Fault Classification of Rotating Machinery using Limited Set of Features and k-NN

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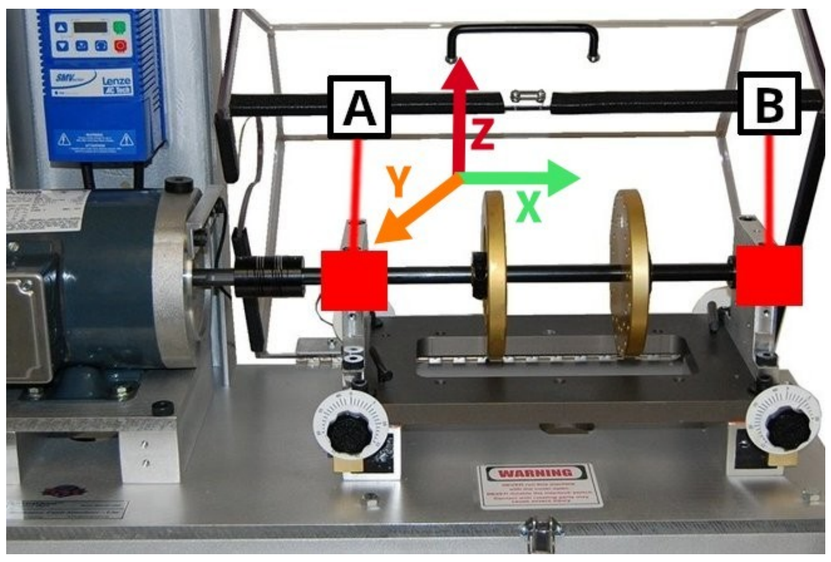
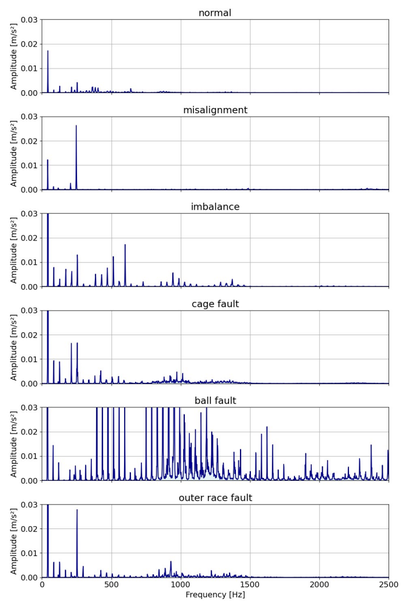
Background

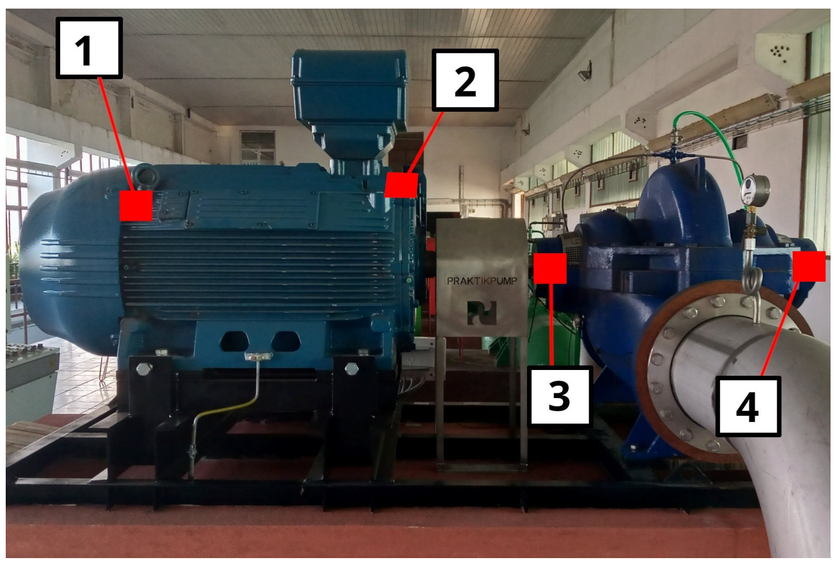
- Diagnose faults with vibration signals
- Condition-based maintenance with IoT devices can prolong life of machinery parts and save costs
- Technical standards: ISO 20186, ISO 13373
- Sensors are wideband MEMS accelerometers
  - High sampling rate > 20 kHz
  - Capture only relevant attributes on the edge device
  - Signal processing and feature engineering
- Datasets: MaFaulDa, CWRU bearings



