

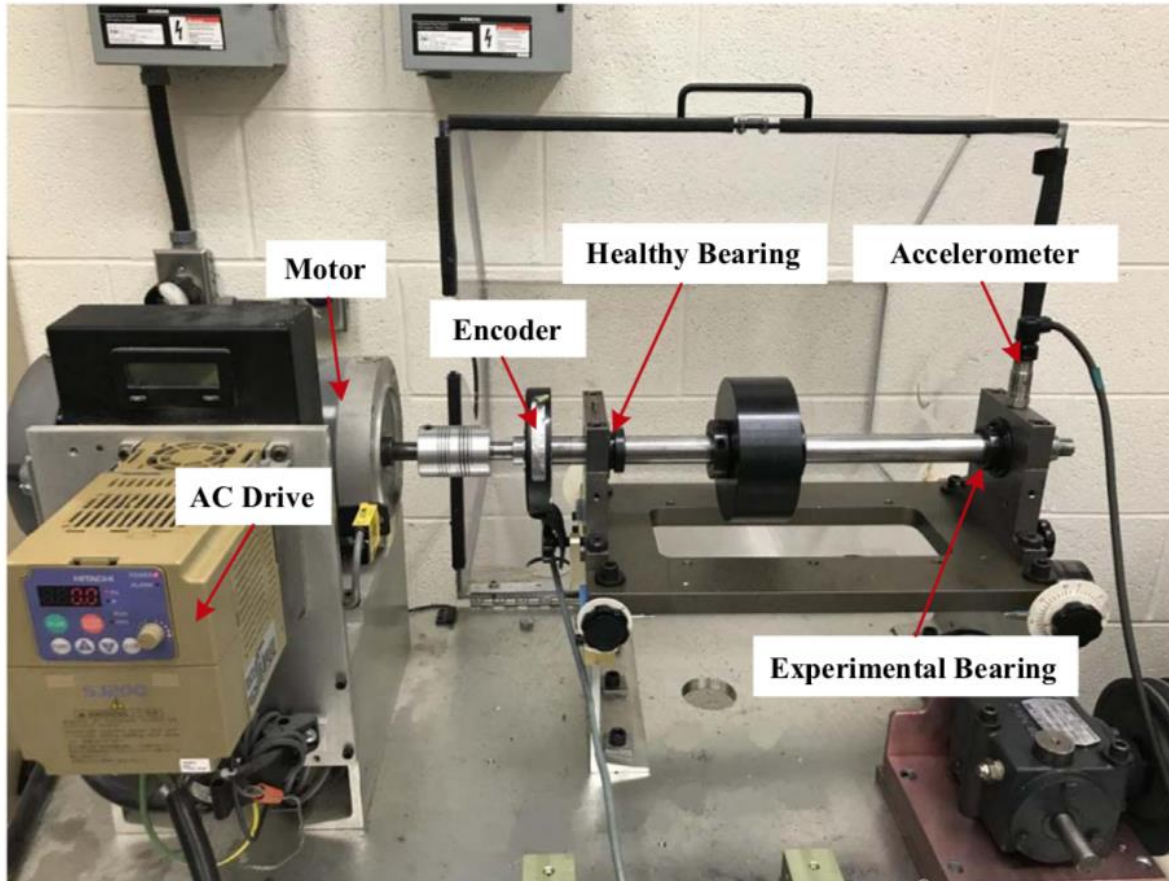
# Vibration Analysis

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Innovative Artificial Intelligence Solutions

