0.35	880

CNN-LSTM Model

window size	f1-score	support
17	0.98	880
50	1	880
100	0.41	880

RESULTS



Model Performance

Model	f1-score	support
CNN	0.94	880
LSTM	0.98	880
CNN-LSTM	1	880

RESULTS

Noisy Data

	0%	2%	5%	10%
f1-score	1	0.99	0.94	0.89

CONCLUSIONS



- Enhancing fault diagnosis by integrating a fusion model.
- A new architecture with a holistic feature representation.
- Compare the model with state-of-the-art methods
- Model Robustness

Thank You!