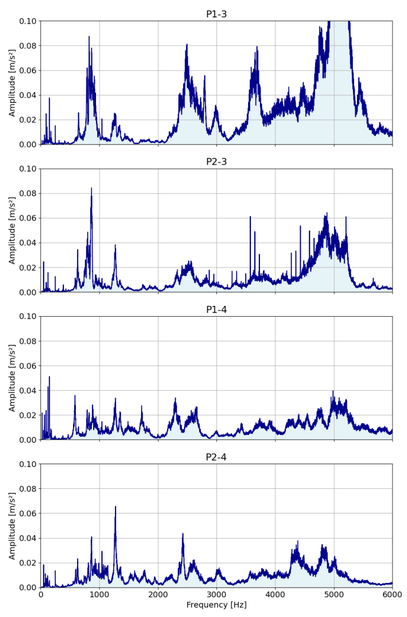
SpectraQuest Machinery Fault Simulator



Labels in MaFaulDa



Pump KSB Omega and WEG W50 motor

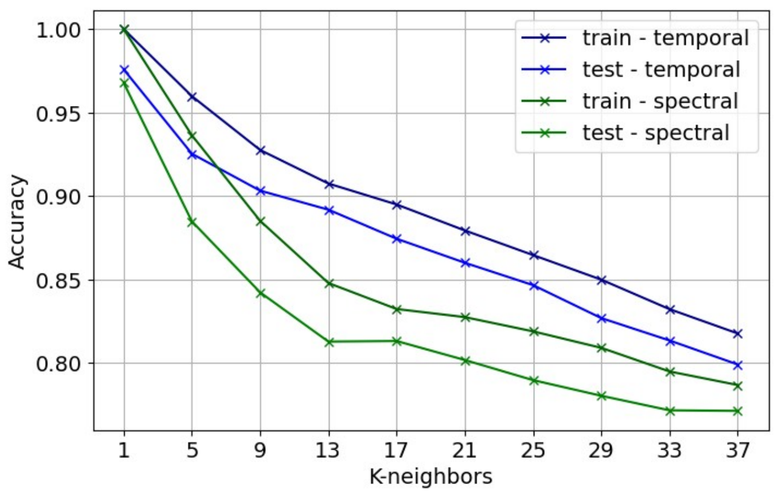


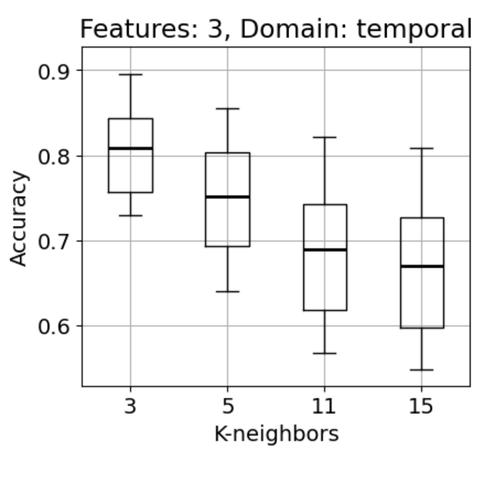
Spectra of water pumps

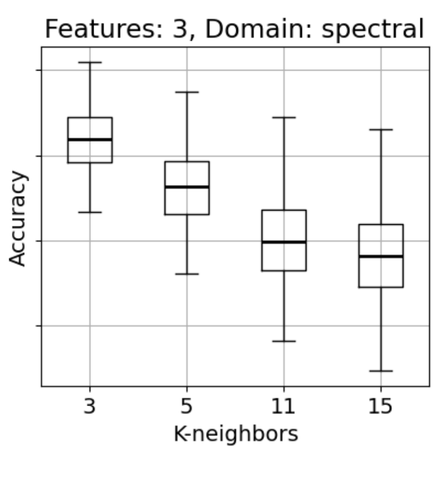
Methodology

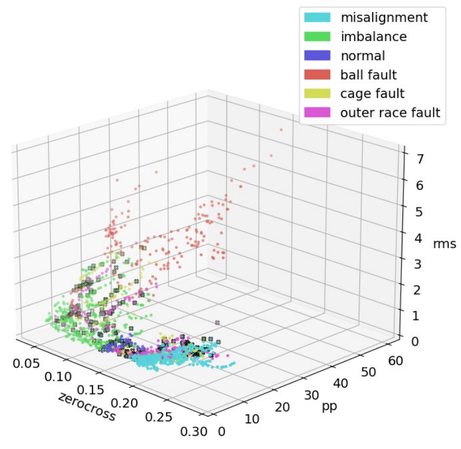
- Data processing pipeline
  - 10 features in time domain
  - 11 features in frequency domain