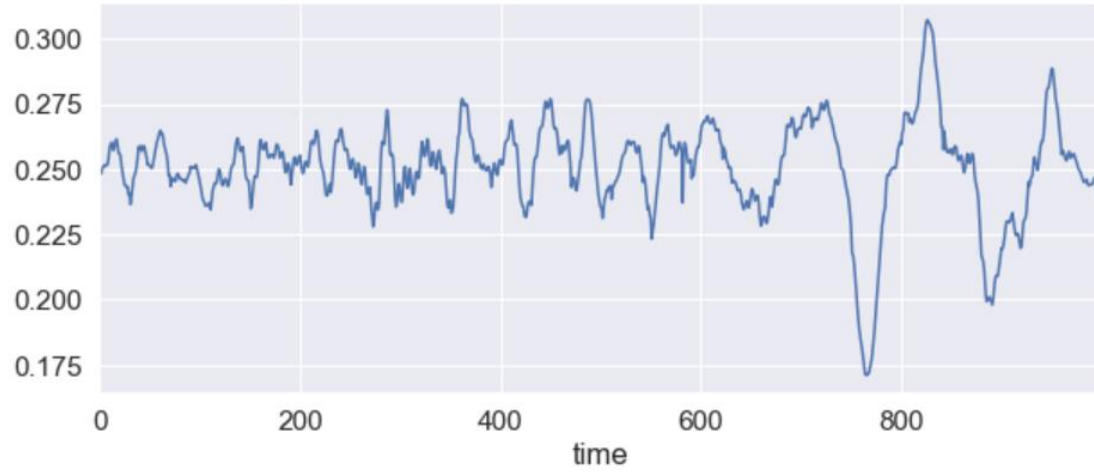
# Experimental setup



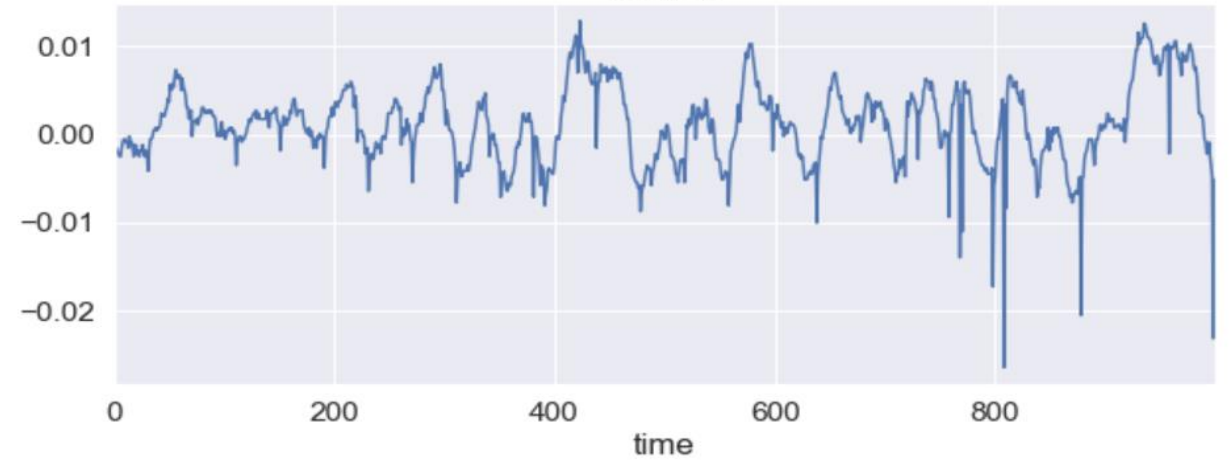
- We used the public data set as described by the research article “[Bearing vibration data collected under time-varying rotational speed conditions](#)”
- Two ER16K ball bearings are installed to support the shaft, the left one is a healthy bearing and the right one is the experimental bearing, which is replaced by bearings of different health conditions.
- The accelerometer collects vibration data.
- The health conditions of the bearing include
  - (i) healthy
  - (ii) faulty with an inner race defect
  - (iii) faulty with an outer race defect
- Goal is to classify these conditions using ML algorithms

