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Multi-Modal Fault Diagnosis in Industrial Systems Using SE-Attention-Based Deep Neural Networks

Communication Info

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Abstract

Reliable fault diagnosis in industrial systems requires the integration of multiple sensor modalities, as single-source approaches often fail to capture complex fault patterns, particularly misalignment faults [1]. This paper proposes a Multi-Branch Deep Neural Network with Squeeze-and-Excitation (SE) attention for multi-class fault classification. The model processes vibration and thermal data through dedicated branches and dynamically learns their relative importance [2]. Experimental results on a real industrial dataset show that the proposed approach significantly outperforms single-modality models, achieving 94.31% accuracy and 94.59% F1-score. Attention analysis [3] reveals that vibration signals dominate overall, while thermal data play a crucial role in detecting specific faults such as misalignment. Feature importance further highlights temperature and axial vibration as the most discriminative signals [4]. These findings demonstrate the effectiveness of multi-modal learning and suggest that a reduced sensor configuration can support efficient and scalable predictive maintenance [5].

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