- Labeling and balancing MaFaulDa dataset
- k-Nearest Neighbors model evaluation with different feature subsets and k values
- History of vibrations from water pumps
- Create sensor device with ESP32 MCU and ST IIS3DWB to gather vibrations from water pumps

Results

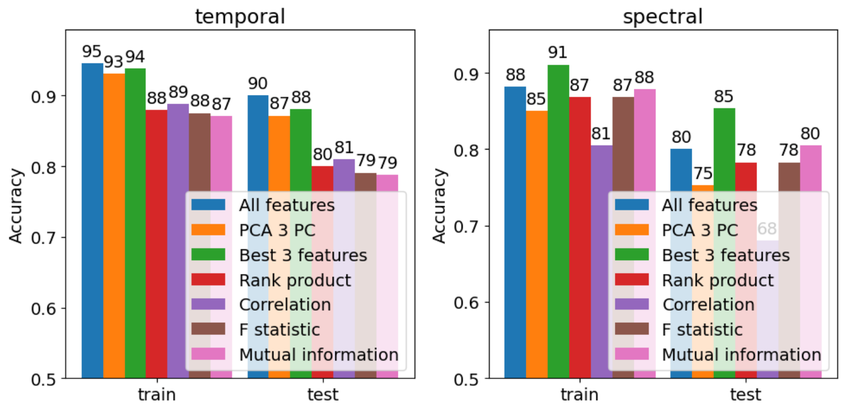


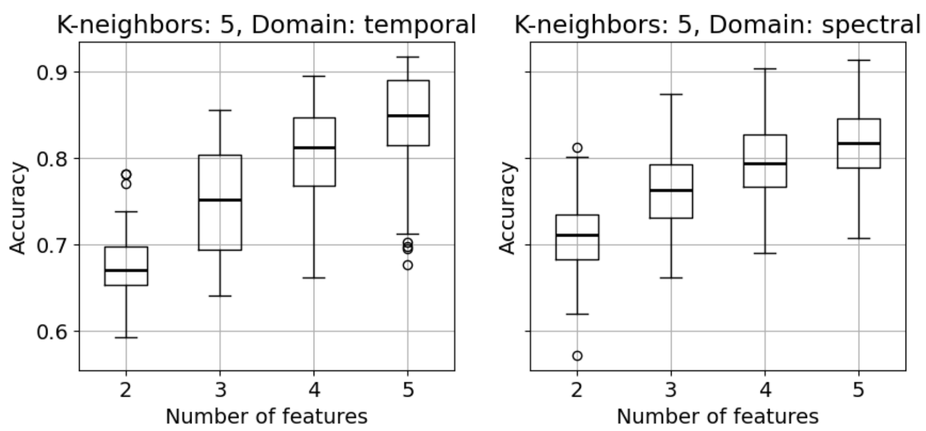


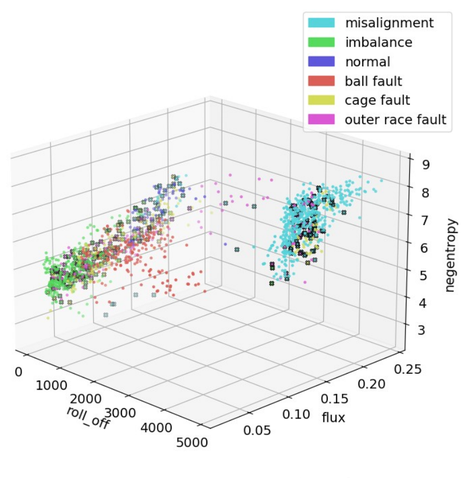




Time domain (83.9%)







Frequency domain (79.1%)