# Signals -1: increasing shaft speed

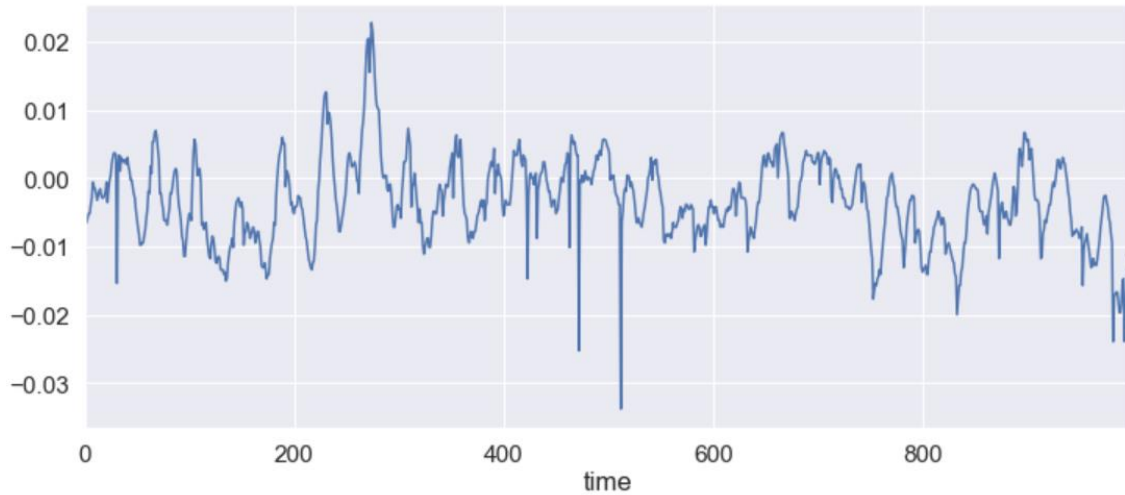
Inner race fault



Normal

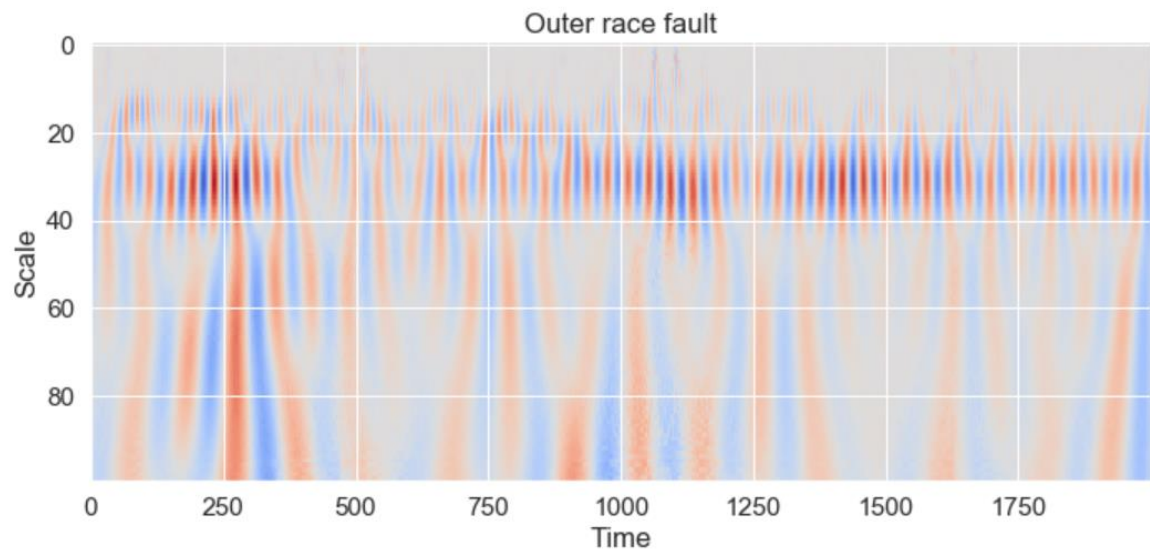
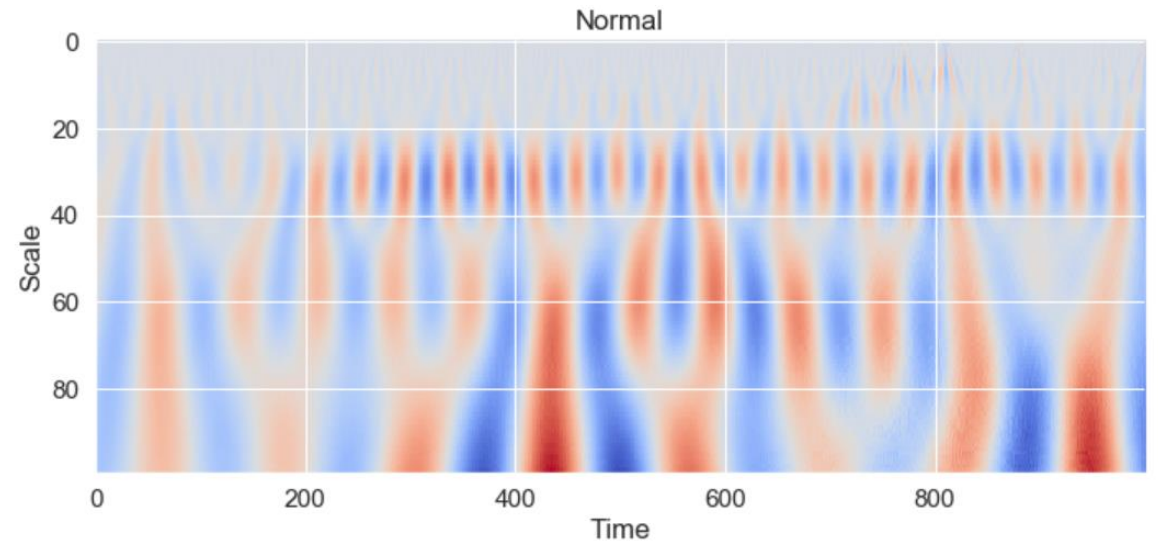
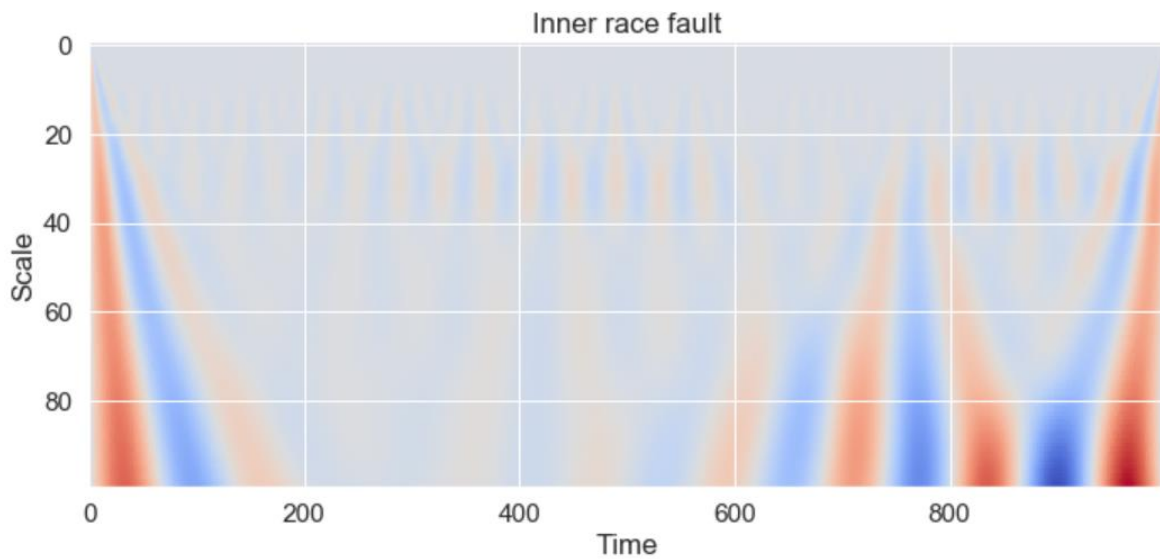


Outer race fault



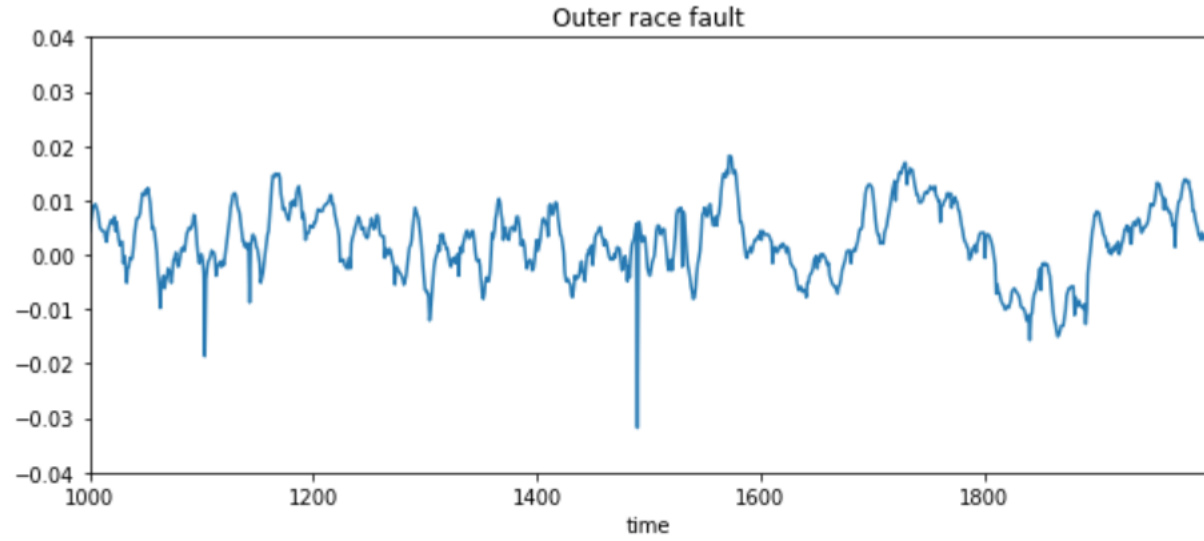
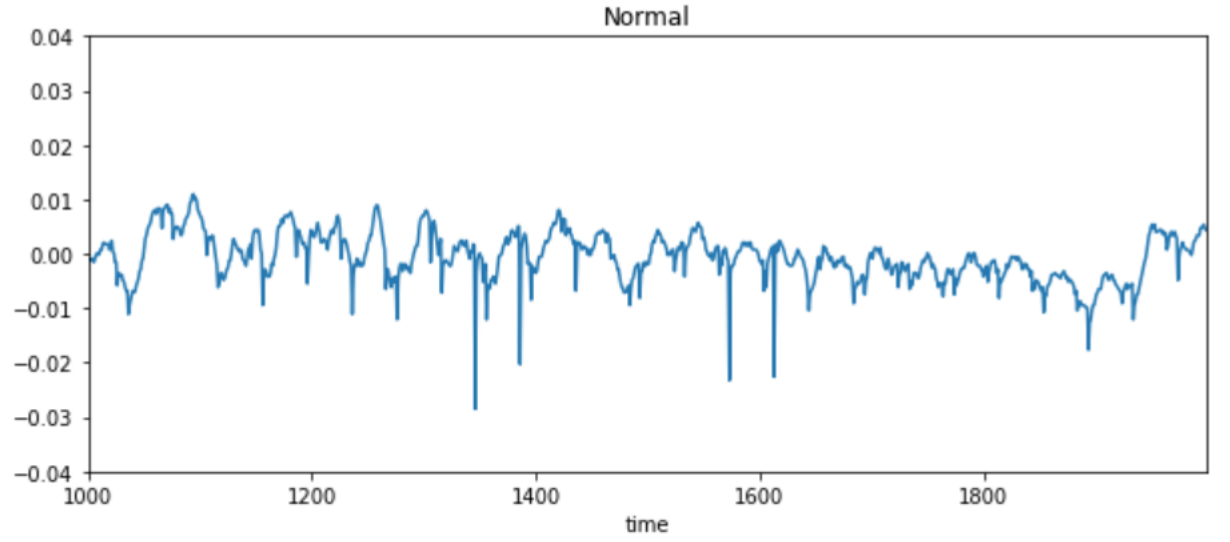
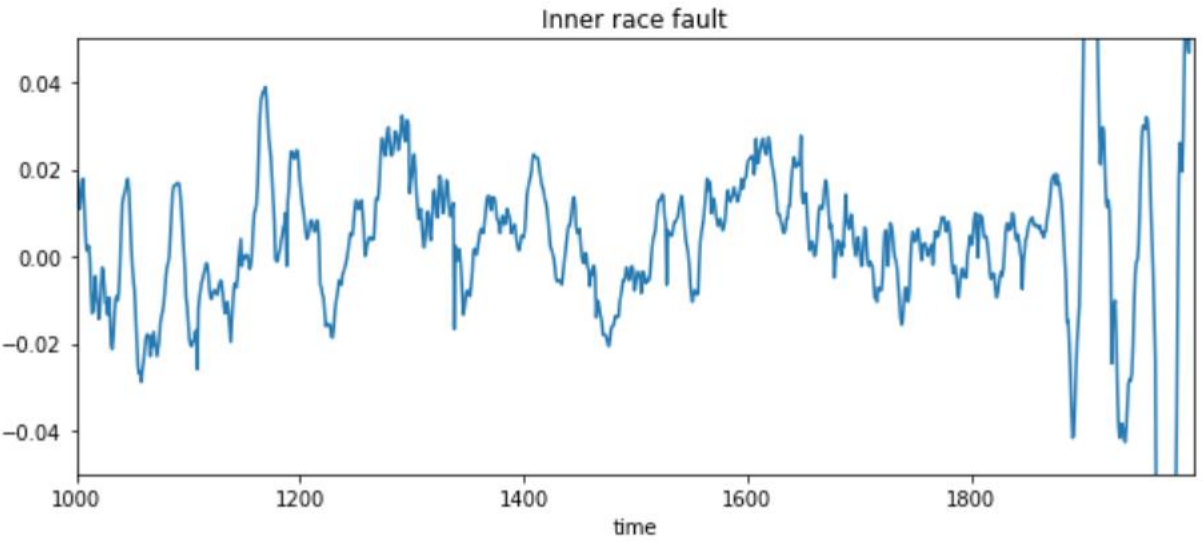
Signals with increasing shaft speed are shown with 3 different bearing conditions (see previous slide).

# Signals -1: CWT transformed



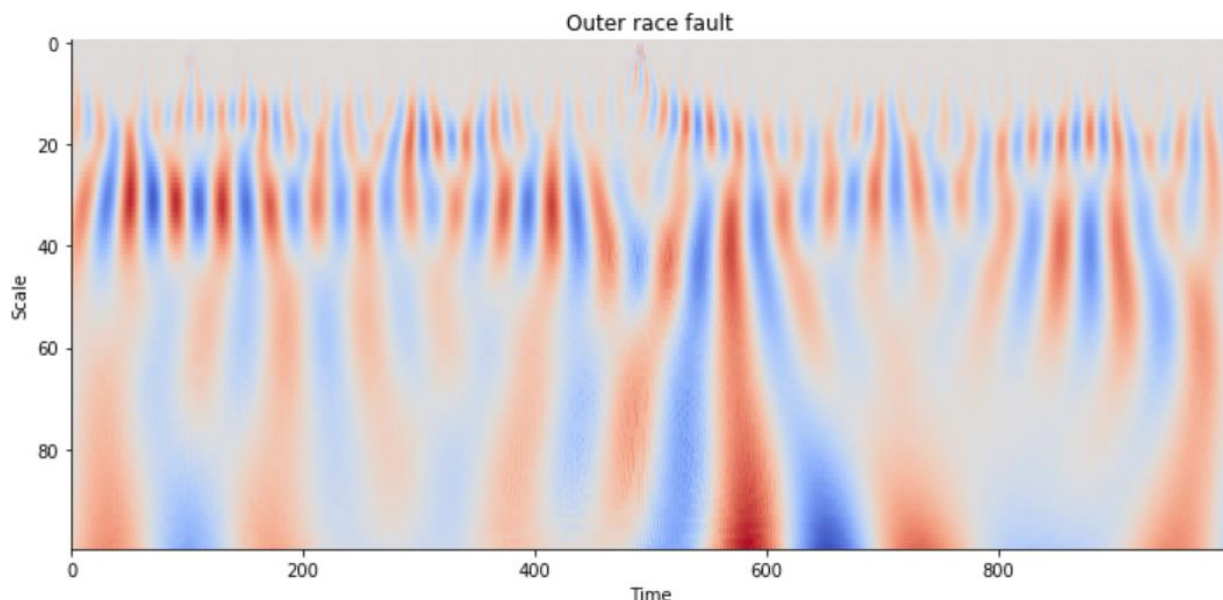
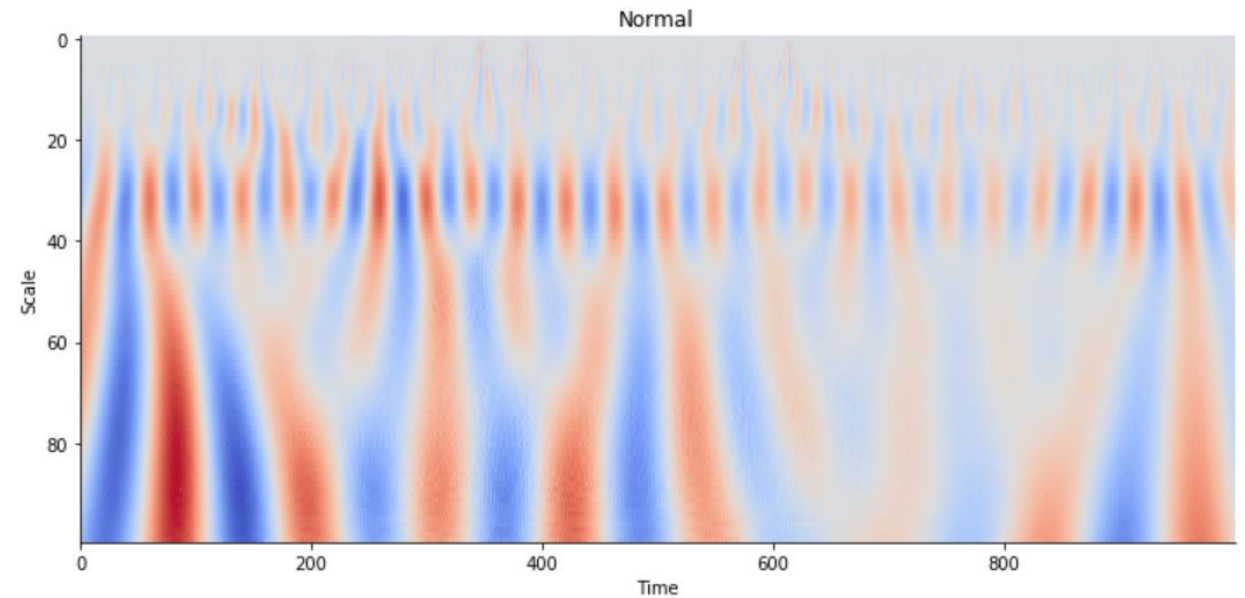
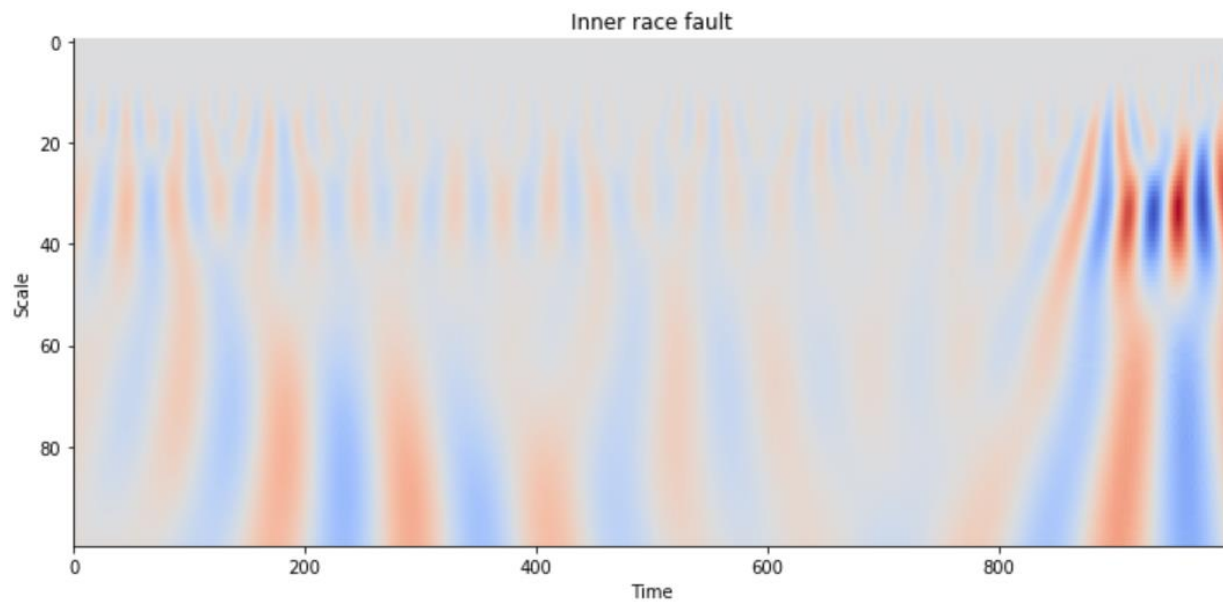
- Signals with increasing speed but presented after transformations using Continuous Wavelet Transform.
- Signals are shown as scalograms “Scale vs Time”.
- Various scales are sensitive to different frequency contributions. So, “anomalous” frequencies can be easily detected.

# Signals -2: increasing and decreasing speed



Signals with increasing and decreasing shaft speed are shown with 3 different bearing conditions (see previous slide).

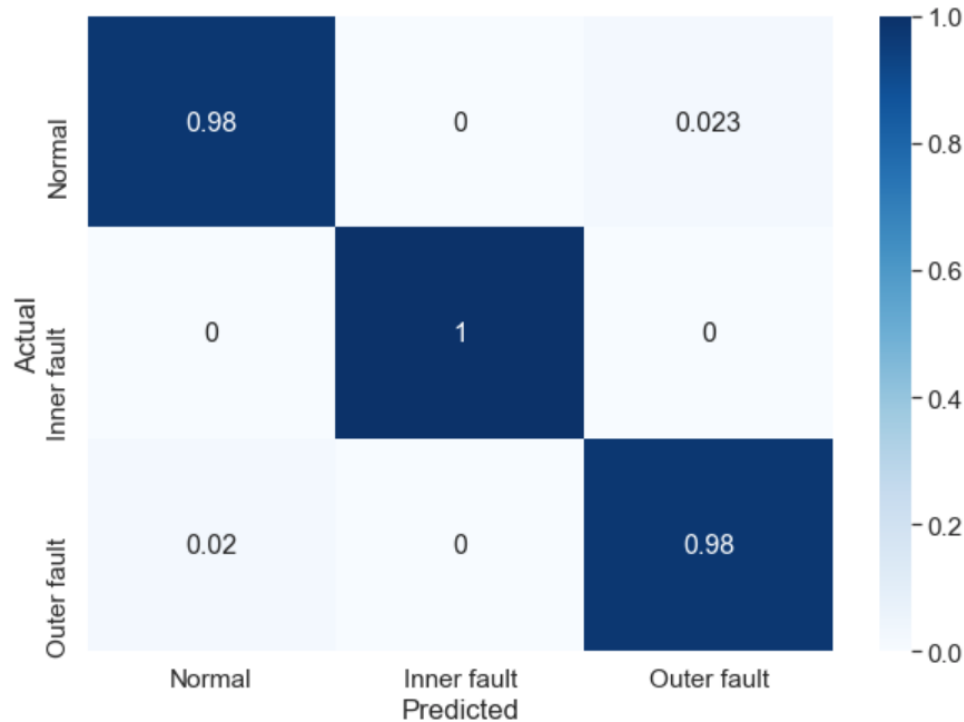
# Signals -2: CWT transformed



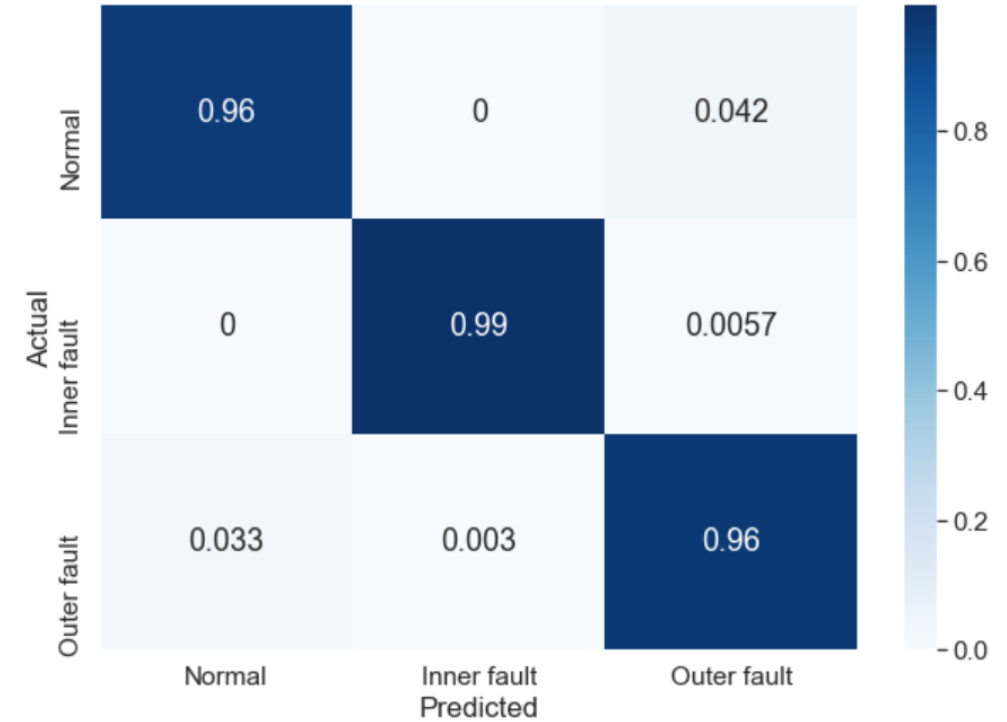
- Signals with increasing and decreasing speed but presented after transformations using Continuous Wavelet Transform.
- Signals are shown as scalograms “Scale vs Time”.
- Various scales are sensitive to different frequency contributions. So, “anomalous” frequencies can be easily detected.

# Classification accuracy

increasing shaft speed



increasing and decreasing shaft speed



- Data is split into 70% training and 30% test sets.
- Classification accuracy on the test set is shown.
- One can see that it is  $\geq 96\%$



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